TENAX OTOMOTİV SANAYİ VE TİCARET ANONİM ŞİRKETİ

MOTOR VEHICLE

REPAIR MANUAL

INTRODUCTION

This Manual is intended to familiarize engineers and technicians of service centers and stations, repair shops with maintenance and repair of TENAX flatbed vehicles with F2.8L Euro-6 engines.

This Manual shall be used in combination with the maintenance and repair documentation for the F2.8L Euro-6 engine.

The main sections of the Manual describe the vehicle components and systems design, maintenance and repair using off-the-shelf spare parts. The Manual contains instructions on components disassembly, assembly, inspection, testing and adjustment, lists of potential faults and troubleshooting recommendations.

Vehicle maintenance frequency and scope are specified in the Operator's Manual and Vehicle log book.

Since the vehicle units and assemblies are subject to continuous modification, the text and illustrations in this manual may differ from the produced vehicle design.

1. General

1.1. Safety requirements for maintenance and repair operations

- Turn off the instruments and the starter (ignition), unless otherwise required during maintenance.
- Keep hands, tools and clothing away from the area of the drive belts or running engine pulleys.
- To avoid injury, always remove rings, watches, loosely hanging jewelry, loose clothing, etc. before working on the vehicle.
- The cooling radiator fan may turn on at any time. Keep hands and clothing away from the fan blades.
- Take precautions when working on a hot engine. Avoid contact with hot parts of the cooling and exhaust systems.
- Do not touch the wires and electrical equipment components with the instruments and the starter (ignition) turned on.
- Do not leave the engine running in an unventilated area.
- To the extent practicable, work in the engine compartment with the engine off and the negative battery terminal disconnected. Where work is necessary in the engine compartment with the engine running, install the vehicle on a firm and level horizontal platform, and brake the vehicle with a parking brake.
- Do not allow sparks and do not use open flames near the battery and fuel system parts.
- Many fluids used in vehicles are poisonous. These include acids, antifreeze, brake fluid, fuel, windshield washer additives, lubricants, and refrigerants. Prevent contact with skin and eyes. Wear protective gloves and glasses where necessary. Follow the instructions on the labels and containers. Protect your eyes when working under a vehicle.
- Prolonged contact with engine oil may cause skin irritation. Wash hands thoroughly after contact.
- When performing body repairs (puttying, painting, sanding), wear a respirator and provide additional room ventilation.
- Operations involving heavy vehicle component or unit removal and installation shall be performed with assistant.
- Handling means used to remove, move and install heavy units shall be equipped

with devices ensuring complete safety.

- Tools and equipment used in the vehicle repair shall be in good condition. Special attention shall be paid to the electrical wiring insulation condition.
- DO NOT work under the vehicle only suspended at the elevator such as jack or hoist. Install additional temporary supports.
- It is not recommended to eat or smoke while working.
- Do not dispose of used hazardous fluids (oils, brake fluid, antifreeze, etc.) by draining these on the ground or into the sewage system.
- When disconnecting the vehicle battery, disconnect the minus lead (minus terminal) first, and then the plus lead.
- For dual battery systems, disconnect both minus leads (minus terminals) first, then the plus leads. When connecting the battery(s), connect the plus lead(s) first, and then the minus lead(s).
- When starting from an external source, approved leads shall only be used.
- With the engine running, do not hold the steering wheel in the position turned all the way for more than 30 seconds, since this may cause the power steering pump gaskets to fail due to oil overheating.
- When refilling fluids, take care to prevent ingress of dirt particles.
- Prior to working on the vehicle, apply parking brake and place wheel chocks under the wheels.
- When jacking up the vehicle, use designated jacking points where possible.
- Do not work on any part of the fuel system with the engine running.
- Diesel fuel is supplied through the fuel line from the fuel pump to the injectors under high pressure. Do not loosen the high pressure fuel line with the engine running.

1.2. General maintenance and repair instructions

During maintenance and repair operations:

- use only original spare parts and materials recommended by the manufacturer. The recommended fuels and lubricants, and operating fluids are listed in the Vehicle Operator's Manual;
- any changes to the vehicle design or equipment not approved by the manufacturer shall be prohibited;
- vehicle maintenance frequency and scope are specified in the Operator's Manual and Vehicle log book;
- during maintenance, do not check tightening torque and retighten threaded joints locked using sealant (see the text of the Manual). Bolt (nut) breaking will result in sealant failure and thus joint loosening.

Routine repairs

The routing repair of unit or component means the elimination of faults detected during the vehicle operation, maintenance or inspection by performing repair operations involving partial or complete unit or component disassembly or replacement, and replacement of individual parts.

Repair operations shall be performed subject to the following general principles:

- use dedicated rigs or a locksmith's workbench to disassemble and reassemble units and components. Tools and fixtures specified in the process chart shall be used for each disassembly and assembly operation;
- when disassembling all units and components, arrange disassembled parts in a certain order, and assemble in the reverse order to disassembly. Before disassembly, the mating parts shall be marked to maintain mutual parts position during reassembly;
- only disassemble parts connected by welding, riveting or fixed fits when it is required due to repair conditions;
- only unscrew studs when it is required due to the unit or component disassembly conditions, when replacing studs and parts. The studs shall be screwed into the threaded holes as far as they will go in the thread runout. Parts and individual components shall be installed loosely on the studs; stud bending shall not be allowed;
- remove oil or water from the blind threaded holes prior to fastening bolts tightening.

To check the technical condition, after disassembly, clean all parts off dust, scale, carbon and tar deposits, and rust, rinse and dry. Do not wash parts made of aluminum and zinc alloys in alkaline solutions.

Parts shall be inspected by visual examination and micrometer inspection. Start parts inspection with visual examination, use magnifying glasses or magnetic flaw detector to detect defects on critical parts. Parts inspected with a magnetic flaw detector shall be demagnetized.

Based on inspection results, replace with new ones:

- parts with significant wear, scoring, chipping or pitting on the working surfaces, and burn marks;
- parts with cracks on the working surfaces and in areas exposed to heavy stress during operation;
- fasteners with more than two threads damaged, as well as bolts and studs with stretched threads;
- bolts and nuts with worn edges, and screws with plugged or broken head slots;
- binding wire, cotter pins, lock washers and plates with bent edges;
- rubber parts with degraded elasticity;
- hoses with cracks and delaminations, and with broken cup terminations;
- pipelines with dents reducing pipe cross-section or with cracks at the flared ends;
- metal panels and fin parts with out-of-repair surface dents, cracks and holes;
- assemblies with loosened fit of press-fitted parts;

Small holes (pitting) shall be allowed on the tooth working surface of maximum 10 % of the tooth surface area (unless otherwise specified in the Manual).

Collar seals shall be free of the working edge and notching area damages; the edge shall be elastic. The surfaces of parts where the collar seals slide shall be free of galling. Re-pressing of used collar seals is not allowed.

Gaskets shall be free of tears, dents and kinks. The circlip ends shall lie in the same plane.

Prior to assembly, prepare all parts as follows:

- remove any nicks and burrs from the mating surfaces of parts;
- when thread is damaged within the permissible limits, repair it using thread-cutting tool;
- weld cracks or holes at unloaded part areas.

Whenever the Manual allows part repair by welding, patch work or welding-on, the weld shall be free of slag inclusions, shallow weld areas, porosity and cracks.

The weld shall be cleaned to provide the proper part appearance, shall show required strength and hardness while not hampering post-welding machining and bench-working. Metal buildups shall be removed to not interfere with the mating parts installation;

- joint faces with distortion slightly exceeding the permissible limit shall be corrected by bedding-in.

Assembly of units and components

- When assembling units and components, mating parts dimensions, clearances and preloads specified in the Manual shall be observed.
- During assembly, the parts to be installed shall be clean and dry, oil passages shall be cleared and checked. To clean parts, use blowing with compressed air. The air used for blowing shall be dry.
- The preservation coating shall be removed from the parts (unless otherwise specified in the manual).
- It shall not be allowed to pool mating couples of parts (specified in the Manual), which shall be installed and replaced as a complete unit.
- Prior to assembly, lubricate gaskets, plug hole threads and through hole threads with non-drying sealing compound (unless otherwise specified in the Manual).
- When tightening connections sealed with rubber gaskets, do not use excessive force to avoid gasket destruction.
- When assembling threaded connections, tighten these to the torques specified in the Manual. Tightening of threaded connections shall be completed in the screw-in stroke.
- Bushings, rings and ball bearings shall be mounted using special mandrels. When pressing in bearings, the force shall not be transmitted through rollers or balls. The pressing tool shall rest against the ring to be pressed. The pressing force shall be aligned with the bearing axis to avoid misalignment of the rings.
- Parts with transitional and press fits shall be pressed out or assembled at the press using special mandrels or fixtures. It shall not be allowed to strike directly on the pressed-out parts with steel hammers, chisels or driftpins.
- Where critical parts shall be installed by hammering due to the assembly conditions, use mandrels and hammers made of non-ferrous metals, rubber, etc., as well as dedicated devices for pressing parts.
- Spring washers, lock nuts, cotter pins, etc. shall be installed at all points specified

in the documentation. Replacement of locking parts with another-type ones shall not be allowed.

- New rubber collars, gaskets and parts shall only be allowed for installation.
- The collar seating surfaces and working edges, and mating parts shall be lubricated with a thin layer of grease (unless otherwise specified in the Manual). The collar seals shall be installed using special mandrels to protect collars from damage.
- Threaded joints installed with sealant shall be cleaned of old sealant, degreased and dried before applying sealant.
- Fluid drained during system bleeding shall not be refilled into the tank as it contains air. The use of this fluid shall only be allowed after settling for a day and filtering.
- During assembly, all rubbing surfaces of the component parts shall be lubricated with oil used in this component. New bearings shall be installed in factory preservative grease (unless otherwise specified in the Manual).
- When assembling parts with clearance fit, free relative movement without seizure shall be ensured.
- Prior to the pipeline disconnection, clean the connection points and adjacent working area from dirt; after the pipeline disconnection, close the openings with plugs to prevent ingress of contaminants in the component and systems. When assembling, remove the plugs immediately prior to connecting the pipelines.
- Self-locking nuts screwing on and off the mating part shall be allowed four times maximum due to the reduced locking properties of the polymer ring insert.
- Parts with tapered threads shall be screwed home. At the same time, at least one full-profile thread shall remain above the part surface.
- The length of the bolt (stud) portion protruding from the nut shall be within one to three threads.
- The cotter pins shall not protrude above the nut slots. The cotter pin ends shall be separated and bent: one end - to the bolt, other end - to the nut.
- Units, components or parts shall be fastened with nuts or bolts uniformly around the perimeter (unless there are special instructions on the tightening order), first with pre-tightening and then with final tightening. In the same joint, the tightening degree shall be the same for all nuts or bolts.
- When assembling units and components and installing these to the vehicle, measures shall be taken to protect the parts from breakage and damage to the machined surfaces.
- After assembly and testing, open holes in units and components shall be sealed

with temporary plugs or gaskets.

- After assembly, all oil cavities in units and components, engine and its systems (fuel system, lubrication and cooling system), brake system, power steering system shall be checked for tightness.
- After assemblies repair and replacement on the vehicle, run-in these to make sure that all mechanisms and systems are in good working order and interact correctly.

2. Engine

For maintenance and repair, refer to the maintenance and repair documentation for the F2.8L Euro-6 engine.

2.1. Engine removal

ATTENTION

1. Prior to the pipeline disconnection, clean the connection points from dirt; after the pipeline disconnection, close the openings with plugs to prevent ingress of contaminants in the component and systems.
2. When removing and installing the engine, protect front suspension brake tubes and HPS pipelines from damage.

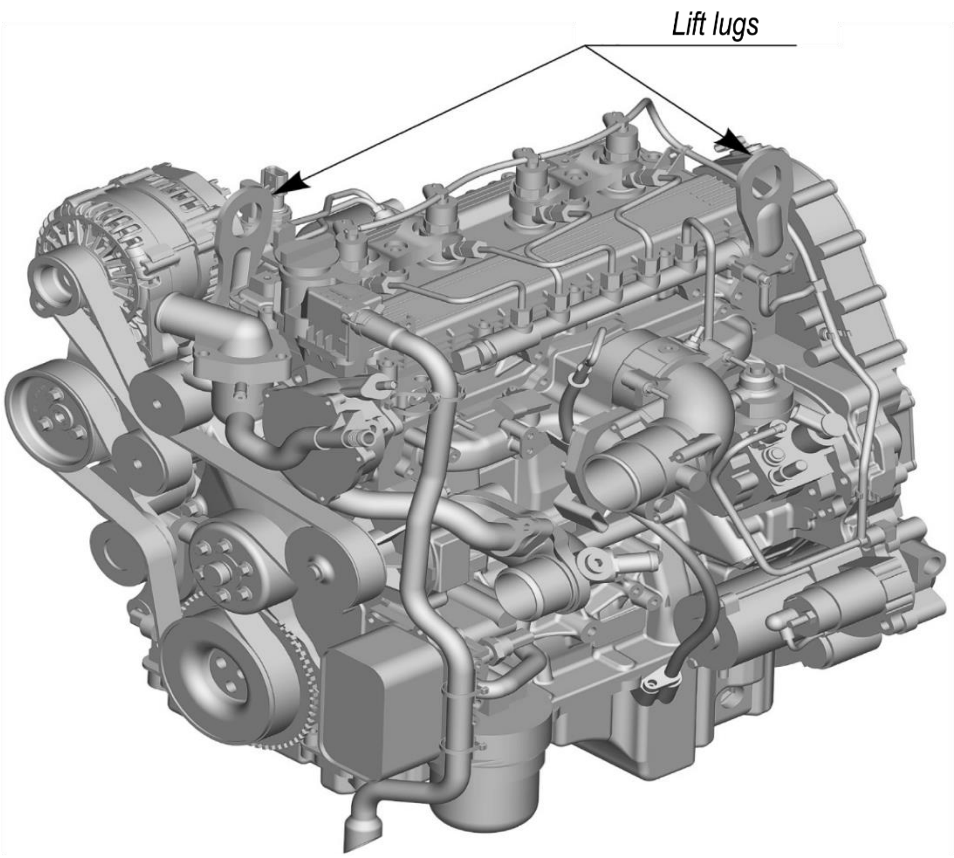


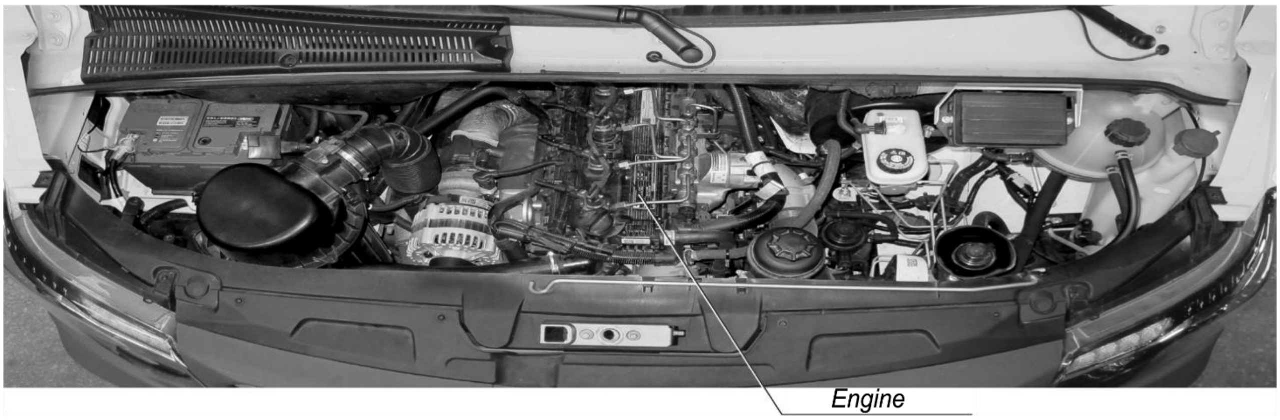
Fig. 2.1 Engine

Place the vehicle over the inspection pit or on trestle with general and portable lighting. The workplace shall be equipped with a hoist or other lifting device with a lifting capacity of at least 350 kg.

To remove engine:

- remove the engine mudguards (see "Engine suspension" sub-section);
- drain the fluid from the cooling system (see "Cooling system" sub-section);
- disconnect leads from the battery;
- drain oil from engine crankcase, gearbox and power steering system (see "Steering" section) having previously removed plugs from oil fill holes;
- disconnect hood from hinges and remove it.

The vehicle underhood space is shown in Fig. 2.2.



2.2. Vehicle underhood space

To remove engine, follow the procedure below:

Operations carried out from the front of the vehicle:

- disconnect and remove the front bumper panel (see "Cabin" section);
- disconnect the front bumper panel mounting brackets from the frontend;
- disconnect and remove the front bumper base;
- disconnect and remove radiator frame base (frontend) (Fig. 2.3). To do this, proceed as follows:
  - remove the hood lock by unscrewing the fastening bolts and removing the hood lock actuator link sheath lug and actuator link from the grooves in the lock body; remove the hood lock actuator link complete with sheath from the frontend;

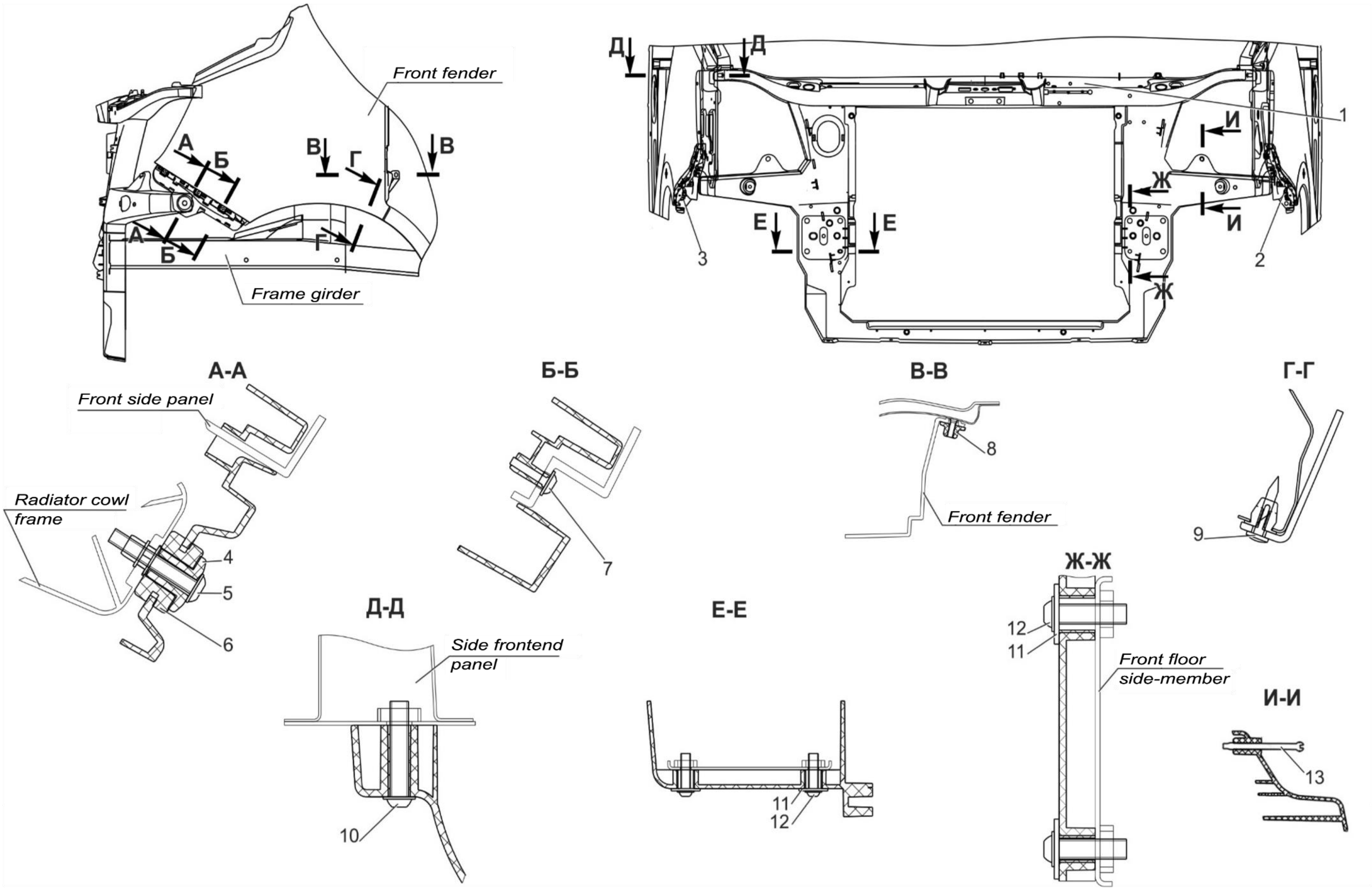


Fig. 2.3. Radiator frame base (frontend) installation: 1 - radiator frame base; 2,3 - front fender holders; 4 - spacer bushing; 5,7,8,10,12 - screws; 6 - bushing; 9 - nut; 11 - washers; 13 - adjusting screw

- remove headlamps by disengaging them from the adjusting screws 5 (Fig. 2.3) installed at the frontend with wiring harness connector previously disconnected and screws fastening the headlamp to the fender and frontend removed (see "Electrical equipment" section)
- disconnect the expansion tank hoses from the frontend
- disconnect the hoses from the HPS tank and the upper fan shroud
- disconnect hoses from HPS radiator;
- disconnect the HPS radiator mounting brackets from the frontend and remove the HPS radiator;
- disconnect the exhaust treatment system return hose from the engine (see "Exhaust and after-treatment (urea supply) systems" sub-section);
- disconnect the exhaust treatment system return hose from the frontend (see "Exhaust and after-treatment (urea supply) systems" sub-section);[1)]
- disconnect the reagent tank filler pipe from the frontend (see "Exhaust and after-treatment (urea supply) systems" sub-section);[1)]
- remove refrigerant from the air conditioning system piping (Fig. 2.4) using a refueling station[2)]; (see "Body" sub-section));
- disconnect the condenser supply line from the compressor discharge line by loosening the compressor retaining nut[2)];
- disconnect the condenser discharge pipe from the body piping by loosening the retaining nut[2)];
- disconnect and remove the condenser[2)];
- disconnect the cooling system radiator supply hose from the thermostat nozzle;
- disconnect the cooling system radiator lower hoses from the radiator and engine and pull them aside without disconnecting the expansion tank hose;
- disconnect the expansion tank steam-discharge hose from the radiator;
- disconnect and remove the cooling system radiator (see "Cooling system" sub-section);
- disconnect the hoses from the charge air cooler connections by loosening the clamps;
- disconnect and remove the charge air cooler (see "Supply systems" sub-section);
- disconnect the air filter from the frontend mounting bracket;
- disconnect the frontend from the fenders, frontend panel stiffener, floor side-members. Remove the frontend with the air intake previously disconnected;

\- disconnect the wiring harness connector from the air conditioner compressor

---

[1)] – For vehicles with the reagent (urea) tank located in the underhood
[2)] - For vehicles equipped with air conditioning

coupling[1];

- disconnect the supply and return lines (Fig. 2.5) from the air conditioner compressor [1];

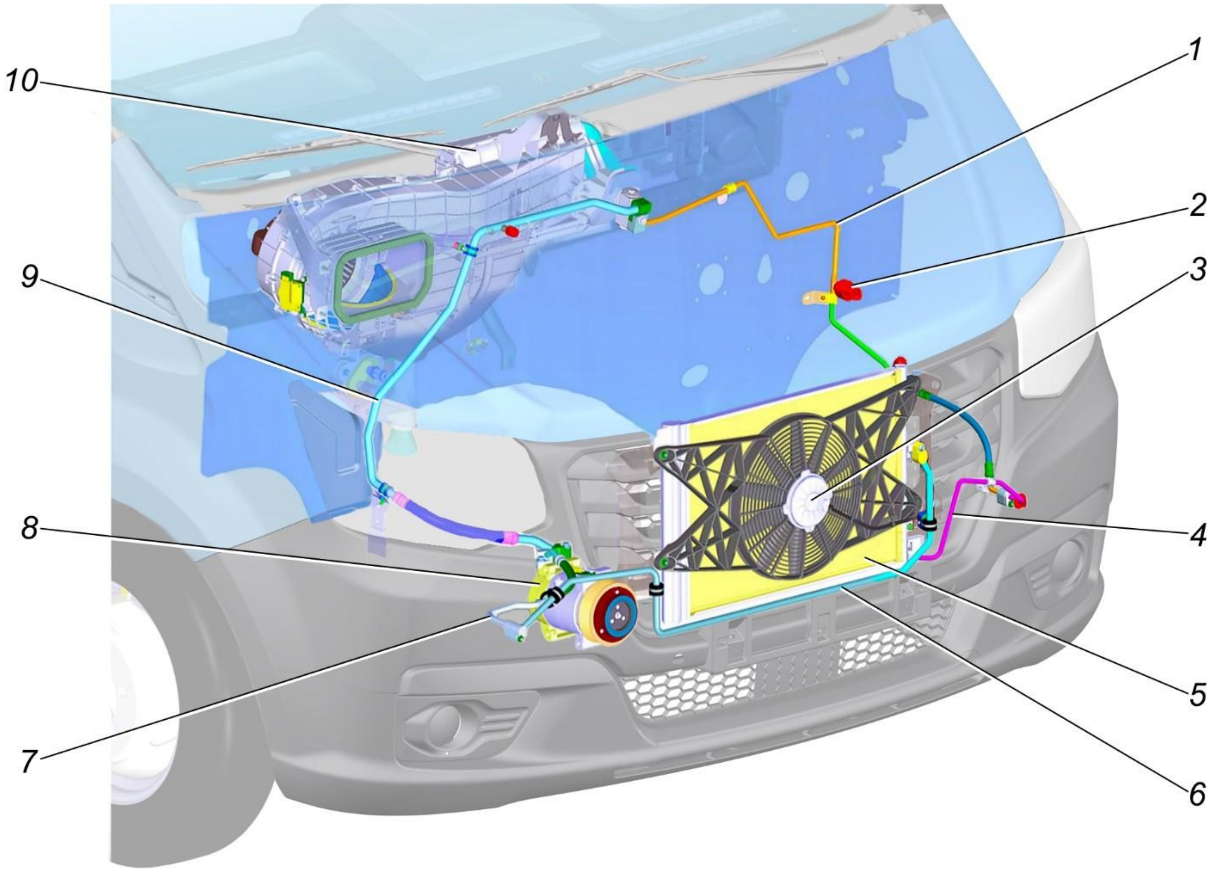


Fig. 2.4. Main components of the vehicle air conditioning system[1]: 1 - body piping; 2 - pressure sensor; 3 - condenser fan; 4 - condenser discharge piping; 5 - condenser; 6 - condenser supply piping; 7 - compressor discharge piping; 8 - compressor; 9 - compressor supply piping; 10 - air handling unit module

[1] For vehicles equipped with air conditioning

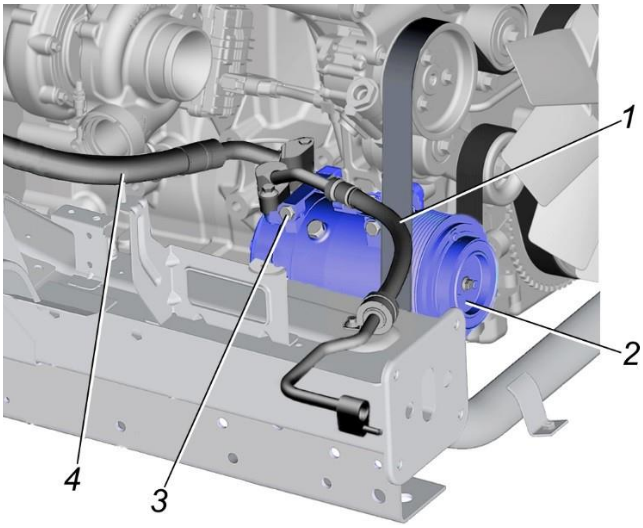


Fig. 2.5. Compressor installation[1]: 1 – compressor supply line; 2 – compressor; 3 – bolt; 4 – compressor discharge line

- disconnect the engine control wiring harness terminal block from the control unit and fasten the harness to the engine
- disconnect the wiring terminal blocks from the fuel heater and fuel fine filter water sensor, and fasten these to the engine
- disconnect the wire lug from the air heater
- disconnect the expansion tank hose from the thermostat nozzle and pull it aside
- disconnect hose from vacuum brake booster;
- disconnect the wiring terminal block from the air filter air temperature and pressure sensor;
- disconnect air filter air duct hose from engine turbocharger and air filter; remove air duct;
- disconnect and remove air filter, filter tube and air intake (see "Supply Systems" sub-section) ;
- disconnect the resonator hose from the air intake;
- disconnect the exhaust treatment system supply hose from the engine (see "Exhaust and after-treatment (urea supply) systems" sub-section);[1]
- disconnect the wire lugs from the alternator;
- disconnect and remove the charge air cooler hoses from the turbocharger and engine inlet pipe;
- disconnect the discharge hose from the HPS pump. Pull the discharge hose away from the engine and secure;
- disconnect the fuel supply tube from the fine fuel filter and the drain tube from the high-pressure fuel pump;
- disconnect heater piping hoses from the engine;
- disconnect the ground wire connecting the engine and the body from the RH

floor side-member stiffener;

- hook the engine to the lift lugs using load-handling device and tighten the hoist chain;

- unscrew the bolts fastening the engine brackets to the front pads.

Operations carried out from the vehicle bottom:

- remove the cable ends from the ball pins of the gearbox control linkage cover arms and remove the cables from the cable mounting bracket attached to the gearbox. Pull the cables away from the gearbox and secure (see "Gearbox" sub-section);

- disconnect wire lugs from the starter;

- disconnect the intake pipe from the turbocharger, catalytic silencer flange, clutch crankcase and the right frame girder, and remove from the vehicle;

- disconnect the clutch servo cylinder assembled with bracket from the clutch crankcase, pull away from the clutch crankcase and secure without disconnecting it from the pipeline;

- remove driveline (see “Driveline” sub-section);

- disconnect the wiring pin blocks from the reverse light switch and speed sensor (pulse sensor);

- disconnect the rear engine support cross-member from the gearbox and girders, and remove from the vehicle with a stand previously installed under the gearbox;

- disconnect the rear engine support cross-member with the pad from the gearbox bracket and girders, and remove from the vehicle with a stand previously installed under the gearbox ((tightening torque for nuts of bolts fastening the cross-member to the frame - 49-61 N·m (5.0-6.2 kgf·m);

- remove the engine assembly with the gearbox from the vehicle.

To install engine to the vehicle, proceed in the reverse order to removal.

When connecting the pipelines to the air conditioner compressor, lubricate the connecting nut sealing rings with PAG oil for R 134a[1)] refrigerant.

[1)] - For vehicles equipped with air conditioning

2.2. Engine suspension

Engine suspension (Fig. 2.6) includes three supports: two front supports consisting of right and left rubber-metal pads absorbing the main torque, and the rear support located under the rear crankcase of the gearbox.

The front supports are mounted to the front engine suspension cross-member, while the rear support is mounted to the rear cross-member.

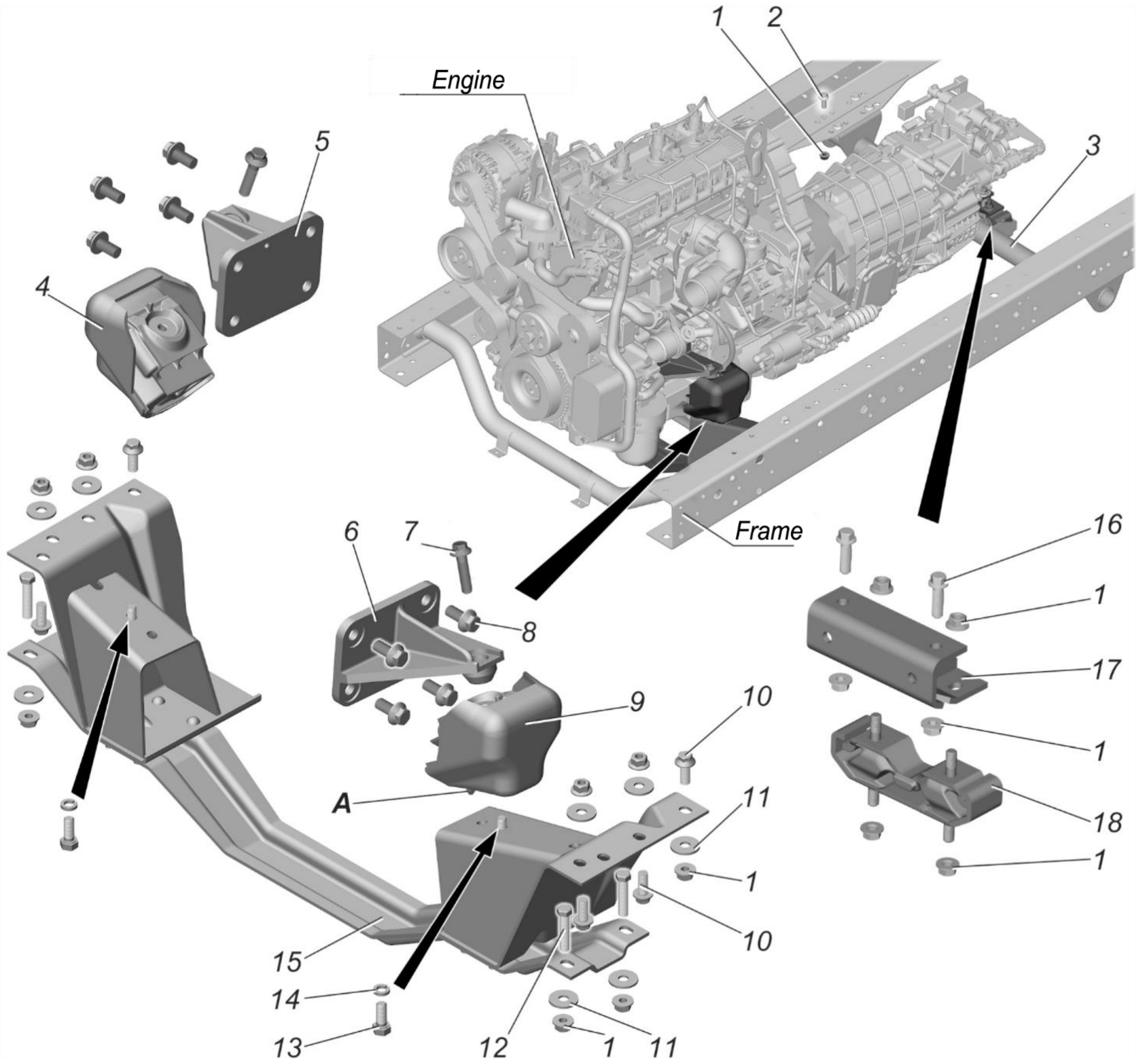


Fig. 2.6. Engine suspension: 1 – nuts; 2, 7, 8, 10, 12, 16 – bolts: 3 – rear engine support cross-member; 4 – front pad RH; 5, 6 – engine brackets; 9 – front pad LH; 11, 14 - washers; 13 – screw; 15 – front engine suspension cross-member; 17 – rear bracket; 18 – rear pad;

Engine suspension maintenance consists of periodical fasteners inspection and tightening, and the suspension pads condition inspection. Delaminated and distorted pads shall be replaced.

ATTENTION
The front engine suspension pads differ in load capacity. When installing the pads, make sure that they are installed correctly: the left front suspension pad bears "white" mark, while the right one bears "green" mark.

To replace front pads, follow the procedure below:

- remove the engine mudguards (engine mudguards installation is shown in Fig. 2.7);
- unscrew bolts 7 (see Fig. 2.6) fastening the front support pads to the engine brackets 5 and 6;
- hook the engine to the lift lugs and install a stand under the engine;
- remove the fuel line and the HPS pipeline from the clip of the front engine suspension cross-member left bracket;
- unscrew the nuts of the cross-member mounting bolts, lower the cross-member 15 complete with the front pads onto the lower girders flanges;
- unscrew screws 13, remove washers and front pads;
- install new pads with pad tab A aligned with the holes in the front engine suspension cross-member brackets;
- install washers and tighten the screws fastening the pads to the cross-member with a torque of 54-68.6 N·m (5.5-7.0 kgf·m). Prior to installation, apply Loctite 243 sealant with Loctite 7471 or Loctite 7649 activator from "Henkel" to the screws;
- install the assembled cross-member on the frame, fix it to the frame with bolts and nuts; nut tightening torque - 49-60.7 N·m (5.0-6.2 kgf·m);
- lower the engine;
- install washers and tighten the bolts fastening the pads to the engine brackets with the torque of 49-60.7 N·m (5.0-6.2 kgf·m). Prior to installation, apply Loctite 243 sealant with Loctite 7471 or Loctite 7649 activator from "Henkel" to the bolts;
- install the engine mudguards. Tightening torque:
  - bolts 21 (Fig. 2.7) – 5.9-7.9 N·m (0.6-0.8 kgf·m);
  - nuts 12, bolts 14 – 17.8-23 N·m (1.8-2.3 kgf·m);
  - nuts 10 – 19.7-23.6 N·m (2.0-2.4 kgf·m);
  - nuts 8 – 27.6-35.5 N·m (2.8-3.6 kgf·m);
  - nuts 18 – 31-39 N·m (3.2-4.0 kgf·m);
  - nuts 16 – 49-61 N·m (5.0-6.2 kgf·m).

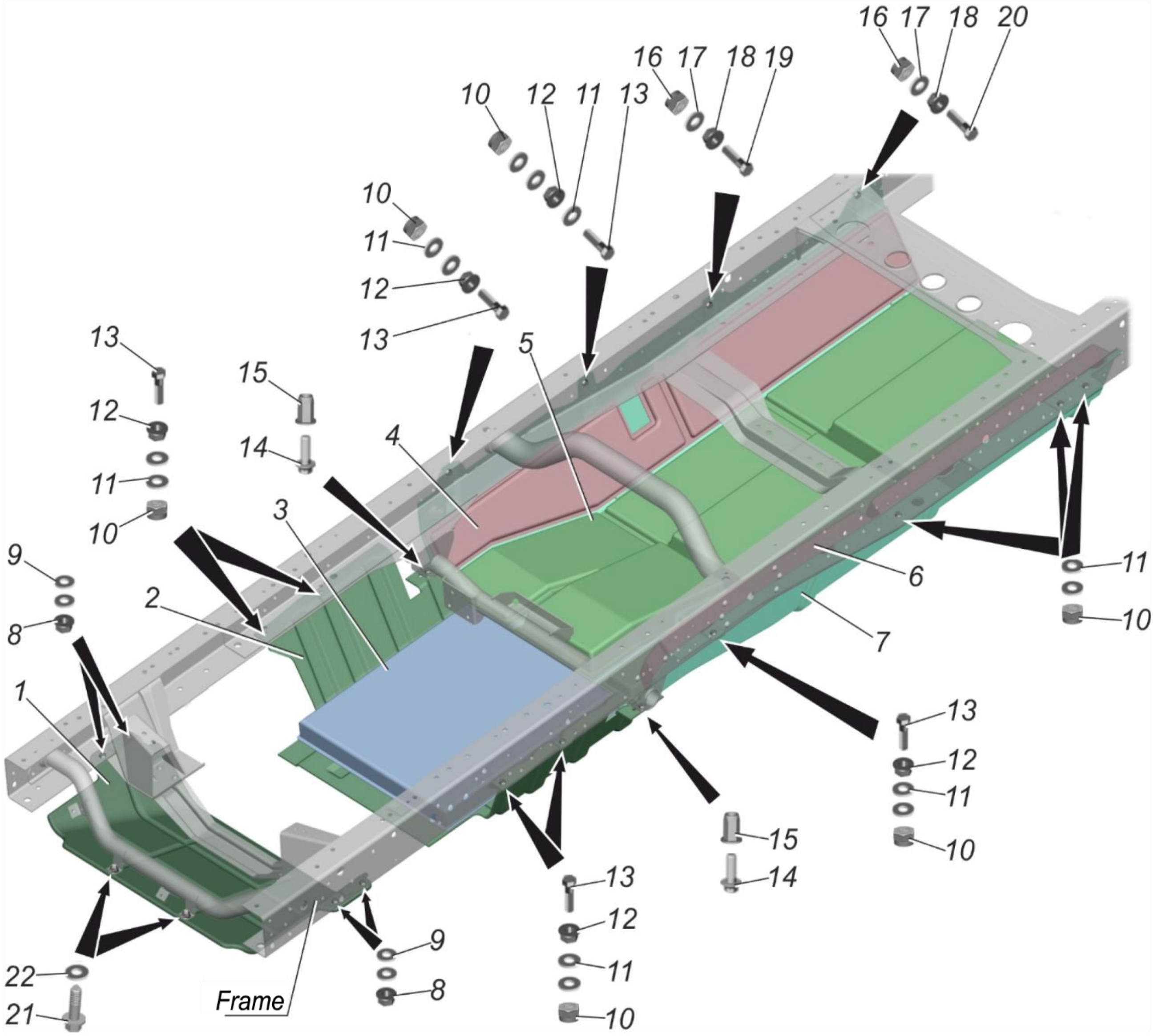


Fig. 2.7. Engine mudguards installation: 1 – engine mudguard (front); 2, 7 – rear mudguards; 3,5 – rear mudguard seals; 4, 6 – rear wall seals; 8, 10, 12, 16 – nuts; 9, 11, 17, 22 – washers, 13, 14, 19, 20, 21 – bolts; 15 – nut (threaded rivet)

To replace rear support pad, follow the procedure below:

- unscrew the nuts of studs fixing the rear support pad 17 (see Fig. 2.6) to the gearbox bracket and rear cross-member;
- hook the gearbox, place a stand under the gearbox crankcase and remove the pad;
- install new pad to the cross-member as shown in the figure and tighten the nuts of the pad mounting studs with a torque of 49-60.7 N·m (5.0-6.2 kgf·m);
- remove the stand and lower the gearbox;
- tighten the nuts of the studs fixing the pad to the gearbox bracket with a torque of 49-60.7 N·m (5.0-6.2 kgf·m).

2.3. Engine cooling system

Closed-circuit forced-circulation liquid cooling system. The system consists of a water jacket in the engine cylinder block and head, coolant pump (water pump), fan with viscosity-operated clutch, upper and lower fan shrouds, thermostat, cooling system radiator, expansion tank, plug with valves, piping, radiator drain cock, coolant temperature gauge and coolant temperature alarm, and coolant level gauge.

The cooling system also includes the exhaust treatment system coolant supply and discharge pipelines.

The engine cooling system includes the main heater radiator (Fig. 2.8) with the cabin heating system control valve.

In some vehicles with a three-seat cabin, the heating system can be equipped with a preheater with an electric pump (Fig. 2.8, b).

In some vehicles with seven-seat cabin, the heating system can be equipped with an additional heater (Fig. 2.8, c) and starting preheater with electric pump.

To control the coolant temperature, the instrument cluster is equipped with a temperature indicator. In addition, the instrument cluster includes warning lights showing up when the coolant temperature exceeds the permissible value, and the coolant level is below the minimum.

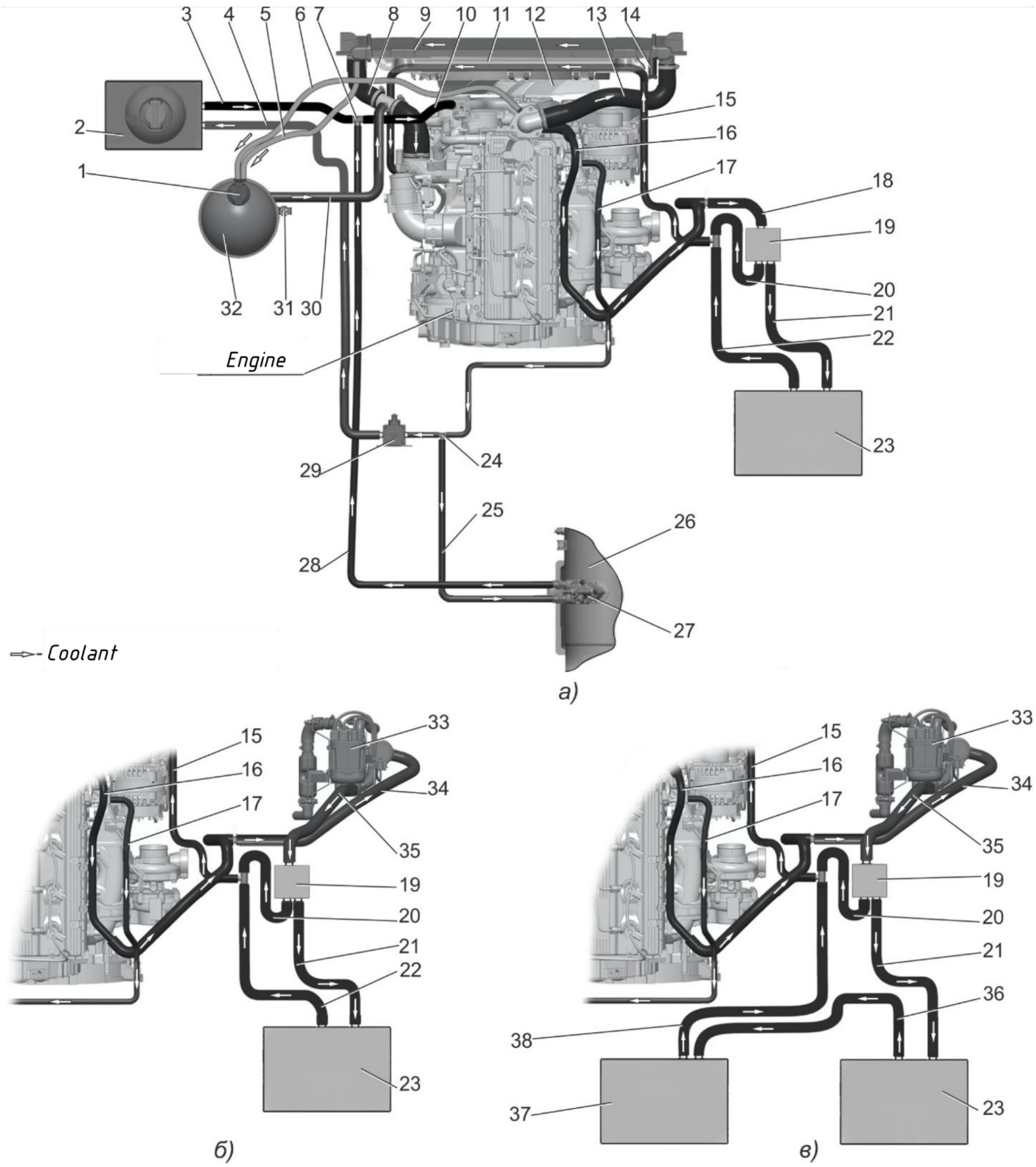


Fig. 2.8. Engine cooling system diagram: a – for vehicles without starting preheater; b – for vehicles with starting preheater; c – for vehicles with starting preheater and additional heater: 1 – expansion tank plug; 2 – reagent (urea) tank; 3, 4, 10, 17, 25, 28 – exhaust treatment system pipelines; 5, 6 – upper expansion tank hoses; 7, 24 – tees; 8 – lower radiator hoses; 9 – cooling system radiator; 11 – fan shroud (upper and lower); 12 – fan with viscosity-operated clutch; 13 – upper radiator supply hose; 14 – radiator drain cock; 15, 16 – heater pipelines; 18, 20, 21, 22, 34, 35 – hoses, 19 – heater control valve; 23 – main heater; 26 – catalytic silencer; 27 – dosing module; 29 – valve; 30 – hose from expansion tank to water pump; 31 – coolant level sensor; 32 – expansion tank; 33 – starting preheater (complete with electric pump); 36, 38 – additional heater pipelines; 37 – additional heater.

Radiator (Fig. 2.9) of corrugated-fin type with vertical tanks made of polymer composite materials. The radiator is mounted to the radiator frame base (frontend) using special members (radiator and frontend locks) and two bolts. Coolant drain cock is located at the bottom of the right (in the vehicle movement direction) radiator tank. The upper fan shroud is attached to the radiator.

Expansion tank (Fig. 2.10) is installed in the underhood space on the left side in the movement direction and is mounted to the bracket and the front end panel extension.

There are two tubes at the top of tank: one tube is connected to the thermostat through the hose, and the other one is connected to the radiator nozzle. Nozzle connected to the lower radiator hoses tee through the hose is located at the bottom of tank.

Coolant level sensor is installed in the expansion tank.

Expansion tank leak-testing. Check the tank tightness in a water bath under air pressure of 150-200 kPa (1.5-2.0 kgf/cm^2) for 30 s. No air bubbles shall be allowed.

The tank is a unserviceable and non-repairable item; in case of failure, replace it with a new one.

The expansion tank hose clamps shall be installed 2-6 mm away from the hose end face.

Expansion tank to thermostat hose clamp tightening torque - 2.5-3.5 N·m (0.25-0.35 kgf·m).

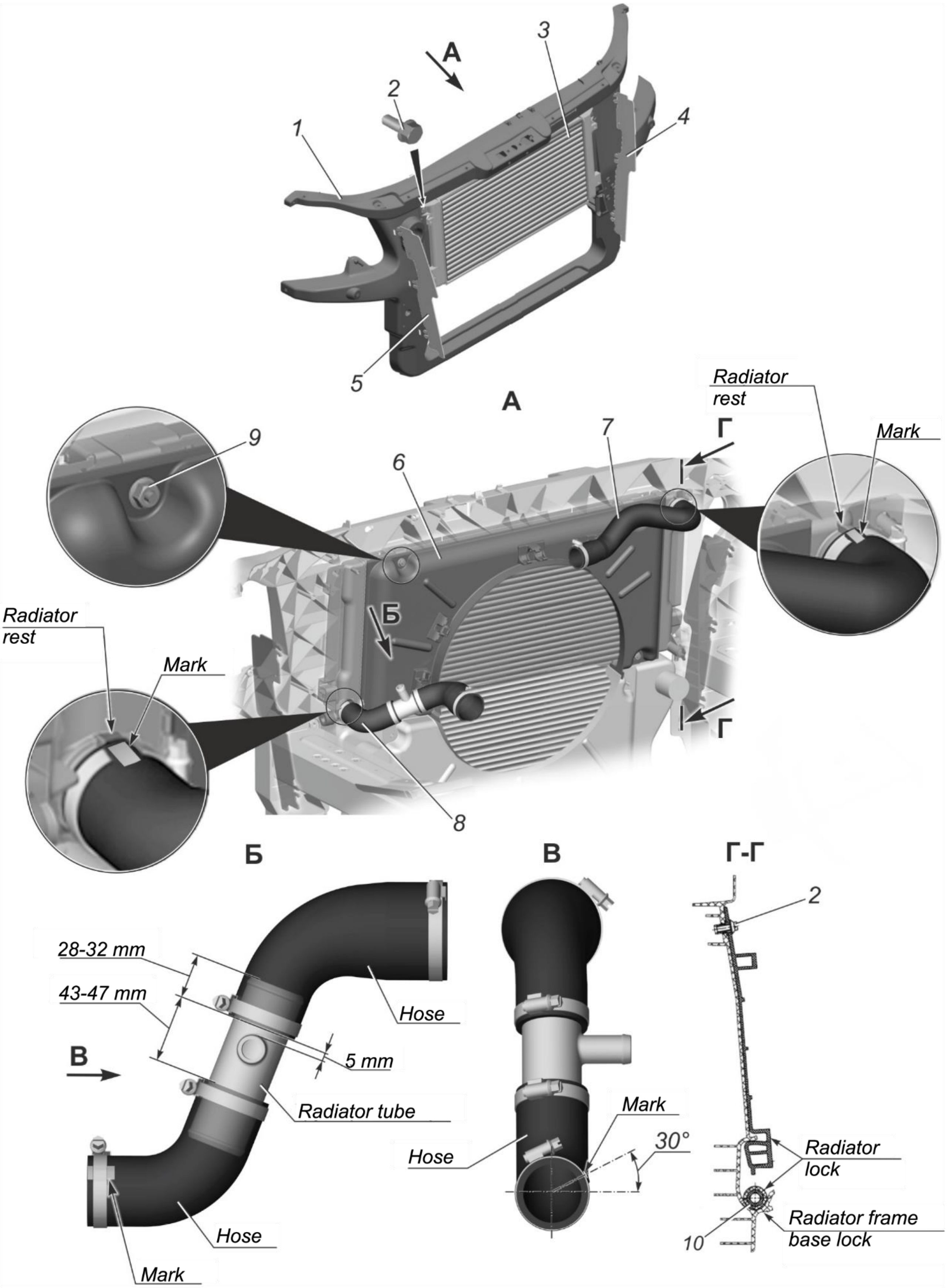


Fig. 2.9. Cooling system radiator installation: 1 – radiator frame base (frontend); 2 – bolt; 3 – radiator; 4, 5 – seals; 6 – upper fan shroud; 7 – hose; 8 – lower hoses; 9 – nut; 10 – pad;

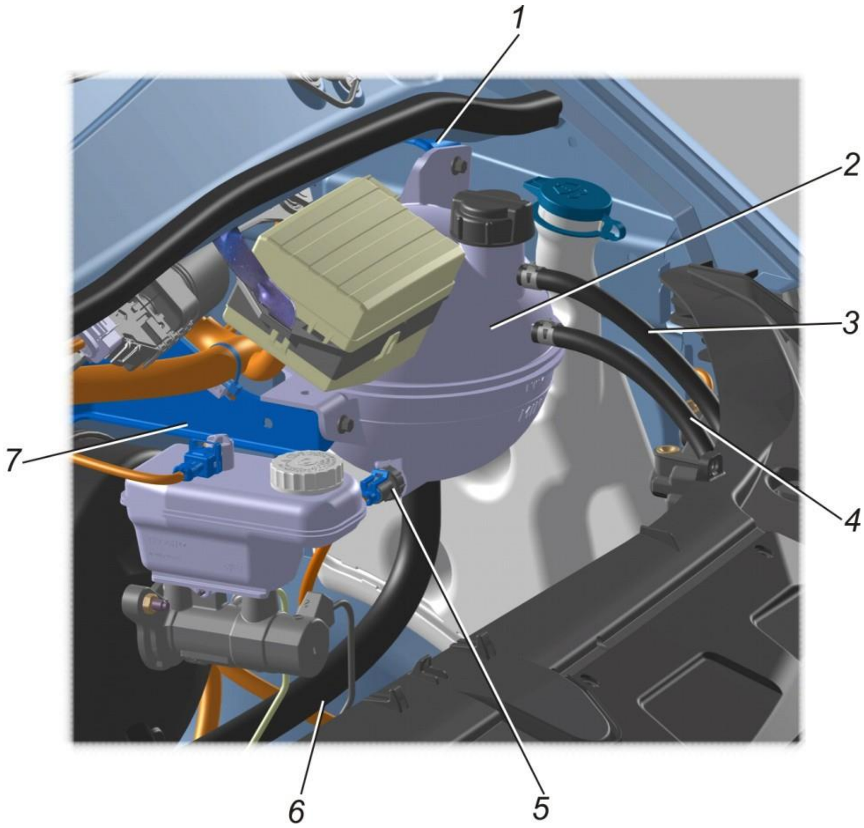


Fig. 2.10. Expansion tank installation: 1 – front end panel extension; 2 - expansion tank; 3, 4, 6 – hoses; 5 – coolant level sensor; 7 – expansion tank bracket

Expansion tank plug (Fig. 2.11) consists of threaded plastic body and valve block. The plug is attached to the expansion tank neck through a rubber gasket.

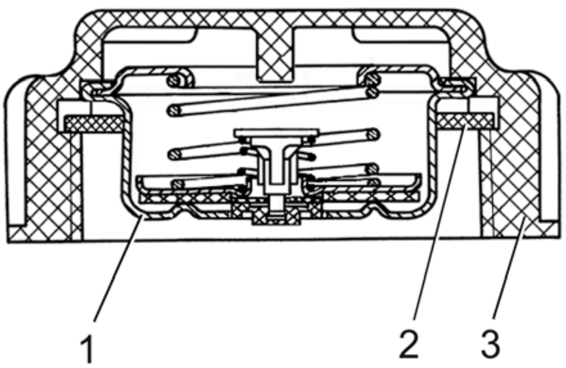


Fig. 2.11. Expansion tank plug: 1 – valve block; 2 – gasket; 3 – body

The valve block ensures the cooling system pressure balancing with environment after the engine stops running and the coolant cools down, as well as overpressure maintenance when the coolant temperature rises.

Cooling system overpressure raises the coolant boiling point to 120°C.

Check periodically the air pressure-actuated discharge valve opening. The air bubbles (when plug is immersed in water) shall occur at a pressure of 0.11-0.15 MPa

(1.1-1.5 kgf/cm^2). Testing with the plug installed to the temporary expansion tank shall be allowed.

Fan with viscosity-operated clutch

The fan with viscosity-operated clutch is mounted to the shaft of the support, of which body is attached to the engine with four bolts. The fan is driven through the poly-V belt.

The eleven-bladed plastic fan (Fig. 2.12) is designed to initiate the required air flow through the radiator block and inside the underhood. The fan is statically balanced. To automatically maintain the required fan rpm providing the optimum coolant temperature, the fan is equipped with a viscosity-operated clutch.

In case of failure, replace fan with viscosity-operated clutch with a new one. The clutch with fan is installed to the threaded end of the fan drive shaft to the stop; tightening torque - 30-50 N·m (3-5 kgf·m). Prior to assembly, apply anaerobic Loctite 243 sealant with Loctite 7471 or Loctite 7649 activator from "Henkel" to the internal threaded surface of the clutch with fan.

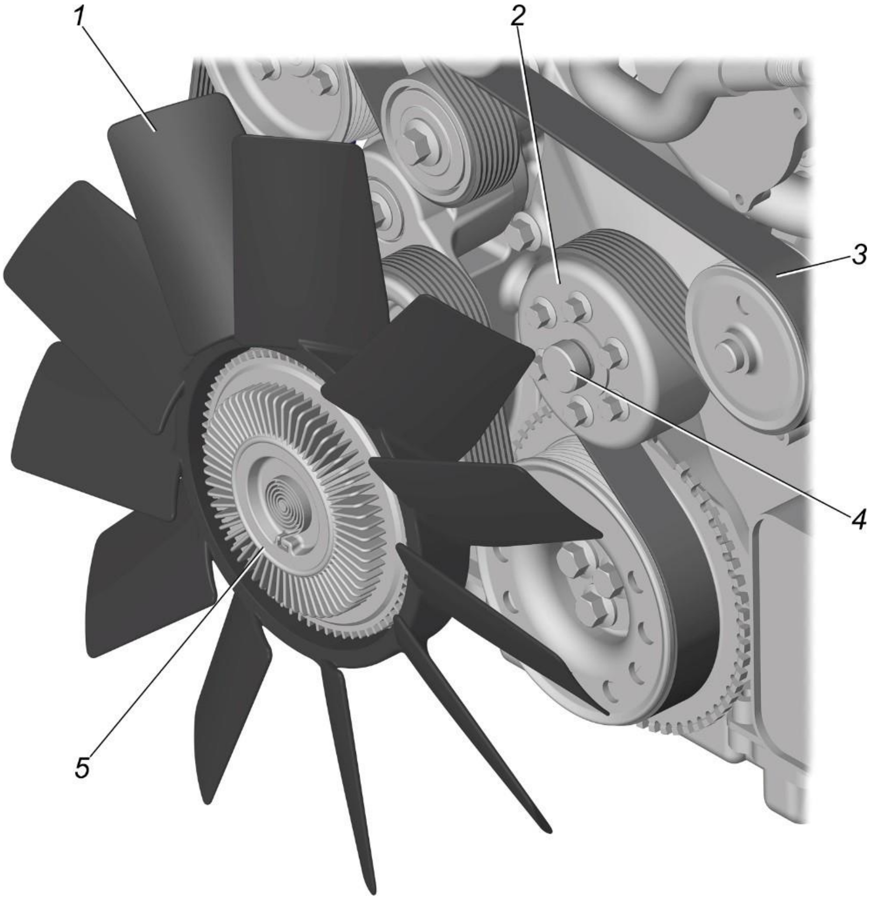


Fig. 2.12. Fan Installation: 1 – fan; 2 – pulley; 3 – attachment drive belt; 4 – fan drive shaft; 5 – viscosity-operated clutch

Viscosity-operated clutch specifications

Rotation direction .... left

Engaging temperature, ºC.. 67-73

Disengaging temperature, ºC, min. 55

Fan speed with the clutch engaged, rpm, min. 3900

Fan speed with the clutch disengaged, rpm, max. 1200

Permissible static unbalance, g·cm 45

Fan specifications

Rotation direction .... left

Permissible static unbalance, g·cm 35

Viscosity-operated clutch and fan limit state:

- turn-on or turn-off temperature increase or decrease by 10%;
- static unbalance increase by 10%;
- fan blade failure;
- viscosity-operated clutch silicone fluid leakage;
- viscosity-operated clutch bearing failure;
- viscosity-operated clutch dents, cracks, corrosion.

Cooling system maintenance

Cooling system maintenance consists in daily check of expansion tank coolant level with cold engine, system leak-testing, periodic coolant density check and coolant replacement according to the Vehicle log book.

In case of heavy fouling of coolant and charge air radiators or in case of reduced cooling system efficiency, clean and wash radiator cores with pressurized water jet using touchless car washing shampoo.

Safety precautions

When servicing the cooling system, remember that the coolant is toxic and flammable, since it contains ethylene glycol, which has a toxic and narcotic effect and the ability to enter the body through dermal route.

When ingested, coolant causes chronic intoxication with damage to vital human organs (affects the blood vessels, kidneys, nervous system).

Therefore, the following precautions shall be observed when using coolant:

- do not suck coolant into mouth when transferring it;
- do not smoke or eat while handling the coolant;
- where coolant splashing may occur during operation, wear protective goggles;
- wash exposed skin areas contacting with coolant with water.

Coolant level inspection

Check the coolant level in expansion tank 1 (Fig. 2.13) on a cold engine only.

The expansion tank liquid level shall not be below the MIN mark and above the upper welded tank flange (MAX mark).

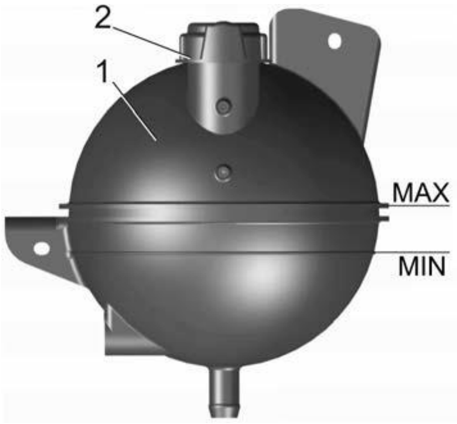


Fig. 2.13. Expansion tank: 1 – tank; 2 – plug

Low-freezing coolants have high thermal expansion coefficient - fluid volume increases significantly with increasing temperature. Therefore, only check the expansion tank coolant level with cold engine and do not fill the expansion tank above the maximum level.

Prior to adding coolant, it is recommended to measure the expansion tank coolant density. Increased density indicates that the coolant level has dropped as a result of water evaporation. In this case, add distilled water to maintain the coolant density and freezing point.

Unchanged density indicates that the coolant level has dropped as a result of coolant leakage. In this case, fill the coolant. In case of frequent topping up, check the system for tightness and repair leaks.

CAUTION

Do not use water as a coolant. The use of water causes corrosion and scale formation resulting in duct clogging in the cylinder head and block, and radiator, thus impairing fluid circulation and heat dissipation from engine parts. This will result in systematic overheating, heavy parts wear and engine failure. In winter, water freezing in the cooling system may cause damage to the cylinder block, cylinder head and radiator.

Check the coolant density during seasonal maintenance before winter operation using an areometer and thermometer. The density shall be as follows:

"Coll Stream Premium 40"…………………………………...1.069-1.072 g/cm^3

(at liquid temperature plus 20 ºC)

"Coll Stream Premium 65"..1.083-1.085 g/cm^3

When the fluid temperature is different, correct the measurement. When the density does not match the specified values, replace the coolant.

Coolant replacement is required due to anti-corrosion properties degradation. Coolant replacement period – as per Vehicle log book.

It is recommended to check the coolant for turbidity once a season (in the fall). To do this, drain approx. 50 ml of coolant from the cylinder block. Considerably cloudy coolant is indicative of heavy corrosion process onset. In this case, immediately replace the coolant with obligatory flushing of the entire system, as described below.

Coolant shall be replaced with cooling system flushing to remove old coolant residues completely, as the fresh coolant additives may react with the old fluid thus reducing the fresh coolant life. Use clean distilled or deionized (salt content not exceeding 6 mg-eq/l) water for flushing.

Coolant replacement procedure

Drain coolant, for which purpose proceed as follows:

- park the vehicle on a level platform;
- open the heater control valve (ignition off with the heater on);
- remove expansion tank plug;
- drain the coolant by opening the radiator drain cock;
- close the radiator drain cock.

Flush the cooling system following the procedure below:

- fill the cooling system with clean distilled or deionized water and tighten the expansion tank plug;
- start the engine and warm it up at medium crankshaft speed to the thermostat opening temperature; to circulate the fluid through the radiator, let the engine run for 5-7 min;
- turn off the engine, let it cool down and drain the water;
- close the drain cock and repeat the above flushing operations once more using

fresh water.

To fill the cooling system, follow the procedure below:

- open the heater control valve (ignition off with the heater on);
- fill the expansion tank with fresh coolant of the recommended grade to the upper welded expansion tank flange level (MAX mark) (see Fig. 2.13). Fill slowly with continuous flow. When expansion tank level stops dropping, vigorously squeeze the lower radiator hose 2-3 times;

Due to the air existing in the system, filling the full fluid amount without starting the engine is impracticable. To remove air locks after filling with fresh coolant, proceed as follows:

- start the engine, warm up to the main thermostat valve opening temperature. After the liquid level in the expansion tank drops, fill coolant and close the tank plug;
- turn off the engine, let it cool down, bring the expansion tank coolant level to normal and close the expansion tank plug;
- warm up the engine to the thermostat opening temperature and let the engine run for 3-5 min (in cycles) at varied crankshaft speeds: 3000 min^{-1} – 0.5 min; 1500 min^{-1} – 0.5 min; minimum idle speed – 0.5 min. Bring the expansion tank coolant level back to normal;
- install expansion tank plug.

Radiator removal and installation

In case of the radiator leakage, remove it from the vehicle.

To do this:

- drain coolant from the engine cooling system;
- disconnect and remove the front bumper panel;
- disconnect the front bumper panel mounting brackets from the frontend;
- disconnect HPS tank hoses from the upper fan shroud;
- disconnect the cooling system radiator supply hose from the thermostat nozzle;
- disconnect the lower cooling system radiator hoses and the expansion tank steam discharge hose from the radiator;
- unscrew two bolts fastening the cooling system radiator to the frontend, disengage the radiator from the frontend "lock" and remove it from the vehicle;
- remove the upper fan shroud, supply hose and rubber pads from the radiator.

Prior to the radiator leak-testing, close the tank connections with plugs or stoppers. Leak-testing shall be conducted in a water bath under air pressure of 149-150 kPa (1.49-1.50 kgf/cm^2) for 30 seconds. Air shall be supplied through a dedicated tube equipped with a valve to shut off the air supply and control pressure gauge. The dedicated tube shall be put on the radiator steam discharge tube.

No air bubbles shall be allowed. In case of failure, replace the radiator with a new one.

Install radiator in the reverse order to removal, Tightening torques:

- bolts fastening the radiator to the frontend – 5.4-7.8 N·m (0.55-0.8 kgf·m),;
- nuts fastening the upper fan shroud to the radiator – 2.8-4.8 N·m (0,3-0,5 kgf·m);
- hose clamps – 3.0-3.5 N·m (0.3-0.35 kgf·m).

Install the supply and lower hoses to the radiator nozzles with hose marks aligned with the radiator rests (see Fig. 2.6).

Radiator hose clamps shall be installed 1-5mm away from the hose end face, expansion tank hose clamp –2-6 mm away from the hose end face.

Check connections for leak-tightness after assembly.

When installing the lower radiator hoses, the following requirements shall be met:

- install the lower hoses to the pipe as shown in Fig. 2.9;
- position clamp locks on the lower hoses as shown in Fig. 2.9;
- lower radiator hose clamps shall be installed 1-5mm away from the hose end face;
- tightening torque of clamps fastening lower hoses to the pipe – 3.0-3.5 N·m (0.3-0.35 kgf·m).

2.4. Supply systems

Engine **fuel supply system** (Fig. 2.14) consists of fuel tank with installed fuel pipes, multifunctional valve and fuel intake module with fuel level sensor, fuel tank plug, fuel lines, fine fuel filter with manual fuel-priming pump (to prime the system), high pressure fuel pump (HPFP), high pressure fuel accumulator and electromagnetic injectors.

The fuel system provides the required fuel amount supply to the engine cylinders in any operating mode.

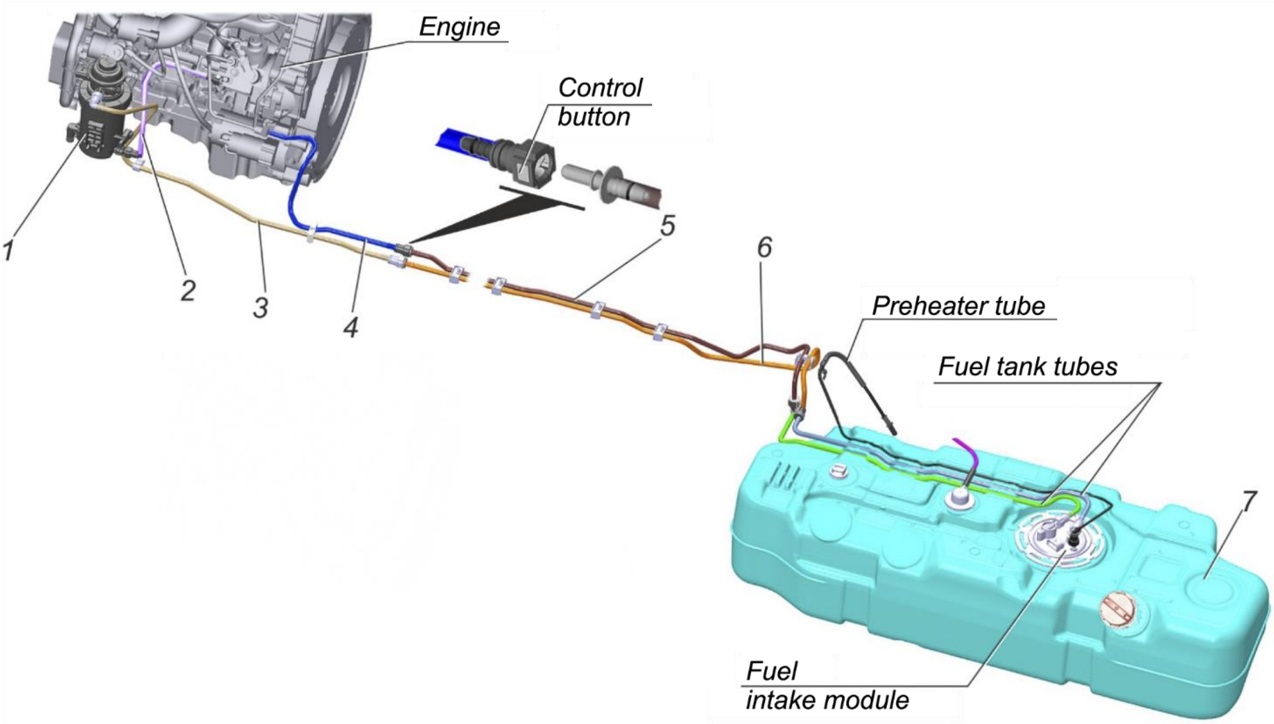


Fig. 2.14. Flatbed vehicle fuel system diagram: 1 – fine fuel filter; 2 – fuel supply pipe to HPFP; 3 – fuel supply pipe to filter; 4 – fuel drain pipe from engine; 5 – fuel drain pipe; 6 – fuel supply pipe; 7 – fuel tank with fuel pipes.

Fuel lines. The vehicle is equipped with polyamide fuel lines with quick-release connectors fixed in polyamide clips.

The **fuel tank** is located on the left side of the frame girder (Fig. 2.15, 2.16).
The vehicle fuel tank is fastened to the frame girder with brackets and clamps.
Rubber shells are installed to the fuel tank mounting brackets.

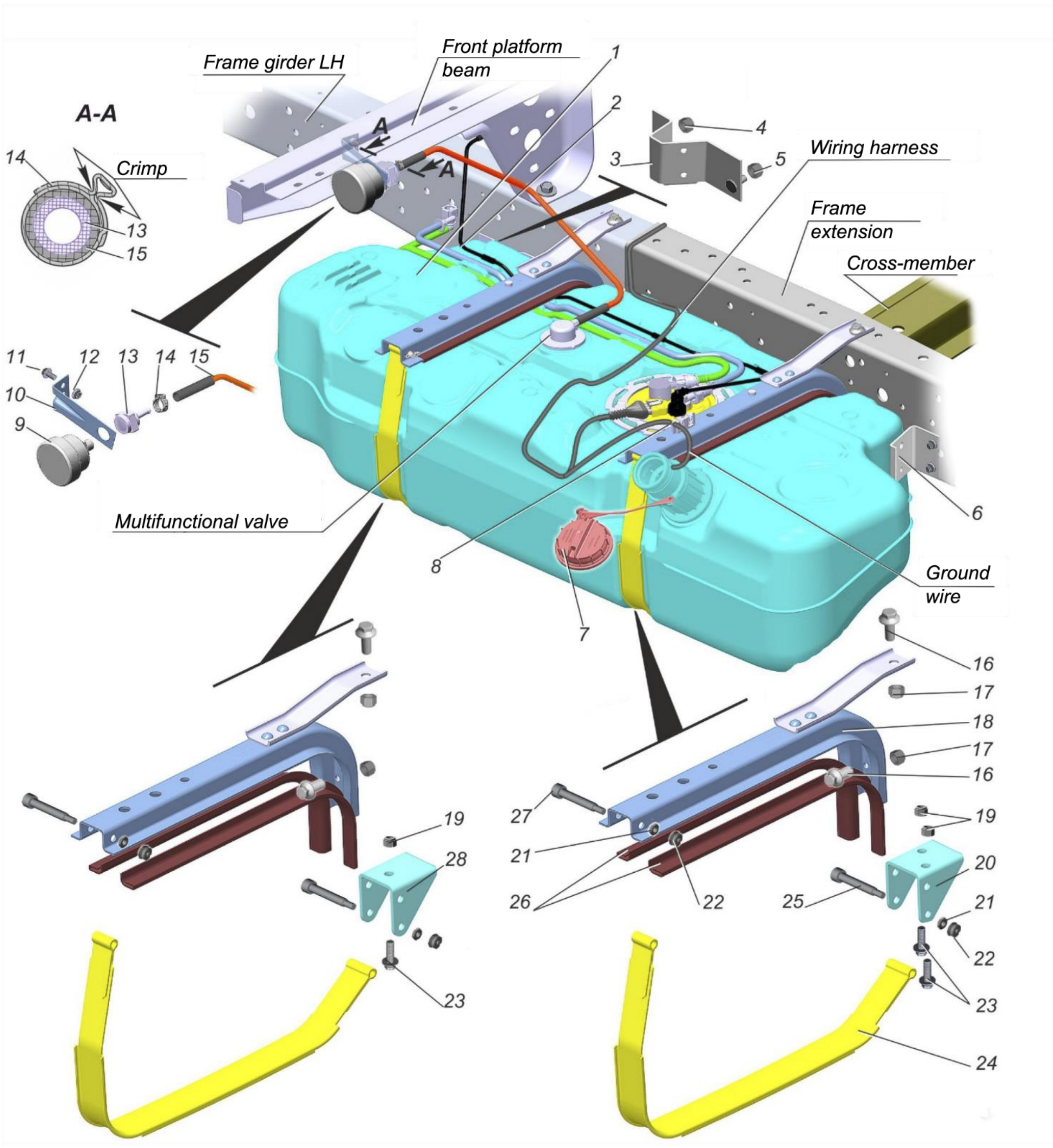


Fig. 2.15. Fuel tank installation to flatbed vehicle with three-seat cab: 1 – fuel tank with fuel intake module; 2 – starting preheater fuel line [1]; 3, 6 – stops; 4, 5, 12, 17, 19, 22 – nuts; 7 – fuel tank plug; 8 – clip; 9 – air filter; 10 – bracket; 11, 16, 23 – bolts; 13 – air filter nut; 14 – clamp; 15 – vent line complete with hoses; 18 – fuel tank bracket; 20, 28 – clamp brackets; 21 – washers; 24 – fuel tank clamp; 25, 27 – special screws; 26 – shells

---

[1] - For vehicles equipped with starting preheater

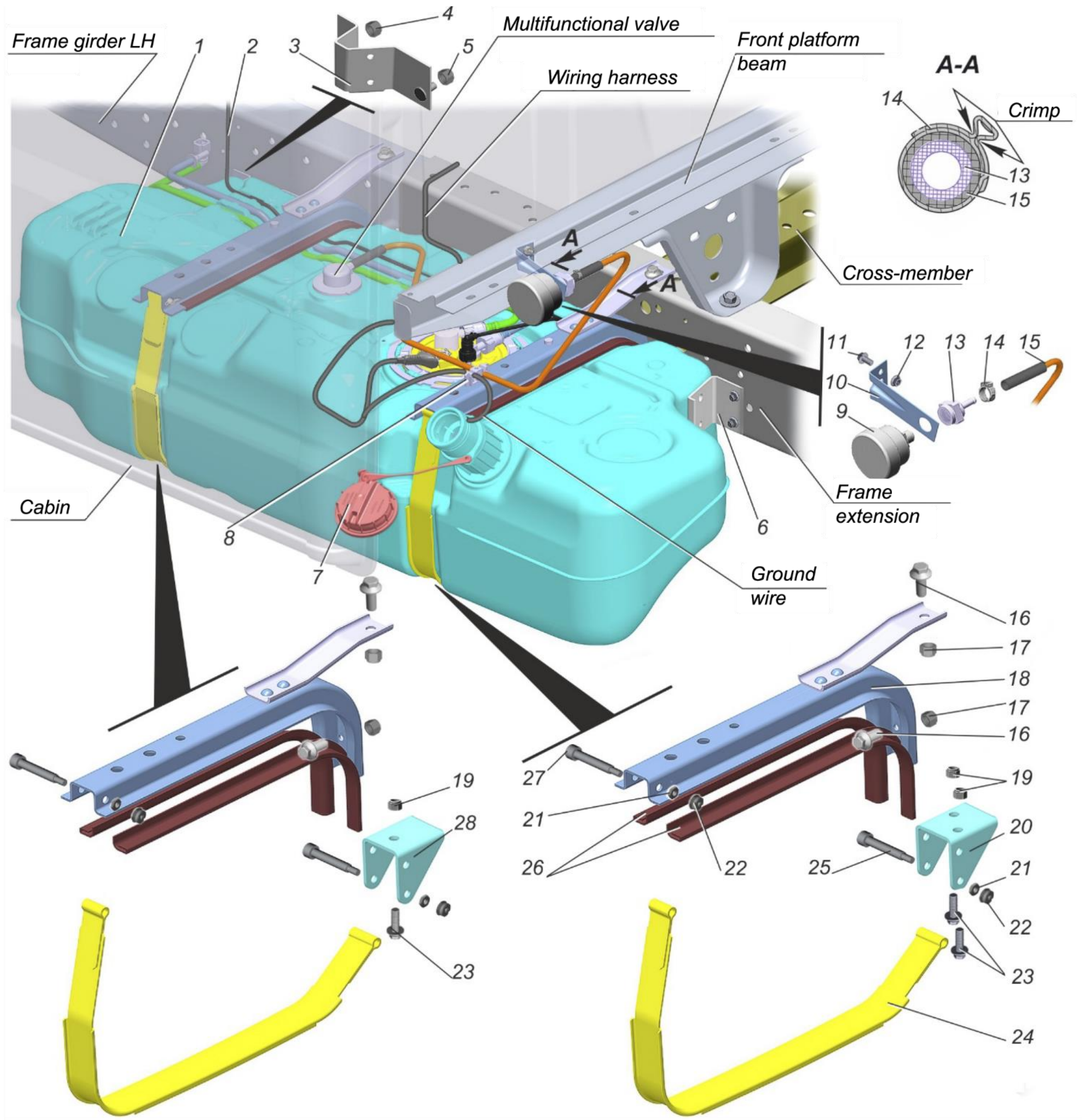


Fig. 2.16. Fuel tank installation to flatbed vehicle with seven-seat cab: 1- fuel tank with fuel intake module; 2 – starting preheater fuel line [1)]; 3, 6 – stops; 4, 5, 12, 17, 19, 22 – nuts; 7 – fuel tank plug; 8 – clip; 9 – air filter; 10 – bracket; 11, 16, 23 – bolts; 13 – air filter nut; 14 – clamp; 15 – vent line complete with hoses; 18 – fuel tank bracket; 20, 28 – clampbrackets; 21 – washers; 24 – fuel tank clamp; 25, 27 – special screws; 26 – shells

[1)] - For vehicles equipped with starting preheater

Fuel lines are attached to the fuel tank (Fig. 2.17), and multifunctional valve is mounted.

On vehicles, the air filter is mounted to the front platform beam (see Fig. 2.15, 2.16).

The fuel tank filler tube is closed with a plug with a safety valve and vacuum valve.

Fuel tank filling capacity – 80 liters. Forced filling of additional fuel quantity shall not be allowed.

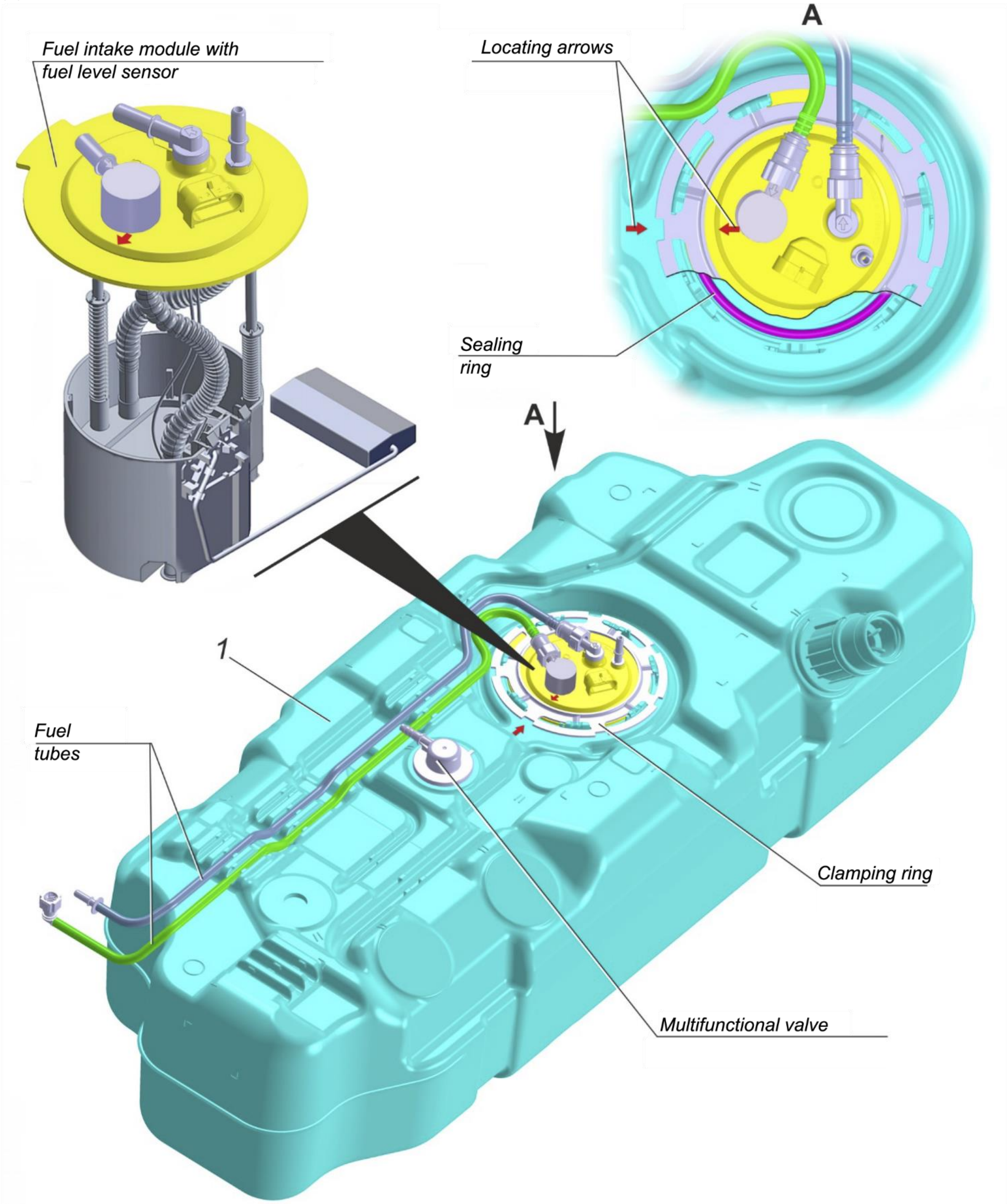


Fig. 2.17. Flatbed vehicle fuel tank: 1 - fuel tank assembly

Fine fuel filter with replaceable filter element is designed to clean fuel in the engine supply system from mechanical impurities and water, and to preheat fuel in winter. The filter is located in the vehicle underhood space and is fastened using bracket 1 (Fig. 2.18) on the left (in the vehicle movement direction) cab girder. The fine fuel filter is connected to the fuel intake module and the engine high-pressure fuel pump through tubes 10, 11 with quick-release connectors.

The fine fuel filter accommodates terminal strips of the water sensor 12 and fuel heater 5 wires.

When the water alarm is actuated, drain water from the filter through the tap 15 located at the filter bottom.

The filter is equipped with a manual fuel-priming pump 6 for priming the low-pressure fuel system and air vent closed with a bolt 7.

Tightening torque of the bolt fastening the fine fuel filter to the bracket – 11-12 N·m (1.1-1.2 kgf·m); that of the bolt fastening the filter bracket to the cab girder – 12-18 N·m (1.2-1.8 kgf·m).

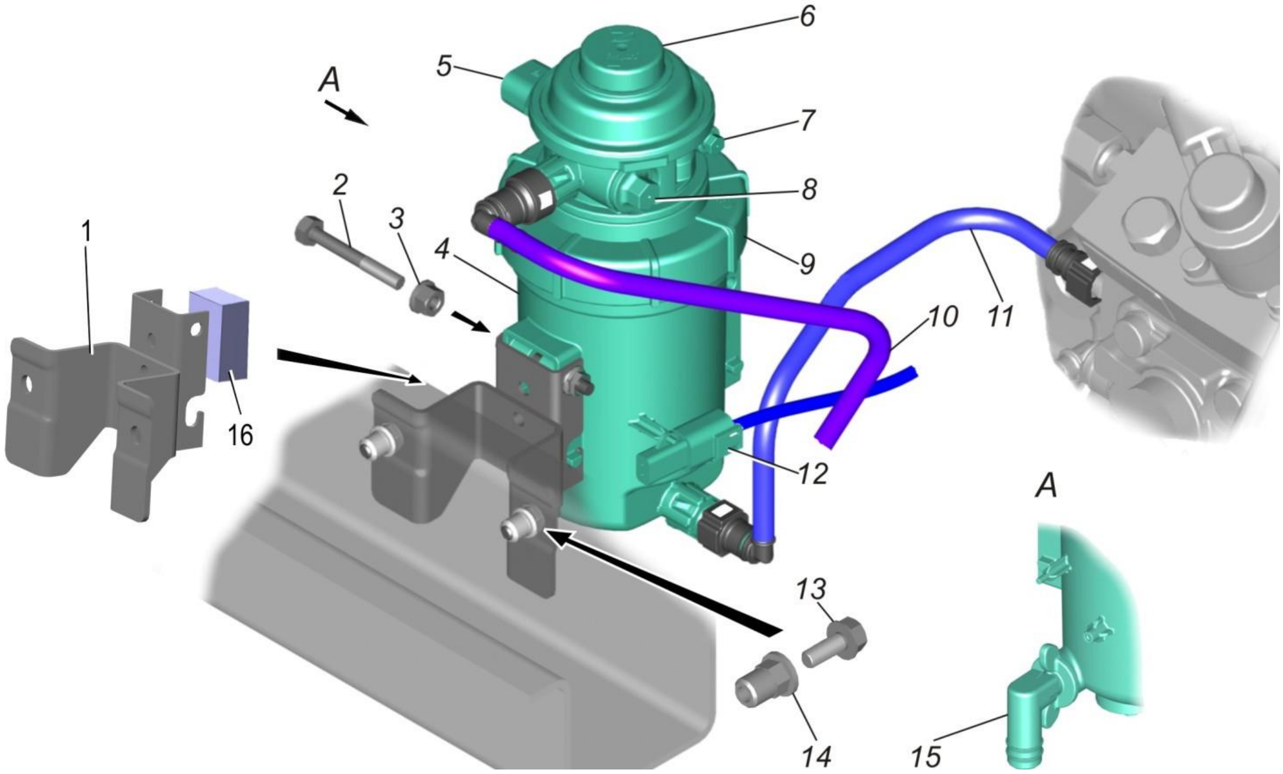


Fig. 2.18. Fine fuel filter installation: 1 – bracket; 2, 13 – bolts; 3 – nut; 4 – filter housing; 5 – fuel heater terminal; 6 – manual fuel–priming pump; 7 – air vent bolt; 8 – plug; 9 – filter housing cover; 10 – fuel supply pipe to the filter; 11 – fuel supply pipe to the HPFP; 12 – fuel water sensor terminal; 14 – threaded rivet; 15 – tap; 16 – spacer gasket.

The **fuel intake module** is designed for fuel intake and fuel tank level control.

The module is installed in the fuel tank and attached to the tank with retaining ring through a rubber sealing ring.

The module consists of cover, recuperator, strainer, float, fuel level sensor and retaining ring.

The cover accommodates two fittings for fuel supply line and fuel drain line connection, fitting for starting preheater fuel line connection[1)] and electrical connector for fuel level gauge connection to the vehicle on-board network.

For the fuel intake module technical specifications, refer to "Electrical equipment" section .

Strainer is installed at the module fuel intake tube inlet to prevent mechanical impurities contained in the fuel from entering the fuel system.

The recuperator is designed to provide stable supply with the low tank level.

For the fuel level gauge structure, refer to "Electrical equipment" section.

The **engine air supply system** consists of air filter, air ducts, charge air cooler, turbocharger and intake manifold.

Air filter (Fig. 2.19) of dry type with filter element.

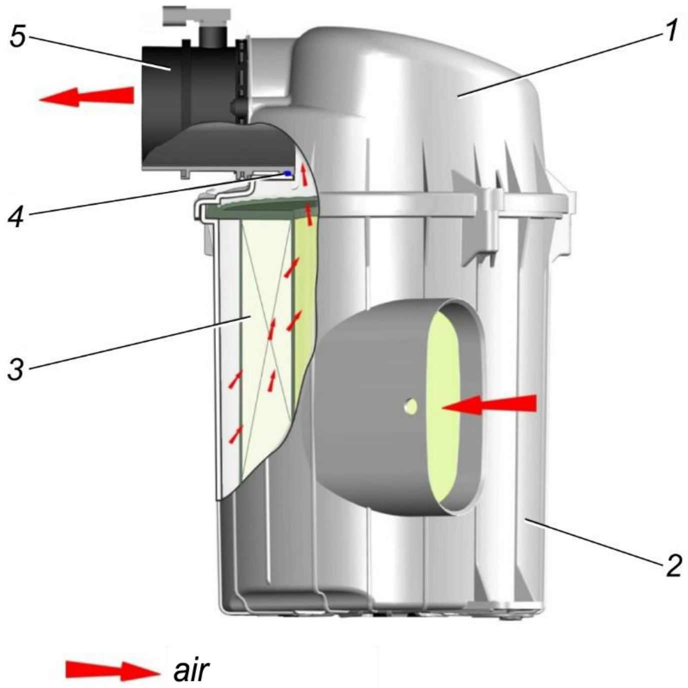


Fig. 2.19. Air filter assembly with insert: 1 – upper housing part; 2 – lower housing part; 3 – filter element; 4 – sealing ring; 5 – insert with sensor

[1)]- For vehicles equipped with starting preheater

The air filter (Fig. 2.20) is fastened with brackets to the right cab floor side-member and the radiator frame base (frontend).

The air intake is fastened to the frontend with snaps and connected to the resonator through the hose.

The resonator is mounted on the right side panel of the cab front and has a condensate drain hole.

The air filter is designed to dedust the air entering the engine.

The air filter consists of a plastic collapsible housing with a nozzle located at the housing side and filter element. The insert with a sealing ring is installed to the discharge opening at the upper housing part and fastened with two screws. The air temperature and pressure sensor is installed to the air filter insert and fastened with screw.

The tightening torque of the screw fastening the air temperature and pressure sensor to the insert – 4.9-7.8 N·m (0.5-0.8 kgf·m).

The filter element is made of porous cardboard with low drag and high filtering capacity.

Air enters the air filter through the air intake and is filtered by passing through the filter element screens. The air is then fed to the engine turbocharger through the nozzle at the filter housing top.

The resonator is designed to reduce noise at certain engine operating modes.

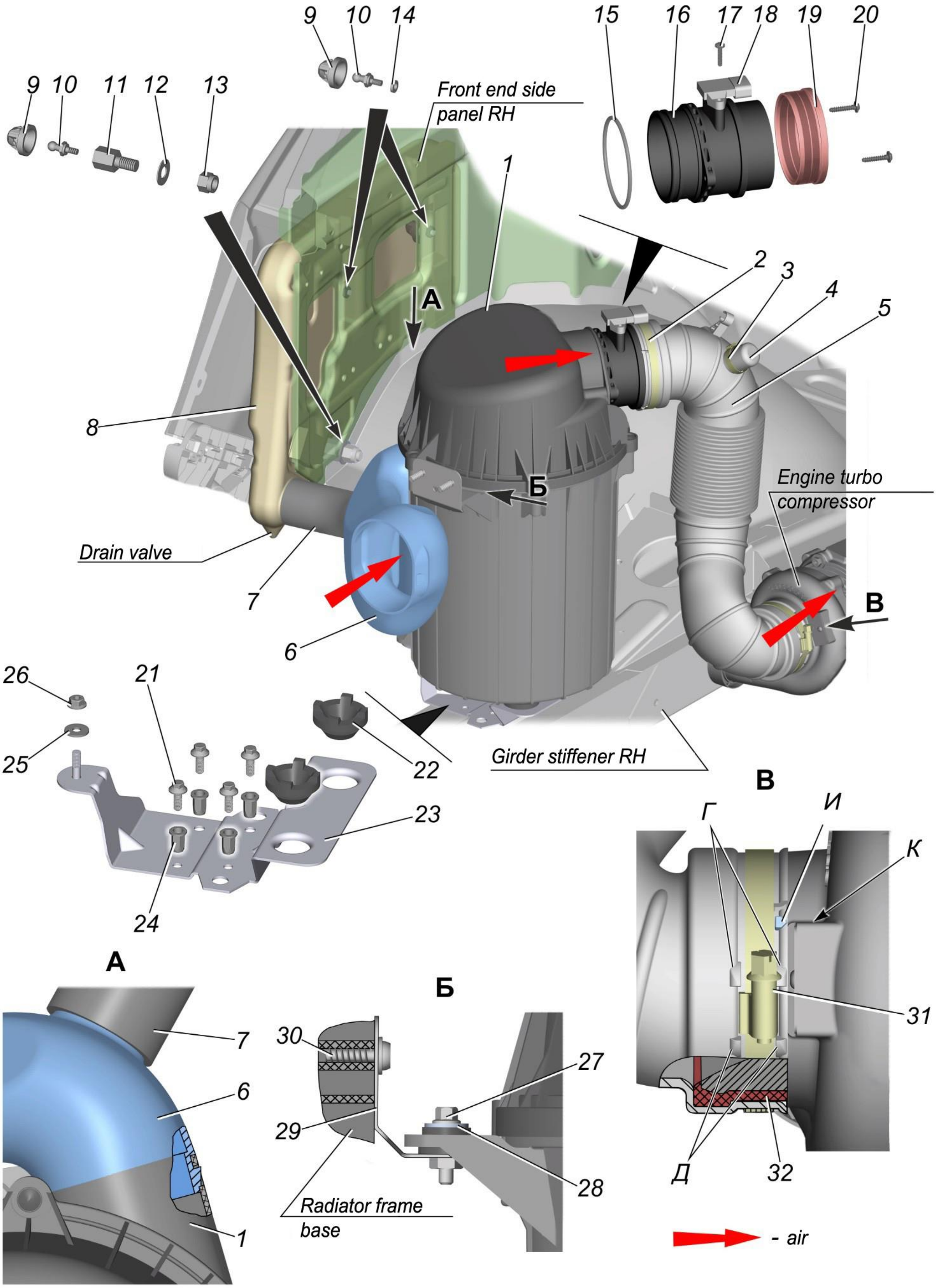


Fig. 2.20. Air filter installation: 1 – air filter; 2, 3, 31 – clamps; 4 – plug; 5 – pipe with nozzle; 6 – air intake; 7 – hose; 8 – resonator; 9 – retaining bushing; 10 – oval–head screw; 11 – boss; 12, 14, 25, 28 – washers; 13, 26 – nuts; 15, 19, 32 – sealing rings; 16 – insert; 17, 20, 30 – screws; 18 – air temperature and pressure sensor; 21, 27 – bolts; 22 – support; 23, 29 – brackets; 24 – threaded rivet.

The **charge air cooler** (Fig. 2.21) of fin-and-tube type made of aluminum provides cooling of air supplied by the turbocharger to the engine intake pipe. The cooler is attached to the radiator frame base (frontend) with special members (cooler and frontend locks) and two bolts. The lower fan shroud is attached to the charge air cooler.

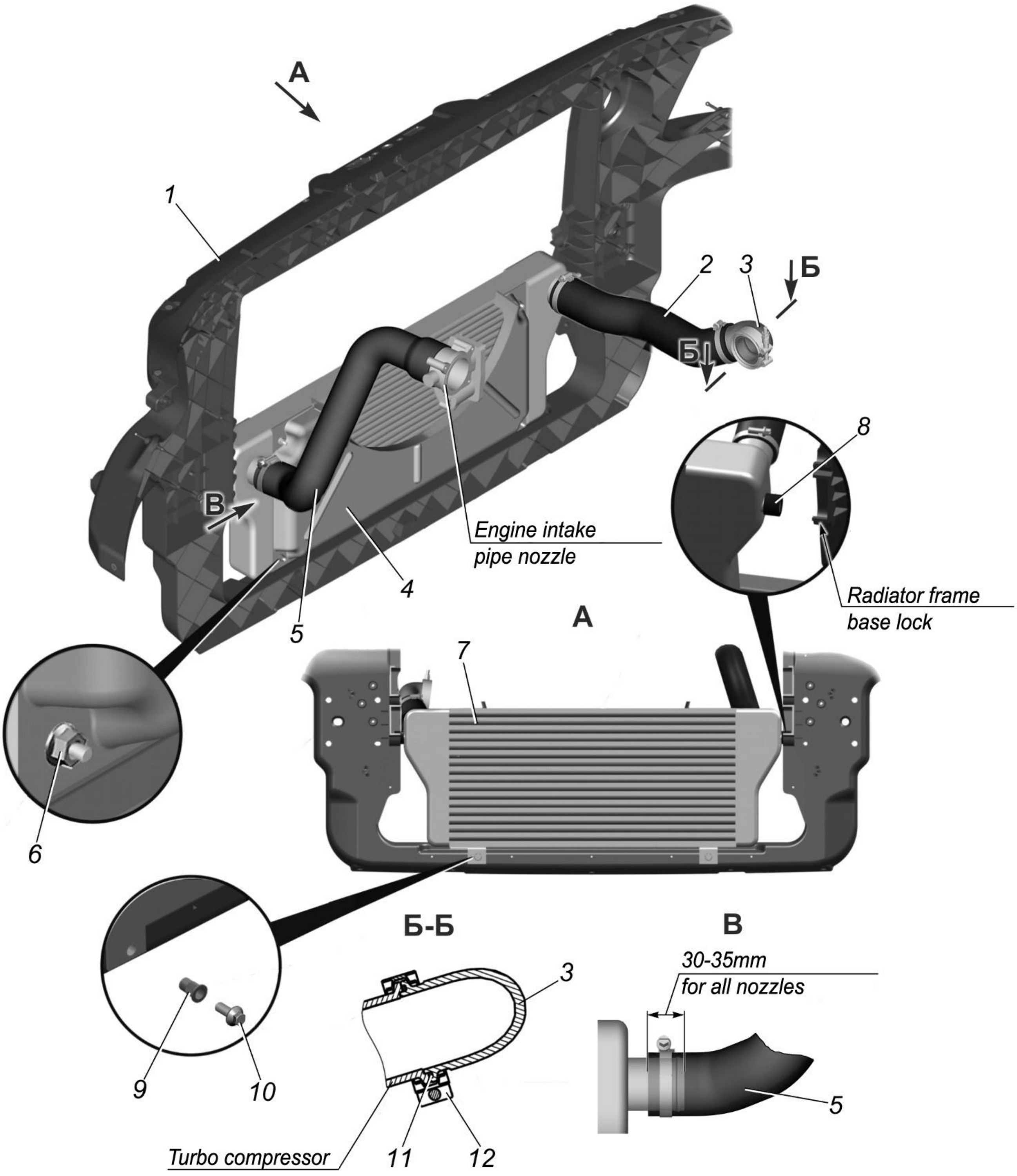


Fig. 2.21. Charge air cooler installation: 1 – frontend; 2.5 – hoses; 3 – discharge nozzle; 4 – lower fan shroud; 6 – nut; 7 – charge air cooler; 8 – pad; 9 – threaded rivet; 10 – bolt; 11 – ring; 12 – clamp

Supply systems maintenance and repair

Fuel system maintenance consists in periodic leak-testing of fuel system connections, sludge and fuel water draining from the fine fuel filter (FFF), FFF filter element replacement and fuel intake module strainer replacement or cleaning.

Thoroughly test fuel system connections for leak-tightness. Leak-testing shall be carried out in good light and with engine idling.

The fuel supply line repair consists in leak elimination by the damaged tube assembly replacement. To ensure tightness and reliability of connections during assembly, connect the quick-release connector and the tip until the characteristic click of the connector lock. The parts to be joined shall be clean. Tubing shall be securely fastened in the clips located on the frame and left engine support bracket.

The fuel intake module strainer shall be replaced or cleaned periodically in accordance with the Vehicle log book.

Air filter maintenance consists of filter cleaning operations and filter element replacement, checking of clamps fastening on air ducts from the air filter to the engine, insert with mass air flow sensor to the air filter housing.

The FFF maintenance (filter element replacement) shall be performed in accordance with the supplier's documentation.

Periodically check the crankcase vent tube condition (pinching shall not be allowed);

Safety precautions

When servicing the fuel system, be aware that diesel fuel and its fumes are harmful to health and observe the following precautions:

- do not suck fuel from the fuel tank through the hose by mouth;
- only repair and service fuel system elements with the engine off;
- do not smoke or eat during work;
- avoid fuel contact with eyes and exposed skin areas; in case of fuel contact, wash with soap and water.

Fuel intake module strainer replacement or cleaning

To replace or clean the fuel intake module strainer, proceed as follows:

- disconnect the electrical connector of the fuel level sensor wires;
- disconnect fuel lines from the fuel intake module;
- turn the retaining ring of the fuel intake module bayonet lock counterclockwise using tap wrench until the ring protrusions come out from under the fuel tank flange retainers and remove the retaining ring. Remove the sealing ring and remove the fuel intake module from the fuel tank;

ATTENTION
When removing the module from the fuel tank, be careful not to damage the fuel level gauge float rod.

- disconnect and remove the recuperator from the module;
- replace the strainer and install the recuperator. When the filter mesh is undamaged, it is allowed to only remove dirt from the filter mesh and rinse it from outside without replacement.

Install the fuel intake module in the reverse order to removal, taking into account the following:

- prior to the retaining ring installation, align the arrows marked on the fuel intake module and fuel tank;
- retaining ring installation torque – 135-406 N·m (13.5-40.6 kgf·m);
- connect the fuel tank tubes with the module until a characteristic click.

Fuel tank connections to the fuel intake module and fuel tubes shall be tight when tested in water bath under air pressure of 30-35 kPa (0.3-0.35 kgf/cm^2) for 10 s (see below for leak-testing).

Fuel tank plug check

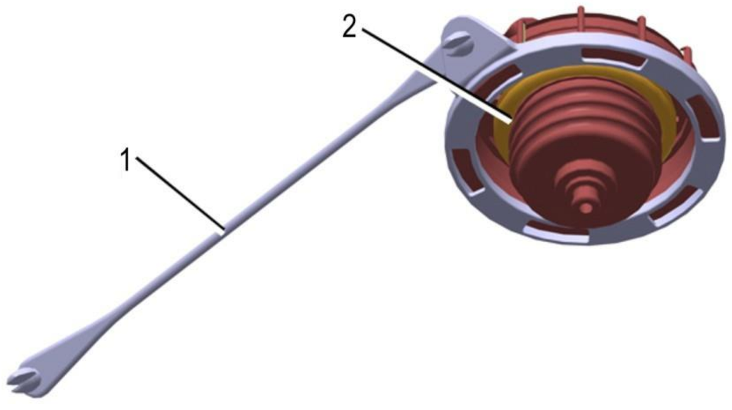


Fig. 2.22. Fuel tank plug with safety valve and vacuum valve: 1 – drive tang; 2 – plug gasket

In case of failure, replace fuel tank plug (Fig. 2.22) with safety valve and vacuum valve with identical or other recommended plug. Use of not recommended plug may cause failure of the fuel supply and evaporation systems. The safety valve shall operate at the fuel tank overpressure of 10-18 kPa (1000-1800 mm H2O); the vacuum valve shall operate at a vacuum of at most 3 kPa (300 mm H2O). The plug shall be tight up to the safety valve opening pressure. During testing, no air bubbles shall be allowed. The plug breaking torque – max. 2.45 N·m (0.25 kgf·m), the plug to the filling pipe making torque – 1-3 N·m (0.1-0.3 kgf·m) (after three clicks).

Fuel tank removal and installation

For replacement of the fuel tank, fuel tubes or filling pipe[1)] installed to it, for fuel intake module maintenance or replacement, the fuel tank shall be removed from the vehicle.

To remove vehicle fuel tank, follow the procedure below:

- remove the fuel tank plug and drain fuel from the fuel tank to a container using a tube with a special siphon pump installed previously in the tank filling pipe;
- disconnect leads from the battery;
- disconnect the air filter bracket from the front platform beam;

[1)] – For alt-metal body vehicles

- remove the fuel tank vent line from the clip fastening it to fuel tank bracket[1];

- disconnect the fuel tank drain and supply lines and the starting preheater fuel line [2]from the vehicle fuel lines;

- disconnect the electrical connector of the fuel intake module fuel level sensor wires;

- disconnect the ground wire from the fuel tank neck and remove it from the clip fastening it to the fuel tank bracket;

- where necessary (with large amount of fuel remaining in the tank), place the assembly trolley hoist under the fuel tank;

- disconnect outer ends of fuel tank mounting clamps from brackets 18 (see Fig. 2.15, 2.16) with nuts previously unscrewed and special screws removed from bracket holes, inner clamp ends from brackets 20 and 28 with nuts previously unscrewed and special screws removed, and remove clamps;

- remove the fuel tank from the vehicle using assembly trolley (hoist);

- disconnect the vent line hose from the air filter nut by loosening the clamp and remove the air filter assembly with bracket and nut from the fuel tank.

- drain the remaining fuel from the tank.

Install the flatbed vehicle fuel tank

in the reverse order to removal:

- where necessary, install a new air filter steam-discharge tube to the fuel tank multifunction valve to the stop;

- install the vent line hose to the air filter nut to the stop, crimp the fastening clamp as shown in Fig. 2.15 and 2.16;

- install the fuel tank assembly to the vehicle and secure with clamps. Tighten the nuts of the bolts fastening the inner clamp ends to the brackets with torque of 4.9-7.8 N·m (0.5-0.8 kgf·m). With clamps installed, tighten the nuts of the special screws fastening the outer clamp ends with a torque of 4.9-7.8 N·m (0.5-0.8 kgf·m). Take care to ensure the shells integrity and correct installation; where necessary, replace fuel tank clamp shells with new ones. The fuel tank flash contact with stop 3 (see Fig. 2.15, 2.16) shall be allowed. The fuel tank wall contact with stops 3 and 6 shall not be allowed;

- connect the ground wire to the fuel tank neck and install it in the fuel tank bracket clip;

- connect the electrical connector of the fuel intake module fuel level sensor wires;

---

[1] - For vehicles with seven-seat cab

[2] - For vehicles equipped with starting preheater

- connect the fuel tank drain and supply lines and the starting preheater fuel line to the vehicle fuel lines until a characteristic click. The tubes shall be securely retained in the clips;
- install the fuel tank vent line into the fuel tank bracket clip[1)] and fasten the bracket complete with air filter, nut and fuel tank vent line to the front platform beam with the bolt and nut;
- connect the wires to the battery;
- install the fuel tank plug. Screw the plug in until it clicks, fix the drive tang in the tank fill tube flange hole;
- check fuel line connections for leak-tightness.

Replacement of fuel lines (fuel pipes) of the fuel tank removed from the vehicle

Where the fuel tank fuel lines (fuel pipes) replacement is required, disconnect these from the fuel intake module and remove from the fuel tank. Fuel lines dismantling force – 20-45 N (2.0-4.5 kgf). Install new fuel lines in the fuel tank clamps with a force of 30-65 N (3.0-6.5 kgf). Connect the fuel tank pipes with the fuel intake module until a characteristic click.

After the fuel lines and fuel intake module replacement, leak-test the fuel tank assembly.

Fuel tank leak-testing

The fuel tank and its connections with the fuel intake module and fuel pipes shall be leak-tested with air under pressure of 30-35 kPa (0.3-0.35 kgf/cm^2) in water bath for 10 seconds. Leak-testing shall be conducted with fuel pipes, fuel tank filling pipe and multifunctional valve plugged. No air bubbles shall be allowed.

Fine fuel filter replacement

To remove FFF for replacement, follow the procedure below:
- disconnect leads from the battery;
- drain fuel from the filter through the tap 15 (see Fig. 2.18);

[1)]- For flatbed and seven-seat cab vehicles

- clean fuel lines 10, 11 from dirt and disconnect from the FFF, disconnect wiring terminals from the water sensor 12 and fuel heater 5;
- unscrew the nut 3 of the bolt fastening the FFF to the bracket 1, remove the bolt 2 and remove the filter.

Install FFF in the reverse order to removal. Tightening torque of bolt 2 fastening the filter to the bracket – 11-12 N·m (1.1-1.2 kgf·m).

Air filter element replacement

The air filter element 3 (see Fig. 2.19) can be replaced without removing the air filter from the vehicle; to do this, follow the procedure below:
- disconnect leads from the battery;
- disconnect the wiring terminal from the air temperature and pressure sensor;
- remove tube 5 (see Fig. 2.20) with sealing ring 19 from the air filter insert 16 by loosening the fastening clamp;
- unscrew the fastening screws and remove the upper filter housing part (cover) complete with the insert;
- remove filter element;
- clean the inner filter surface from dirt;
- install new filter element to the lower housing part;
- install the filter cover complete with the insert and fasten with screws with the torque of 2.8-3.5 N·m (0.28-0.35 kgf·m);
- install the tube 5 to the air filter insert to the stop with the sealing ring previously installed in the tube to the stop, and tighten the fastening clamp 31 with the torque of 1.96-2.9 N·m (0.2-0.3 kgf·m). Install the pipe fastening clamp 31 lock between the stops D and E (see Fig. 2.20);
- connect the wiring terminal to the air temperature and pressure sensor;
- connect leads to the battery.

Air filter removal and installation

To remove air filter, follow the procedure below:
- disconnect leads from the battery;
- disconnect the wiring terminal from the air temperature and pressure sensor;
- disconnect the air filter from the frontend mounting bracket;
- disconnect and remove the pipe with sealing rings from the turbocharger and air filter insert;
- disconnect the resonator hose from the air intake;

- unscrew the nut fastening the air filter to the cab side-member bracket, disconnect the air intake from the frontend by disengaging the air intake clips from the frontend, and remove the air filter complete with spacers and air intake from the vehicle.

Install the air filter in the reverse order to removal, taking into account the following.

Tightening torque of the nut fastening the air filter to the cab side-member bracket – 4.9-7.8 N·m (0.5-0.8 kgf·m),

When installing the air filter ducts, the following requirements shall be met:

- install air intake 6 (see Fig. 2.20) to the air filter nozzle and the radiator frame base until the air intake latches engage;
- install sealing rings 19 and 32 in the pipe to the stop;
- install the tube 5 to the turbocharger nozzle to the stop aligning the mark I and edge J as shown in Fig. 2.20;
- install the tube 5 to the air filter insert to the stop;
- install the pipe fastening clamp 31 lock between the stops D and E (see Fig. 2.20);
- tighten pipe fastening clamps with torque of 1.96-2.9 N·m (0.2-0.3 kgf·m).

Charge air cooler replacement

When charge air cooler is leaking, replace it.

To do this:

- drain oil from power steering system;
- disconnect and remove the front bumper panel;
- disconnect and remove the front bumper panel mounting brackets from the frontend;
- disconnect and remove the front bumper base;
- disconnect the hoses from the HPS radiator by loosening the fastening clamps;
- disconnect the HPS radiator mounting brackets from the frontend and remove the HPS radiator;
- disconnect the hoses from the cooler nozzles by loosening the clamps;
- unscrew two bolts fastening the charge air cooler to the frontend, disengage the cooler from the frontend "lock" and remove it from the vehicle;
- remove the lower fan shroud and rubber pads from the cooler.

The charge air cooler shall be leak-tested with compressed air under pressure of 200-300 kPa (2-3 kgf/cm^2). Immerse the charge air cooler in water for 30 s with holes previously plugged. Air is supplied through a special tube inserted into the nozzle and equipped with a valve to shut off the air supply and control pressure gauge.

No air bubbles shall be allowed.

In case of failure, replace the cooler with a new one.

Install the charge air cooler in the reverse order to removal.

Install hoses as shown in Fig. 2.21.

Tightening torque of bolts fastening the charge air cooler to the frontend – 18-25 N·m (1.8-2.5 kgf·m); nuts fastening the lower fan shroud to the cooler – 2.8-4.8 N·m (0.3-0.5 kgf·m); hose clamps – 3.0-3.5 N·m (0.3-0.35 kgf·m); hose clamps shall be installed 5-8 mm away from the hose end face. Where necessary, replace the discharge nozzle sealing ring 13 (see Fig. 2.17); clamp nut tightening torque 14 – 8-11 N·m (0.8-1.1 kgf·m).

Check connections for leak-tightness after assembly.

2.5. Exhaust and after-treatment (urea supply) systems

Vehicle exhaust system (Fig. 2.23) consists of a thermally insulated intake pipe with compensator, catalytic silencer and muffler.

The intake pipe compensator is designed to reduce vibrations transmitted from the engine to the exhaust system and reduce the noise level.

The catalytic silencer is designed to reduce the soot particles emission to the atmosphere with exhaust gases and reduce nitrogen oxide content in the exhaust gases.

The catalytic silencer includes three sections: DOC (oxidation catalyst), DPF (diesel particulate filter) and SCR (catalytic converter). The exhaust gas flows through the DOC section where carbon monoxide and hydrocarbons are decomposed and dissociated. The remaining particles pass through the DPF section where soot particles are incinerated. The exhaust gases then pass through the SCR section, where urea is mixed with the exhaust gases, and the nitrogen oxide contained in the exhaust gases is converted into less hazardous substances.

The following sensors connected to the engine control unit through an electrical circuit are installed at the catalytic silencer:

- exhaust gas differential pressure sensor (back pressure sensor),
- four gas temperature sensors (temperature sensor pack),
- two nitrogen oxide sensors.

The muffler is designed to reduce noise and convert the exhaust gas energy.

The exhaust system is attached to the vehicle using brackets and elastic elements. Exhaust system members are connected by means of fixed flanges with sealing gaskets between them. The intake pipe is attached to the clutch crankcase by means of U-bolt and clamp.

The exhaust system maintenance consists of periodical leak-testing of the exhaust system components and connections, and intake pipe connection to the turbocharger nozzle, and faults elimination where necessary. No exhaust leak shall be allowed. Where necessary, check the shock absorbers for lack of elasticity and cracks.

The intake pipe and muffler are of solid design, therefore, in case of failure, replace these with new ones.

For catalytic silencer troubleshooting, maintenance and repair, see supplier's documentation.

For exhaust system sensors and alarms, see "Electrical equipment" section.

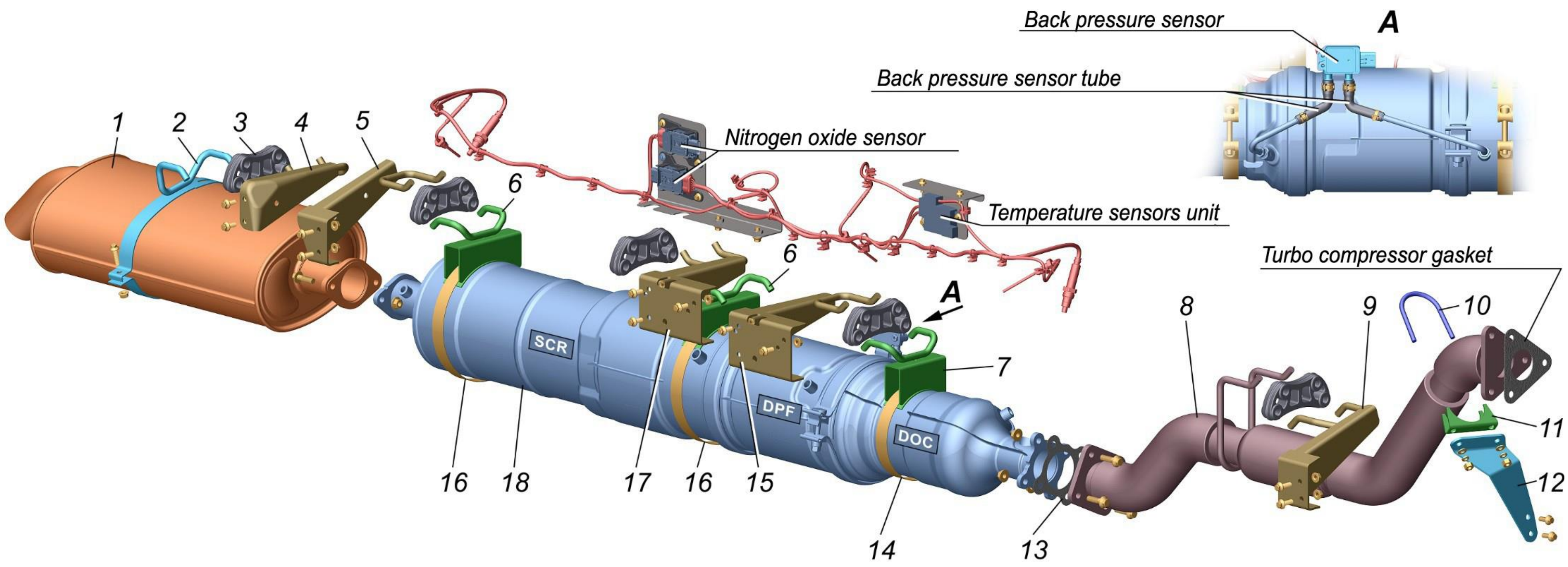


Fig. 2.23. Exhaust system: 1 – muffler; 2, 4 – muffler brackets; 3 – shock absorber; 5, 6, 7, 9, 12, 15, 17 – brackets; 14, 16 – clamps; 8 – intake pipe; 10 – U-bolt; 11 – clamp; 13 – gasket; 18 – catalytic silencer.

Tighten the parts in the following order with following tightening torques:

- bolts fastening the intake pipe to the turbocharger nozzle – 47-52 N·m (4.7-5.2 kgf·m);
- nuts of bolts fastening the intake pipe flanges to the catalytic silencer, catalytic silencer to the muffler, bolts fastening the U-bolt to the clutch crankcase – 22-32 N·m (2,2-3,2 kgf·m);
- catalytic silencer and muffler clamps fastening screws – 29-31 N·m (2.9-3.1 kgf·m).

Install back pressure sensor tube clamps 1-3mm away from the tube end faces.

After installation, leak-test the exhaust system connections.

Exhaust after-treatment (urea supply) system consists of a reagent (urea) tank, filling pipe[1)], supply module, heated urea lines (discharge, inlet and supply) dosing module, coolant valve[1)], coolant inlet and discharge lines. The urea supply system is controlled through the engine control unit signals.

The reagent tank is designed for storing urea. The reagent tank is equipped with a urea level sensor, urea quality sensor and urea temperature sensor.

The filling pipe[1)] is used to fill the reagent tank.

The supply module is used to supply urea to the dosing module.

The urea inlet and discharge lines are used to supply (discharge) urea from the reagent tank to the supply module.

The urea supply line is used to supply pressurized urea from the supply module to the dosing module.

The dosing module is used for urea dosing according to the control unit signals.

The coolant supply line is used to heat the urea in the reagent tank and the dosing module. The coolant supply line is equipped with a valve to shut off the urea supply to the reagent tank.

The coolant is fed the engine thermostat through the discharge line.

The vehicle exhaust treatment systems are shown in Fig. 2.24 and 2.25.

[1)] For vehicles with a reagent (urea) tank located in the underhood space

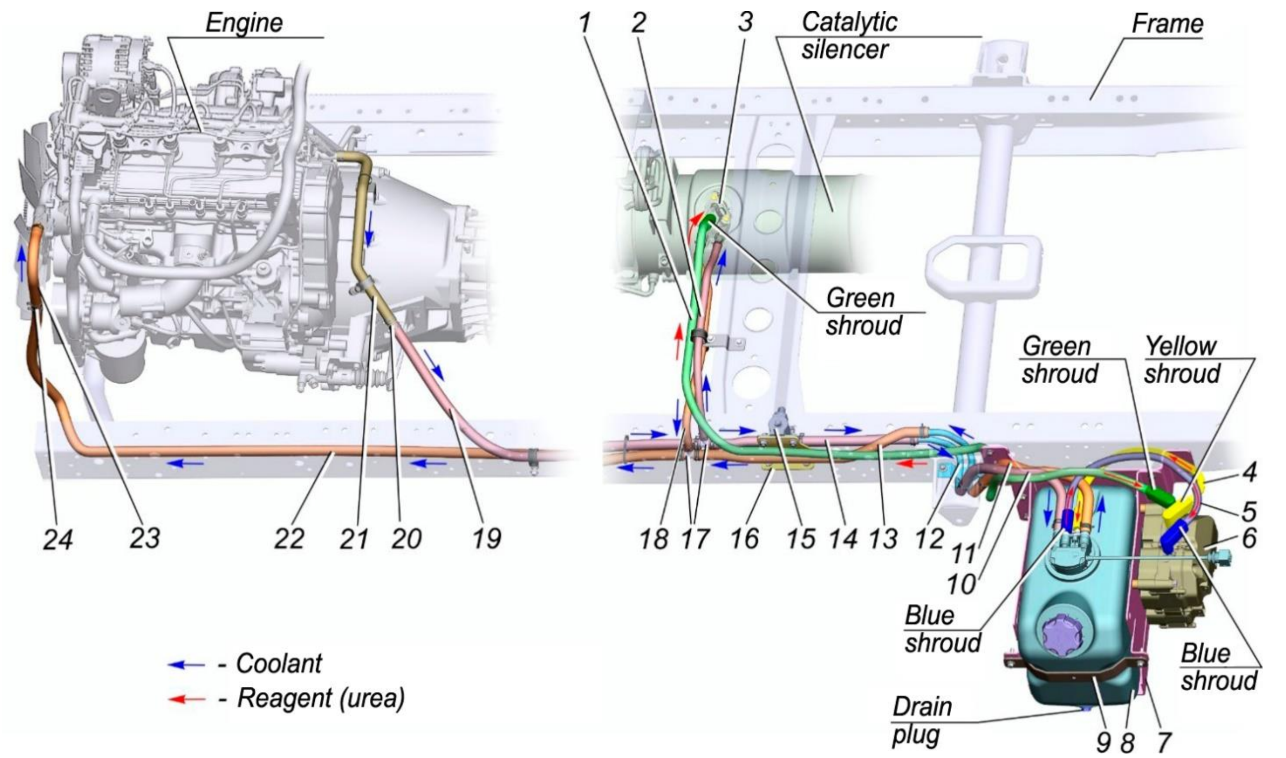


Fig. 2.24. Exhaust treatment system (urea supply system for vehicles with urea tank located on the frame girder): 1 – urea supply line; 2, 10, 11, 13, 14, 18, 19, 21, 22, 23 – hoses; 3 – dosing module; 4 – urea discharge line; 5 – urea inlet line; 6 – supply module; 7 – reagent tank bracket; 8 – reagent (urea) tank; 9 – reagent tank clamp; 12 – tubes with bracket; 15 – valve; 16 – bracket; 17 – tees; 20, 24 – connecting fittings.

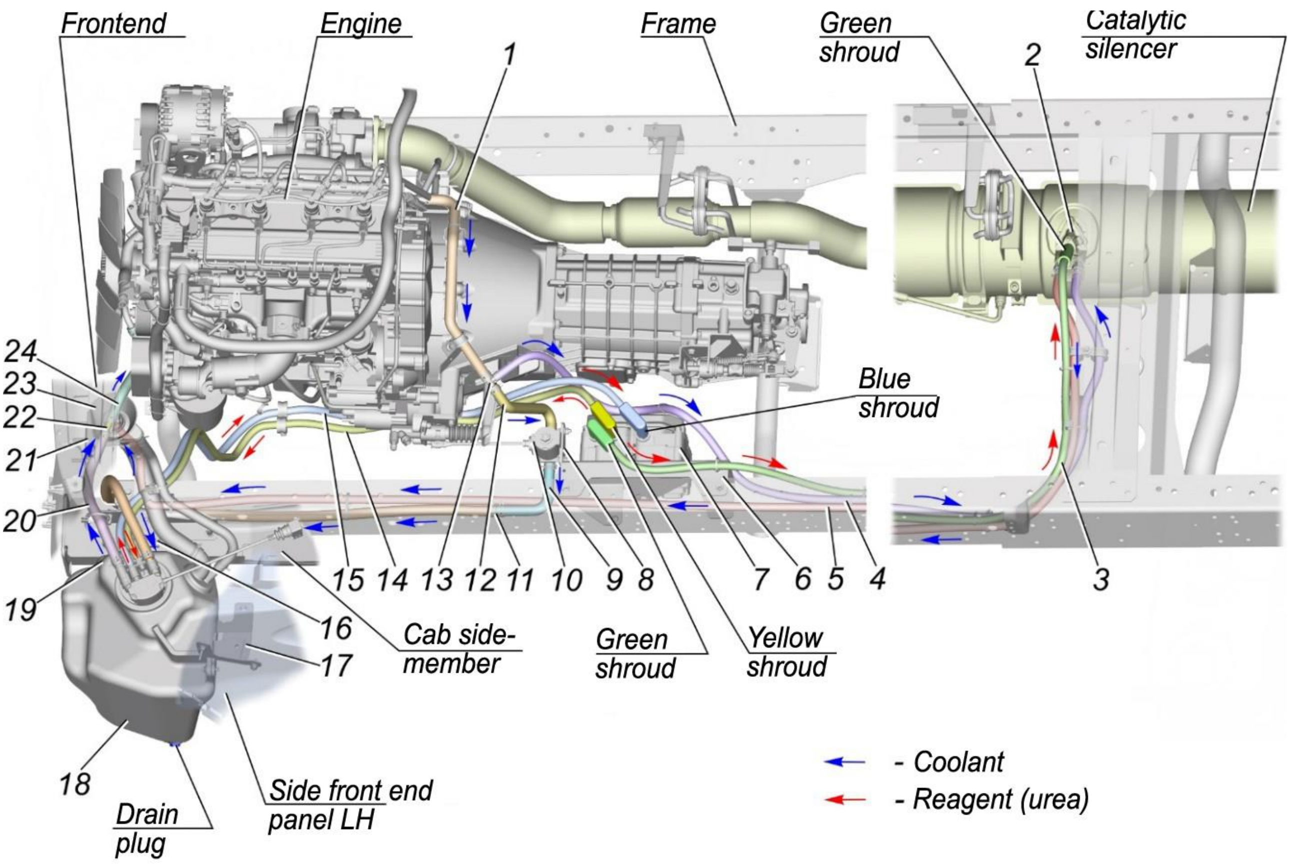


Fig. 2.25. Exhaust treatment system (urea supply system for vehicles with urea tank located in the underhood): 1, 4, 5, 9, 12, 20, 24 – hoses; 2 – dosing module; 3 – urea supply line; 6, 8, 16, 17, 19, 21 – brackets; 7 – supply module; 10 – valve; 11 – connection fitting; 13, 22 – tees; 14 – urea discharge line; 15 – urea inlet line; 18 – reagent (urea) tank; 23 – reagent tank filling pipe.

The reagent tank is mounted behind the fuel tank on the left frame girder using bracket and clamp; the supply module is attached to the reagent tank bracket with screws.

At the some vehicles, the reagent tank may be mounted in the underhood and fastened to the left cab side-member, the left floor recess and the left side front end panel by means of brackets.[1)]

The reagent tank filling neck[1)] is fastened to the radiator frame base with bracket.

The supply module is attached to the left frame side-member with bracket.

The dosing module is bolted to the catalytic silencer.

All urea supply system parts are of solid design, therefore, in case of failure, replace these with new ones.

General requirements for the exhaust treatment system repair

Prior to disconnecting urea lines and coolant line hoses, clean the connection area from dirt; after disconnection, close all the holes with plugs to prevent ingress of contaminants in the components and parts.

After assembly, leak-test urea lines (discharge, inlet and supply) connections. No urea traces in the connections shall be allowed.

After assembly, leak-test connections of the coolant supply and return lines and eliminate leaks.

When assembling, connect the quick-release connectors and the dosing module nozzles until a characteristic click of the retainer in the connector.

Install urea lines (discharge, inlet and supply) in accordance with Figures 2.24 and 2.25.

The urea line quick release connectors shall be clicked into place.

The urea lines shall not be pinched or broken.

When installing coolant line hoses, no tension or excessive sagging shall be allowed.

Sheaths shall be installed on the coolant lines uniformly along the entire length.

[1)] For vehicles with a reagent (urea) tank located in the underhood space

Tightening torques:

- reagent tank drain plug – 15-25 N·m (1.5-2.5 kgf·m);
- nuts of bolts fastening the reagent tank clamp to the bracket – 21-23 N·m (2.1-2.3 kgf·m);[1)]
- bolts fastening the urea tank to the brackets - 16-22 N·M (1.6-2.2 kgf·m);[2)]
- bolts fastening the filler pipe to the frontend bracket - 5.9-8.8 N·m (0.6-0.9 kgf·m);
- bolts fastening the dosing module to the catalytic silencer - 6,5-8 N·m (0,65-0,8 kgf·m);
- screws fastening the supply module to the bracket - 19-20 N·m (1.9-2.0 kgf·m).

Vehicle reagent tank removal and installation

To remove the reagent tank located on the frame girder, follow the procedure below:

- disconnect leads from the battery;
- disconnect the electrical connectors of the reagent tank wiring;
- drain urea from the tank to container with the reagent tank cover previously removed and the drain plug unscrewed;
- disconnect the urea supply line from the urea tank. Drain the urea from the urea supply line to container;
- disconnect the urea inlet and discharge lines from the urea tank. Drain the urea from the urea lines to container;
- drain coolant from the engine cooling system (see "Coolant replacement procedure" sub-section);
- disconnect the coolant supply and discharge line hoses from the urea tank by loosening the clamps. Drain coolant from the pipelines to container;
- remove the reagent tank fastening clamp with nuts previously loosened and bolts removed;
- remove the reagent tank from the vehicle.

Install the reagent tank, located on the frame girder in the reverse order to removal, taking into account the requirements of the "General requirements for the exhaust treatment system repair" sub-section.

To remove the urea tank located in the underhood space, follow the procedure below:

- disconnect leads from the battery;
- disconnect and remove the front bumper panel (see "Cabin" section);

[1)] - For vehicles with urea tank located on the frame girder
[2)] - For vehicles with reagent (urea) tank located in the underhood space

- disconnect and remove the front bumper base;
- disconnect electrical connectors of the urea tank wiring;
- drain urea from the urea tank to container by unscrewing the drain plug;
- disconnect and remove the filling pipe by first loosening the bolts fastening the filler pipe to the bracket and loosening the clamps fastening the filling pipe hoses to the urea tank;
- disconnect the urea inlet and discharge lines from the urea tank. Drain the urea from the urea lines to container;
- drain coolant from the engine cooling system (see "Coolant replacement procedure" sub-section);
- disconnect the coolant supply and discharge line hoses from the urea tank by loosening the clamps. Drain coolant from the pipelines to container;
- remove the urea tank from the vehicle with three bolts fastening the urea tank to the brackets previously unscrewed.

Install the reagent tank located in the underhood space in the reverse order to removal, taking into account the requirements of the "General requirements for the exhaust treatment system repair" sub-section.

Urea tank leak-tightness test. The urea tank shall be leak-tested with air under pressure of 27-33 kPa (0.27-0.33 kgf/cm^2) in a water bath for 10 seconds. No air bubbles shall be allowed.

During the leak test, all open holes in the urea tank shall be plugged. No dust, water, oil and other impurities shall be allowed inside the tank.

Filling pipe check.[1)]

No dust, water, oil and other impurities shall be allowed inside the filling pipe.

The torque for making the cover onto the filling pipe neck – 1-2 N·m (0.1-0.2 kgf·m) min.

To remove the supply module, follow the procedure below:

- disconnect leads from the battery;
- disconnect the wiring electrical connector from the supply module;
- disconnect the urea lines (discharge, inlet and supply) from the urea tank. Drain the urea from the urea lines to container;
- cut off the strip fastening the coolant supply line to the supply module;[1)]
- remove the supply module from the vehicle with three screws fastening the supply module to the bracket previously removed.

1) - For vehicles with reagent (urea) tank located in the underhood space

Install the supply module in the reverse order to removal, taking into account the requirements of the "General requirements for the exhaust treatment system repair" sub-section.

To remove the dosing module, follow the procedure below:

- disconnect leads from the battery;
- disconnect the urea supply line from the urea tank. Drain the urea from the urea lines to container;
- drain coolant from the engine cooling system (see "Coolant replacement procedure" sub-section);
- disconnect the quick-release connectors of the coolant supply and discharge lines from the dosing module. Drain coolant from the pipelines to container;
- remove the dosing module from the catalytic silencer by removing the three mounting bolts.

Install the dosing module in the reverse order to removal, taking into account the requirements of the "General requirements for the exhaust treatment system repair" sub-section..

3. Transmission

3.1. Clutch

3.1.1. Clutch and clutch linkage design

The vehicle clutch (Fig. 3.1) is the normally closed single-plate dry clutch consisting of two main parts: pressure plate assembled with the casing and driven plate assembled with friction pads.

The clutch is controlled through the clutch release linkage (suspended pedal, main and servo hydraulic drive cylinders, pipeline) and the clutch release (clutch release yoke and clutch release sleeve assembled with bearing).

Clutch and clutch release are located in the flywheel and clutch housings.

Clutch housing is aligned with the engine crankshaft axis using two pins pressed into the engine flywheel housing.

The pressure plate casing is attached to the flywheel with special alignment bolts. Driven plate with friction pads is clamped between the pressure plate and flywheel by pressure plate diaphragm spring force. The transmission primary shaft splined end enters the driven plate hub. In this position, the clutch is engaged, and torque is transmitted from the engine crankshaft to the transmission primary shaft.

The clutch is disengaged when the clutch pedal is depressed; the sleeve presses on the ends of the pressure plate diaphragm spring lobes, as a result, pressure plate is withdrawn from the driven plate by leaf springs releasing the driven plate and separating the engine from gearbox.

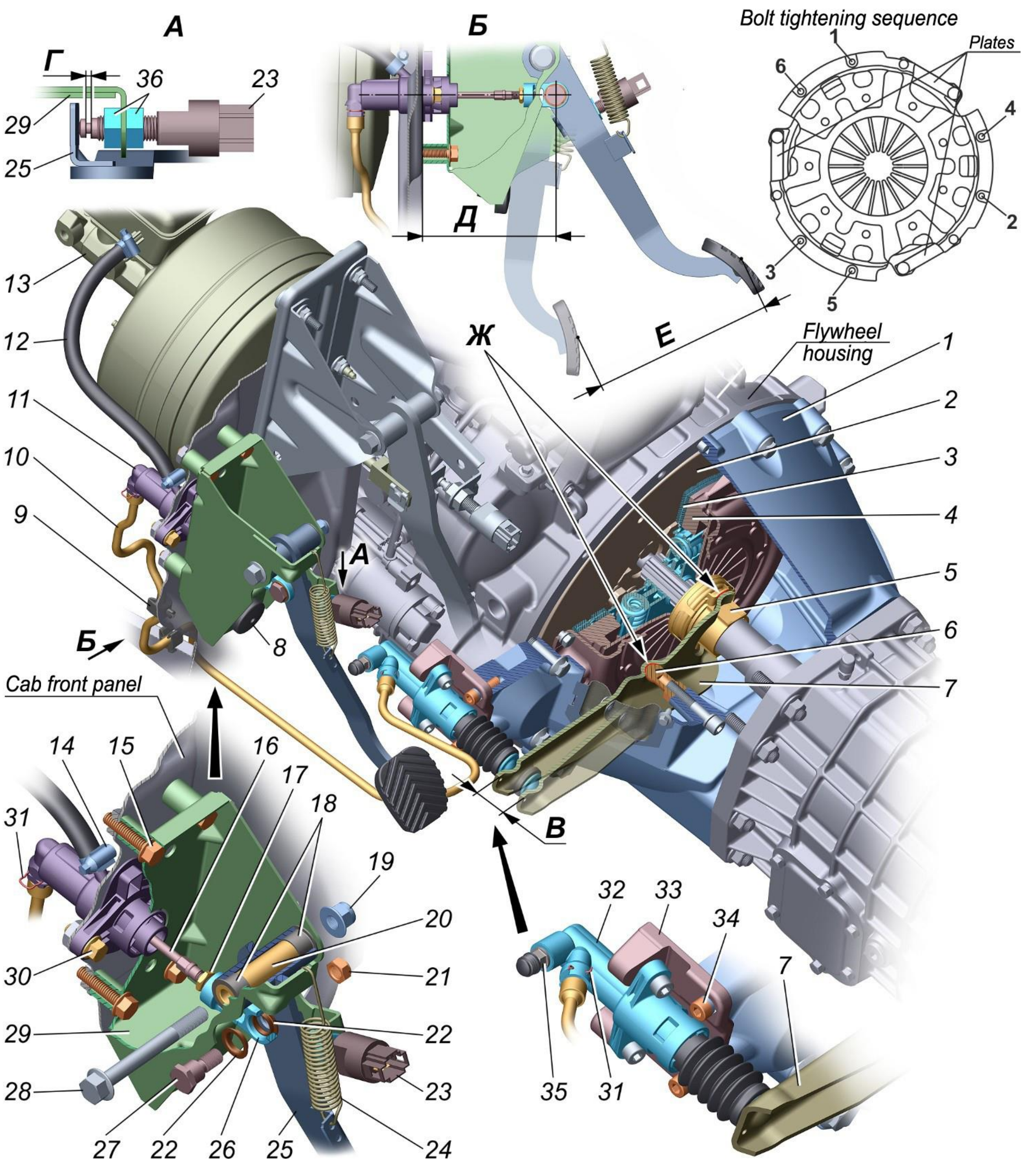


Fig. 3.1 Clutch and clutch release linkage: B – clutch release yoke end stroke; D – clutch pedal position signal switch adjustment dimension; E – push rod eye installation dimension; F – clutch pedal stroke; 1 – clutch housing; 2 – flywheel; 3 – driven plate; 4 – pressure plate; 5 – sleeve with bearing; 6 – clutch release yoke support; 7 – yoke; 8 – clutch pedal buffer; 9, 31 – clips; 10 – pipeline; 11 – clutch main cylinder; 12 – hose; 13 – vacuum booster with brake main cylinder and tank; 14 – clamp; 15, 28, 30 – bolts; 16 – push rod; 17, 19, 21, 36 – nuts; 18 – pedal axis bushings; 20 – spacer bushing; 22 – push rod axis bushings; 23 – clutch pedal position signal switch; 24 – spring; 25 – clutch pedal; 26 – push rod eye; 27 – pedal push rod axis; 29 – clutch pedal bracket; 32 – clutch servo cylinder; 33 – bracket; 34 – screw; 35 – bleeding valve.

Clutch release linkage (see Fig. 3.1) - hydraulic, consists of a suspended pedal mounted to bracket in the cab, main and servo cylinders and pipeline.

The bracket assembled with the clutch pedal is fastened with four bolts to the cab front panel. The clutch main cylinder push rod eye 26 is hinged to the pedal. The clutch pedal position signal switch 23 is mounted to the pedal bracket.

The linkage transmits the force applied to the pedal by the driver to the clutch release for clutch disengagement and provides smooth clutch disengagement, thus reducing dynamic loads on the transmission parts and enhancing vehicle driving comfort.

The main clutch cylinder 11 is attached to the cab front panel with two bolts. The clutch main cylinder is connected with the brake main cylinder tank through hose 12; hose connections tightness is ensured due to fastening clamps 14 installed.

Clutch servo cylinder 32 is mounted to bracket 33 at the clutch housings with push rod resting on the yoke arm. For air removal from linkage, valve 35 closed with a rubber cap is screwed in the servo cylinder.

Pipeline 10 connecting the main and servo cylinders has is detachably mounted to the clutch cylinders and attached to the cab front panel with clips.

To disengage the clutch, yoke end stroke B shall make 21.5-23.5mm with system bled.

3.1.2. Clutch and linkage maintenance

Clutch maintenance consists of:

- hydraulic drive condition and tightness check, brake main cylinder tank working fluid refilling where necessary or its replacement at intervals specified in the Vehicle log book (see "Brakes" section, "Brake fluid replacement" sub-section);
- clutch housing fastening check, bolts tightening to the specified torques where necessary.

For system bleeding procedure to remove air, see "Hydraulic drive system filling with fluid and air removal (bleeding)" sub-section.

Possible malfunctions and troubleshooting

Fault cause	Remedy
Incomplete clutch disengagement - clutch slipping (gears do not engage or not readily engage)	
Air in the hydraulic drive system	Bleed the clutch hydraulic drive system
Driven plate hub seized on the primary shaft splines	Remove seizure on splines (clean and lubricate splines)
Distorted driven plate	When face runout exceeds 0.5 mm, replace driven plate
Pressure plate tangential leaf springs deformation	Replace pressure plate
Pressure plate body distortion	Align the pressure plate with the flywheel and tighten the mounting bolts (see "Clutch installation to the vehicle" sub-section).
Incomplete clutch engagement – clutch slippage (specific odor, slow acceleration, travel speed reduction, slow climbing).	
Driven plate friction pads chipped or fouled	Replace driven plate. In case of slight fouling, wash the pad surface with kerosene and grind with fine sandpaper
Excessive wear of friction facings, flywheel and pressure plate working surfaces	When the friction pad surface to rivet clearance is 0mm, replace driven plate. Replace flywheel or pressure plate
Clutch judder	
Driven plate friction pads fouled	Replace driven plate. In case of slight fouling, wash the pad surface with kerosene and grind with fine sandpaper
Worn friction facings	When the friction pad surface to rivet clearance is 0mm, replace driven plate.
Driven plate hub jammed on the primary shaft splines	Remove seizure on splines (clean and lubricate splines)
Loss of driven plate leaf springs flexibility	Replace driven plate
Pressure plate tangential leaf springs deformation	Replace pressure plate
Pressure plate body distortion	Align the pressure plate with the flywheel and tighten the mounting bolts (see "Clutch installation to the vehicle" sub-section)

Fault cause	Remedy
Transmission vibration and noise in riding	
Driven plate damping device parts broken or worn	Replace driven plate
Friction washer worn or friction damper compression spring slackened	Replace driven plate
Clutch "squeak" and noise with engine running	
Clutch release bearing failure	Replace bearing with clutch assembly

3.1.3. Clutch and clutch linkage repair

3.1.3.1. General requirements

Clutch pressure and driven plates, clutch main and servo cylinders, clutch release sleeve and pipeline are imported items, therefore these are not subject to repair during operation; in case of failure, these shall be replaced with new ones.

To repair vehicle, put it on a trestle, elevator or inspection pit.

To prevent ingress of contaminants into the clutch linkage cavity, clean the parts and the adjacent area from dirt prior to disconnection, and after disconnection, plug the cylinder bores and pipeline nozzles.

Prior to pipeline disconnection, move the fixing clips on the clutch cylinders; after removing the pipeline from the cylinders, return fixing clips to the original position.

When assembling, remove the plugs immediately prior to connecting the pipeline. Ingress of foreign particles into the clutch linkage hydraulic system shall not be allowed.

Insert the pipeline nozzle into the clutch main and servo cylinder bodies to the stop with a characteristic click.

The clutch pipeline shall be securely fastened in the clips.

ATTENTION
Do not wash the bearing before and after sleeve installation to the vehicle.

When assembling, the tightening torques for the screw connections specified in the "Tightening torques for clutch and clutch linkage screw connections" sub-section shall be observed.

Tightening torques for clutch and clutch linkage screw connections

Assemble the clutch and clutch linkage with the following tightening torques:

- clutch pressure plate mounting bolts - 20-29 N·m (2.0-2.9 kgf·m);
- studs fastening the gearbox to the clutch housing - 24-30 N·m (2.4-3.0 kgf·m);
- screw fastening support for the clutch release yoke - 45-50 N·m (4.5-5.0 kgf·m);
- boot frame and the clutch housing cover plate mounting bolt - 4-8 N·m (0.4-0.8 kgf·m);
- screws fastening the servo cylinder bracket to the clutch housing - 14-20 N·m (1.4-2.0 kgf·m);
- bolts fastening clutch housing to engine - 30-35 N·m (3.0-3.5 kgf·m);
- screws fastening the servo cylinder to the bracket - 12-16 N·m (1.2-1.6 kgf·m).
- clutch main cylinder push rod eye lug lock nuts - 6.9-11.8 N-m (0.7-1.2 kgf-m);
- clutch servo cylinder bleeding valve - 5-7 N·m (0,51-0,71 kgf·m);
- pedal mounting bolt nut - 40-56 N·m (4.0-5.6 kgf·m);
- bolts fastening the clutch main cylinder and pedal bracket to the cabin front panel - 12.9-19.4 N·m (1.3-2.0 kgf·m);
- clutch pedal push rod axis nut – 23.53-35.3 N·m (2.4-3.6 kgf·m);
- clutch main cylinder hose clamp mounting bolts - 3,5-3,8 N·m (0.36-0.39 kgf·m);
- clutch pedal position signal switch mounting nuts - 2-4 N·m (0.2-0.4 kgf·m);

3.1.3.2. Clutch removal and installation

Clutch removal shall comply with the requirements specified in "3.1.3.1. General requirements" sub-section.

To remove the clutch, proceed as follows:

- disconnect the wiring pin blocks from the reverse light switch and speed sensor;
- disconnect the clutch servo cylinder assembled with bracket from the clutch housing, lift servo cylinder and secure without disconnecting it from the clutch linkage pipeline;
- unscrew the clutch release yoke boot frame mounting bolt and remove the yoke;
- remove driveline (see “Driveline” sub-section);
- remove the gearbox complete with the clutch release sleeve (see "Gearbox" sub-section);
- disconnect and remove the clutch housing. Disconnect and remove the pressure and driven plates.

Install the clutch to the vehicle in the reverse order to removal.

ATTENTION
When installing the driven plate, the plate side marked "FLYWHELL-SIDE" shall face the flywheel.

To install the driven and pressure plates, partially screw in the mounting bolts with washers and align the driven plate using a mandrel; tighten the mounting bolts, taking into account the following:

- Tighten the mounting bolts alternately in three stages uniformly in the sequence shown in Fig. 3.1. At final stage, tighten the bolts to the required torque;
- with the gearbox installed to the vehicle, install the yoke and tighten the boot frame mounting bolt. Prior to installation, apply "Olista Longtime 3EP" or "Castrol Tribol GR 4020/460-2 RD" grease on the bearing surfaces **G** (see Fig. 3.1) of yoke for the release sleeve and spherical seating.

To facilitate the clutch yoke installation, the clutch housing aperture located on the right side can be used with mounting bolts previously unscrewed and the cover plate removed. Tighten the bolts after the cover plate installation.

Perform other clutch to vehicle installation operations in the reverse order to removal (see "Driveline" and "Gearbox" sub-sections).

3.1.3.3. Clutch linkage removal and installation

To remove the clutch linkage from the vehicle, follow the procedure below (in compliance with the requirements specified in "3.1.3.1. General Requirements" sub-section):

- remove the protective cap, unscrew the clutch servo cylinder bleeding valve by 1 - 1.5 turns with temporary hose previously installed with free end lowered into a clean transparent container;
- drain the fluid from the clutch linkage hydraulic circuit by vigorously pressing and smoothly releasing the clutch pedal;
- remove the temporary hose from the clutch servo cylinder bleeding valve;
- disconnect the pipeline from the cabin front panel and from the clutch main and servo cylinders with the fixing clip previously unlocked at the cylinders ends. After disconnecting the pipeline, insert cylinder fixing clip to the stop (characteristic click);
- disconnect the clutch release servo cylinder complete with bracket from the clutch housing and remove it, disconnect the servo cylinder from the bracket;
- disconnect the hose from the brake main cylinder tank by loosening the clamp;
- unscrew the nut and remove the push rod axis to disconnect the clutch main cylinder push rod from the pedal;
- unscrew the four mounting bolts and disconnect the wiring pin block from the clutch pedal position signal switch to disconnect and remove the bracket with the clutch pedal from the cab front panel;
- unscrew two mounting bolts to disconnect and remove the clutch main cylinder from the cab front panel. Where necessary, unscrew the eye and nut from the push rod and remove the two polyamide bushings from the eye.

To disassemble the bracket with the clutch pedal, proceed as follows:

- remove the pedal spring from the bracket;
- unscrew the pedal bolt nut, remove the bolt, remove the pedal from the bracket and remove the spacer bushing from the pedal hub;
- remove two polyamide bushings from the pedal hub.

Reassemble the pedal bracket in the reverse order to disassembly, taking into account the following:

- prior to assembly, apply Barbatia 4 (SHELL), Energrease C3-Y (British Petroleum Co.), Mobilgrease Graphited 3 (Mobil Oil Corp.) grease on outer and inner surfaces of the polyamide bushings and mating parts.

Install the clutch linkage to the vehicle in the reverse order to removal in compliance with the requirements specified in "3.1.3.1. General Requirements" sub-section.

Prior to installation to the vehicle, assemble the servo cylinder with the adapter bracket.

Screw the eye on the main cylinder push rod observing the installation dimension D = 120.3-121.7 mm (see Fig. 3.1). Lock the push rod eye with a nut. Install two polyamide bushings in the push rod eye. Prior to assembly, apply Barbatia 4 (SHELL), Energrease C3-Y (British Petroleum Co.), Mobilgrease Graphited 3 (Mobil Oil Corp.) grease on outer and inner surfaces of the polyamide bushings and mating parts;

Insert the pipeline nozzles in the clutch main and servo cylinder bodies to the stop with a characteristic click;

Secure pipeline in the clips located on the front panel.

After the clutch linkage installation to the vehicle, prime and bleed the linkage hydraulic system. To check the quality of air removal from the hydraulic system, press the clutch pedal with a force of 150-170 N (15.3-17.3 kgf) with the clutch release yoke end stroke B of 21.5-23.5 mm (see Fig. 3.1). Leak-test connections.

When deviating from the dimension B, adjust the clutch pedal installation height to fulfill the pedal stroke condition E = 168-183 mm by loosening the lock nut 17 and rotating the push rod 16. Tighten lock nut after the adjustment completion.

After bleeding the system, adjust the clutch pedal position signal switch 23 installation; the switch stem adjustment dimension G shall be 1-3 mm. To adjust the switch position, move it with nuts 36 loosened. During adjustment, the switch stem shall rest on the pedal pressure pad. Tighten nuts 36 after the adjustment completion.

3.1.3.4. Linkage hydraulic system priming and venting (bleeding)

To prime and vent (bleed) the linkage hydraulic system, follow the procedure below:

- unscrew the brake main cylinder tank cap and fill the tank to the "max" mark;
- remove the protective cap from the clutch servo cylinder bleeding valve and put rubber hose on the bleeding valve head;
- immerse the free hose end in brake fluid poured in a transparent container;
- pressurize the system by sharply pressing clutch pedal 4-5 times with an interval of 1-2 s. Hold the pedal depressed and unscrew servo cylinder bleeding valve by 1 - 1.5 turns, making sure to keep the free hose end immersed in the fluid;
- when the fluid flow to container stops, tighten the valve, then release the pedal;
- repeat the above steps until the fluid flowing out of the hose is free of air bubbles;
- remove the hose and put the protective cap.

During the bleeding, press the pedal sharply and release smoothly; timely refill the brake main cylinder tank to prevent the tank level dropping below the "min" mark.

After the linkage hydraulic system bleeding completion, add brake fluid to the brake main cylinder tank up to "max" mark (see "Brakes" section).

WARNING
Fluid drained during system bleeding shall not be refilled into the tank as it contains air. The use of this fluid shall only be allowed after settling for a day and filtering

3.2. Gearbox

The vehicle is equipped with a six-stage gearbox (Fig. 3.2).
The gearbox weight (empty) – 55.8 kg.

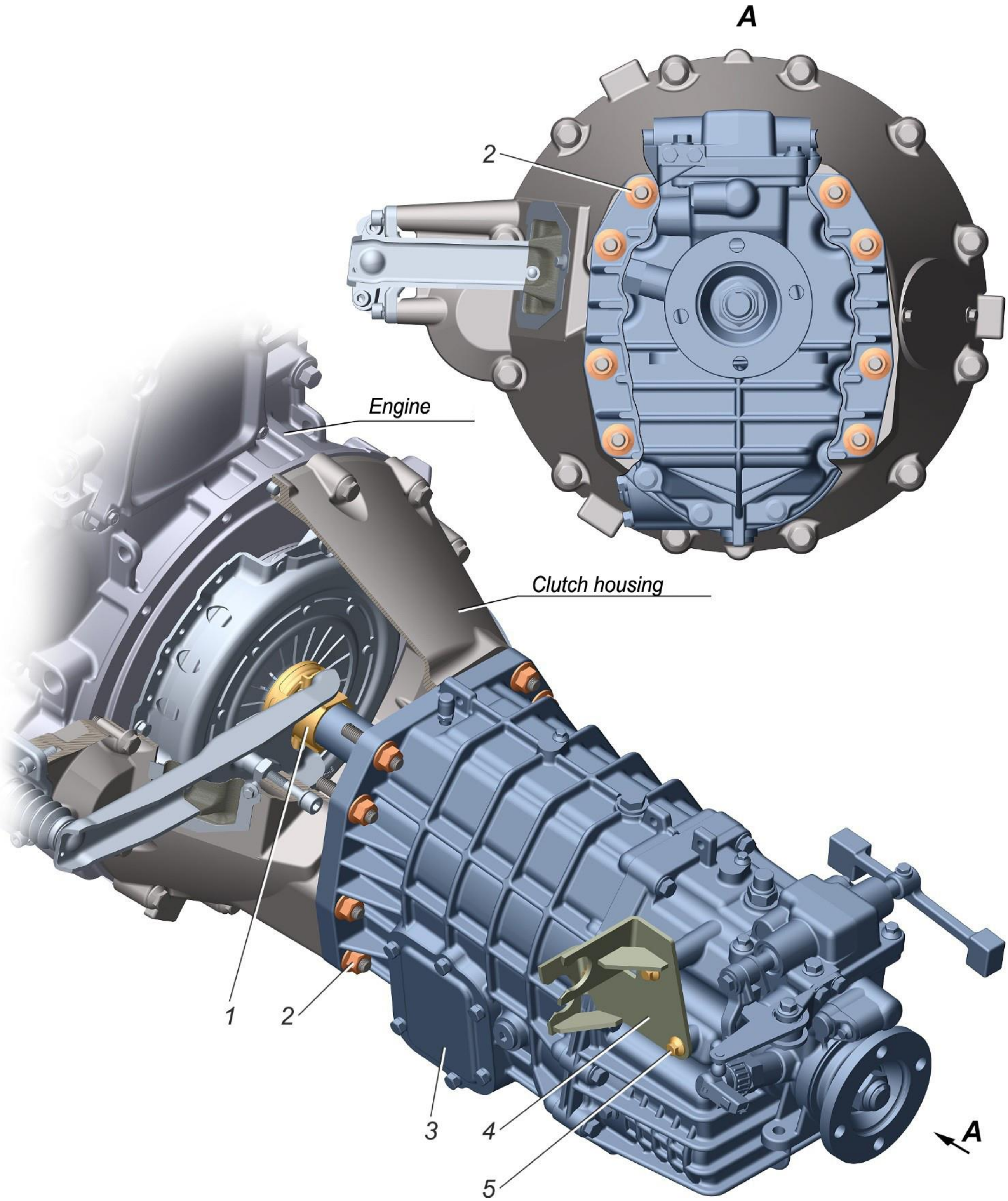


Fig. 3.2. Gearbox installation to the engine: 1 – clutch release sleeve; 2 – nut; 3 – gearbox; 4 – cable bracket; 5 – bolt

The gearbox housing is made of aluminum alloy and consists of two parts - front 5 (Fig. 3.3) and rear 10 housings. To ensure the required shaft supports alignment with holes for the shift mechanism rod, housings are aligned using the locating grommets (pins) 37 pressed in the rear housing and are connected to each other with thirteen flange bolts.

Primary shaft 1, secondary shaft 9 gears and gear rims are in constant mesh with the countershaft 19 gears and gear rims, and are helical gears. 5th and 6th speed gear teeth are cut on the secondary shaft. 1st, 2nd, 3rd speed gears and secondary shaft reverse gears rotate on needle bearings with plastic cages. 3rd speed gear and countershaft drive gear are interference-fitted on the countershaft where the 2nd speed gear teeth and long teeth are cut acting also as the gear rims of the 1st speed gear and countershaft reverse gear. The countershaft 5th and 6th speed gears rotate on needle bearings with plastic cages.

Reverse idler gear 27 rotates on a needle bearing 29 on an axis 30, of which supports are located one in the rear housing, and the other one in the axis bushing 32 attached to the rear housing with bolt 31. Brass washer 28 is installed between the reverse idler gear and the rear housing.

All speed gears are equipped with inertial-type synchronizers. 1st - 2nd speed gear synchronizer is triple-cone, 3rd speed gear - double-cone, 4th speed gear, 5th - 6th speed gears and reverse gear - single-cone. 5th - 6th speed gear synchronizer is located on the countershaft; the other synchronizers are located on the secondary shaft. The engaged gear rpm equalization with the secondary shaft (countershaft) rpm required for faultless gear change is achieved due to braking torque arising from the friction forces on the cone surfaces of the locking rings and the gear rim (for 1st, 2nd speeds and reverse). The locking rings are connected to the secondary shaft (countershaft) via hubs.

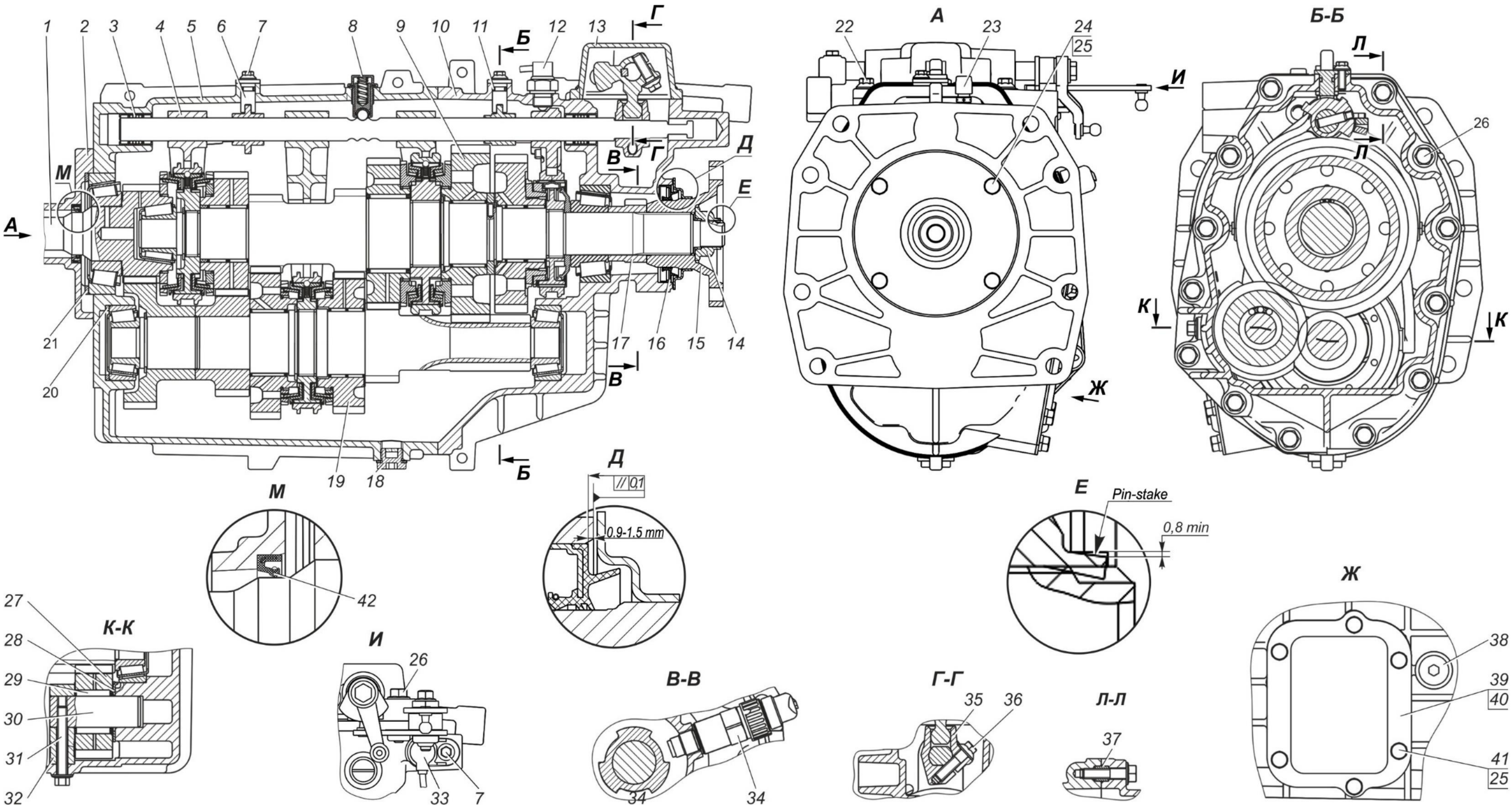


Fig. 3.3. Gearbox: 1 – primary shaft assembly; 2 – primary shaft bearing cover; 3 – linear movement ball bearing; 4 – gear shift mechanism; 5 – front gearbox housing; 6 – stop dog; 7, 22, 24, 31, 36, 41 – bolts; 8 – retainer; 9 – secondary shaft assembly; 10 – rear gearbox housing, 11 – sealing ring; 12 – reverse light switch; 13 – control linkage cover assembly; 14 – flange mounting nut; 15 – secondary shaft flange; 16,42 – collar seals; 17 – speed sensor rotor; 18 – magnetic plug; 19 – countershaft assembly; 20, 21 – adjustment rings; 23 – breather; 25 – washer; 26 – flange bolts; 27 – reverse idler gear; 28 – reverse gear thrust washer; 29 – radial roller bearing without rings; 30 – reverse idler gear axis; 32 – axis bushing; 33 – neutral (phase)[1] sensor; 34 – speed (pulse) sensor; 35 – gear engagement stem head; 37 - centering pin; 38 - oil filler plug; 39 – cover plate; 40 – cover plate gasket.

[1] - Installed to some vehicles

Triple-cone 1st - 2nd speed synchronizer (Fig. 3.4) has an increased braking torque due to increased number of friction pair taper surfaces: gear rim outer surface - inner ring inner surface, inner ring outer surface - intermediate ring inner surface, intermediate ring outer surface - outer ring inner surface. The rings are connected through protrusions as follows: outer ring with the synchronizer hub, intermediate ring with gear rim (protrusions engage the gear rim grooves), inner ring with the outer ring. Synchronizer consists of a hub, sleeve and three T-blocks. The non-demountable synchronizer T-block consists of body with the spring and ball installed. The ball is crimped on both sides after installation.

3rd speed synchronizer (Fig. 3.5) differs from the 1st - 2nd speed synchronizer by smaller size and the lack of taper surface at the gear rim; therefore, it is the double-cone synchronizer.

4th speed (Fig. 3.4) and 5th - 6th speed (Fig. 3.6) synchronizers are of the same size as the 3rd speed synchronizer, but differ from it by the lack of the inner ring; therefore these synchronizers are single-cone ones.

Despite the similarity of appearance, ring sets and sleeves of 4th speed synchronizer and 5th - 6th speeds synchronizer differ from each other and are not interchangeable.

Domestic single-cone synchronizer (Fig. 3.7) with single locking ring and taper gear rim is installed at reverse gear.

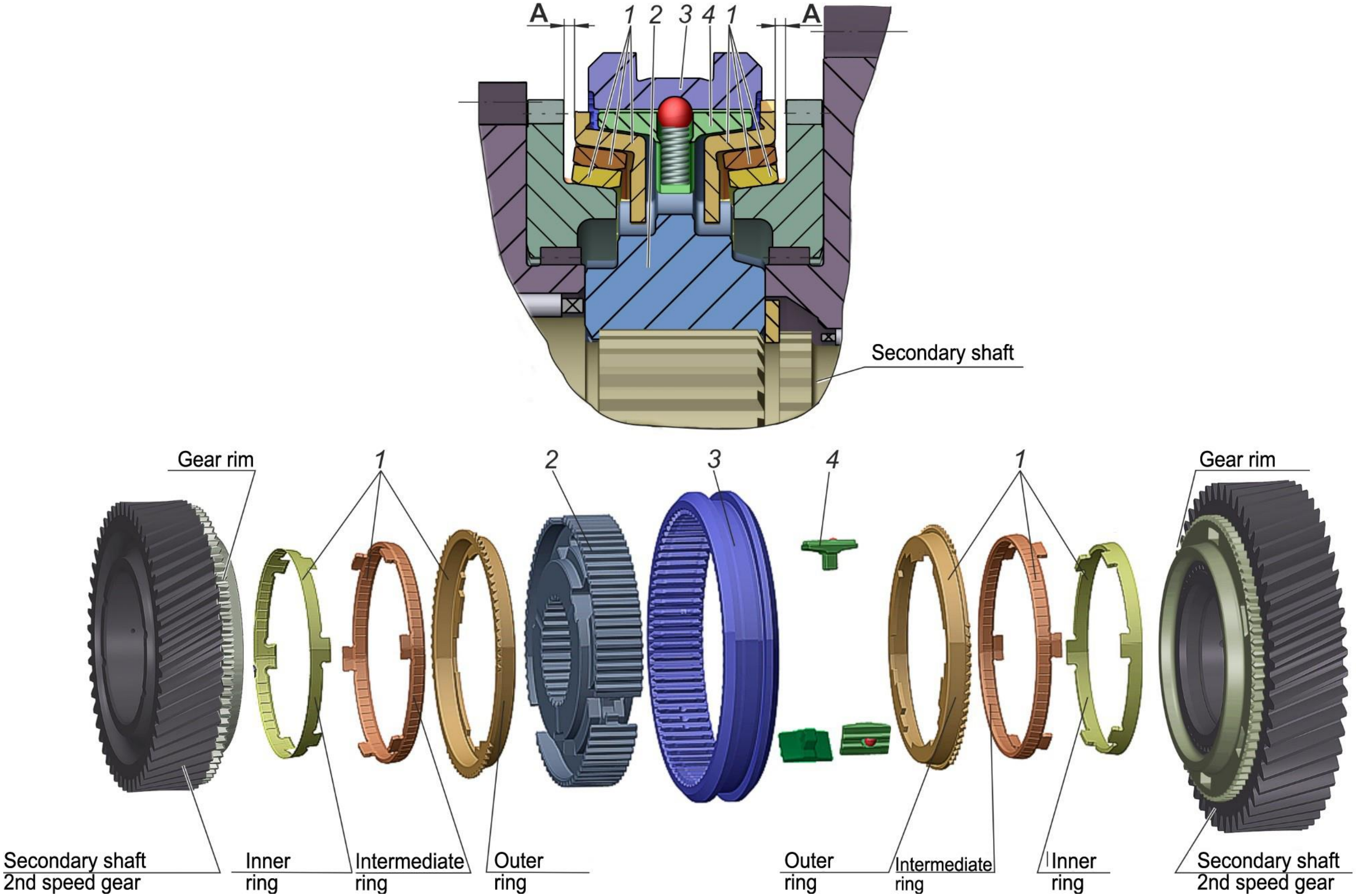


Fig 3.4. 1st and 2nd speed synchronizer: A= 1.0-2.2mm; 1 – 1st and 2nd speed synchronizer locking ring set; 2 – synchronizer hub; 3 – synchronizing sleeve; 4 – synchronizer T-block.

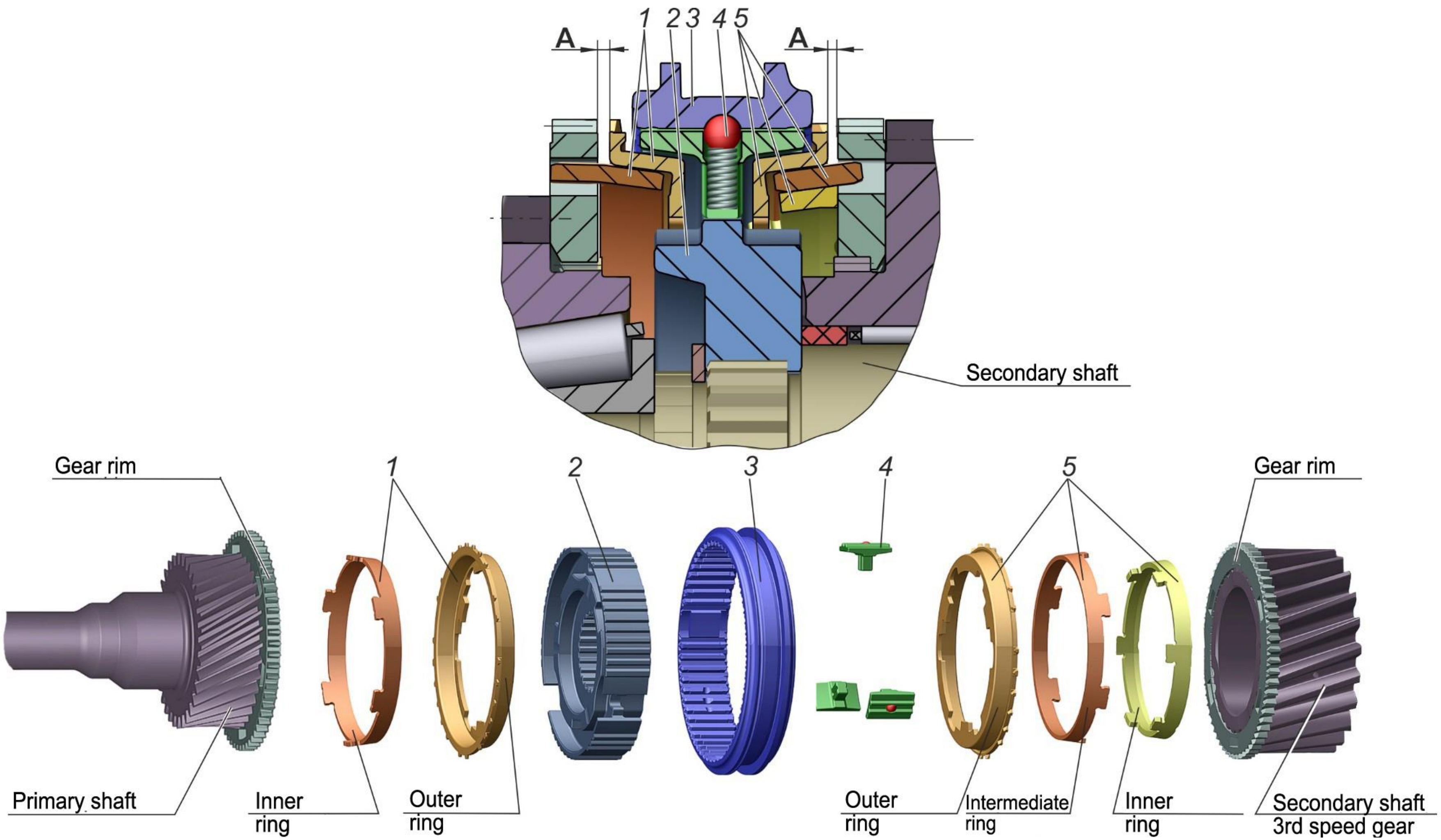


Fig. 3.5. 3rd – 4th speed synchronizer: A= 1,0-1,7 mm; 1 – 4th speed synchronizer locking ring set; 2 – synchronizer hub; 3 – synchronizing sleeve; 4 – synchronizer T-block; 5 – 3rd speed synchronizer locking ring set.

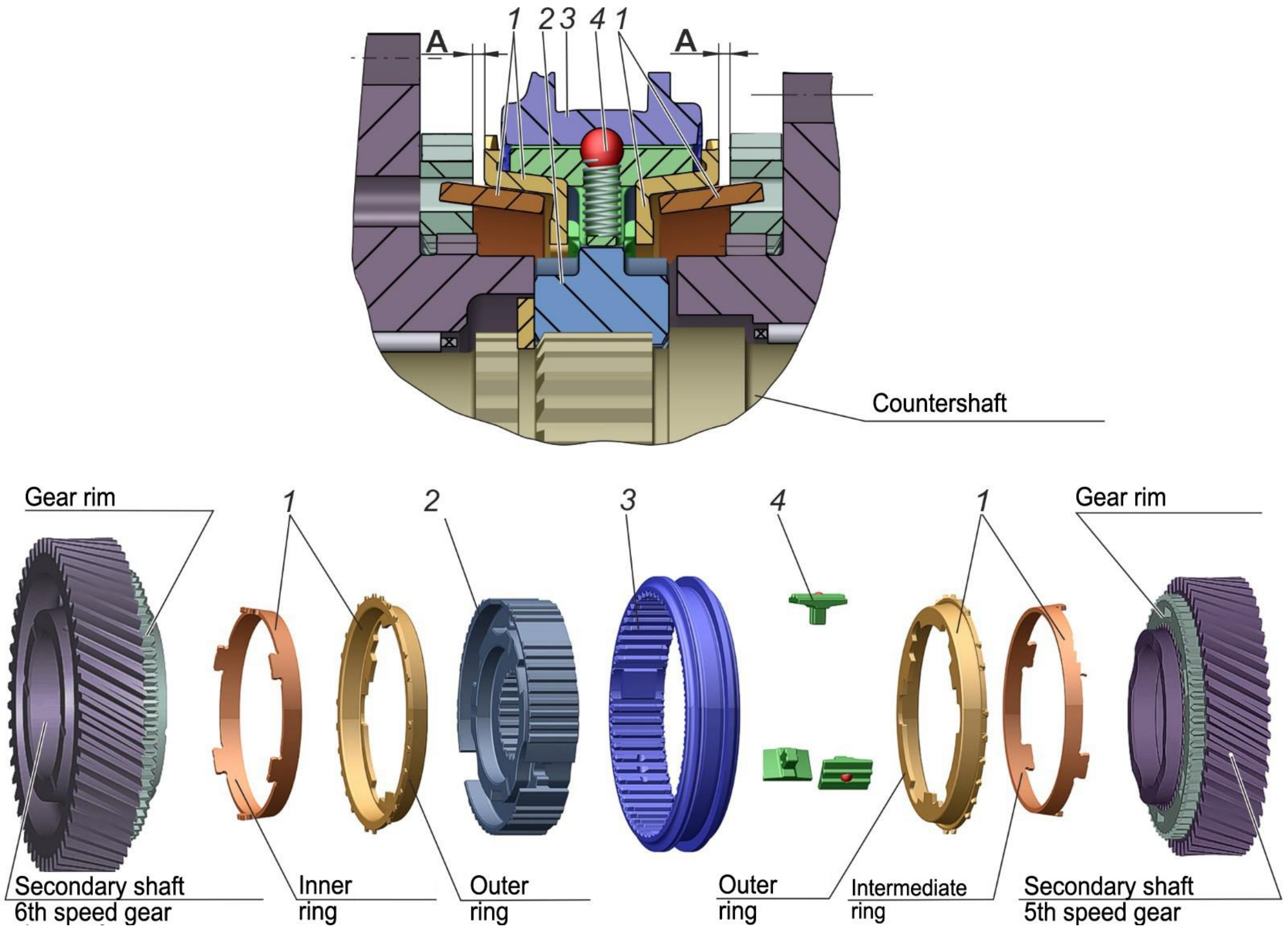


Figure 3.6. 5th - 6th speed synchronizer: A= 1.0-1.7mm; 1 – 5th and 6th speed synchronizer locking ring set; 25 – synchronizer hub; 3 – synchronizing sleeve; 4 – synchronizer T–block.

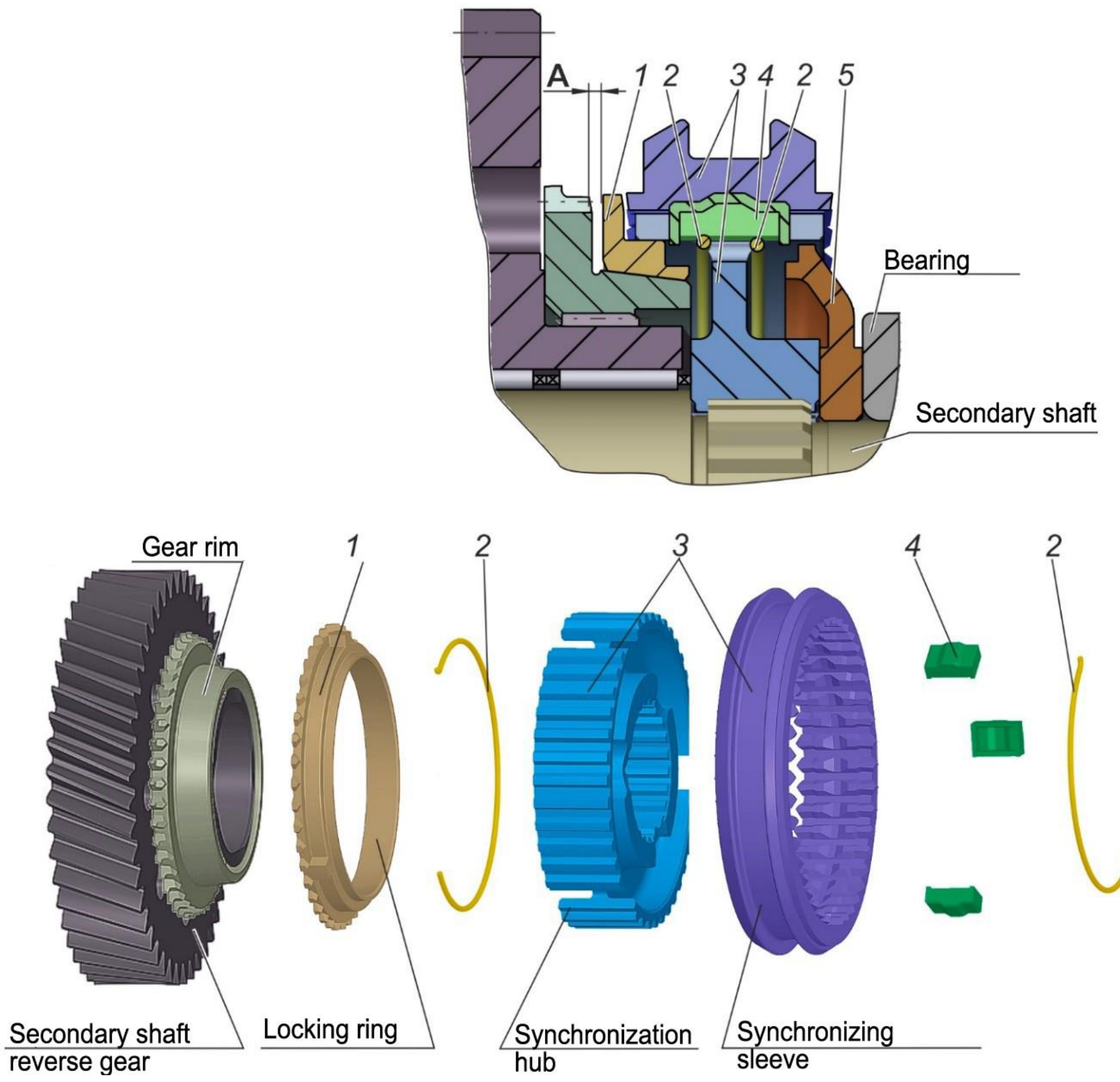


Figure 3.7. Reverse synchronizer: A = 1.1 -1.5 mm; 1 - locking ring; 2 - synchronizer spring; 3 - synchronizing sleeve with hub; 4 - synchronizer T-block; 5 - thrust washer.

Gears are engaged by the inner sleeve teeth meshing with the outer synchronizer gear rims. The sides of the synchronizer sleeve and gear rim teeth are beveled inward forming a lock in the engaged position, thus preventing gears self-disengagement. 1st - 2nd speed sleeve travel is restrained by the gear faces, 3rd - 4th and 5th - 6th speed sleeves travel is restrained by the sleeve protrusions, and reverse sleeve travel is restrained by gear rim teeth protrusions.

All gear rims are connected to the gears and the primary shaft by pressing on the splines. After pressing, all these spline connections, except for the reverse gear, are subjected to a special operation in order to prevent the gear rim from running out the gear: the end face of gear to primary shaft spline connection is heated and deformed to form retaining shoulder, which prevents the gear rim from running out the gear. Thus, the reverse gear rim to gear connection is demountable, while those of other speed gears are non-demountable.

Axial forces from the secondary shaft and countershaft helical gear teeth are taken up by locking rings 14, 18 (see Fig. 3.19), thrust washer 16 and shaft shoulders.

All shafts rotate on taper bearings installed in the blind sockets of the front and rear housings, and primary shaft bearing cover.

Countershaft bearings are preloaded by selection and installation of one of the adjustment rings 20 (see Fig. 3.3) in the front housing socket during assembly. Secondary and primary shaft bearings are preloaded by selection and installation of one of the adjustment rings 21 in the primary shaft bearing cap socket during assembly.

Gear shift mechanism contains stem 5 (Fig. 3.8) moving longitudinally and rotating in two linear motion ball bearings 3 (see Fig. 3.3) installed in the front and rear housing. Two pins 11 (Fig. 3.8) are pressed into the stem, and gear engagement head 35 (see Fig. 3.3) is installed at the end through terminal connection. In addition, shift yokes 7, 9, 12, 15 (see Fig. 3.8) are mounted at the stem allowing the free relative movement and rotation of stem. Yokes include detachable T-blocks 8, 13, 16 entering the engagement sleeve grooves. Each yoke is bolted (screwed) to one of the push rods 2, 3, 6 with grooves where the stem pin 11 enters. One pin controls the 3rd - 4th and 5th - 6th speed yoke push rods, the other controls 1st - 2nd speed and reverse push rods. Control linkage cover lever acts on the gear engagement head to select speed gears by stem rotation and engage gears by longitudinal stem movement. In selecting, the pin selects the desired push rod, and in engaging, it moves the push rod together with the yoke.

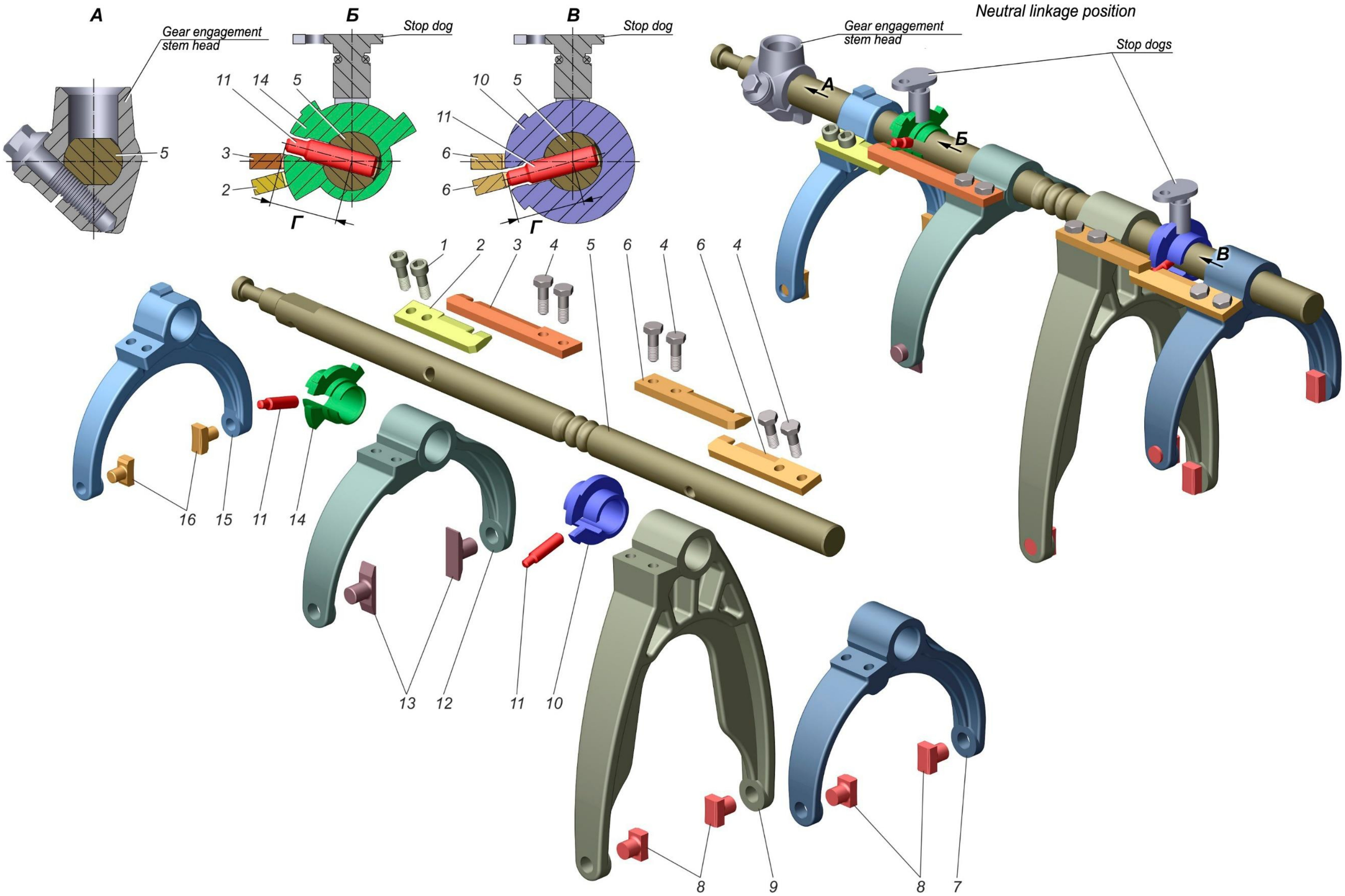


Fig. 3.8. Gear-shift mechanism: D=21.9-22mm; 1 – screw; 2 – reverse gear engagement yoke push rod, 3 – 1 and 2 speed gears yoke push rod; 4 – bolt; 5 – gear engagement stem; 6 – 3, 4, 5, 6 speed gears yoke push rod; 7 – 3 and 4 speed gears shift yoke; 8 – T–block of 3 and 4, 5 and 6 speed gear shift yokes; 9 – 5 and 6 speed gear shift yoke; 10 – 3, 4, 5, 6 speed gears stem head; 11 – push rod pin; 12 – 1 and 2 speed gear shift yoke; 13 – T-block of 1 and 2 speed gear shift yokes; 14 – 1 and 2 speed gear stem head, 15 – reverse engagement yoke; 16 – reverse engagement yoke T-block.

To prevent two gears from engaging simultaneously and to position the parts, mechanism is provided consisting of two heads 10 and 14 and two stop dogs 6 (see Fig. 3.3) - one per pin. The heads are freely mounted on the stem. Each of heads has a longitudinal groove to take the pin and a protrusions entering the stop dog groove and the yoke push rods grooves. The stop dogs are fixed to the housings with bolts and have rubber sealing rings 11 (see Fig. 3.3).

When the stem is rotated for selection, the pins act on the heads and rotate these together with the stem. In this case, the head protrusions cover the push rod grooves of all yokes except for the switched yoke push rod groove (the pin enters it). At the same time, the head protrusions are continuously meshed with the stop dog grooves, thus preventing longitudinal head movement as well as all yokes except for the switched yoke. In addition, the 1st - 2nd speed gear and reverse gear head has additional projections resting on the stop dog and restraining the head, pin and stem rotation.

The stem is secured in engaged and disengaged positions by means of the retainer 8 (see Fig. 3.3) with a ball and spring.

The control linkage cover assembly consists of a cover 4 (Fig. 3.9), in which the gear shift shaft 12 is mounted on two linear motion ball bearings 10. Gear shift lever 11 is mounted to the shaft through the key 18 and prevented from movement relative to the shaft with a tie bolt. Gear engagement lever 7 is bolted to one gear shift shaft end with two flats. Ball pin for attaching the gear engagement cable is located at the lower lever part. Counterweight 14 is bolted to the other shaft end. The counterweight inertia mass contributes to a clearer and more informative gear engagement and disengagement. Gear selection lever 15 assembled with a support is mounted to the linkage cover wall.

Ball pin 5 for the gear selection cable attachment and ball pin 6 are mounted in the selection lever 4 (Fig. 3.10). Slider 1 is installed on the ball pin 6; when mounted on the cover, it connects the selection lever with the gear engagement lever 7 (see Fig. 3.9) by entering the groove formed by the washer 8 and gear engagement lever 7.

Control linkage cover assembly is attached to the rear gearbox housing with four bolts.

When in neutral position, the shift lever 7 lower head is always retained in the position corresponding to the 3rd and 4th speed gears engagement by means of springs 2 and safety-locks 3.

In the case of failure, remove control linkage cover from the vehicle and repair it.

When shifting gears (in accordance with the diagram on the lever handle (see Fig. 3.11)), the master support lever transmits force through cables to the selection and engagement levers and then to the control linkage cover gear-shift lever.

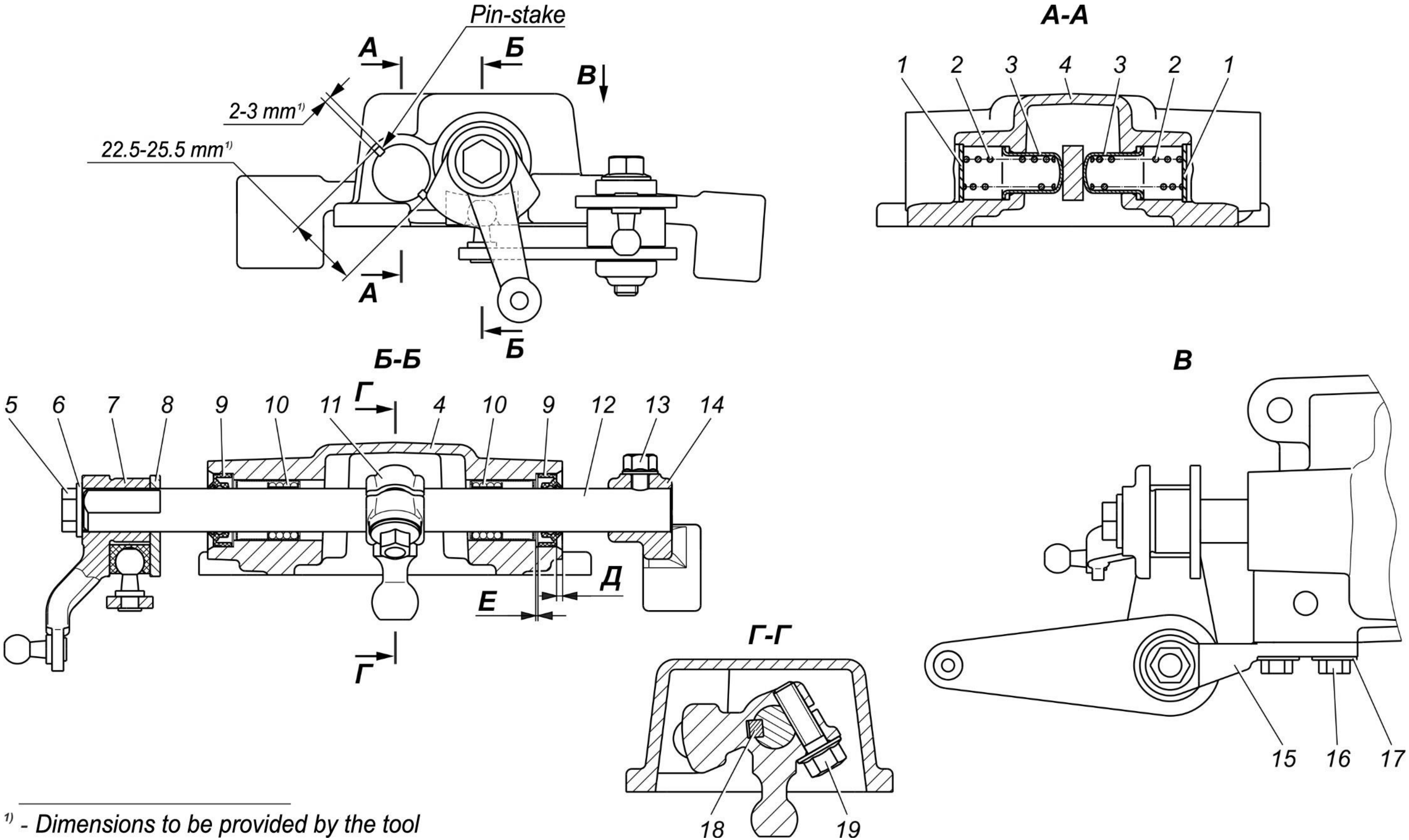


Fig. 3.9. Control linkage cover assembly: 1 – plugs; 2 – safety–lock springs; 3 – engagement safety–locks; 4 – control linkage cover; 5, 13, 16, 19 – bolts; 6,8,17 – washers; 7 – engagement lever; 9 – collar seals; 10 – linear motion ball bearings; 11 – gear–shift lever; 12 – gear–shift shaft; 14 – counterweight; 15 – selection lever assembled with support; 18 – key.

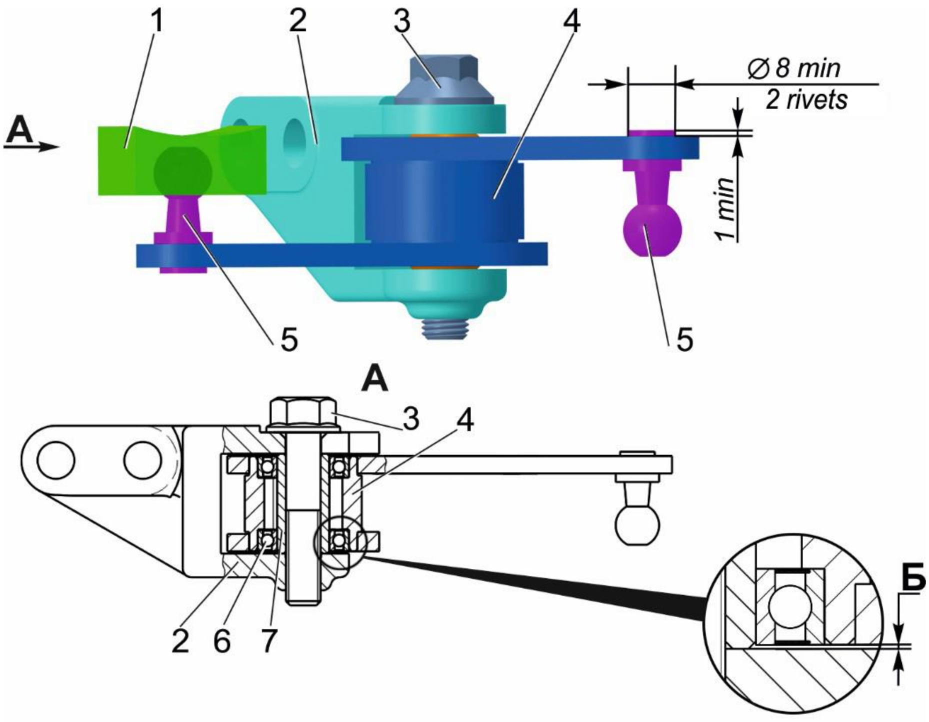


Figure 3.10. Selection lever with support: 1 – slider; 2 – support; 3 – bolt; 4 – selection lever; 5 – ball pins; 6 – radial ball bearing; 7 – bushing.

When selecting the gear, the gear selection lever transmits force through the slider to the gear engagement lever 7 (see Fig. 3.9) moving the shaft 12 together with the gear-shift lever 11 along its axis.

When engaging the gear, the selected gear in the gearbox is engaged by acting on the gear-shift lever 7 and turning it together with the shaft and gear-shift lever 11.

Oil-drain plug 18 (see Fig. 3.3) is equipped with magnet capturing small metal particles in the oil, which result from gearbox parts wear.

The speedometer drive includes speed (pulse) sensor 34 installed in the rear housing and speed sensor rotor 17 at the secondary shaft.

The gearbox is equipped with reverse engagement sensor 12 and the neutral sensor 33[1].

The gearbox allows the power take-off through the aperture closed with stamped cover plate bolted to the gearbox.

The vehicle is equipped with **cable control linkage** for remote gearbox control. Cable control linkage includes master support 1 (Fig. 3.11) with a gear-shift lever mounted to the dashboard, control linkage cover 3 (translator) mounted to the rear gearbox housing, and two cables 2 with front ends hinged to the master support gear-shift lever and peripheral ends hinged to the control linkage cover levers.

---

[1] - Installed to some vehicles

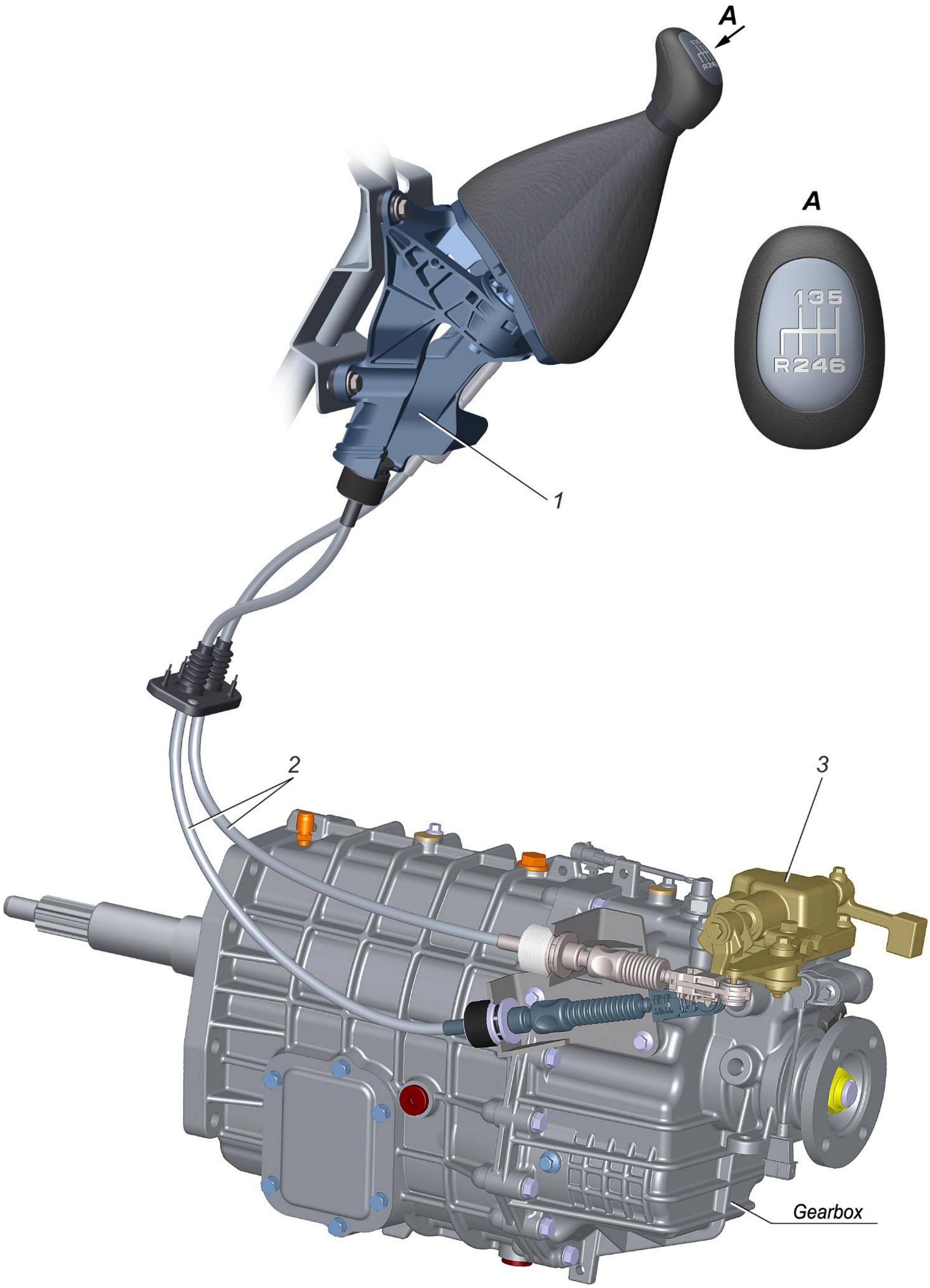


Figure 3.11. Gearbox cable control linkage diagram: 1 – master support with gear–shift lever; 2 – gear selection and engagement cables (set); 3 – control linkage cover assembly

The master support with the gear-shift lever mounted on it converts movements of this lever into the remote actuator cable movements.

The master support is fastened to the dashboard bracket with four bolts.

The cable set encased in rigid sheaths includes gear selection and shift cable with cable ends and a cab floor seal. The cable ends are mounted to the spherical pins of the master support lever and the control cover gear selection and shift levers. The cable sheaths are attached lengthwise to the master support and gearbox brackets.

In case of master support and cable failure, repair or replace these with new ones.

Gearbox maintenance peculiarities

The gearbox maintenance consists of periodic visual examination, gearbox fastening check, oil level check and oil change according to the Vehicle operation manual, and breather cleaning according to the vehicle maintenance instructions.

The oil level shall be checked through the gearbox filler port with the vehicle standing on level platform some time after the operation to allow the oil to cool and run off the walls, and foam to settle.

Drain hot oil immediately after the operation with observance of safety precautions. When the used oil is very dirty and contains metal particles, the gearbox shall be flushed.

Flush the gearbox in the following manner:

- fill 3 liters of gear oil into the housing through the gearbox filler port;
- set chokes under the front wheels and raise the rear axis until the wheels on one side or all axis wheels break contact with floor;
- engage first gear in the gearbox and start the engine for 2-3 minutes;
- drain the oil through the gearbox housing bottom drain hole;
- fill the gearbox with fresh oil up to the filler port lower edge. Check the oil level through the port located on the left side of the front housing. When filling the gearbox, do not turn gears, as this will result in excessive oil filling causing oil leakage through the collar seals.

During operation, pay special attention to the front housing breather condition.

The breather communicates the internal gearbox cavity to atmosphere, so its contamination causes pressure build-up and oil leakage.

At the initial operation period, until the oil seals are seated, slight oil seepage (but not drip) and oil stains at the packing seal areas shall be allowed.

Potential gearbox faults and remedies

Fault cause	Remedy
Bad gear shifting	
Incomplete clutch release, air in the clutch release hydraulic system or insufficient fluid in the clutch main cylinder	Bring brake main cylinder tank level to the normal level and bleed the clutch hydraulic system.
Loosened locking bolts of yoke push rods, gear-shift linkage engagement head	Remove and replace worn bolts, apply sealant on the threaded portion of the push rod bolts and tighten the bolts to the specified torque (see "Gearbox assembly", "Gear-shift linkage assembly" sub-section).
Loosened control linkage cover lever mounting bolts	Tighten the mounting bolts to the specified torque. Apply sealant on threaded bolt portion prior to tighten the engagement lever mounting bolt (see "Control linkage cover assembly" sub-section).
Burrs on the inner surface of the engagement sleeve teeth	Remove burrs
Cable seizure or restricted movement due to moisture, dirt under the cable sheath or cable wear.	Replace cables (as a set)
Failure to synchronize gear engagement (crackling sound at engagement)	
For reverse - reduction of the clearance between the synchronizer locking ring and gear rim faces due to taper surfaces wear.	When the clearance is less than 0.5 mm, install new set of gear with a gear rim and locking ring or install a new ring with lapping it to the gear rim taper.
For 3rd, 4th, 5th, 6th speeds - reduction of the clearance between the outer synchronizer locking ring and the gear rim faces due to locking ring taper surfaces wear.	When the clearance is less than 0.4 mm, install new locking ring set (see "Gearbox assembly" sub-section).
For 1st and 2nd speeds -- reduction of the clearance between the outer synchronizer locking ring and the gear rim faces due to locking ring and gear rim taper surfaces wear.	When the clearance is less than 0.4 mm, install new locking ring set or new locking ring set and gear (see "Gearbox assembly" sub-section).

Fault cause	Remedy
Locking ring deformation (ring is not fixed on a taper when pressed and turned by hand).	For reverse - install new set of gear with gear rim and locking ring or install new ring with lapping it to the gear rim taper. For 3rd, 4th, 5th, 6th speeds, install new locking ring set. For 1st, 2nd speeds, install new locking ring set or new locking ring set and gear (see "Gearbox assembly" sub-section)
Spontaneous gear disengagement	
Loosened gearbox to clutch housing mounting nuts or gearbox housing mounting bolts	Tighten nuts or bolts
Worn engagement sleeve teeth faces or splined ring teeth	Replace worn parts
Retainer spring slackening	Replace retainer
Noise in gearbox	
Bearings are worn	Replace bearings
Worn or chipped tooth working surface, broken gear teeth	Replace damaged gears
Low housing oil level	Top up oil to normal level
Oil leakage from the gearbox	
Worn collar seals	Replace collar seals
Dirty or damaged breather	Clean breather or replace with a new one
Loosened oil drain and oil fill plugs	Tighten plugs to specified torque (see "Gearbox assembly" sub-section)
Control linkage cover plugs leaking	Install new plugs (see "Control linkage cover assembly" section).
Loosened mounting bolts of front cover, cover plate, front and rear housings, and gear-shift control linkage cover	Tighten mounting bolts to the specified torque; where necessary, lubricate the threaded bolt portion (see "Gearbox assembly" sub-section)
Damaged cover plate gasket or nicked housing and cover mounting faces	Replace gasket, grind nicks

Fault cause	Remedy
When any gear is engaged, torque is not transferred to propeller shaft	
Loosened countershaft drive gear fit to shaft	Replace countershaft assembly
When 3rd gear is engaged, torque is not transferred to propeller shaft	
Loosened 3rd speed gear fit to countershaft	Replace countershaft assembly

Gearbox repair

ATTENTION
For additional requirements for cables and master support removal and installation, refer to the supplier's documentation.

Gearbox removal

To remove the gearbox, follow the procedure below:

- put the vehicle on trestle, elevator or inspection pit to provide convenient access to the gearbox from below;
- remove cable ends from the ball pins of the control linkage cover levers;
- remove the cables from the cable mounting bracket attached to the gearbox by pulling the cable lock bushings off the bracket (first white and then black one) and remove the cables;

ATTENTION
Protect the cable bellow boots and ends from damage.

- drain oil from gearbox;
- remove driveline following the procedure in “Driveline” sub-section;
- disconnect the wiring pin blocks from the reverse light switch, neutral sensor[1)] and speed sensor;
- unscrew two bolts fastening the clutch linkage servo cylinder bracket to the clutch housing, lift up the servo cylinder with the push rod without disconnecting it from the pipeline;
- unscrew the boot frame mounting bolt and remove the clutch release yoke;

[1)] - Installed to some vehicles

- raise the rear of the engine and install a stand under the clutch housing or engine cylinder block;
- unscrew the nuts of studs fastening the rear engine suspension pad to the gearbox;
- disconnect the cross-member from the frame girders and remove from the vehicle;
- install assembly trolley-hoist (stand) under the gearbox;
- unscrew the nuts of studs fastening the gearbox to the clutch housing, move back the gearbox installed on the assembly trolley-hoist to disengage the primary shaft splines from the clutch driven plate and remove the gearbox together with the clutch release sleeve from the vehicle (the operation shall be performed by two people).

Gearbox disassembly

To disassemble the gearbox, follow the procedure below:

– remove the sleeve with the clutch release bearing from the gearbox primary shaft bearing cover;
- disconnect the cable bracket from the gearbox;
- unscrew four bolts fastening the control linkage cover 3 (Fig. 3.12) to the gearbox, remove the cover and close the gearbox opening;
- lock the secondary shaft flange, unstake and unscrew the secondary shaft flange nut, remove the flange;
- unscrew pulse sensor 37;
- unscrew neutral sensor 1 mounting bolt, remove sensor;
– unscrew reverse light switch 6;
– unscrew breather 22;
- unscrew stop dog 20 mounting bolts and remove stop dogs with sealing rings 19;
- unscrew retainer 18;
- unscrew the primary shaft bearing cover 25 mounting bolts and remove the cover;
- remove the adjustment ring 23 from the cover;
- unscrew the front housing 27 and rear housing 38 mounting bolts 39;

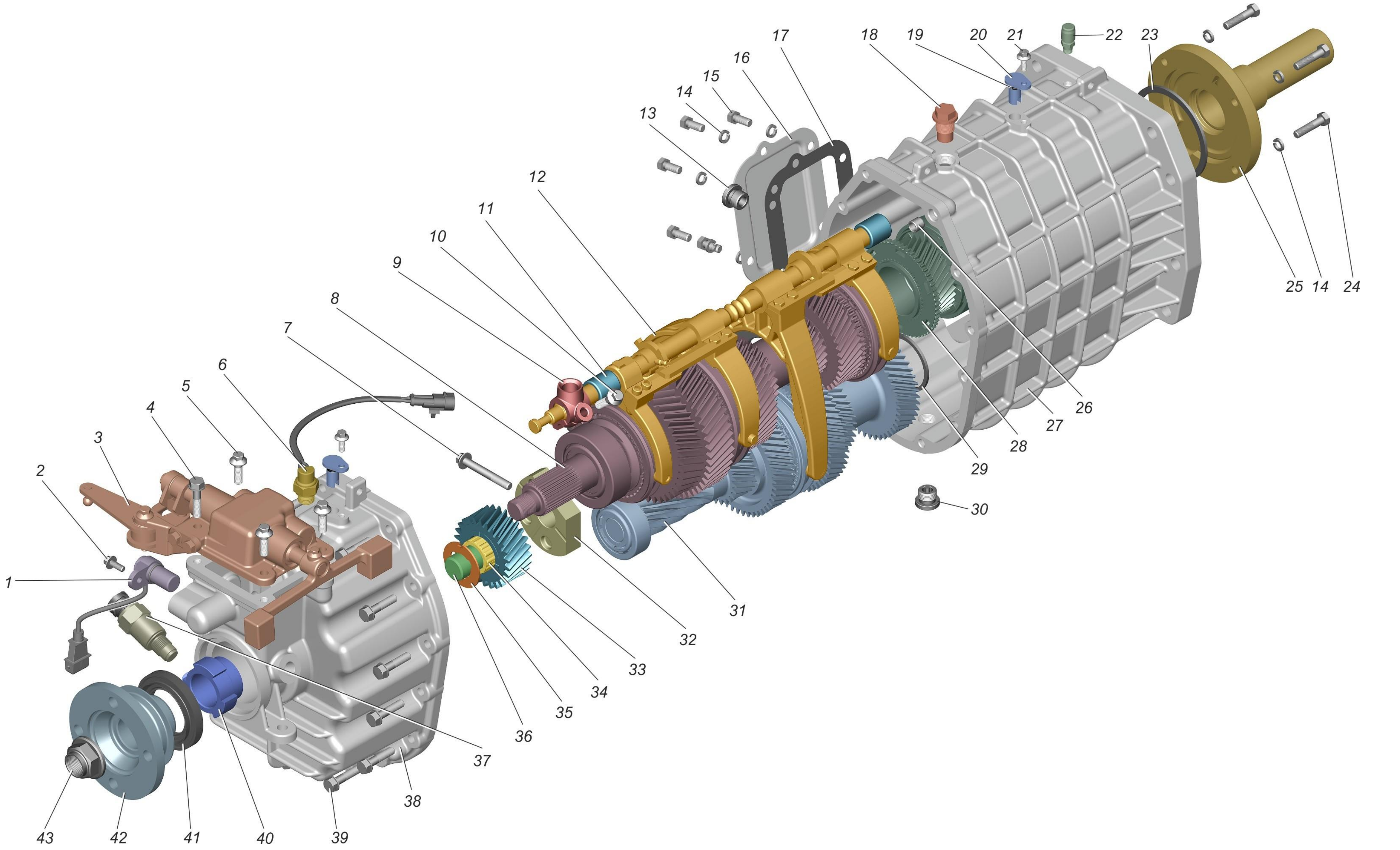


Fig. 3.12. Gearbox structure: 1 – neutral (phase)[1] sensor; 2, 4, 5, 7, 10, 15, 21, 24 – bolts; 3 – control linkage cover assembly; 6 – reverse light switch; 8 – secondary shaft assembly; 9 – engagement stem head; 11 – linear motion ball bearing; 12 – gear–shift mechanism; 13 – oil filler plug; 14 – washer; 16 – cover plate; 17 – cover plate gasket; 18 – retainer; 19 – sealing ring; 20 – stop dog; 22 – breather; 23, 29 – adjustment rings; 25 – primary shaft bearing cover with collar seal; 26 – centering pin; 27 – front gearbox housing; 28 – primary shaft assembly; 30 – magnetic plug; 31 – countershaft assembly; 32 – axis bushing; 33 – reverse idler gear; 34 – radial roller bearing without rings; 35 – reverse gear thrust washer; 36 – reverse idler gear axis; 37 – speed (pulse) sensor; 38 – rear gearbox housing, 39 – flange bolts; 40 – speed sensor rotor; 41 – collar seal; 42 – secondary shaft flange; 43 – flange mounting nut.

---

[1] - Installed to some vehicles

- separate the front and rear gearbox housings by holding the rear housing and moving the front housing (acting on the clutch housing mounting flange) (Fig. 3.13). When separating the housings, do not force on primary shaft tailshaft face to avoid damage to the synchronizer;

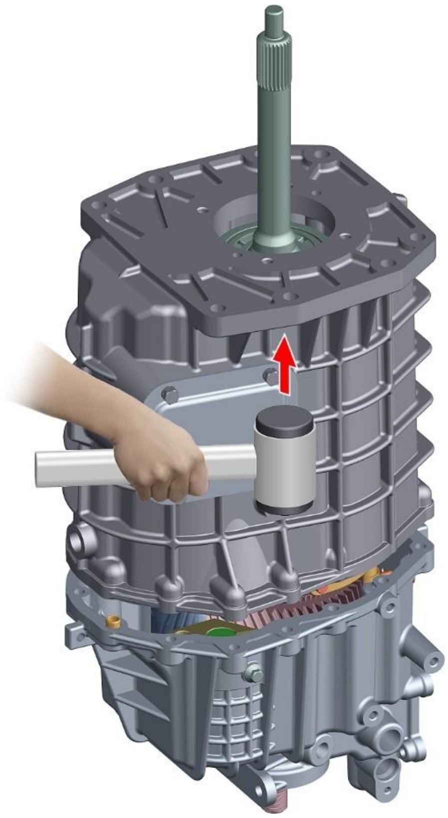


Fig. 3.13. Front and rear housings separation

- remove the countershaft taper bearing outer race and adjustment ring 29 (see Fig. 3.12) from the front housing socket;
- unscrew oil filler 13 and oil drain plug 30 from the front housing;
- unscrew cover plate mounting bolts, remove cover 16 and cover gasket 17;
- turn the stem and unscrew gear engagement head 9 mounting bolt;
- unscrew reverse idler gear axis bushing 32 mounting bolt 7, remove axis bushing and axis 36;
- remove the primary shaft taper bearing outer race;
- remove package of primary and secondary shafts, and countershaft with taper bearing inner races, reverse idler gear with needle bearing and gear-shift mechanism from the rear housing;
- remove reverse idler gear with needle bearing, gear-shift mechanism 12, and countershaft, secondary and primary shafts assemblies from the package;

- remove gear engagement head 9, speed sensor rotor 40, reverse idler gear washer 35 from the rear housing;
- remove the taper bearing outer races from the rear housing;
- where necessary, press out: collar seal 41 from the rear housing and collar seal from the primary shaft bearing cover, linear motion ball bearings 11 from the front and rear housings, locating grommets (pins) 26 from the rear housing.

Primary shaft disassembly

To disassemble the primary shaft (see Fig. 3.17), press out the taper bearing inner race.

Countershaft disassembly

To disassemble the countershaft (see Fig. 3.18), follow the procedure below:
- press the taper bearing 1 inner races out of the shaft 14 ends;
- remove countershaft drive gear retaining ring 2;
- press drive gear 3 and third speed gear 4 out of the shaft;
- remove sixth speed gear 7 with needle bearing 5 and set of synchronizer rings 8 from the shaft, mark locking rings to put in place when reassembling;
- remove a set of rings 8 from the 6th speed gear and remove the needle bearing 5 in a plastic cage;
- remove the retaining ring 6 of the 5th and 6th speed synchronizer hub from the shaft;
- remove hub 11 and the 5th and 6th speed gear engagement synchronizer sleeve 9 assembled with T-blocks 10 from the shaft; to do this, hold the shaft vertically and knock a wooden pad with the tailshaft face;
- check that the aligned marks are available on the hub and the 5th and 6th speed gear engagement sleeve; otherwise, mark these parts to install to the same position when reassembling;
- remove 5th and 6th speed gear engagement sleeve from the hub;
- remove synchronizer T-blocks (3 pcs.);
- remove fifth gear 12 with a set of synchronizer rings 8 from the shaft, mark the locking rings to install to the same position when reassembling;
- remove a set of rings from the 5th speed gear;
- remove split-cage needle bearing 13 from the shaft.

Secondary shaft disassembly

To disassemble the secondary shaft (see Fig. 3.19), follow the procedure below:

- remove the set of rings 3 of the 4th speed gear synchronizer;
- Press out taper bearing 1 (without damaging the cage) from the left shaft end;
- remove retaining ring 2 of the 3rd and 4th speed gears synchronizer hub;
- remove hub 7 and the 3rd and 4th speed gear engagement synchronizer sleeve 4 assembled with T-blocks 5 from the shaft; to do this, hold the shaft vertically and knock a wooden pad with the tailshaft face;
- check that the aligned marks are available on the hub and the 3rd and 4th speed gear engagement sleeve; otherwise, mark these parts to install to the same position when reassembling;
- remove 3rd and 4th speed gear engagement sleeve from the hub;
- remove synchronizer T-blocks (3 pcs.);
- remove the third speed gear 9 with needle bearings 25, plastic spacer ring 8 and a set of synchronizer rings 6 from the shaft;
- remove a set of rings from the 3rd speed gear
- remove spacer ring 8 and needle roller bearings 25 in a plastic cage from the gear; mark to install to the same position when reassembling;
- press out package of parts (Fig. 3.14) from the secondary shaft using universal puller (fix legs to the reverse gear rim): tapered bearing 23 inner race (see Fig. 3.18), thrust washer 22, reverse gear synchronizer 21 hub and sleeve assembled with T-blocks and synchronizer springs, reverse gear 19 with locking ring 20 and needle bearings 25;

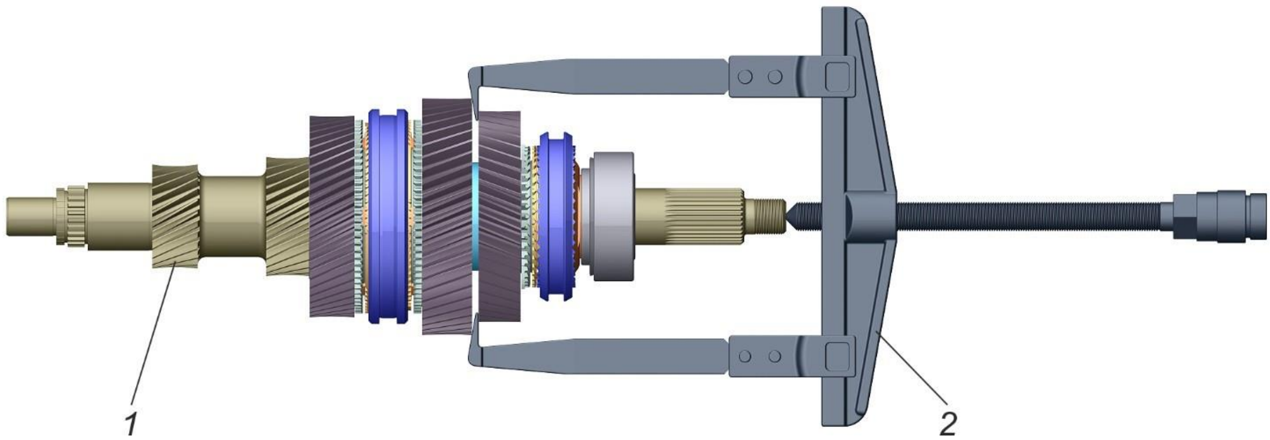


Fig. 3.14. Reverse gear removal: 1 – secondary shaft assembly; 2 – universal puller

- check that the aligned marks are available on the hub and the reverse engagement sleeve; otherwise, mark these parts to install to the same position when reassembling;

-remove the reverse gear engagement sleeve from the hub (see Fig. 3.7);

-remove synchronizer T-blocks (3 pcs.);

-remove synchronizer springs (2 pcs.) from the hub;

-remove the locking ring 20 (see Fig. 3.19) from the reverse gear;

-remove the needle bearings in the plastic cage and mark them to install to the same position when reassembling;

-remove 1st speed gear thrust washer retaining ring 18 from the shaft;

-remove the 1st speed gear thrust washer 16;

-remove the locking pin 17 (in case of replacement);

- remove first speed gear 15 with needle bearing 26 and a set of synchronizer rings 12 from the shaft, mark the locking rings to install to the same position when reassembling;

- remove a set of rings from the 1st speed gear and remove the needle bearing in the plastic cage;

- remove 1st and 2nd speed gear synchronizer hub retaining ring 14 from the shaft;

-remove hub 11 and sleeve 13 of the 1st and 2nd speed gear engagement synchronizer assembled with T-blocks 5 from the shaft; to do this, hold the shaft vertically and knock a wooden pad with the tailshaft face;

- check that the aligned marks are available on the hub and the 1st and 2nd speed gear engagement sleeve; otherwise, mark these parts to install to the same position when reassembling;

-remove 1st and 2nd speed gear engagement sleeve from the hub;

-remove synchronizer T-blocks (3 pcs.);

- remove second speed gear 10 with needle bearing 27 and a set of synchronizer rings 12 from the shaft, mark the locking rings to install to the same position when reassembling;

- remove a set of rings from the 2nd speed gear and remove the needle bearing in the plastic cage;

Gear-shift mechanism disassembly

To disassemble the gear-shift mechanism (see Fig. 3.8), follow the procedure below:

- unscrew bolts 4 (screws 1) and remove push rods 2,3 and 6 from the shift yokes;
- remove 3rd - 4th gear shift yoke 7, reverse gear shift yoke 15, stem heads 10 and

14 from the stem;

- press out the 1st - 2nd speed gear and reverse gear pin 11;
- remove the 1st - 2nd and 5th - 6th gear shift yokes 12 and 9 from the stem;
- where necessary, press out 3rd - 4th and 5th - 6th speed gears pin 11;
- where necessary, remove T-blocks 8,13,16 from the yokes.

Note: mechanism can be disassembled without disconnecting the push rods from the yokes. In this case, rotate and move stem longitudinally to disengage yoke push rods with stem heads from grooves.

Control linkage cover disassembly

To disassemble the control linkage cover, follow the procedure below:

- disconnect the selection lever 8 with the support from the control linkage cover 17 (Fig. 3.15) by unscrewing two mounting bolts 6 and disassemble, where necessary,. To do this:

1) remove slider 1 (see Fig. 3.10) from lever ball pin,
2) unscrew bolt 3, remove the selection lever with bushing from the support.
3) press bushing 7 out of bearings 6.
4) press the bearings 6 out of the selection lever 4 body;

- remove counterweight 1 (see Fig. 3.15) from the shaft 19 by unscrewing mounting bolt 2;
- unscrew bolt 15 fastening gear-shift lever 16 to the shaft, hold the lever and move the gear-shift shaft so that the key 18 comes out of the lever hub, and remove the key from the shaft groove. Remove the shaft assembly with gear engagement lever 11 from the control linkage cover.

Where necessary, unscrew mounting bolt and remove the gear engagement lever 11 and washers 12 and 10 from the gear-shift shaft;

- remove collar seals 9 from the cover;
- press the bearings 14 out of the cover.

Do not remove springs 4 and safety-locks 5 from the cover unless necessary. Where the safety-locks are seized and do not return properly by spring force, knock out plugs 3 and remove the springs and safety-locks from the cover.

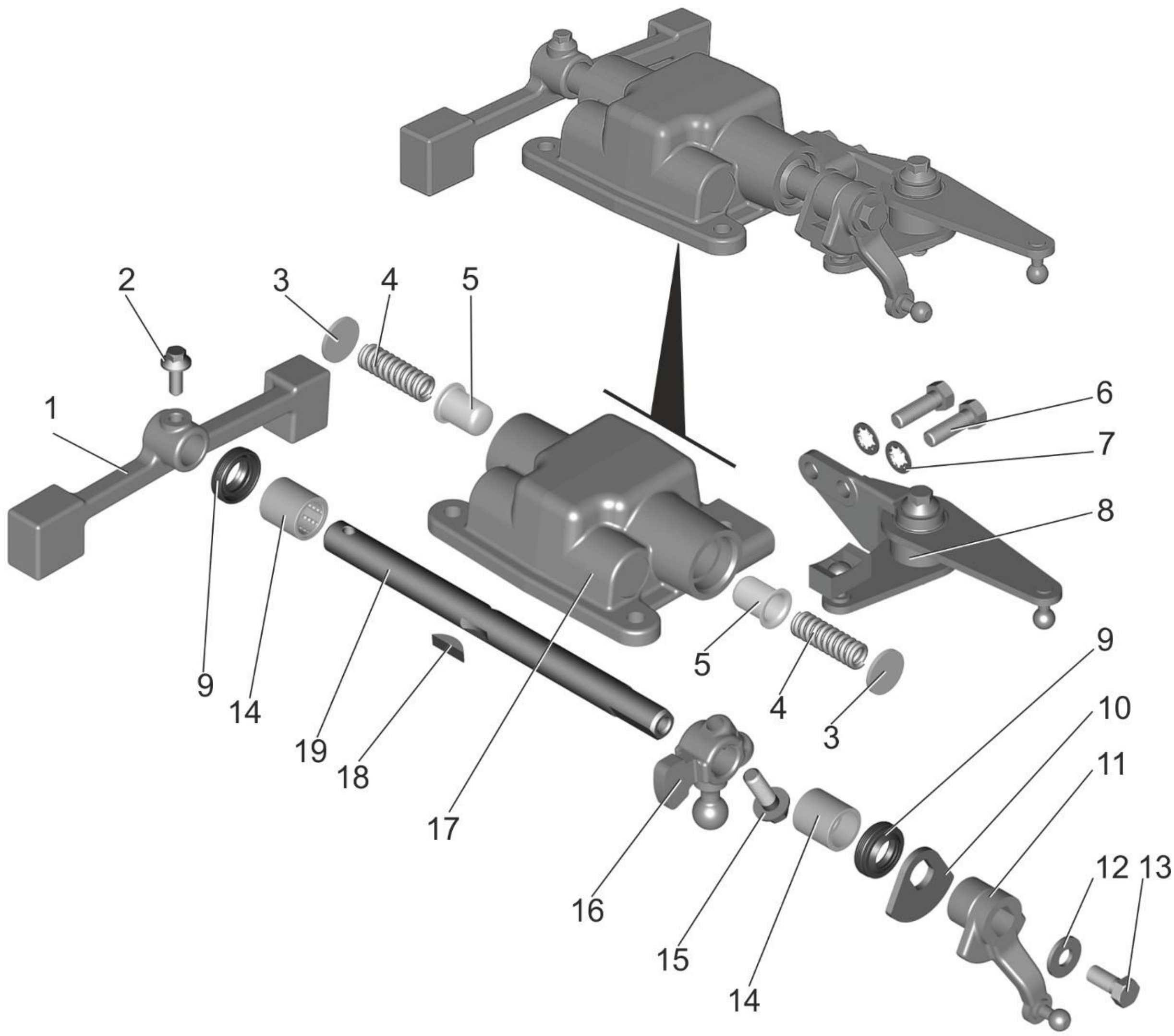


Fig. 3.15. Control linkage cover assembly: 1 – counterweight; 2, 6, 13, 15 – bolts; 3 – plugs; 4 – safety–lock springs; 5 – engagement safety–locks; 7, 10, 12 – washers; 8 – selection lever assembled with support; 9 – collar seals; 11 – engagement lever; 14 – linear motion ball bearings; 16 – gear–shift lever; 17 – control linkage cover; 18 – key; 19 – gear-shift shaft.

Parts inspection and control

Soak disassembled gearbox parts except for bearings in a detergent solution, then wash. Thoroughly clean part oil channels, if any. After washing, thoroughly inspect parts.

Gearbox parts shall be free of chips, cracks, scoring, crushing, pitting and heavy wear signs. Small holes (pitting) on the tooth working surface of maximum 10% of the tooth surface area shell be allowed. Collar seals shall be free of the working edge and notching area damages; the edge shall be elastic. The surfaces of parts where the collar seals slide shall be free of galling. Re-pressing of used collar seals is not allowed.

Aperture gaskets shall be free of tears, dents and kinks. The mounting faces shall be free of nicks and marks. The circlip ends shall lie in the same plane. No bent stems, deformed yokes, pins, heavily worn yoke T-blocks, pins and gear-shift mechanism yoke push rod grooves shall be allowed. Taper surfaces of synchronizer locking rings shall be free of scoring and uneven wear. Ring gear rims shall be free of dents. The gear rim taper surfaces shall not be wavy. Rings shall not wobble on the gear rim taper. Synchronizers are considered operable when the clearance between the locking rings and gear rim faces is not less than the values specified in the "Potential gearbox faults and remedies" sub-section, and the rings shall be locked on the cone when pressed and turned by hand.

No chipped roller running surfaces at the primary and secondary shafts, and countershaft, secondary shaft and countershaft gears, reverse axis and idler gear shall be allowed.

No scoring at the secondary shaft and countershaft gear faces, thrust washer and shoulders shall be allowed.

No loosened fit of the pins in the gear-shift mechanism stem shall be allowed. The dimension of the pin protrusion from the stem shall be as shown in Fig. 3.8.

After gearbox disassembly, wash bearings in clean washing solution and blown with compressed air. Bearings shall be free of cracks, chips, marks and pitting signs on cages, bodies and raceways. No seizure when rotating one of the bearing races shall be allowed. Rollers shall rotate easily while not falling out of the cage. No signs of bearing race slipping on the shaft, galling and crumpling in the housing bearing seats shall be allowed.

Worn and damaged parts shall be replaced.

General requirements for gearbox assembly

When replacing the synchronizer locking rings, clearance between the ring and gear rim faces for new parts shall be in accordance with Fig. 3.3, 3.4, 3.5, 3.6. Locking rings of all synchronizers except reverse one are supplied as spare parts set. When replacing the reverse synchronizer locking ring, tight fit of the ring and gear rim taper surfaces without wobbling shall be ensured. To do this, the ring shall be lapped to the gear rim taper surface using lapping compound to provide the taper surfaces contact area of at least 85% and the thread wear flat width at the ring taper not exceeding 0,17mm. After lapping, install parts as a set.

Install gear-shift sleeve hubs to the secondary shaft and countershaft complete with sleeves, T-blocks and springs (for reverse gear). When installing the hubs on the shafts, the tightest possible fit shall be obtained.

Gear-shift sleeve assembled with hubs shall allow easy axial movement of parts. For reverse synchronizer, the bent ends of both springs shall be located in the same T-block, and the spring coils shall be oppositely directed (Fig. 3.16).

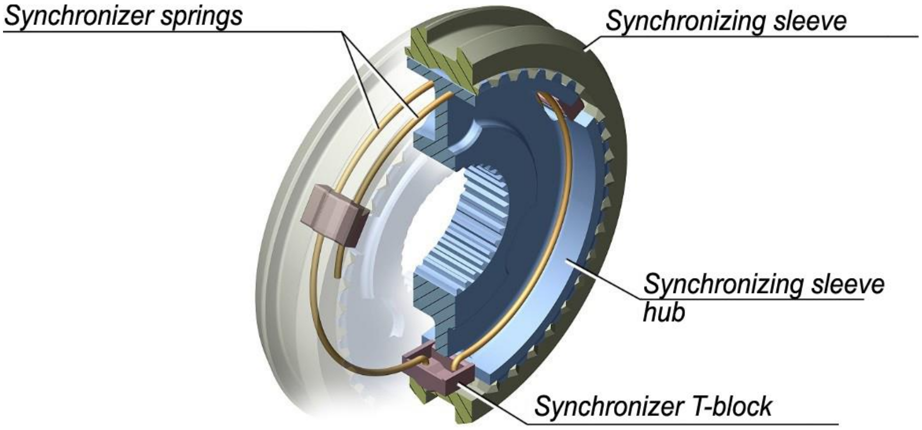


Fig. 3.16. Synchronizer springs installation

Bearings shall be pressed onto the shafts with force only applied to the inner bearing race.

All gearbox parts rubbing surfaces and bearings shall be lubricated with gearbox oil. Lubricate all rubbing surfaces of gear-shift mechanism and control linkage cover parts with SRI Grease EP2, Ulti-Plex Synthetic Grease EP1.5 (CHEVRON) or Albida EVS grease (Shell). For ease of assembly, it is allowed to lubricate bearings, T-blocks, synchronizer springs and other parts with SRI Grease EP2, Ulti-Plex Synthetic Grease EP1.5 (CHEVRON) or Albida EVS grease (Shell). New bearings shall be installed in factory preservative grease.

Prior to assembly, always lubricate the lips of the primary shaft collar and the control linkage cover collar with SRI Grease EP2, Ulti-Plex Synthetic Grease EP1.5 (CHEVRON) or Albida EVS grease (Shell).

Install the secondary shaft collar seal with factory-applied lubricant. No dirt getting into the applied lubricant, applied lubricant spreading over the collar surface or applied lubricant removal shall be allowed.

When assembling, apply thin layer of "Loctite 518" sealant on the mating planes of the front and rear housings, primary shaft bearing cover, control linkage cover. Apply thin layer of Loctite 5900 (Henkel) or Loctite 5699 (Henkel) sealant on aperture gasket, threaded portion of the pulse sensor, reverse sensor and retainer, mounting bolts of primary shaft cover, cover plate and stop dogs, reverse idler gear axis mounting bolt head, cover control linkage plugs.

Apply Loctite 243 (Henkel) or Weicon AN 302-43 (Weicon) anaerobic sealant on mounting bolts (3-4 threads) of gear-shift push rod yokes, gear-shift lever, counterweight, selection lever, pin to stem press-fitting surface. Before applying the sealant, clean the part surfaces from the old sealant and degrease them.

Tighten parts with the following torques:

- stop dog, neutral sensor mounting bolts – 8-10 N·m (0.8-1.0 kgf·m);
- shift yoke push rod, counterweight mounting bolts – 12-16 N·m (1.2-1.6 kgf·m);
- primary shaft bearing cover, cover plate, gear engagement lever, selection lever support mounting bolts – 14-18 N·m (1.4-1.8 kgf·m);
- housing, control linkage cover, gear engagement head, reverse idler gear axis, gear-shift lever, selection lever mounting bolts - 16-21 N·m (1.6-2.1 kgf·m);
- oil filler and oil drain plug, reverse light switch, pulse sensor, stem retainer – 16-36 N·m (1.6-3.6 kgf·m);
- secondary shaft flange nut – 270-350 N·m (28-36 kgf·m).

Secondary shaft gears axial clearances shall be 0.13 – 0.5mm. These are ensured through design and do not require adjustment.

Since at manufacture, each gear pair is selected for noise, then the replacement of either gear of the pair may cause some gearbox noise increase.

When assembling, take into account the dimensions of the gearbox mating parts (Table 3.1).

Primary shaft assembly

To assemble the primary shaft, proceed as follows:

- press the taper bearing 2 (Fig. 3.17) inner race on the primary shaft 1 journal all the way to end face;
- install the primary shaft taper bearing outer race;

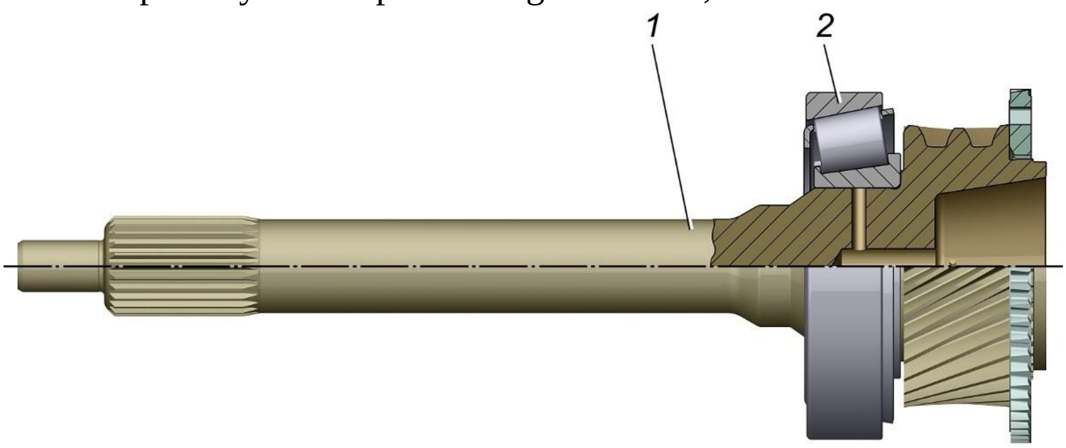


Fig. 3.17. Primary shaft assembly: 1 – primary shaft; 2 – roller bearing

Countershaft assembly

To assemble the countershaft, proceed as follows:

- assemble the hub 11 (Fig. 3.18) with the engagement sleeve 9 and synchronizer T-blocks 10 in accordance with the instructions above;
- install split-cage needle bearing 13 to the countershaft 14;
- install fifth speed gear 12 to the countershaft;
- install the set of locking rings 8 and assembled hub with the 5th and 6th speed gears engagement sleeve and synchronizer T-blocks to the countershaft. When installing, make sure that:
  - intermediate ring protrusions (see Fig. 3.6) enter the 5th speed gear rim grooves;
  - synchronizer outer ring protrusions enter the hub grooves;
- install retainer ring 6 (see Fig. 3.18) to the shaft;
- install needle bearing 5 in the cage in the sixth speed gear 7 bore;
- install set of synchronizer locking rings 8 and 6th speed gear assembled with a needle bearing to the countershaft. When installing, make sure that:

• synchronizer outer ring protrusions enter the hub grooves;

• intermediate ring protrusions enter the 6th speed gear rim grooves;

- press third speed gear 4 and countershaft drive gear 3 on the countershaft all the way to the shaft end face with preheating to a temperature of 120...150°C. Third speed gear 4 and countershaft drive gear 3 shall not rotate when torque of 1625-1752 N·m (165.6-178.6 kgf·m) is applied;
- install retainer ring 2;
- press inner races of taper bearings 1 on the countershaft all the way to the shaft end face.

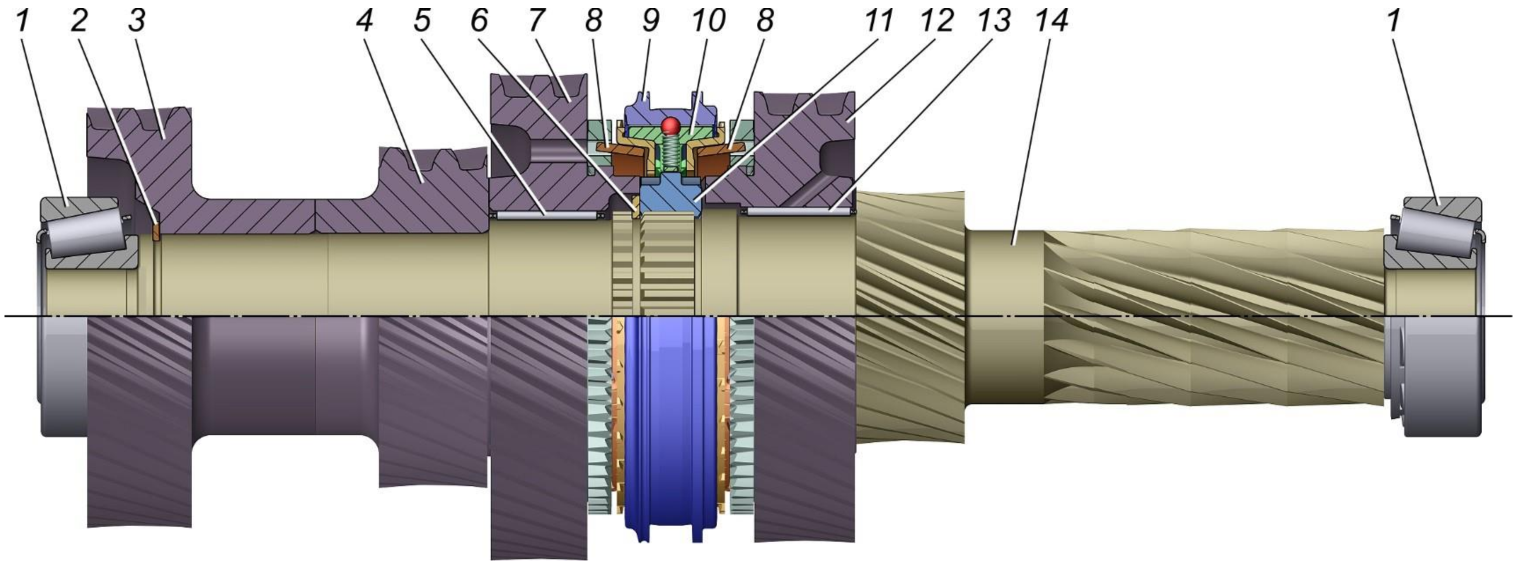


Fig. 3.18. Countershaft assembly: 1 – roller bearing; 2, 6 – retainer rings; 3 – countershaft drive gear; 4 – countershaft 3 speed gear; 5 – needle roller bearing without rings; 7 – countershaft 6 speed gear; 8 – set of 5 and 6 speed gears synchronizer locking rings; 9 – 5 and 6 speed gears synchronizing sleeve 5 and 6; 10 – synchronizer T-block; 11 – 5 and 6 speed gears synchronizer hub; 12 – 5 speed countershaft gear; 13 – split-cage roller needle roller bearing without rings; 14 – countershaft.

Secondary shaft assembly

To assemble the secondary shaft, proceed as follows:

- assemble the hubs with the engagement sleeves, T-blocks and springs (for reverse) of synchronizers according to the instructions above;
- install 1st speed gear thrust washer pin 17 to the secondary shaft 24 (Fig. 3.19);
- install needle bearing 27 in the cage to the second speed gear 10 bore;
- install the 2nd speed gear with needle bearing to the secondary shaft;

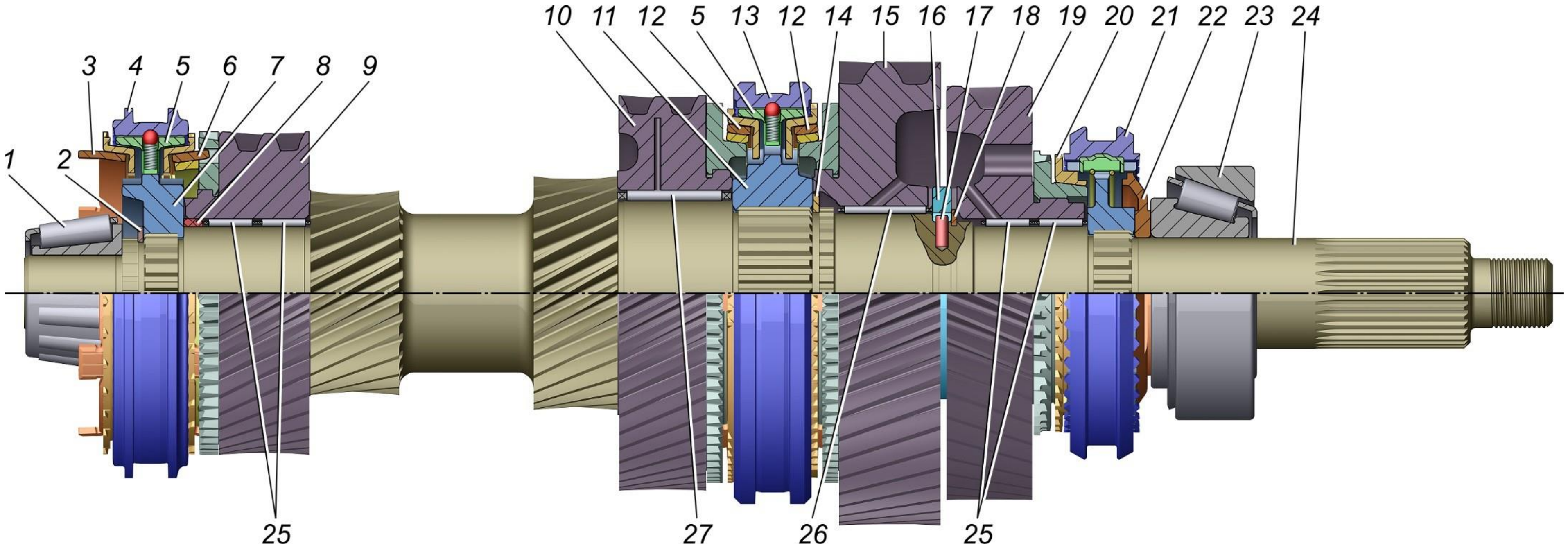


Fig. 3.19. Secondary shaft assembly: 1 – roller taper bearing without outer race; 2, 14, 18 – locking rings; 3 – set of 4th speed gear synchronizer locking rings; 4 – 3rd and 4th speed gears synchronizing sleeve; 5 – synchronizer T-block; 6 – set of 3rd speed gear synchronizer locking rings; 7 – 3rd and 4th speed gears synchronizer hub; 8 – spacer ring; 9 – 3rd speed gear; 10 – 2nd speed gear; 11 – 1st and 2nd speed gears synchronizer hub; 12 – sets of 1st and 2nd speed gear synchronizer locking rings; 13 – 1st and 2nd speed gears synchronizing sleeve; 15 – 1st speed gear; 16, 22 – thrust washers; 17 – pin; 19 – reverse gear; 20 – reverse synchronizer locking ring; 21 – reverse synchronizer; 23 – taper roller bearing; 24 – secondary shaft; 25, 26, 27 – needle roller bearings without rings.

- install set of locking rings 12 and assembled hub 11 with the 1st and 2nd speed gears engagement sleeve 13 and synchronizer T-blocks 5 to the secondary shaft. When installing, make sure that:
    - intermediate ring protrusions enter the 2nd speed gear rim (see Fig. 3.4) grooves;
    - synchronizer inner ring protrusions enter the outer ring face grooves;
    - synchronizer outer ring protrusions enter the hub grooves;
- install retaining ring 14 (see Fig. 3.19);
- install needle bearing 26 in the cage to the first speed gear 15 bore;
- install set of synchronizer rings 12 and 1st speed gear assembled with needle bearing to the secondary shaft. When installing, make sure that:
    - synchronizer outer ring protrusions (see Fig. 3.4) enter the hub grooves;
    - synchronizer inner ring protrusions enter the outer ring face grooves;
    - intermediate ring protrusions enter the 1st speed gear rim grooves;
- install thrust washer 16 (see Fig. 3.19) to the secondary shaft, making sure that the pin installed in the shaft enters the thrust washer groove;
- install the retainer ring 18 to the shaft;
- install pre-lapped synchronizer locking ring 20 to the reverse gear 19 taper;
- install the needle bearings 25 IN cages to the reverse gear bore;
- install reverse gear with needle bearings and synchronizer locking ring to the secondary shaft;
- press hub assembled with reverse synchronizing sleeve 21 to the secondary shaft, making sure that the synchronizer locking ring protrusions at the reverse gear enter the hub grooves;
- install reverse thrust washer 22 to the shaft;
- press taper bearing 23 inner race on the secondary shaft all the way to the washer end face;
- install needle bearings 25 in the cage and spacer ring 8 to the third speed gear 9 bore as shown;
- install 3rd speed gear with needle bearing and spacer ring to the secondary shaft;
- install set of locking rings 6 and hub 7 assembled with the 3rd and 4th speed gears engagement sleeve 4 and synchronizer T-blocks 5 to the secondary shaft. When installing, make sure that:
    - intermediate ring protrusions (see Fig. 3.5) enter the 3rd speed gear rim grooves;

- synchronizer inner ring protrusions enter the outer ring face grooves;
- synchronizer outer ring protrusions enter the hub grooves;

- install a set of locking rings 3 to the secondary shaft (see Fig. 3.19);
- press taper bearing 1 without the outer race on the secondary shaft all the way to the end face.

Gear-shift mechanism assembly

Bolt tightening torques, application of sealant and grease in accordance with the section "General requirements for the assembly of the gearbox".

To assemble the gear-shift mechanism (see Fig. 3.8), follow the procedure below:

- press pin 11 of the 3rd - 4th and 5th - 6th speed gears into the stem 5 keeping the dimension D= $12.5_{-0.1}$mm;
- sequentially install heads and shift yokes to the stem except for the reverse yoke;
- press the pin 11 of the 1st - 2nd gear and reverse gear into the stem keeping the dimension D= $12.5_{-0.1}$mm;
- install reverse shift yoke 15 to the stem;
- install push rods 2, 3 and 6 to the shift yokes aligning the push rod grooves with the stem heads and screw mounting bolts 4 (screws 1);
- install T-blocks 8, 13 and 16 to the shift yokes. The yoke T-blocks have distinctive features (Fig. 3.20):

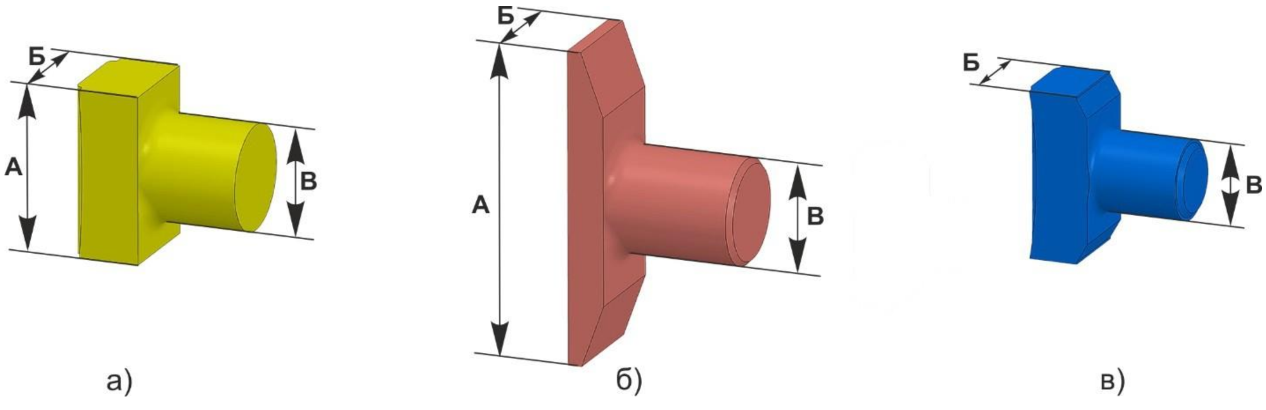


Fig. 3.20. Gear-shift yoke T-blocks: a – 3 and 4, 5 and 6 gear shift yoke T–block; **b** – 1 and 2 gear shift yoke T- block; **c** – reverse gear shift yoke T-block. T-block dimensions:

- 3 - 4, 5 - 6 gear shift yoke: -C=$\Phi 10^{-0.010}_{-0.046}$mm; B=$10.75_{-0.25}$mm; A=16mm
- 1 and 2 speed gear shift yoke: -C= $\Phi 10^{-0.010}_{-0.046}$ mm; B =$10.75_{-0.25}$mm; A=30mm
- reverse gear shift yoke: C= $\Phi 7.5^{-0.010}_{-0.046}$mm; B=$8_{-0.25}$mm

NOTE
The gear-shift mechanism can be assembled with yokes assembled with push rods. In this case, rotate and move stem longitudinally to engage yoke push rod grooves with stem heads.

When assembled, the gear-shift mechanism is movable. When installing it to the gearbox, for assembly convenience, it is allowed to temporarily fasten the pin, head and push rods together with adhesive tape to prevent mutual movement of the mechanism parts.

Control linkage cover assembly

Ball pins swing against the control linkage cover levers shall not be allowed. Where necessary, clinch the pin as shown in Fig. 3.10 (1mm min, Φ8mm min) or install new lever assemblies with pins.

Bolt tightening torques, application of sealant and grease in accordance with the section "General requirements for the assembly of the gearbox".

To **assemble** the control linkage cover, follow the procedure below:

- assemble the selection lever with support: press the bearing 6 (see Fig.3.10) on the bushing 7 keeping the dimension B=0.4-0.6mm and press into the lever body 4 to the stop. Press the second bearing on the bushing and in the body at the same time. Install the selection lever with the bushing in the support 2, tighten the mounting bolt 3. Install the slider 1 on the pin.

The selection lever shall rotate freely around its axis without seizure;

- press the bearings 10 (see Fig. 3.9) into the cover holes using a mandrel and keeping the dimension F=1-2mm;
- press the collar seals 9 into the cover holes without misalignment using a mandrel and keeping the dimension E=2.0-2.2mm from the outer cover face;
- install washer 8, gear engagement lever 7 and washer 6 to the shaft 12 as shown in Fig. 3.9 and fasten with bolt;
- install the shaft assembly with gear engagement lever to the left bearing of the control linkage cover, then install the gear engagement lever 11 to the shaft aligning it as shown in figure, and install it to the right cover bearing by moving the shaft;
- install key 18 to the shaft slot;
- move the gear-shift lever mounted to the shaft over the shaft key with the shaft key previously aligned with the lever slot. Align the mounting bolt holes in the gear-shift lever and shaft, screw in and tighten the mounting tie bolt 19;
- install the selection lever 15 with support to the control linkage cover and fasten with two bolts 16 with washers, making sure that the selection lever slider enters the

groove formed by the washer 8 and engagement lever 7;

- install counterweight 14 to the gear-shift shaft and fasten with a bolt;
- install springs 2 and safety-locks 3 to the control linkage cover. Press in new plugs 1 and pin-stake each plug at two diametrically opposite points (for pin-stake dimensions, see Fig.3.9.).

Gearbox assembly

Bolt tightening torques, application of sealant and grease in accordance with the section "General requirements for the assembly of the gearbox".

To assemble the gearbox, proceed as follows:

- press locating grommets 1 in the rear housing 2 (Fig. 3.21) to the stop;

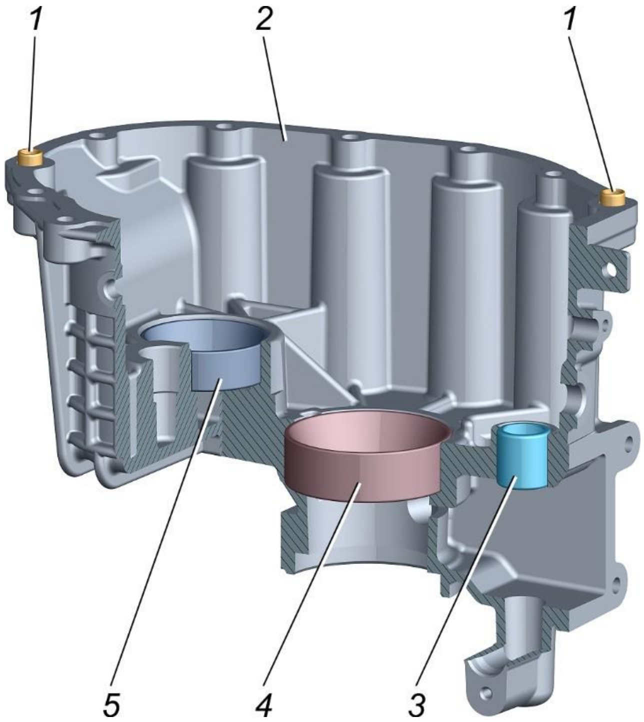


Fig. 3.21. Gearbox rear housing: 1 – locating grommets; 2 – rear gearbox housing; 3 – linear motion ball bearing; 4 – secondary shaft bearing cage; 5 – countershaft bearing cage

- install outer cages 5 and 4 of countershaft and secondary shaft taper bearings to the rear housing all the way to the housing end faces;
- press linear motion ball bearings in the rear and front (see Fig. 3.24) housings flush with the housing boss end faces, as shown;

- vise rear housing gearbox in upright position;
- put gear engagement head 7, speed sensor rotor 9 (if the collar is already pressed into the rear housing), reverse idler gear washer 12 in the rear housing 13 (Fig. 3.22)

with the washer protrusion entering the appropriate housing groove (see Fig.).

When installing, apply grease on the washer 12 surface adjacent to the housing to prevent the washer protrusion disengaging from the housing groove at the gear installation;

- put assembled primary shaft 2 on the assembled secondary shaft 4 tailshaft. Make sure that:
  - the 4th speed gear synchronizer outer ring (see Fig. 3.5) protrusions enter the 3rd and 4th speed gear hub grooves;
  - the intermediate ring protrusions enter the primary shaft gear rim grooves;
- attach assembled countershaft 1 (see Fig. 3.22) to the gear rims of connected primary and secondary shafts. Strap down the resulting package for ease of further installation. Connect the gear-shift mechanism 3 to the secondary shaft and countershaft with the gear-shift yoke T-blocks inserted in the grooves of the corresponding sleeves. Attach reverse idler gear 14 to the secondary shaft and countershaft gear rims;
- insert the resulting package into the rear housing holding the reverse idler gear 12 (it is advisable to carry out this operation by two people). Make sure that the gear-shift mechanism stem enters the gear engagement head 7 hole, the secondary shaft end enters the speed sensor rotor 9 hole, and the reverse idler gear washer tab is still in the housing groove;

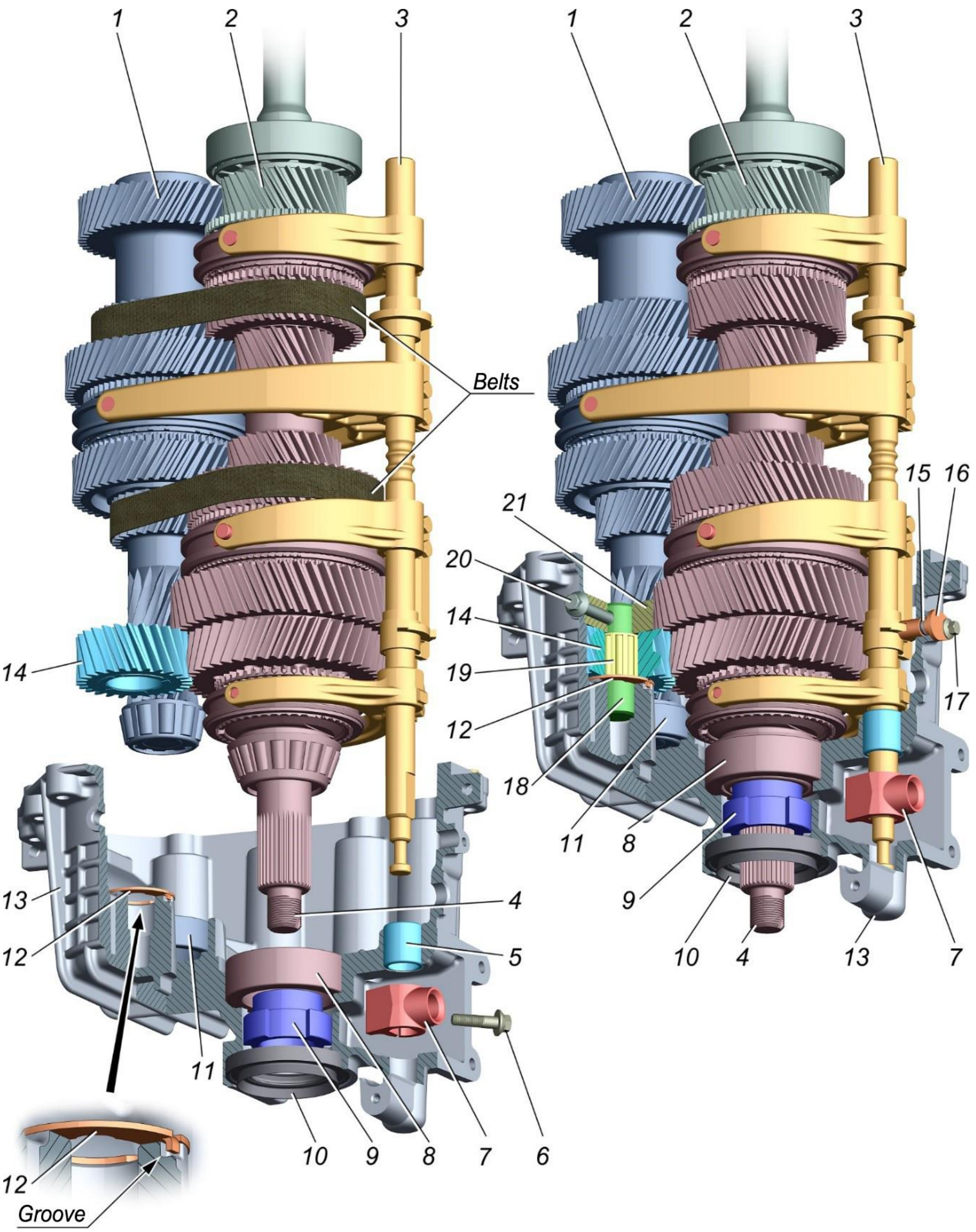


Fig. 3.22. Shafts and gears installation to the rear housing: 1 – countershaft assembly; 2 – primary shaft assembly; 3 – gear-shift mechanism; 4 – secondary shaft assembly; 5 – linear motion ball bearing; 6, 17, 20 – bolts; 7 – gear engagement stem head; 8 – secondary shaft taper bearing outer race; 9 – speed sensor rotor; 10 – collar seal; 11– countershaft taper bearing outer race; 12 – reverse gear thrust washer; 13 – rear gearbox housing, 14 – reverse idler gear; 15 – sealing ring; 16 – stop dog; 18 – reverse idler gear axis; 19 – radial roller bearing without rings; 21 – axis bushing.

- install the needle bearing 19 in the reverse idler gear bore, install reverse idler gear axis 18 and axis bushing 21 to the rear housing and fasten with bolt;
- position the gear engagement head 7 over the stem flats, align the head and stem holes by turning the stem with the head; tighten the head mounting bolt;
- install stop dog 16 with sealing ring 15 to the rear housing making sure that the stop dog groove enters the stem head; fasten the stop dog with bolt;
- screw oil filler plug, oil drain plug and breather in the front housing;
- determine the countershaft bearing adjustment ring 20 thickness (see Fig. 3.3).

Adjustment ring thickness **T** shall be such that the countershaft taper bearing preload of 0.03-0.13mm is provided during assembly. Adjustment ring thickness is determined according to the formula:

$$\mathbf{T=A+H-B,}$$

where A (Fig. 3.23) is actual dimension from the front housing rear mounting face to the front housing bearing seat end face, mm;

H is the countershaft taper bearing preload, 0.03-0.13mm;

B is actual dimension from the rear housing mounting face to the countershaft front bearing outer cage end face (with the countershaft installed in the rear housing), mm.

Adjustment rings of 2.4-3.5mm thick are available divided into 12 groups. In neighboring groups, the ring thickness differs by 0.1mm.

- install the selected adjustment ring 2 (Fig. 3.24) in the front housing socket;
- install the countershaft taper bearing outer cage 3 in the front housing socket;

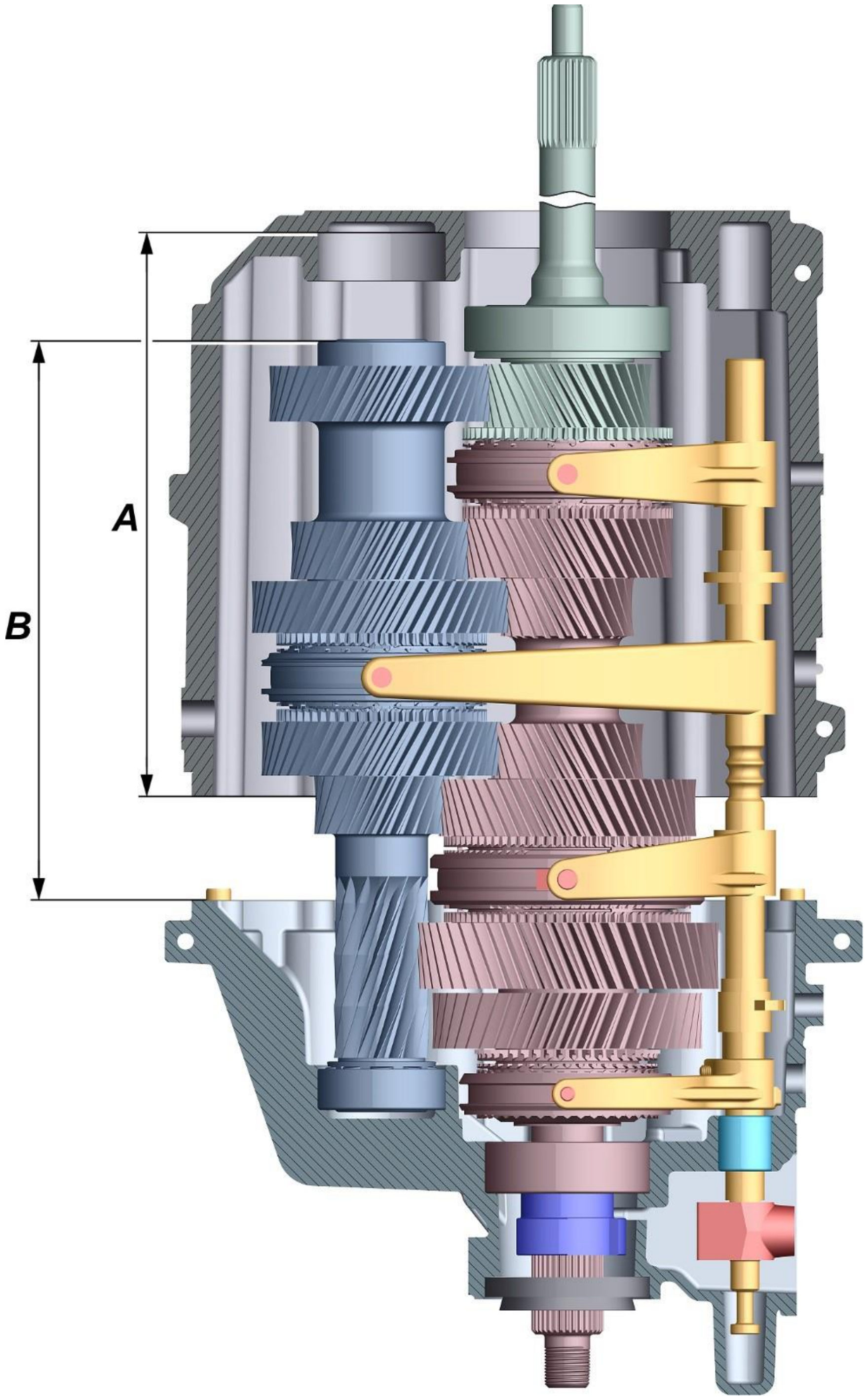


Fig. 3.23. Countershaft bearing adjustment ring thickness determination diagram

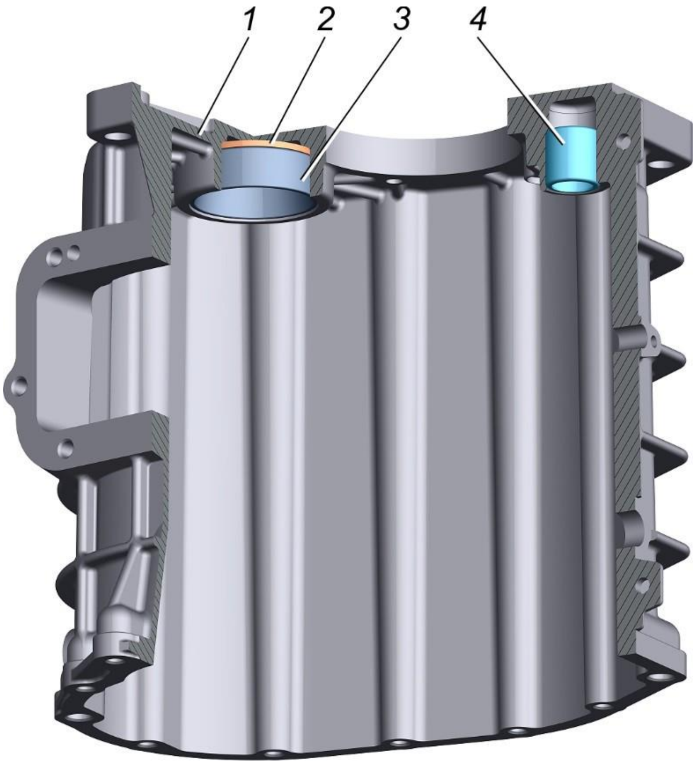


Fig. 3.24. Gearbox front housing: 1 – front gearbox housing; 2 – adjustment ring; 3 – countershaft bearing cage; 4 – linear motion ball bearing

- install the front housing on the primary shaft taper bearing (Fig. 3.25) aligning the rear housing locating grommets 1 (see Fig. 3.21) with the corresponding front housing holes (it is advisable to carry out this operation by two people);

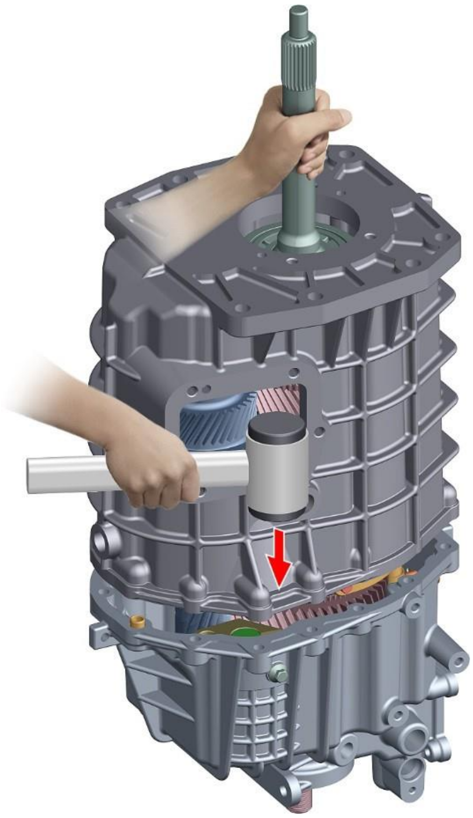


Fig. 3.25. Front housing installation

- install and tighten thirteen bolts 26 (see Fig. 3.3) fastening the front and rear housings;
- install the stop dog 6 with sealing ring to the front housing making sure that the stop dog groove enters the stem head; fasten the stop dog with bolt;
- screw the rod retainer 8 in the front housing;
- screw the reverse light switch 12 in the rear housing;
- install the neutral sensor 33 in the rear housing and fasten with a bolt;
- press the collar 42 in the primary shaft bearing cover to the stop using a mandrel;
- determine the secondary and primary shaft bearing adjustment ring 21 thickness.

Adjustment ring thickness **T** shall be such that the secondary and primary shaft taper bearings preload of 0.03-0.13mm is provided during assembly Adjustment ring thickness is determined according to the formula:

T=A+H-B,

where A (Fig. 3.26) is actual dimension from the mounting face to the end face of bearing socket in the primary shaft bearing cover, mm;

H is the secondary and primary shaft taper bearings preload, 0.03-0.13mm;

B is actual dimension from the front housing mounting face to the primary shaft bearing outer cage end face, mm.

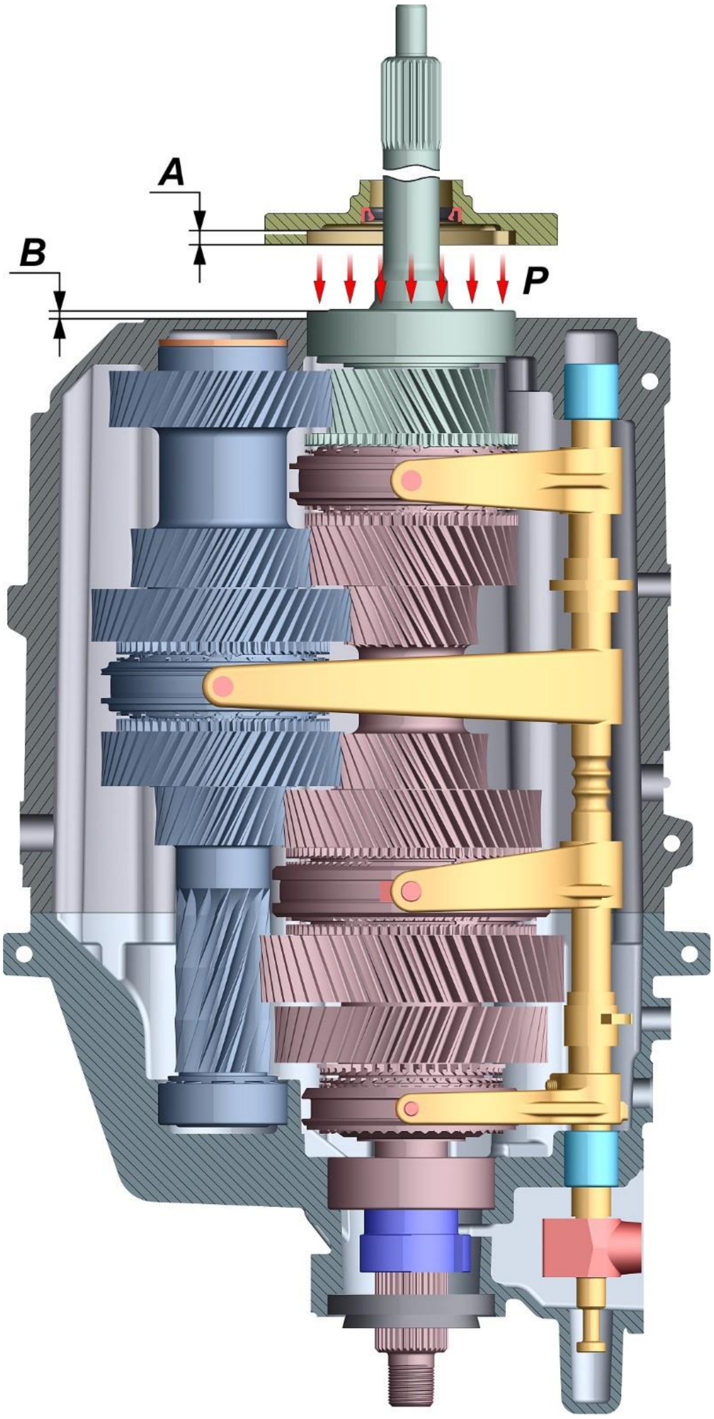


Fig. 3.26. Secondary and primary shaft bearing adjustment ring thickness determination diagram

Prior to parts measurement, rotate the primary shaft (at least 5 revolutions). Measurements shall be performed with load of 10 kgf applied to the primary shaft bearing outer cage end face.

Adjustment rings of 2.2-3.6mm thick are available divided into 15 groups. In neighboring groups, the ring thickness differs by 0.1mm.

- install the selected adjustment ring in the primary shaft bearing cover socket;

- install the assembled primary shaft bearing cover 2 (see Fig. 3.3) and washers, and fasten with four bolts;

- install the speed sensor rotor 17 to the secondary shaft (with the collar seal 16 not yet pressed in the rear housing);

- press the collar seal 16 in the rear housing without misalignment using a mandrel and keeping the dimension of 0.9...1.5mm. Collar face to housing face parallelism tolerance – 0.1mm. Install the secondary shaft collar seal with factory applied lubricant. No dirt getting into the applied lubricant, applied lubricant spreading over the collar surface or applied lubricant removal shall be allowed;

- install the flange on the secondary shaft, screw the flange nut and pin-stake it into the shaft groove as shown in Fig. 3.3;

- screw the pulse sensor 34 in the rear housing;

When assembling, check that there is no axial movement of the countershaft and secondary shaft.

To control the countershaft axial movement, remove the primary shaft bearing cover and cover plate. Enter the indicator in the front gearbox housing drain port located under the primary shaft bearing cover until the indicator rod rests on the countershaft drive gear. Rest on the countershaft through the cover plate. Check the countershaft movement observing the indicator pointer deflection. When the pointer deflects, disassemble the gearbox and re-adjust the countershaft bearings preload. When there is no countershaft movement, install the primary shaft bearing cover and cover plate.

Check the secondary shaft axial movement in the same manner on the secondary shaft flange. Primary shaft starting torque with the lever in neutral position shall not exceed 1 N·m (0.1 kgf·m);

- install the cover plate with gasket and washers to the rear housing, and tighten six mounting bolts;
- install the control linkage cover 13 to the rear gearbox housing;
- screw and tighten four bolts fastening the cover to the gearbox.
- connect the cable bracket to the gearbox. Tightening torque for bolts fastening the cable bracket to the gearbox – 12-18 N·m (1.2-1.8 kgf·m).

Gearbox installation

To install the gearbox, follow the procedure below: Prior to the gearbox installation, apply "Olista Longtime 3EP" or "Castrol Tribol GR 4020/460-2 PD" grease

to the outer and side surfaces of the gearbox primary shaft splines;

- install the gearbox on the clutch housing studs using assembly trolley (hoist) with clutch release sleeve assembled with bearing installed to the gearbox and ensuring that the primary shaft front end enters the flywheel bearing hole, the primary shaft splines enter the clutch driven plate splines, and those of the cover centering surface enter the clutch housing hole. It is recommended to install the gearbox by two people. Prior to installation, it is recommended to engage direct gear in the gearbox to allow the primary shaft rotation by turning the secondary shaft flange, which is required to enter the clutch driven plate splines; then disengage the gear;

- tighten the nuts of the gearbox mounting studs. Remove the assembly trolley (hoist);
- install the cross-member assembly with the rear engine suspension pad to the vehicle, install bolts, washers and tighten the nuts of the bolts fastening the cross-member to the girders.

ATTENTION
Install the cross-member mounting bolts simultaneously on both sides.

- remove the stand from under the clutch housing or engine cylinder block;
- install washers and tighten the nuts of the studs fastening the pad to the gearbox (see "Engine" section, "Engine Suspension" sub-section);

Tightening torque for nuts of the gearbox mounting studs – 49-60 N·m (5.0-6.2 kgf·m), nuts fastening the pads to the cross-member and gearbox and bolts fastening rear engine suspension cross-member to the girders – 31.5-39 N·m (3.2-4.0 kgf·m);

- connect the wiring pin blocks to the reverse light switch, neutral sensor and speed sensor;
- install driveline following the procedure in “Driveline” sub-section;
- install the clutch release yoke making sure that the yoke legs are positioned correctly at the clutch release sleeve flats (see "Clutch" sub-section);
- screw in the clutch release yoke boot frame mounting bolt and tighten with torque of 4-8 N·m (0.4-0.8 kgf·m);
- install the clutch servo cylinder assembled with the bracket to the clutch housing, tighten the bracket mounting bolts with torque of 14-20 N·m (1.4-2.0 kgf·m);
- fix the cables in the gearbox bracket sockets (to click) as shown in Fig. 3.28;
- set the control linkage cover master support lever and the gear engagement lever to the neutral position, connect the cable ends to the spherical pins of the control linkage cover levers with grease previously packed in the cable end spheres, and fasten the cable ends to the cables (see "Installation of master support with cables" sub-section);
- fill oil in the gearbox in accordance with the Vehicle operation manual.

Master support with cables removal and installation

ATTENTION
For additional requirements for cables and master support removal and installation, refer to the supplier's documentation.

ATTENTION
Protect the cable bellow boots and ends from damage.
Do not install cables with damaged cable sheaths or rubber bellows to the vehicle.
Do not rinse or additionally lubricate cables during maintenance and repair.

To **remove the master support with cables**, follow the procedure below:

- remove the cable ends (Fig. 3.28) from the control linkage cover levers ball pins;
- remove the cables from the cable mounting bracket attached to the gearbox by pulling the cable lock bushings off the bracket (first white and then black) and removing the cables from the bracket;
- disconnect the boot frame from the dashboard console;
- disconnect and remove the dashboard console (see "Cabin" section, “Dashboard” sub-section);
- remove the floor mat, unscrew two floor cable gland mounting screws (Fig. 3.27);
- unscrew four bolts fastening the master support to the dashboard bracket and remove the master support by pulling the cables through the floor holes taking care not to damage the bellows;
- remove the cable ends from the master support lever ball pins;
- remove the cables from the master support cable mounting bracket.

Install the master support with cables in the reverse order to removal:

ATTENTION
In case of replacement of the polyamide nuts 6 (Fig. 3.27) fastening the cable gland to the cabin floor, install new nuts as shown.

- fasten the cables in the master support bracket sockets (to click) as shown in Fig. 3.27;

- pack the cable end spheres with the SRI Grease EP2, Ulti-Plex Synthetic Grease EP1.5 (CHEVRON) or Albida EVS grease (Shell), install the cable ends to the master support lever spherical pins;

- insert the cables through the floor holes from the cab, taking care not to damage the bellows;

- install the master support to the dashboard and fasten with four bolts 2 with washers. Bolts tightening torque - 12-18 N·m (1.2-1.8 kgf·m). Prior to tightening the bolts, apply Loctite 243 (Henkel) or Weicon AN 302-43 (Weicon) sealant to the bolt threaded portion.

- install the floor cable gland and fasten with two screws 5. When installing, prevent all cable parts from contact with the floor hole edge.

- install the floor mat;

- secure the cables in the gearbox bracket sockets (to click) as shown (Fig. 3.28);

- set the master support lever to neutral position.

To do this, install the temporary pin ($Ø6^{-0,05}_{-0,1}$ mm, length 120mm) in the master support and master support lever hole A (Fig. 3.28).

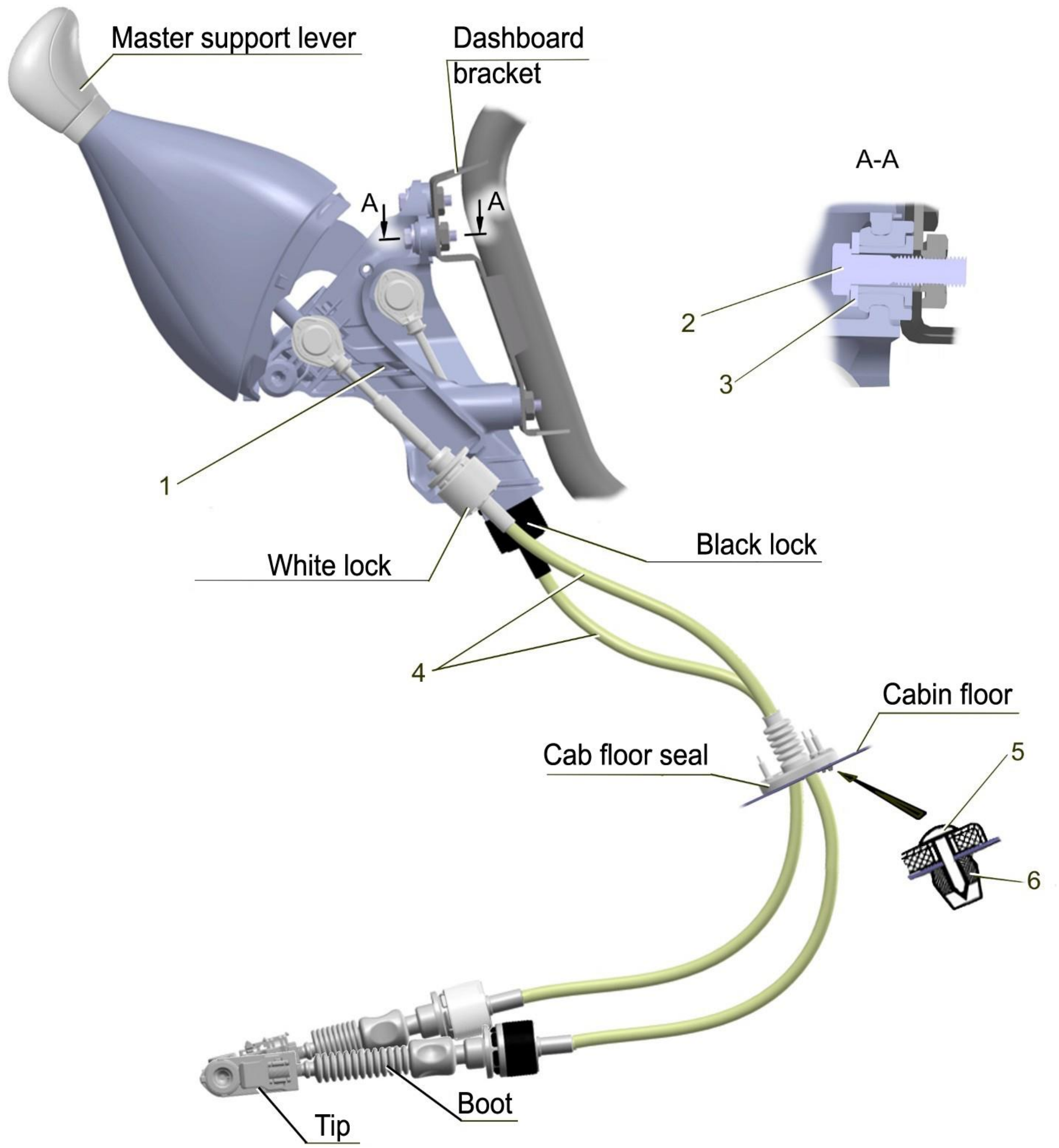


Fig. 3.27. Master support with cables installation: 1– master support; 2– bolts; 3– washers; 4 – cables; 5 – screws; 6 – nuts.

- set the control linkage cover gear engagement lever to neutral position by selecting the middle position of three available ones and shifting gears through the counterweight arms.

The control linkage cover selection lever is set to neutral position by two safety-lock springs.

- put and snap the cable ends on the gearbox lever spherical pins as shown in Fig. 3.28. No levers distortion shall be allowed;

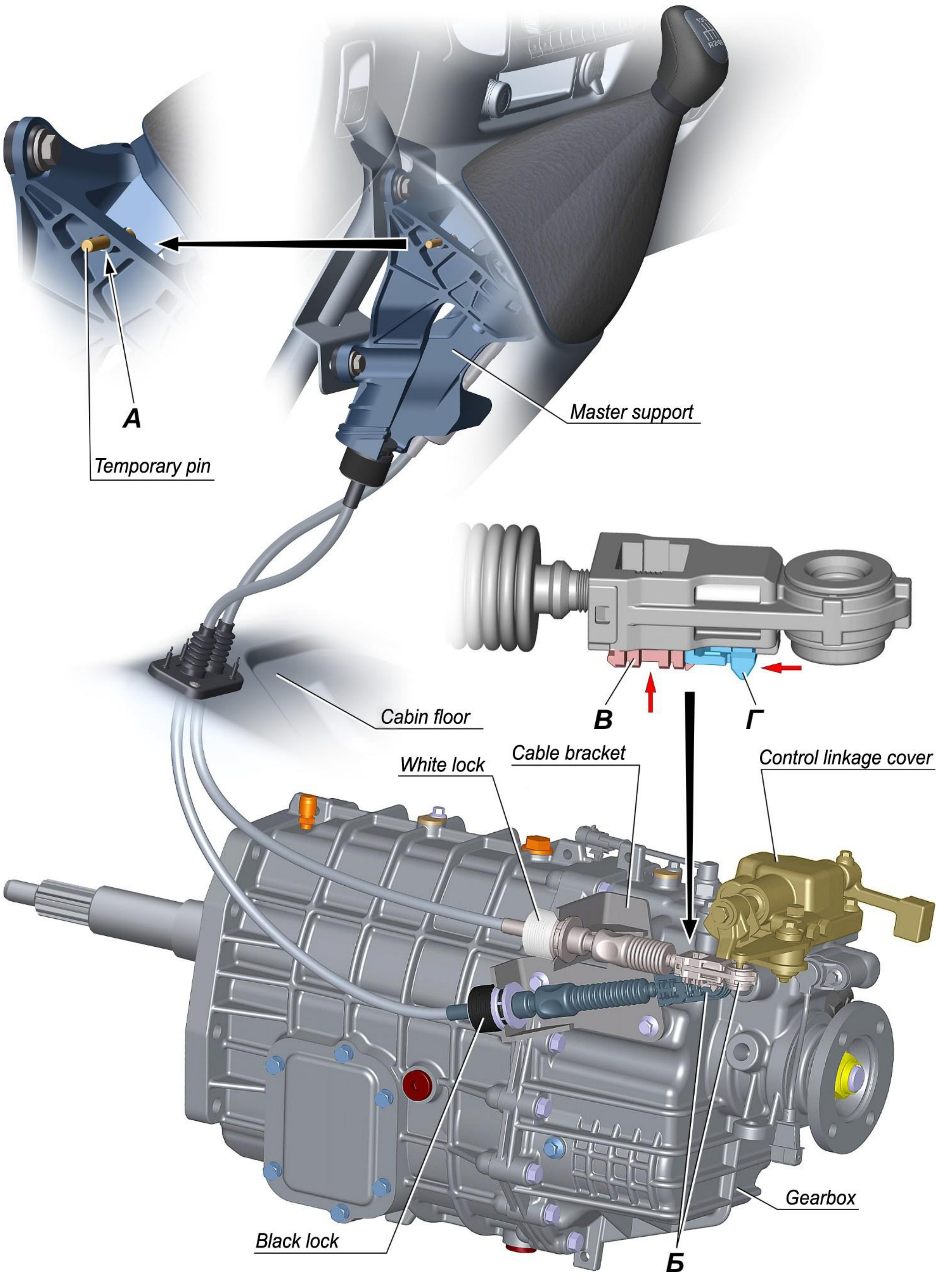


Fig. 3.28. Cables installation

- To secure the ends B to the cables, move the latch G to the right until it stops and fix the cable end with the latch B by moving the latch B in the arrow direction until it stops. Then move latch D in the arrow direction until it stops.

- install and secure dashboard console (see "Cabin" section, "Dashboard" sub-section);

- attach the boot frame to the dashboard console.

Table 3.1

Dimensions of gearbox mating parts, mm

Mating parts	Hole	Shaft	Fit
Front gearbox housing – primary shaft bearing	$Ø100^{+0.035}$	$Ø100_{-0.013}$	$\text{Clearance}^{0,000}_{0.048}$
Rear gearbox housing – secondary shaft bearing	$Ø80^{+0.03}$	$Ø80_{-0.011}$	$\text{Clearance}^{0,000}_{0.041}$
Front gearbox housing – countershaft bearing	$Ø62^{+0.03}$	$Ø62_{-0.011}$	$\text{Clearance}^{0,000}_{0.041}$
Rear gearbox housing – countershaft bearing	$Ø62^{+0.03}$	$Ø62_{-0.011}$	$\text{Clearance}^{0,000}_{0.041}$
Reverse idler gear – reverse idler gear axis + two reverse idler gear bearing rollers	$Ø35^{+0.033}_{+0.020}$	$Ø25_{-0.013}+$ $+2(5_{-0.007})$	Total radial $\text{clearance}^{0.02}_{0.06}$
3rd speed gear, secondary shaft reverse gear – secondary shaft + two bearing rollers	$Ø47^{+0.025}_{+0.009}$	$Ø42^{-0.009}_{-0.025}+$ $+2(2.5_{-0.007})$	Total radial $\text{clearance}^{0.018}_{0.064}$
Countershaft 6th speed gear – countershaft + two bearing rollers Secondary shaft 1st speed gear – secondary shaft + two bearing rollers	$Ø55^{+0.029}_{+0.010}$	$Ø50^{-0.009}_{-0.025}$ $+2(2.5_{-0.007})$	Total radial $\text{clearance}^{0.019}_{0.068}$
Countershaft 5th speed gear – countershaft + two bearing rollers	$Ø57^{+0.029}_{+0.010}$	$Ø52^{-0.009}_{-0.025}$ $+2(2.5_{-0.007})$	Total radial $\text{clearance}^{0.019}_{0.068}$
Secondary shaft 2nd speed gear – secondary shaft + two bearing rollers	$Ø65^{+0.029}_{+0.010}$	$Ø58^{-0.010}_{-0.029}$ $+2(2.5_{-0.007})$	Total radial $\text{clearance}^{0.020}_{0.072}$
Stem yokes and heads – stem	$Ø19^{+0.092}_{+0.040}$	$Ø19_{-0.021}$	$\text{Clearance}^{0.040}_{0.113}$
Engagement head – stem	$15^{+0.05}_{+0.02}$	$15^{-0.006}_{-0.031}$	$\text{Clearance}^{0.026}_{0.081}$

Mating parts	Hole	Shaft	Fit
Pin – stem	$Ø7^{-0.025}_{-0.047}$	$Ø7_{-0.015}$	$\text{Preload}^{0.010}_{0.047}$
Push rod - pin	$5^{+0.24}_{+0.15}$	$Ø5_{-0.018}$	$\text{Clearance}^{0.150}_{0.258}$
Push rod – stem head	$5^{+0.24}_{+0.15}$	$5^{-0.03}_{-0.06}$	$\text{Clearance}^{0.18}_{0.30}$
Stop dog – stem head	$5^{+0.24}_{+0.15}$	$5^{-0.03}_{-0.06}$	$\text{Clearance}^{0.18}_{0.30}$
Engagement head – gear-shift lever	$Ø16^{+0.36}_{+0.12}$	Sphere $16_{-0.1}$	$\text{Clearance}^{0.12}_{0.46}$
Engagement sleeve groove – reverse engagement yoke T-block Engagement sleeve groove – 1st and 2nd gears shift yoke T-block Engagement sleeve grooves –3rd-4th and 5th-6th gear shift yokes T-blocks	$9{,}5^{+0.26}_{-0.13}$ 10.97 ± 0.05 $11^{+0.1}$	$8_{-0.25}$ $10.75_{-0.25}$ $10.75_{-0.25}$	$\text{Clearance}^{2{,}01}_{1.37}$ $\text{Clearance}^{0.17}_{0.52}$ $\text{Clearance}^{0.25}_{0.60}$
Front and rear gearbox housing – stop dogs	$Ø12^{+0.075}_{+0.032}$	$Ø12_{-0.05}$	$\text{Clearance}^{0.032}_{0.125}$
Rear gearbox housing – neutral sensor	$Ø18^{+0.11}$	$Ø17.98_{-0.24}$	$\text{Clearance}^{0.02}_{0.37}$
Primary shaft – bearing	$Ø45_{-0.01}$	$Ø45^{+0.018}_{+0.002}$	$\text{Preload}^{0.002}_{0.028}$
Countershaft - bearing	$Ø25_{-0.008}$	$Ø25^{+0.015}_{+0.002}$	$\text{Preload}^{0.002}_{0.023}$
Secondary shaft – bearing	$Ø35_{-0.010}$	$Ø35^{+0.013}_{+0.002}$	$\text{Preload}^{0.002}_{0.023}$
Countershaft drive gear – countershaft	$Ø43^{+0.014}_{-0.011}$	$Ø43^{+0.076}_{+0.060}$	$\text{Preload}^{0.046}_{0.087}$
Countershaft 3rd speed gear – countershaft	$Ø43.5^{+0.014}_{-0.011}$	$Ø43.5^{+0.076}_{+0.060}$	$\text{Preload}^{0.046}_{0.087}$
Gearbox rear housing – reverse idler gear axis	$Ø25^{+0.041}_{+0.020}$	$Ø25_{-0.013}$	$\text{Clearance}^{0{,}020}_{0.054}$
Axis bushing – reverse idler gear axis	$Ø25^{+0.027}$	$Ø25_{-0.013}$	$\text{Clearance}^{0{,}00}_{0.04}$

Control linkage cover mating parts dimensions

Mating parts	Hole	Shaft	Fit
Gear-shift shaft – key	$6^{+0.05}$	$6_{-0.03}$	Clearance$^{0.00}_{0.08}$
Gear-shift lever – key	$6^{+0.065}_{+0,015}$	$6_{-0.03}$	Clearance$^{0.015}_{0.095}$
Gear-shift shaft – gear-shift lever	$\text{Ø}15^{+0.040}_{+0.016}$	$\text{Ø}15_{-0.011}$	Clearance$^{0.016}_{0.051}$
Gear-shift shaft – gear engagement lever	$12^{+0.03}$	$12^{-0.006}_{-0.017}$	Clearance$^{0.006}_{0.047}$
Selection lever – gear engagement lever	$14^{+0.085}_{+0.032}$	$14_{-0.11}$	Clearance$^{0.032}_{0.195}$
Ball pin – selection and engagement levers	$\text{Ø}6^{+0.1}$	$\text{Ø}6^{+0.03}_{-0.03}$	Clearance 0.13 Preload 0.03
Bearing – support bushing	$\text{Ø}12_{-0.007}$	$\text{Ø}12^{+0.012}_{+0.001}$	Preload$^{0.001}_{0.019}$
Bearing – selection lever	$\text{Ø}21^{+0.021}$	$\text{Ø}21_{-0.008}$	Clearance$^{0.000}_{0.029}$
Selection lever ball bearings	–	–	Radial clearance 0.003 – 0.018

3.3. Driveline

The driveline (Fig. 3.29) consists of countershaft and rear shaft with noise-absorbing inserts, with three U-joints and intermediate support. The rear shaft has a movable splined joint. To maintain the mutual position of splined parts, the brackets J (transport retainer mounts) shall be opposite each other (position deviation ±3°). The front and rear joint flanges are fastened to the gearbox and rear axle flanges with four bolts and nuts.

The intermediate support is attached to the frame cross-member.

Driveline dimensions are shown in Table 3.2.

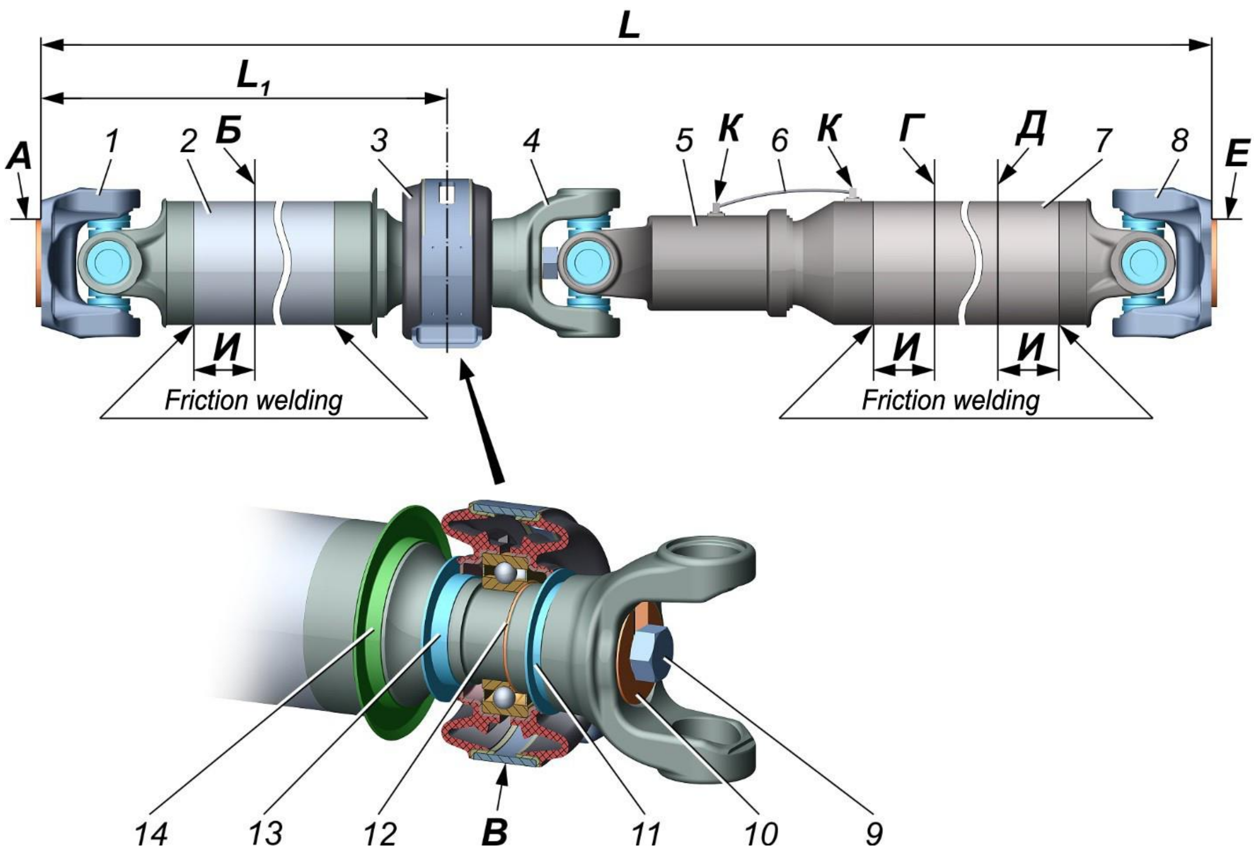


Fig. 3.29. Driveline: A, C, F – balancing bases; B, D, E – balancing planes; I=76.2 mm; 1,8 – flanges; 2 – countershaft; 3 – intermediate support; 4 – splined yoke; 5 – sliding yoke; 6 – transport retainer; 7 – rear shaft; 9 – bolt; 10 – U-washer; 11, 12, 13 – deflectors, 14 – washer.

Table 3.2

Driveline dimensions
WITH free-sliding splines compressed

Driveline designation	L, mm	L_1, mm
C41R92.2200010 (TW.97135.47.02) (3745mm vehicle wheelbase)	2657±3	1362±1.5
A21R32.2200010-60 (TW.97135.65.02) (3745mm vehicle wheelbase)	2667±3	1362±1.5
A21R22.2200010-60 (TW.97135.66.02) (3145mm vehicle wheelbase)	2069±3	764±1.5
C45R02.2200010-20 (TW.97135.59.02) (3950mm vehicle wheelbase)	2860±3	1362±1.5

Driveline technical data

U-joint torque
(rotation shall be
smooth without jamming) ....0.6-1.5 N·m (0.06-0.15 kgf·m)

Shaft tube runout, max. 0.5mm

Driveline maintenance

Driveline maintenance consists in fasteners inspection and, where necessary, tightening of the nuts fastening propeller shaft flanges to gearbox and rear axle flanges, and nuts fastening intermediate support to body cross-member to the specified torque.

Joints, intermediate support bearing and sliding splined joint are lubricated with grease during assembly and shall not be lubricated during operation.

Potential driveline faults and remedies

Fault cause	Remedy
Driveline knock at sudden vehicle movement changes or when shifting gears000	
Worn bearings, cross-piece studs or splined joint Loosened driveline fasteners	Replace driveline Tighten the fasteners

Fault cause	Remedy
Driveline vibration	
Lost balancing plate	Perform driveline dynamic balancing
Loosened intermediate support attachment to the frame cross-member	Tighten the attachment
Nicked or dirty centering faces (groove, shoulder) or flange faces of driveline, gearbox and rear axle drive gear. Gap in flanges contact	Eliminate faults and dirt or replace defective parts of the rear axle, gearbox or driveline.
Worn splined joint of the rear propeller shaft	Replace driveline
Loosened fit, or exposed reinforcement of intermediate support bracket rubber member. Rotated of broken rubber member. Broken intermediate support bearing	Replace intermediate support
Excessive driveline unbalance	Balance the driveline
Either joint is worn or broken	Replace driveline
Bent or buckled propeller shaft tube	Replace driveline
Loosened driveline flanges attachment	Tighten the attachment
Loosened splined yoke mounting bolt	Tighten the mounting bolt to the required torque
Increased driveline noise	
Very tight rotation, seizure or clicks during joint operation (rotation)	Replace driveline
Worn support bearings	Replace intermediate support
Loosened fit of the intermediate support deflectors	Replace the deflectors. Where necessary, replace the intermediate support

Driveline repair

Intermediate support replacement shall be allowed provided that the driveline is repaired at a specialized maintenance station.

When no transmission vibrations occur in riding, and the driveline does not require repair (driveline is removed from the vehicle to repair other vehicle components), then install the driveline maintaining its original angular position relative to the gearbox flanges and the rear axle drive gear. To do this, apply marks on the propeller shaft, gearbox and rear axle flanges. Use of paint or damage to flange mounting surfaces shall not be allowed.

Driveline removal from vehicle

To remove the driveline, proceed as follows:

- unscrew nuts 8 (Fig. 3.30) of bolts fastening the intermediate support to the frame cross-member 2;

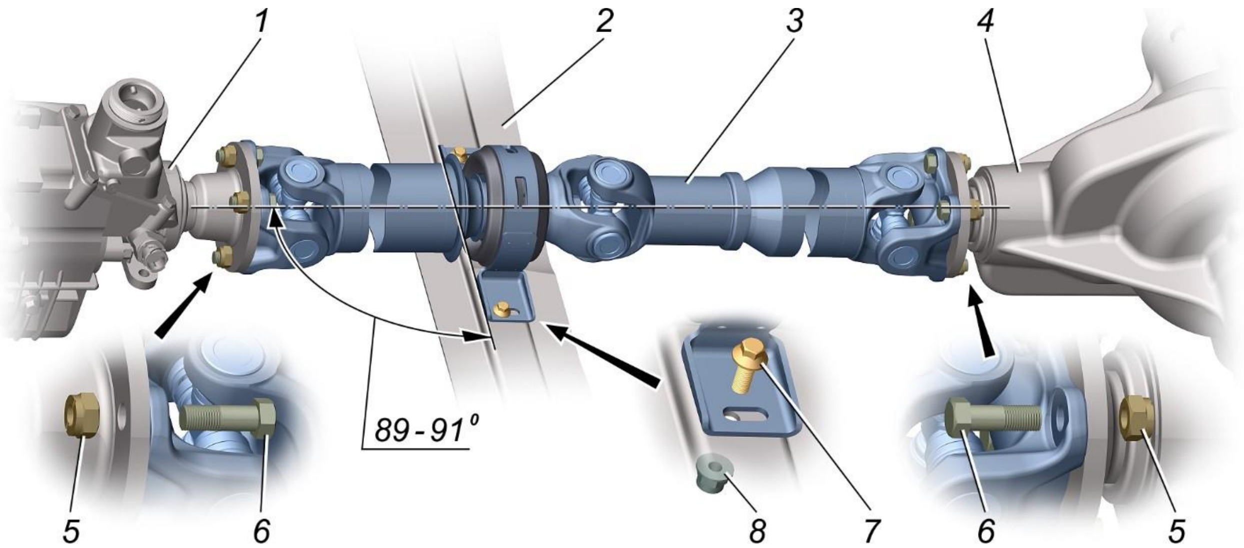


Fig. 3.30. Driveline installation: 1 – gearbox; 2 – frame cross–member; 3 – driveline; 4 – rear axle; 6, 7 – bolts; 5, 8 – nuts

- unscrew nuts of bolts fastening driveline flange connections to gearbox and rear axle with marks previously applied on the flanges to maintain their mutual position;
- disconnect driveline and rear axle flanges by pushing the rear shaft splined part into the splined yoke;
- fix the sliding splined joint by tying the propeller shaft with wire through the brackets J (see Fig. 3.29);
- slide the driveline back down to separate the driveline and gearbox flanges, and remove it from the vehicle.

Intermediate support replacement

To replace the intermediate support, the driveline shall be removed from the vehicle.

The intermediate support shall be replaced in accordance with the supplier's documentation.

When replacing the intermediate support, all parts included in the repair kit CB.04022.09.99 shall be replaced at the same time (for the repair kit composition, see supplier's documentation).

Driveline balancing

To restore balance, driveline balancing is required. Driveline dynamic balancing shall be carried out at the special-purpose rig. Permissible unbalance values - maximum 20 g·cm in each balancing plane at a speed of 5000 min^{-1} based on the A, C and F surfaces (see Fig. 3.29). The number of plates in each balancing plane shall not exceed three ones.

Driveline installation to vehicle

Prior to installation, make sure that the driveline, gearbox and rear axle seating surfaces are free of dirt.

To install driveline, follow the procedure below:

- install the driveline to the frame cross-member, align marks and attach the front joint flange to the gearbox flange; tighten the mounting bolt nuts to the torque of 49-61 N·m (5.0-6.2 kgf·m);
- remove transport retainer;
- align the marks and connect the rear joint flange to the rear axle drive gear flange, tighten the mounting bolt nuts to the torque of 49-61 N·m (5.0-6.2 kgf·m) (for C41R92.2200010 driveline) or 29.4-36.3 N·m (3.0-3.6 kgf·m) (for A21R32.2200010-60 driveline);
- attach the intermediate support to the frame cross-member maintaining the angle 89-91° (see Fig. 3.49) and tighten mounting bolt nuts to the torque of 28-36 N·m (2.8-3.6 kgf·m). 89 -91° angle shall be provided by the tool.

The driveline mating parts dimensions are given in Table 3.3.

Table 3.3.

Dimensions of driveline mating parts, mm

Mating parts	Hole	Shaft	Fit
For C41R92.2200010 driveline			
Driveline flange pilot fillet – gearbox and rear axle flanges	Ø$69.85^{+0.030}$	Ø$69.85_{-0.05}$	Clearance$^{0.000}_{0.080}$
For A21R32.2200010-60 driveline			
Driveline flange pilot fillet – gearbox flange	Ø$69.85^{+0.030}$	Ø$69.85_{-0.05}$	Clearance$^{0.000}_{0.080}$
Driveline flange pilot fillet – rear axle flange	Ø$60^{+0.030}$	Ø$60_{-0.05}$	Clearance$^{0.000}_{0.08}$

3.4. Rear axle

3.4.1. Rear axle (gross vehicle weight up to 3.5 tons)

The vehicle is equipped with a non-demountable rear axle with hypoid final drive (Fig. 3.31).

The final drive and differential are installed in the axle housing cavity and closed with a cover after adjustment.

Rear axle housing consists of a cast reduction case made of high-strength cast iron with pressed and welded steel axle casings. Spring pads, shock absorber brackets and trunnions with flanges for hubs and disk brakes installation are welded to the axle casings.

The rear axle reduction part structure is shown in Fig. 3.32.

Drive and driven gears of the final drive are paired based on contact and noise, numbered with the same serial number, so in case of either gear damage, these shall be replaced as a set.

Spacer bushing located between inner races of the drive gear bearings is deformed as the drive gear nut is tightened, thus providing bearings preload. Adjustment ring 8 is installed between the drive gear end face and the inner bearing; correct drive gear position relative to the driven gear is defined through the ring thickness selection.

Differential assembled with taper bearings is installed in the rear axle housing sockets closed with bolted covers.

The vehicles can be equipped with rear axles with non-locking dismountable differential or with locking differential.

Final drive gears backlash and differential bearings preload are adjusted by nuts 10 (Fig. 3.32). Nuts are locked with retainer plates 15. Pinion gears and side gears are enclosed in the differential housing consisting of left and right cases bolted together. Support washers are installed Under the pinion gears and side gears. The cross-piece where the pinion gears are mounted is composed of two axes.

The driven gear is mounted to the differential case and bolted.

To prevent pressure build-up inside the axle, breather 5 is installed on the top of left axle casing (see Fig. 3.31).

The rear axle hub part structure is shown in Figure 3.33.

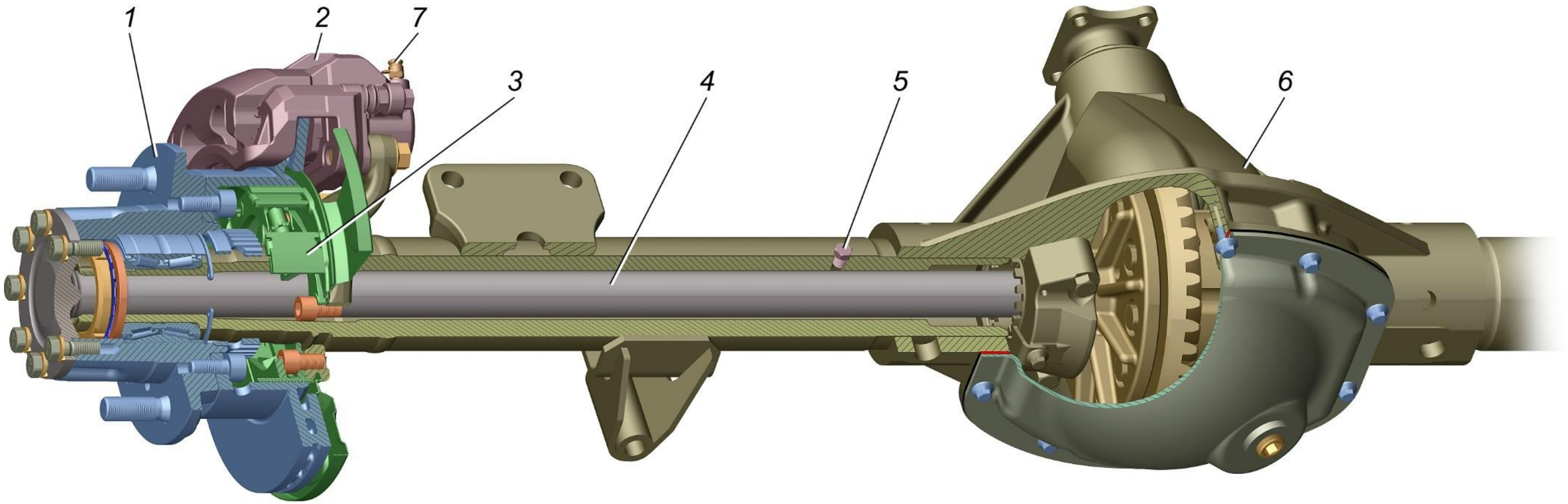


Fig. 3.31. Rear axle: 1 – rear axle hub with brake disk and bearing; 2 – left disk brake; 3 – left parking brake; 4 – rear axle shaft; 5 – breather; 6 – rear axle reduction gear with axle casings; 7 – bleeding valve.

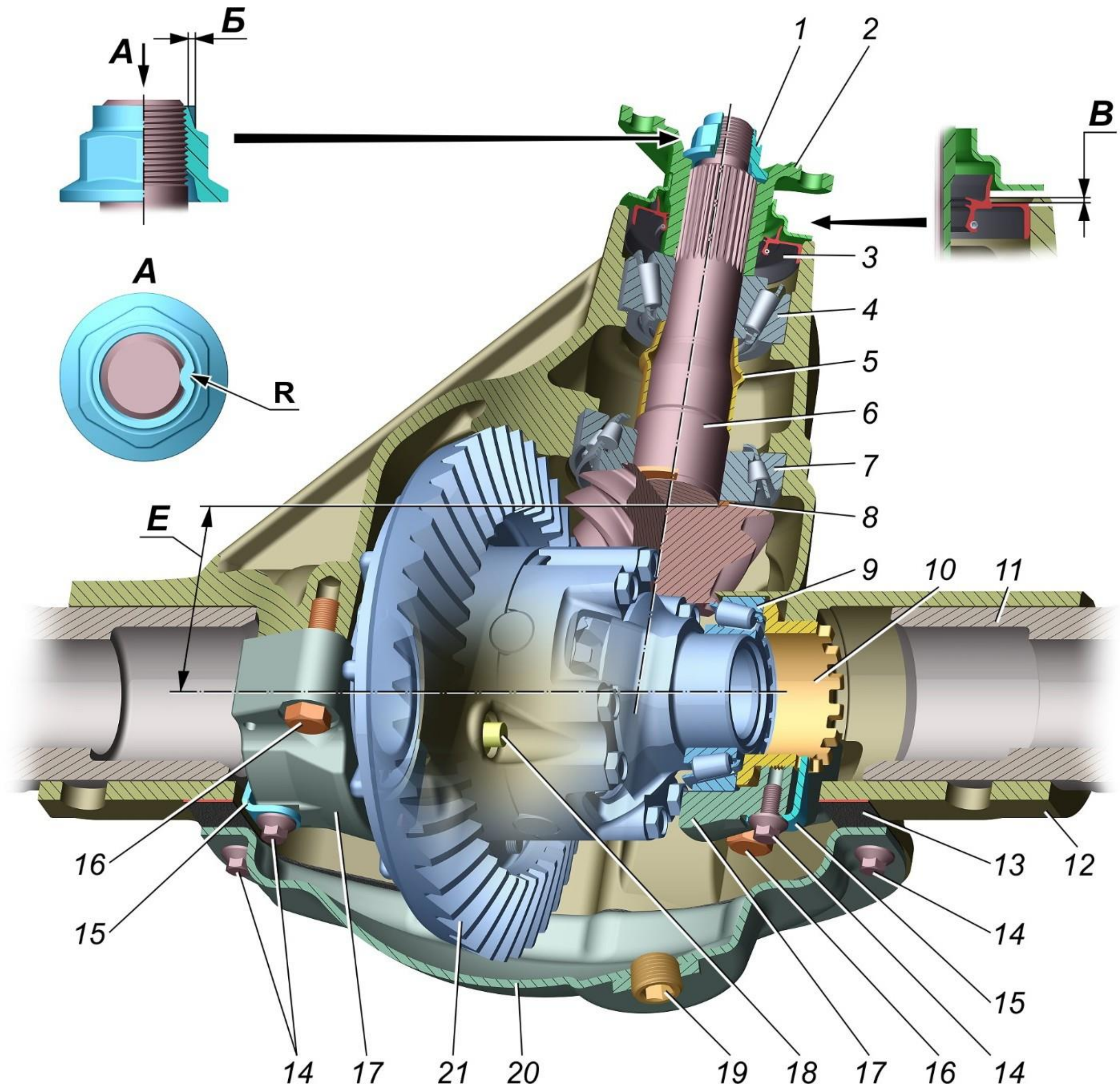


Fig. 3.32. Rear axle reduction gear with axle casings: B=0.8 mm, min.; C=0.9-1.5mm; R = 1.2mm, min.; 1 – nut; 2 – drive gear flange; 3 – collar seal; 4, 7, 9 – bearings; 5 – spacer bushing; 6 – drive gear; 8 – adjustment ring; 10 – differential bearing nut; 11 – axle casing; 12 – rear axle housing; 13 – gasket; 14, 16 – bolts; 15 – retainer plate; 17 – differential bearing cover; 18 – oil drain magnetic plug; 19 – oil fill plug; 20 – housing cover; 21 – differential with driven gear.

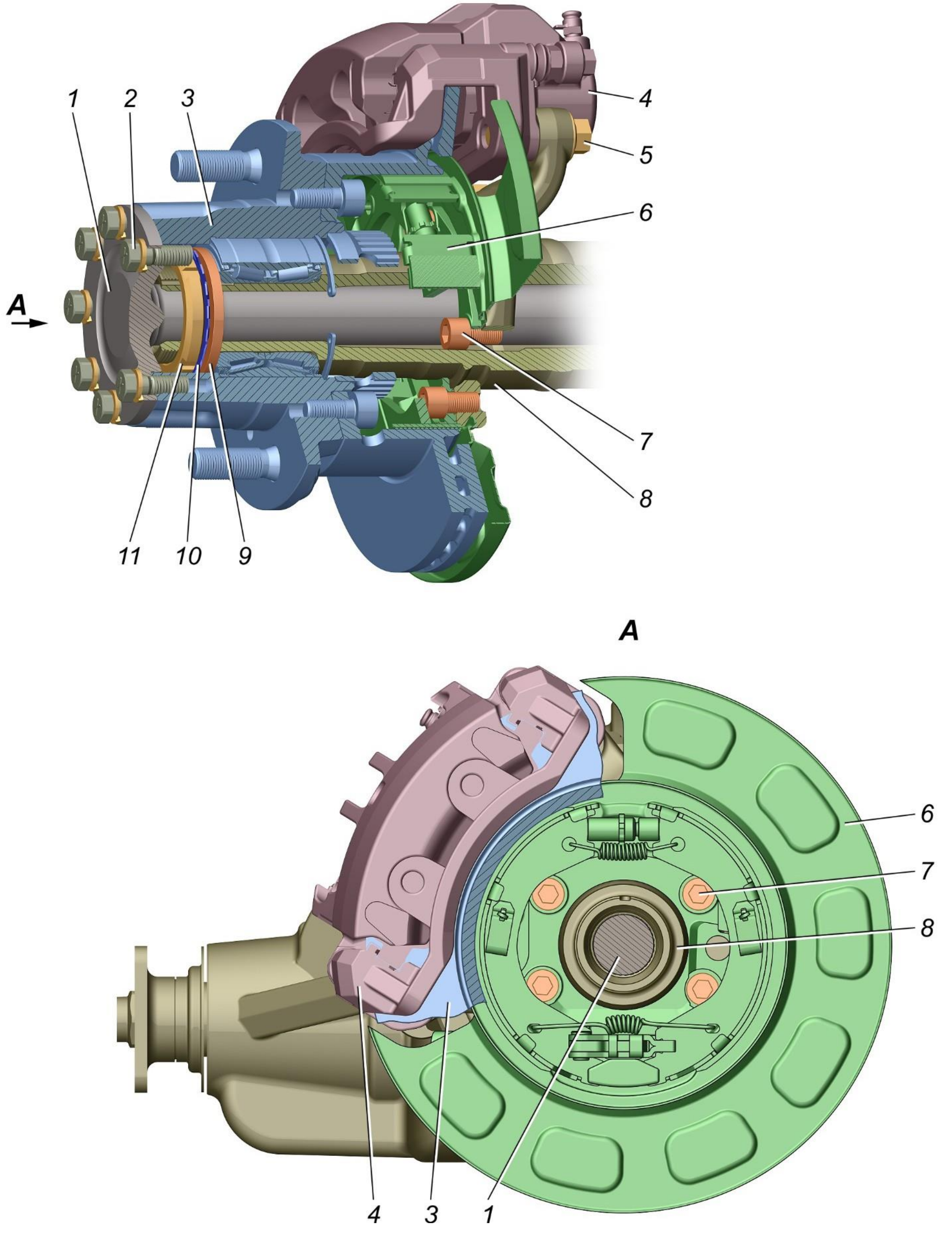


Fig. 3.33. Rear axle (hub part) 1 – rear axle shaft; 2, 5 – bolts; 3 – rear wheel hub with brake disk and bearing; 4 – disk brake; 6 – parking brake; 7 – screws; 8 – axle casing; 9 – thrust washer; 10 – lock washer; 11 – slotted nut.

Axle shafts 1 are installed in the splined bores of the side gears with flanges attached to the wheel hub 3 with bolts 2.

Rear wheel hubs 1 (Fig. 3.34) rotate on double-row taper roller bearings 3 mounted on the axle trunnions. Non-adjustable and maintenance-free double-row taper roller bearing is sealed on both sides: collar seal is installed on one bearing side, and cassette is installed on the other side.

The bearing is pressed with the outer ring in the hub and locked against axial movement with retaining ring 7, while the inner rings are freely mounted on the trunnion.

ATTENTION
When pressing the bearing in, the collar seal shall face the outside of the hub as shown in figure.

The bearing is packed with grease, so no grease filling or replacement is required during operation.

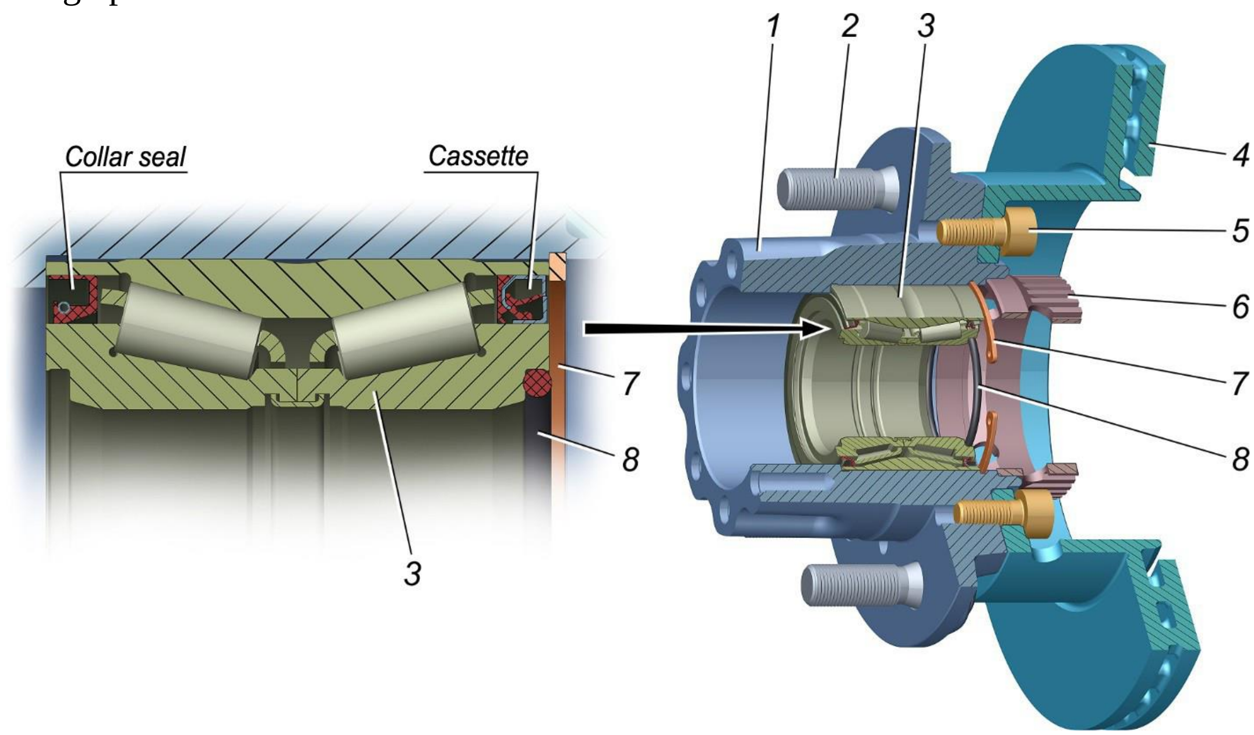


Fig. 3.34. Rear wheel hub with brake disk and bearing: 1 – rear wheel hub; 2 – wheel hub bolt; 3 – double–row taper roller bearing; 4 – brake disk; 5 – screw; 6 – rear ABS rotor; 7 – retaining ring; 8 – sealing ring.

Six wheel mounting bolts 2 are pressed in the hub flange holes. The bolt seating surface is spline-rolled.

The hub 3 (see Fig. 3.33) is fastened with thrust washer 9 and slotted nut 11 screwed onto the threaded trunnion end. The slotted nut is locked by bending the washer 10 tab.

On the inside of the hub, bearing to axle trunnion connection is sealed with a rubber ring 8 (see Fig. 3.54) preventing the grease expelling from the hub.

Brake disks 4 are attached to the rear hubs with screws 5 locked with sealant.

Disk brakes (left and right) of the service brake system are attached to the flanges welded to the axle housing trunnions with flange bolts 5 (see Fig. 3.33). Disk brake mounting bolts are locked with sealant.

Drum-type parking shoe brakes 6 are built in the rear wheel brake disks. The disk surface acts as the parking brake drum.

The parking shoe brakes (right and left) are attached to the welded housing flanges with screws 7. Parking brake mounting screws are locked with sealant.

ABS speed sensor is installed in the parking brake base hole and secured with a screw. ABS rotor 6 (see Fig. 3.34) is pressed onto the wheel hub from the inside.

Structural features of rear axle with locking differential

Some vehicles may be equipped with a locking differential (Fig. 3.35, 3.36) with electric locking control. The differential lock is activated through the dashboard switch with the dashboard indicator lighting up. When the switch is pressed again, or the vehicle reaches a speed of 30 km/h, the differential lock is disabled, and the dashboard indicator light goes out.

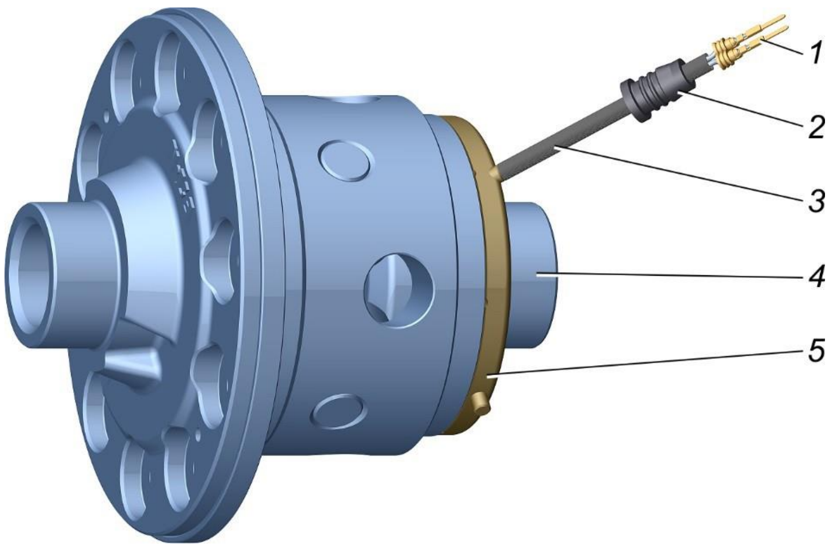


Fig. 3.35. Locking differential with electric locking control: 1 – wiring harness contacts; 2 – wiring harness seal; 3 – differential solenoid wiring harness; 4 – differential; 5 – solenoid

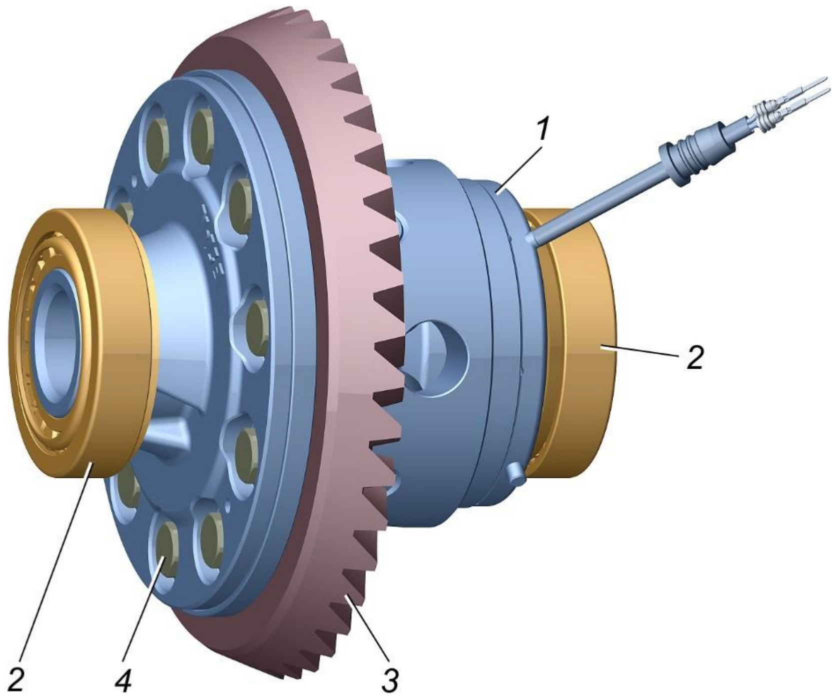


Fig. 3.36. Locking differential complete with bearings and driven gear of the final drive: 1 – differential; 2 – bearings; 3 – driven gear; 4 – bolt

When the lock is actuated, voltage is applied to the differential solenoid electrical contacts, and the clutch installed inside the differential connects rigidly the differential body and the left side gear allowing rigid connection of the rear axle left and right wheels with total engine torque transferring to these.

When the differential 23 (Fig. 3.37) rotates, solenoid located on the differential body remains stationary due to the use of a retainer plate 21 bolted to the right differential bearing cover, which holds solenoid cage pin 18 in the groove.

The differential solenoid wiring harness 5 (Fig. 3.38) is led through an additional hole in the reduction case and connected to the vehicle harness through the terminal strips. Rubber seal is installed in the hole to protect the axle cavity from water and dirt. The bracket 1 is used to attach electromagnet harness terminal strip is to the axle housing.

The locking differential is non-repairable; in case of failure, replace it with a new one.

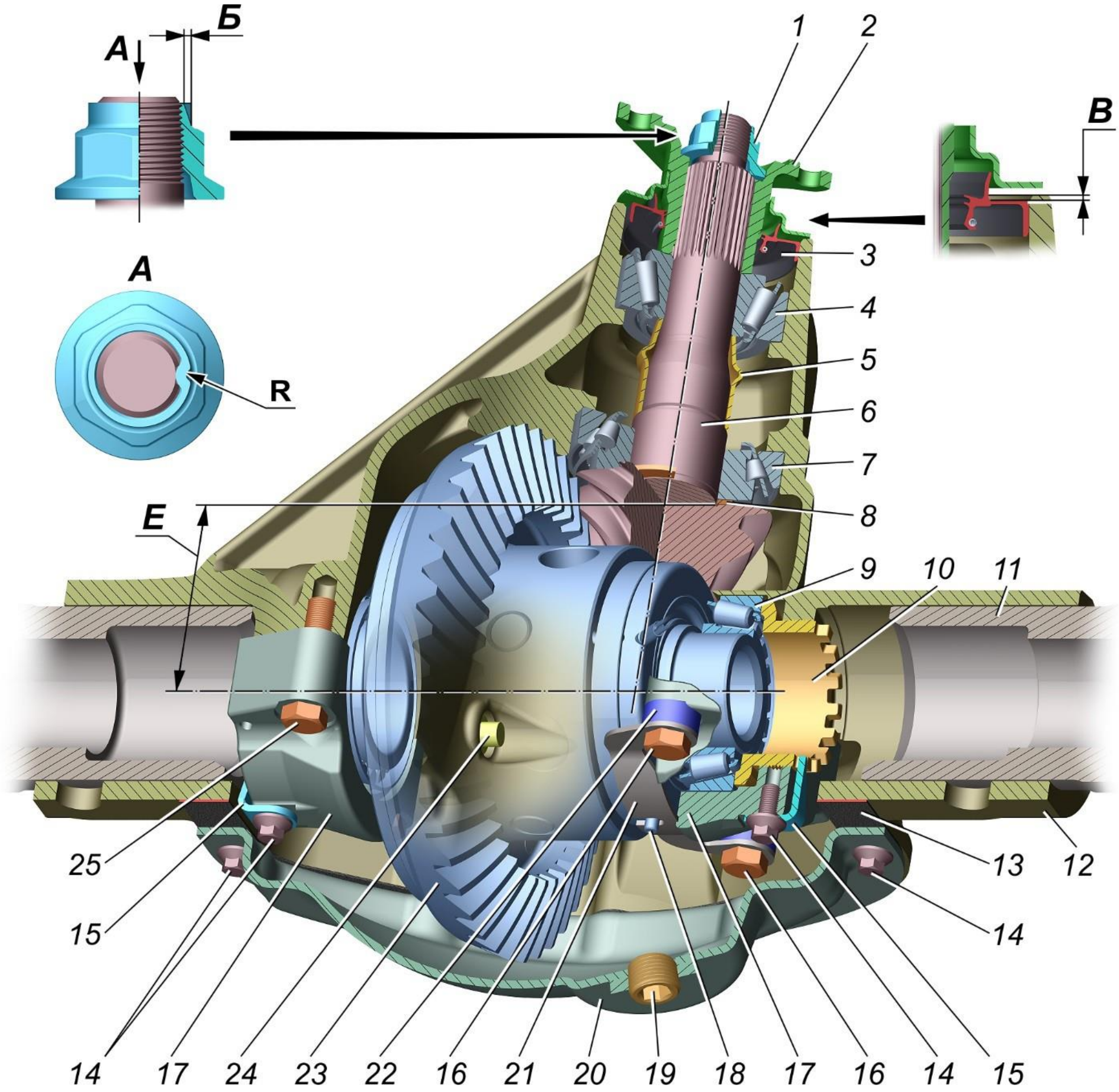


Fig. 3.37. Reduction gear of rear axle with locking differential: B=0.8 mm, min.; C=0.9-1.5 mm; R = 1.2 mm, min.; 1 – nut; 2 – drive gear flange; 3 – collar seal; 4, 7, 9 – bearings; 5 – spacer bushing; 6 – drive gear; 8 – adjustment ring; 10 – differential bearing nut; 11 – axle housing; 12 – rear axle housing; 13 – gasket; 14, 16, 25 – bolts; 15 – retainer plate; 17 – differential bearing cover; 18 – electromagnet cage pin; 19 – oil filler plug; 20 – housing cover; 21 – retainer plate; 22 – washer; 23 – locking differential with driven gear; 24 – magnetic plug.

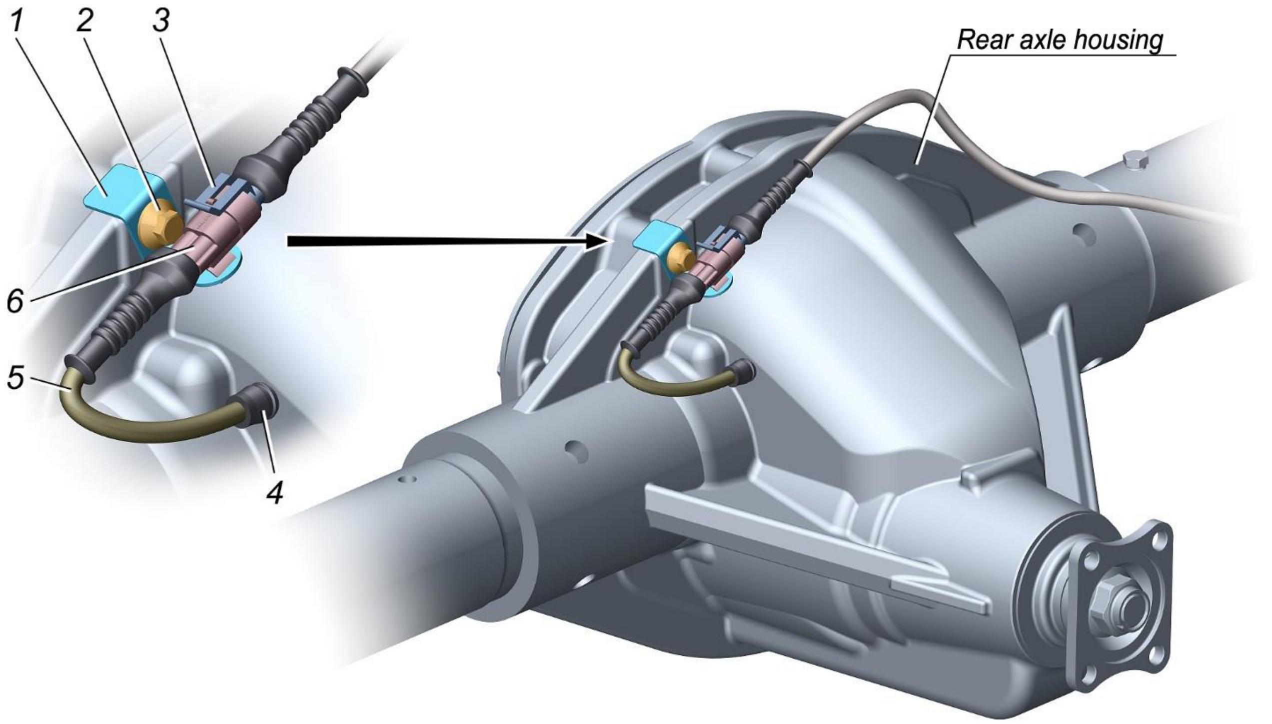


Fig. 3.38. Differential control wiring harness terminal attachment: 1 – bracket; 2 – bolt; 3 – car wiring harness receptacle; 4 – wiring harness seal; 5 – differential solenoid harness; 6 – pin shoe

Rear axle maintenance

During operation:

- check for oil leakage through final drive gear collar seal and wheel hub bearing seals, gearbox housing cover gaskets and axle shaft flanges, fill and drain plugs. Sweating at these areas is not a sign of leaking, when there is no dripping;
- clean the rear axle breather from dirt;
- check the axle housing oil level; fill the oil as necessary, change the oil according to the Vehicle operation manual;
- check axle shaft mounting bolts tightness.

Final drive bearings, backlash and final drive tooth bearing position are factory-adjusted; generally, adjustment is not required during operation. Adjustment is only required after the axle reassembly and parts replacement, or when the bearings are heavily worn. Do not reduce final drive gear backlash increased due to teeth wear by adjustment, as this will result in mesh failure causing increase in rear axle noise or teeth breakage. The taper bearing play shall be eliminated without disturbing the mutual position of the driven and driving gears.

To adjust the drive gear and differential bearing preload, backlash and tooth-contact pattern, disconnected propeller shaft, remove the axle shafts, remove the rear housing cover and perform necessary operations through the open hatch as outlined in the "Rear axle repair” subsection.

To assess the technical condition of rear axle reduction gear parts without disassembling, measure the total axle play.

Total axle play measurement

To measure the rear axle drive gear flange total play, proceed as follows:

- Place chocks under the vehicle rear wheels;
- disengage speed gear and brake the vehicle with parking brake;
- turn the propeller shaft by hand until effort is felt;
- apply marks (lines) on the flange deflector and reduction case (marks shall be aligned);
- turn the propeller shaft in the opposite direction by hand until effort is felt and apply mark on the housing aligned with the deflector mark;
- measure the distance between the housing marks. When this distance exceeds 12mm, it indicates excessive teeth wear of the drive and driven gears of the final drive, differential gears or splines of side gears and axle shafts.

Potential rear axle faults and remedies

Fault cause	Remedy
Increased axle noise (hum)	
Play or chipped working surfaces of the drive gear or differential bearings.	Check the bearing working surfaces; replace bearings as necessary. Adjust the bearing preload
Pulsating axle noise ("reeling")	
Loose driven gear mounting, or it is installed with a misalignment	Tighten driven gear mounting bolts with sealant and check driven gear tail runout
High-tone axle noise ("wailing")	
Abnormal oil level	Restore normal oil level
Non-recommended oil is used	Replace oil
Improperly adjusted final drive gears teeth contact	Check and adjust the teeth- pattern contact
Scored working surface of the final drive teeth	Replace final drive gears as a set
Heavy axle knock when pressing the throttle pedal sharply after coasting or turning	
Worn differential parts	Replace worn parts or parts differential[1)] assembly
Locking device actuation failure (for locking differential)	
Faulty electric actuator or worn differential parts	Troubleshoot the electrical actuator or replace the differential assembly (see "Locking differential wiring diagram")
Continuous axle knock or crunching	
Spalled or chipped gear teeth or bearings	Replace worn parts

[1)] - For vehicles with locking rear axle differential

Fault cause	Remedy
Axle knocks and intermittent noise from the wheels side	
Increased antitorque moment, rotation jamming or increased axial clearance in wheel hub bearings	Replace worn bearing
Oil leakage through the drive gear collar seal or sealing ring of the hub bearing to axle trunnion connection, and in the gearbox to cover, axle shaft flange to hub parting planes	
Damaged sealing lip of the drive gear collar seal, or the collar misalignment. Damaged sealing ring Dirty breather Damaged gearbox cover gasket, loose gearbox cover or axle shaft mounting bolts	Replace collar seal Remove sealing ring Clean breather Replace the defective reduction case cover gasket, or tighten mounting bolts with sealant previously applied on the axle shaft flange surface.

Rear axle repair

Tightening torques for rear axle threaded connections and sealants used

When assembling and installing the rear axle, maintain the following tightening torques:

- spider mounting bolts – 27.3-35.3 N·m (2.8-3.6 kgf·m). Prior to tightening the bolts, apply Loctite 243 (Henkel) or Weicon AN 302-43 (Weicon) sealant on the bolt threaded portion [1)];

- bolts fastening the driven gear to the differential case - 67-74 N·m (6.8-7.5 kgf·m). Prior to tightening the bolts, apply Loctite 243 (Henkel) or Weicon AN 302-43 (Weicon) sealant on the bolt threaded portion;
- rear axle hub mounting nuts – 353-392 N·m (36-40 kgf·m);
- rear axle shaft mounting bolts – 90-125 N·m (9.0-12.5 kgf·m);
- rear axle parking brake base mounting screws – 98-122 N·m (10.0-12.5 kgf·m). Prior to screwing in, apply Loctite 243 (Henkel) or Weicon AN 302-43 (Weicon) sealant on the screw threaded portion.

[1)] For vehicles with non-locking differential

No sealant getting on the parking brake working surfaces (brake shoes and brake disk surfaces) shall be allowed;

- rear axle disk brake mounting bolts – 157-196 N·m (16-20 kgf·m). Prior to tightening, apply Loctite 243 (Henkel) or Weicon AN 302-43 (Weicon) sealant on the bolt threaded portion over length of 3-5 threads from the bolt end;
- rear axle brake disk mounting screws – 88-108 N·m (9-11 kgf·m). Prior to tightening the screws, apply Loctite 243 (Henkel) or Weicon AN 302-43 (Weicon) sealant on the screw threaded portion end over length of 3-5 threads;
- bolts fastening the cover to the reduction case – 23.5-27.4 N·m (2.4-2.8 kgf·m);
- differential bearing cover mounting bolts – 88-108 N·m (9-11 kgf·m). Prior to tightening the bolts, apply Loctite 243 (Henkel) or Weicon AN 302-43 (Weicon) sealant on the bolt threaded end (¾ of the length) and the housing bolt hole threads;
- differential bearing nut retainer plate mounting bolts - 14-18 N·m (1.4-18 kgf·m).

Axle removal from vehicle

To remove the axle from vehicle, follow the procedure below:

- place the vehicle on trestle or inspection pit and place chocks under the front wheels
- drain oil from the axle housing;
- apply the parking brake and set the gear-shift lever to neutral position;
- disconnect leads from the battery;
- unscrew nuts of bolts fastening the driveline to the rear axle drive gear flange and disconnect the propeller shaft from the rear axle by sliding it forward;
- disconnect the lower shock absorber joints from the axle brackets by loosening the nuts and removing the mounting bolts;
- loosen nuts of bolts fastening the stabilizer rod cushion casings to the struts;
- disconnect the rear suspension stabilizer rod from the lower stabilizer brackets by loosening the nuts and removing the mounting bolts; remove the cushion casings and pull the rod with the struts off the axle;
- loosen mounting nuts of rear wheels and spring U-bolts;
- raise the rear vehicle part until the wheels are off ground, place temporary stand under the frame and rest the vehicle on it;
- unscrew wheel mounting nuts and remove the wheels;
- disconnect the rear parking brake control cables from the rear axle parking brake linkages; to do this:

- loosen the parking brake control cables tension as much as possible by unscrewing the cable sheath end adjustment nuts;
- disconnect cable and brake hose mounting brackets from the rear axle (these will hang on the cables);
- unlock cables at brake linkage brackets by removing fixing clips;
- pulling the sheath end, pull the cable through the slot out of the brake linkage bracket and further out of engagement with the expanding link lever (perform the same operation for the other cable);

- disconnect and remove rear axle flexible brake hoses (see instructions in "Brakes" section);

- disconnect ABS sensors from the axle (see "Electrical equipment" section);

- disconnect the differential solenoid wiring harness receptacle from the vehicle harness [1];

- bring the trolley-hoist under the rear axle and lift the axle;

- unscrew the spring U-bolt mounting nuts, disconnect the rear suspension stabilizer brackets and remove the U-bolts;

- lower the rear axle and slide it out from under the vehicle.

Rear axle installation to vehicle

To install the axle to vehicle, follow the procedure below:

- drive the axle under the vehicle with the rear vehicle part resting on the temporary stand;

- bring the trolley-hoist under the rear axle and rest the axle on it to ensure stable position;

- lift the axle and place it under the springs exactly at the mounting location so that the spring tie bolt heads enter the holes in the axle spring pads;

- install U-bolts and lower stabilizer brackets. Install nuts to U-bolts and pre-tighten. Remove the hoist from under the axle;

- connect the differential solenoid wiring harness receptacle to the vehicle harness[1];

- connect ABS sensors to the axle (see "Electrical equipment" section);

- install and secure rear axle flexible brake hoses (see instructions in "Brakes" section);

- connect rear parking brake control cables to rear axle parking brake linkages in reverse order to removal;

---

[1] - For vehicles with locking rear axle differential

- install the wheels and pre-tighten the mounting nuts. When installing the wheels, the valves shall be diametrically opposed to each other with valve extension screwed on tightly

- remove the temporary stand from under the frame and lower the vehicle

- finally tighten the spring U-bolt and wheel mounting nuts;

- connect lower shock absorber joints to rear axle brackets by tightening nuts of shock absorber mounting bolts;

- attach stabilizer rod to lower brackets and tighten mounting bolt nuts;

- tighten the nuts of bolts fastening the stabilizer rod cushion casings to the struts (see "Chassis" section);

- connect the propeller shaft to the drive gear flange (see "Driveline" sub-section);

- fill oil in the axle housing (see "Rear axle hub part assembly" sub-section);

- test for functioning and bleed the brake system;

- test parking brake for functioning (see "Brakes" section).

Rear axle disassembly

Rear axle hub part disassembly

To disassemble the axle, follow the procedure below:

-remove disk brakes by loosening two mounting bolts per each (see "Brakes" section);

-unscrew eight axle shaft mounting bolts per each and remove axle shafts using puller (Fig. 3.39). To make sure that the legs 1 enter the hub recessions, bring legs together to the stop when unscrewing the bolt 2 from the axle 4. By turning screw 3, disengage axle shaft 5 from side gear;

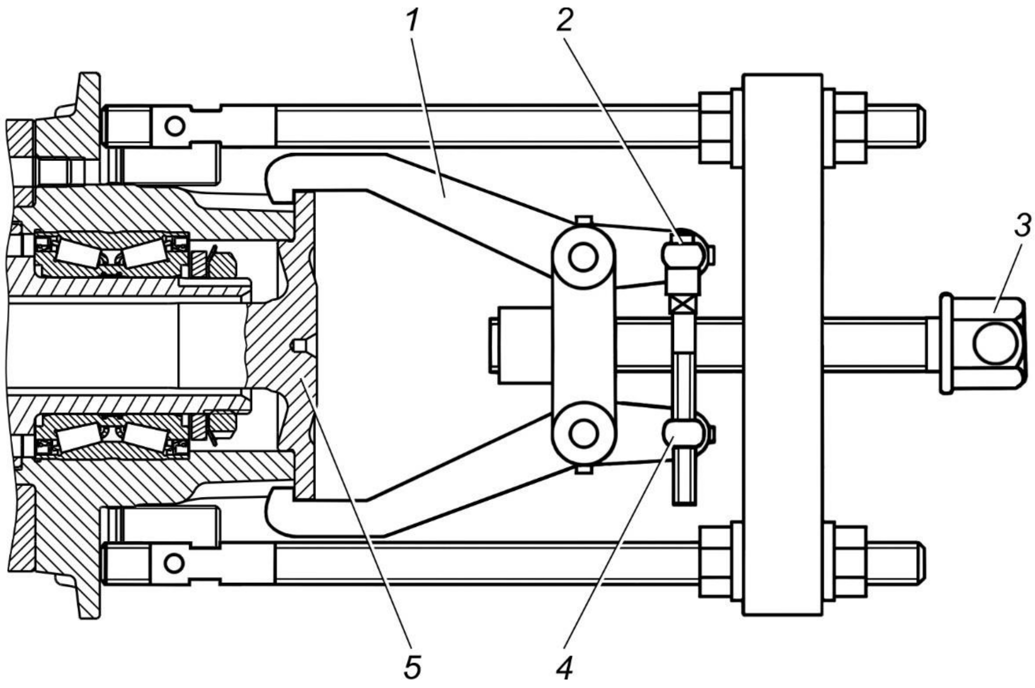


Fig. 3.39. Rear axle shaft removal: 1 – legs; 2 – bolt; 3 – screw; 4 – axle; 5 – axle shaft

- bend the lock washer tab out of the nut slot, unscrew the hub bearing mounting nut, remove the lock washer and thrust washer;
- remove the hubs with brake disks and bearings, remove the sealing rings.

To replace brake disk, unscrew six mounting screws and remove the disk from the hub.

To replace ABS rotor, press the rotor from the hub using the puller with puller legs inserted into the rotor holes (Φ10mm).

To replace double-row bearing, press the rotor from the hub, remove the retaining ring and press the bearing out of the hub using a mandrel.

- unscrew four screws per each fastening parking brake base to housing flange and remove parking brakes complete with shoes.
- unscrew breather.

Rear axle reduction part disassembly

- unscrew the bolts fastening the cover to the reduction case and remove the cover and gasket;
- unscrew the differential bearing nut retainer plate mounting bolts, remove retainer plates;
- push the solenoid wiring harness seal from the outside into the housing[1)];

[1)] - For vehicles with locking rear axle differential

- unscrew the differential bearing cover mounting bolts, remove two washers [1)] and the solenoid[1)] retainer plate, remove covers, remove the bearing nuts and the differential assembled with driven gear. Mark the bearing covers and outer races, so that to install to original positions when reassembling;
- unstake and unscrew the drive gear flange mounting nut, remove the flange, remove the drive gear;
- remove the drive gear outer bearing collar seal and inner race from the housing;
- remove the bearing spacer bushing and compress the drive gear rear bearing inner ring with the puller as shown in Fig. 3.40. To fit insert 4 shoulders tightly between the bearing cage and gear, squeeze supports 2 with bolts and nuts 3. Remove the bearing inner race by turning the screw 1;
- remove the adjustment ring;
- in case of replacement, press the drive gear bearing outer races out of the reduction case.

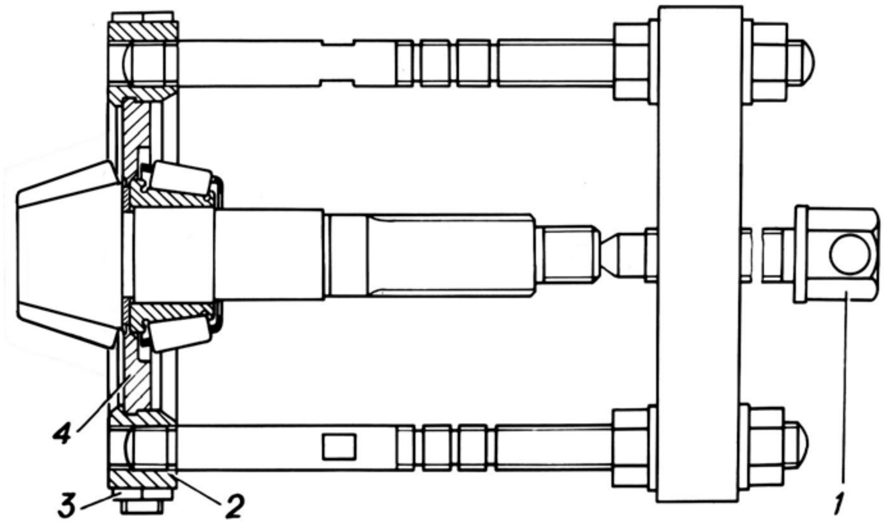


Fig. 3.40. Bearing removal from the final drive gear: 1 – puller screw; 2 – support; 3 – nut; 4 – insert

Differential disassembly

ATTENTION
(For vehicles with locking rear axle differential)
When dismantling the locking differential driven gear and bearings, take care not to damage the solenoid wiring harness and seal.
Due to the restricted distance from the solenoid 5 (see Fig. 3.35) to the locked differential bearing, differential bearings shall be dismantled with great care avoiding the puller insert 1 (Fig. 3.41) impact on the solenoid to prevent its breaking.

To disassemble the differential, follow the procedure below:

- unscrew the driven gear mounting bolts, remove the driven gear;
- in case of replacement, press the bearing inner races from the differential cases complete with inserts using the puller as shown in Fig. 3.41. To fit insert 1 shoulders tightly in the differential case recesses, squeeze supports 2 with bolts and nuts 3; press the bearing race by turning the screw 5;

For non-locking differential

- unscrew differential case mounting bolts, separate cases, remove support washers, pinion gears, side gears and pinion gear axes.

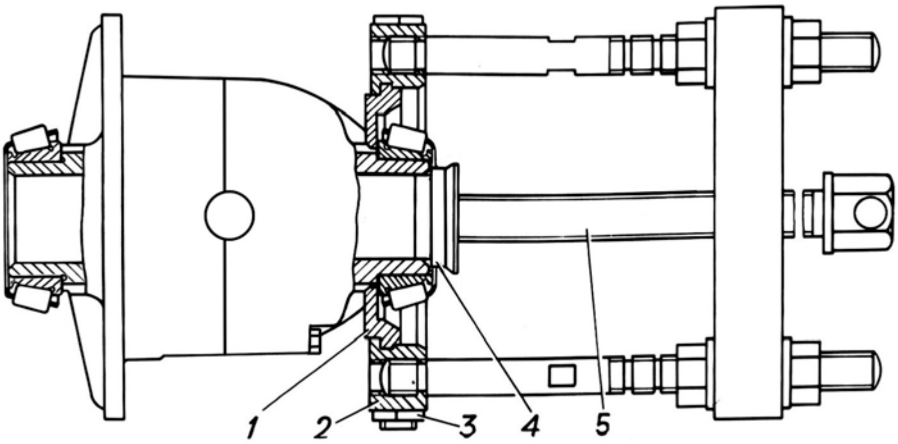


Fig. 3.61. Removing the bearing inner race from the differential compensating case:
1 – insert; 2 – support; 3 – nut; 4 – thrust block; 5 – puller screw

Rear axle parts inspection and control

Thoroughly soak disassembled rear axle parts (except for bearings) in detergent solution (Nefras), then rinse and dry. Wash bearings in clean washing solution and blown with compressed air. After washing, thoroughly inspected parts for:

- gasket tears;
- nicks and scores on the machined surfaces;
- scoring, chipping and spalling on the gear teeth surfaces;
- pitting, wear of running surfaces of bearing rollers and races;
- step wear of roller ends, burn marks;
- wear and galling on thrust washers and mating surfaces of differential cases, side gears and pinion gears, mating surfaces of the pinion gear axes and pinion gears (for dismountable differential), axle housing trunnions, the drive gear flange surface at the collar seating area;
- damage to threads of adjustment nuts of differential bearings and hubs, reduction case and rear axle trunnions;
- damage to threaded holes;
- damage on the drive gear flange end and seat face (driveline flange mating surfaces);
- bent axle shafts (when checking at the centers, maximum hub seat face runout – 0.05mm, maximum flange end runout – 0.08mm);
- thread wear and loose fit of wheel to hub mounting bolts.

Remove all irregularities and burrs from the seating and mounting faces. In case of excessive wear, parts shall be replaced with new ones. Parts to be replaced as a set:

- drive and driven gears of the final drive;
- right and left spiders (for dismountable differential);
- side gears and pinion gears (for dismountable differential);

The collar seals shall be replaced in case of damaged or worn lip.
Re-installation of dismantled collar seals shall not be allowed.

Rear axle assembly

When assembling rear axle:

- Apply Loctite 5900 (Henkel) or Loctite 5699 (Henkel) sealant on oil fill and oil drain plugs, cover gasket.

- Apply uniform layer of Loctite 518 sealant on the axle shaft flange surface adjacent to the hub.

CAUTION

1. Tightening of threaded connections shall be completed in the screw-in stroke.
2. Prior to installation, lubricate the reduction gear taper bearings with the oil used in the axle.
3. Threaded joints installed with sealant shall be cleaned, degreased and dried prior to applying sealant.

Non-locking differential assembly

Prior to assembly, lubricate all rubbing surfaces of differential parts with oil used in the axle. To assemble the differential, follow the procedure below:

- install side gear washer 4 and side gear 5 to one of spiders 2 or 10 (Fig. 3.62). Install the washer with extrusions facing the side gear;

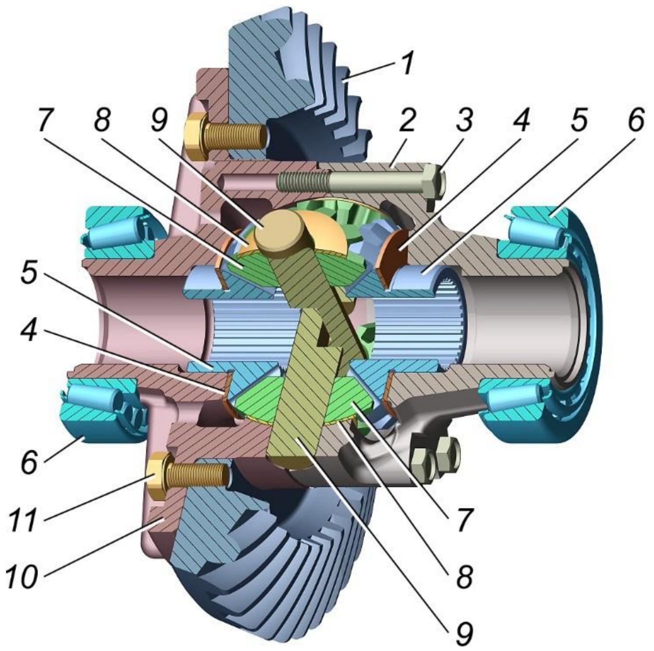


Fig. 3.42. Differential assembly with driven gear: 1 – driven gear; 2– right differential spider; 3,11 – bolts; 4 – side gear washer; 5 – side gear; 6 – bearing; 7 – pinion gear; 8 – pinion gear washer; 9 – pinion gear axis; 10 – left differential spider.

- install pinion gears 7 and pinion gear support washers 8 to the pinion gear axis 9;
- install the pinion gear axis with pinion gears and washers to the spider with the slot upwards;
- assemble the second pinion gear axis as above;
- install the second pinion gear axis with the slot down and install the second side gear and washer on top. Install the washer with extrusions facing the side gear;

- install the second spider so that the marks on the right and left spiders are opposite to each other;

- screw and tighten the spider mounting bolts 3 with anaerobic sealant previously applied to the threaded bolt portion. Prior to applying the sealant, clean the part surfaces from the old sealant and degrease;

- check the differential gears free rotation by rotating one of the side gears using splined mandrel with the stationary differential housing.

The rotation shall be smooth, without jamming. The torque required to start the differential gears shall not exceed 14.7 N·m (1.5 kgf·m).

Installation of differential and driven gear bearings [1)]

To assemble the differential, follow the procedure below:

ATTENTION
(For vehicles with locking rear axle differential)

When assembling the locking differential driven gear and bearings, take care not to damage the solenoid wiring harness and seal.

- press driven gear 1 on the left spider and fasten with bolts 11 (Fig. 3.42). Prior to tightening the bolts, apply anaerobic sealant on the threaded end;

- to check the driven gear tail runout, install the differential to the fixture (Fig. 3.43); runout shall not exceed 0.08mm. When it exceeds this value, remove the driven gear, turn by half a turn and reinstall to the spider, then recheck runout;

[1)] - For locking and non-locking rear axle differentials

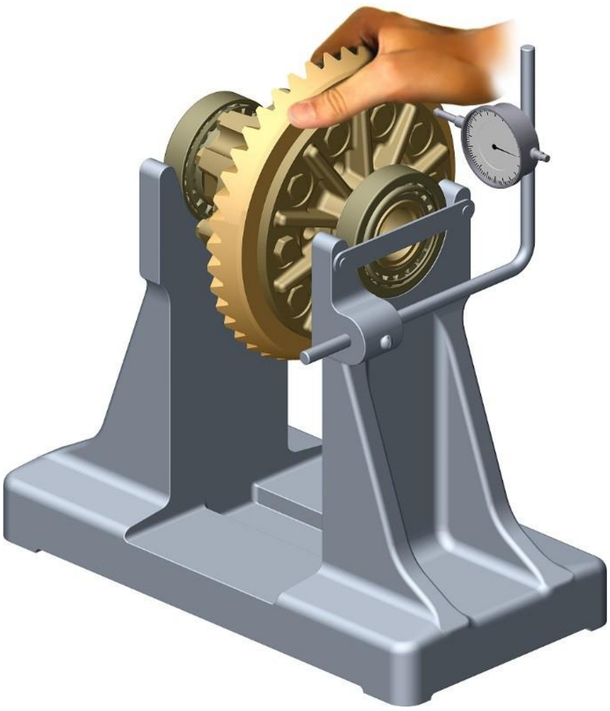


Fig. 3.63. Driven gear tail runout check

- press inner races of bearings 6 on the right and left differential spider journals up to the stop at the shoulder. The 0.03mm feeler gauge shall not enter between the bearing end faces and spider support shoulders.

Axle reduction part assembly

To the axle reduction part, follow the procedure below:

- install the adjustment ring 8 (see Fig. 3.32) on the drive gear and press-on the rear bearing 7 inner race to the stop.

When installing new drive gear, final drive gear or axle housing bearings, adjust the drive gear position by selecting the adjustment ring of proper thickness.

To adjust the drive gear position, follow the procedure below:

- press the outer races of drive gear bearings 4 and 7 in the housing neck to the stop. The 0.03mm feeler gauge shall not enter between the housing end face and the race;
- install special mandrel #1 (Fig. 3.44) with the drive gear bearing inner races in the reduction case;
- to make special mandrel, use substandard drive gear grinding the neck D for the rear bearing to a diameter of $40^{-0,010}_{-0,025}$mm and the rear face B with the end runout tolerance relative to the C and D surfaces of 0.02mm, and measure the actual size A;

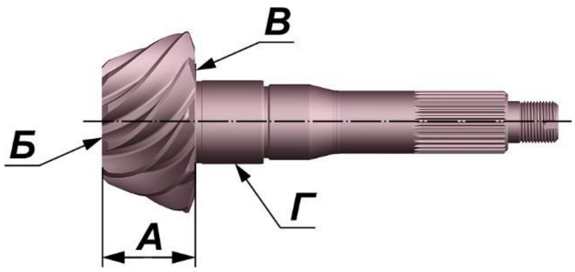


Fig. 3.44. Special-purpose mandrel #1

- install flange 2 (see Fig. 3.32) and tighten the mounting nut to the mandrel antitorque moment 1.5-2.5 N·m (0.15-0.25 kgf·m) for new bearings and 0.5-1.0 N·m (0.05-0.10 kgf·m) for used bearings (mileage of over 50km). When tightening the nut, rotate the mandrel for correct positioning of bearing rollers;

- install special mandrel #2 (Fig. 3.45) in the reduction gear case sockets for differential bearings, install and fasten differential bearing covers;

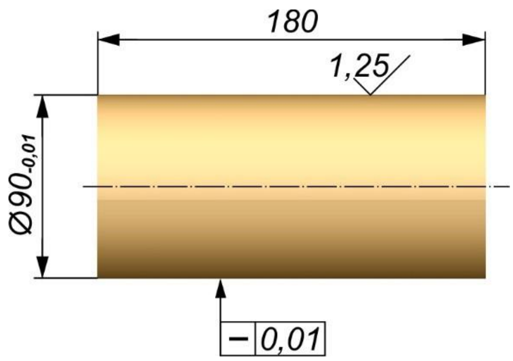


Fig. 3.45. Special-purpose mandrel #2

- measure dimension B (Fig. 3.46) from the rear face of mandrel #1 to mandrel #2;

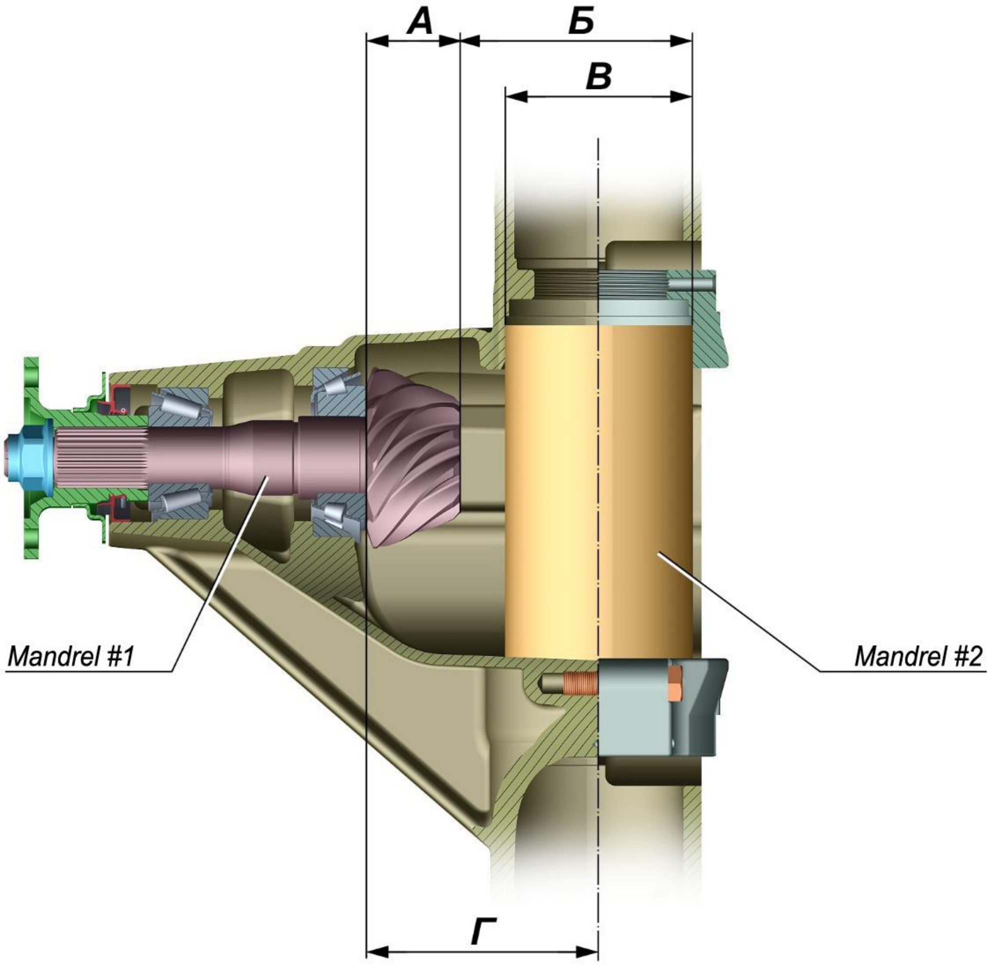


Fig. 3.46. Drive gear position adjustment diagram

- determine the dimension G from the differential axis to the end face of the drive gear rear bearing; D = A + B - C/2;

- determine the adjustment ring thickness H = D - F, where the dimension F = 109.48-109.52mm (see Fig. 3.32) - the distance between the differential axis and the drive gear end face adjacent to the adjustment ring;

- select the adjustment ring of the required thickness $H_{-0.01}$ (see Table 3.4);

Table 3.4

Adjustment rings for the drive gear mounting

Group number	Adjustment ring thickness	Group number	Adjustment ring thickness
1	1.79	12	2.01
2	1.81	13	2.03
3	1.83	14	2.05
4	1.85	15	2.07
5	1.87	16	2.09
6	1.89	17	2.11
7	1.91	18	2.13

Group number	Adjustment ring thickness	Group number	Adjustment ring thickness
8	1.93	19	2.15
9	1.95	20	2.17
10	1.97	21	2.19
11	1.99	22	2.21

- remove temporary mandrels #1 and #2 and bearing inner races;
- install the selected adjustment ring to the drive gear and press-on the rear bearing inner race.

To adjust the drive gear bearing preload, follow the procedure below:

- install the drive gear front bearing inner race in the housing;
- press new four-lip drive gear collar seal in the housing without misalignment using a special mandrel taking are not to damage the collar end dust boot. After pressing, the collar end face shall be 0.9-1.5mm (for non-locking differential) and 0-0.6mm (for locking differential) lower the housing face and parallel to it with tolerance of 0,15 mm. The collar face shall not protrude above the housing face.

ATTENTION
Do not remove the factory-applied lubricant between the two radial dust boots of collar seal. Do not apply any grease or gear oil on the collar working surfaces and drive gear flange prior to collar pressing-in.

- install drive gear with new spacer bushing to the housing and tighten the nut to the drive gear antitorque moment of 1.5-2.5 N·m (0.15-0.25 kgf·m) for new bearings and 0.5-1.0 N·m (0.05-0.10 kgf·m) for used bearings (mileage of over 50km). Replace the flange nut with a new one to ensure the necessary adjustment accuracy. When tightening the nut, periodically measure the drive gear antitorque moment. After the final adjustment, the drive gear bearing antitorque moment increase to 3.0 N·m (0.3 kgf·m) for new bearings and to 1.5 N·m (0.15 kgf·m) for used bearings shall be allowed. When the drive gear bearing antitorque moment exceeds 3.0 N·m (0.3 kgf·m) for new bearings and 1.5 N·m (0.15 kgf·m) for used bearings, replace the spacer bushing and readjust.

ATTENTION
The spacer bushing shall not be reused.

To adjust the bearing preload, tooth-contact pattern and final drive gears backlash, follow the procedure below:

ATTENTION
(For vehicles with locking rear axle differential)

When installing the locking differential in the rear axle reduction case, take care not to damage the solenoid wiring harness and seal.
After installation, insert the wire with the seal into the reduction case hole and install the seal until the seal shoulder stops at the case inner surface.
Prior to screwing in the differential bearing cover mounting bolts, install the solenoid retainer plate and two washers under the bolt heads (to the right differential spider). The solenoid protrusion shall fit into the retainer plate groove. Contact between retainer plate and the solenoid surface shall not be allowed.

- install differential complete with driven gear and bearings, and differential bearing adjustment nuts to the housing. The bearing outer races shall be tightly pressed against the inner races;
- install the differential bearing covers, two washers [1)] and solenoid retainer plate [1)], tighten their mounting bolts to maximum torque ensuring the tightening of the differential bearing adjustment nuts. Prior to tightening the bolts, apply Loctite 243 (v. "Henkel") or Weicon AN 302 43 (v. "Weicon") sealant on the threaded bolt end (¾ of the length) and the housing bolt hole threads. Prior to applying the sealant, clean the parts surfaces from the old sealant and degrease;
- install the indicator fixture by screwing in the bearing cover holes for the adjustment nut retainer plate bolts as shown in Fig. 3.47;

[1)] - For vehicles with locking rear axle differential

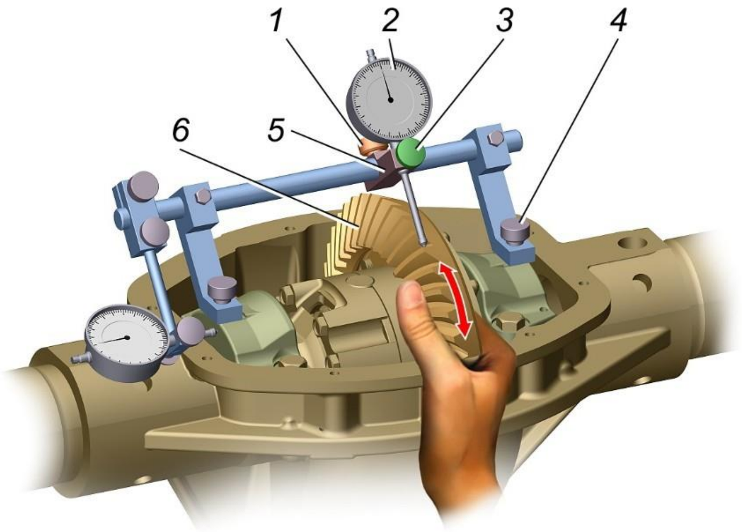


Fig. 3.47. Final drive gears backlash check with indicator fixture: 1 – bracket tightening screw; 2 – indicator for checking the driving and driven gears backlash; 3 – indicator rod mounting screw: 4 – mounting screw; 5 – indicator bracket; 6 – driven gear

- press differential bearing adjustment nuts with a slight force and set the backlash of 0.15-0.17 mm (for new gears). Perform measurement (at least five points evenly spaced around the driven gear circumference) with indicator perpendicular to the driven gear tooth at large pitch by rocking driven gear in both directions until the driven gear tooth contacts with the drive gear tooth. When adjusting the bearings, rotate the drive gear for correct positioning of bearing rollers;
- alternately tighten the differential bearing adjustment nuts to the drive gear antitorque moment increase by 1.5-3.0 N·m (0.15-0.30 kgf·m) for new bearings and 0.5-1.0 N·m (0.05-0.10 kgf·m) for used bearings (mileage of over 50km).

When tightening the nuts, periodically measure the drive gear antitorque moment. Do not loosen the differential bearing adjustment nuts to meet the backlash and bearing preload requirements. To adjust, first loosen the nuts by 2-3 notches and then tighten.

Then tighten the differential bearing cover bolts and recheck the backlash;

- check the tooth-contact pattern at the gears. To do this, apply thick red-lead putty on the teeth, then rotate the drive gear with slight effort first in one direction, and then oppositely. In case of wrong tooth contact pattern, change the drive and driven gears positions to achieve the required pattern. Then recheck the differential bearings preload, backlash amount and tooth contact pattern (Fig. 3.68.);
- lock the drive gear nut by pushing the nut neck dent into the drive gear groove (see Fig. 3.32, 3.37);
- install the retainer plates of the differential bearing nuts and secure with bolts;
- install the housing cover and gasket and tighten the bolts. Prior to installation, apply sealant on both gasket sides.

ATTENTION
(For vehicles with locking rear axle differential)

Connect the differential solenoid wiring harness to the differential solenoid pin shoe.

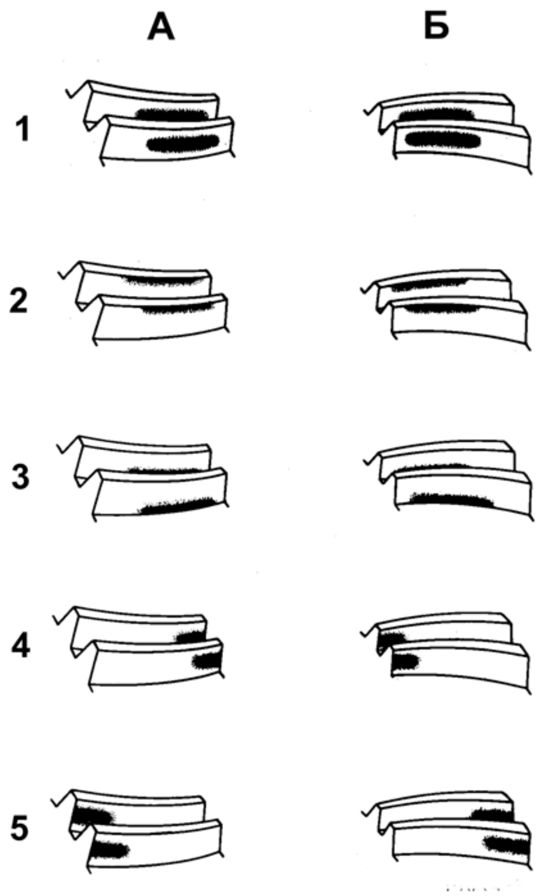


Fig. 3.68. Final drive gears tooth-contact pattern: A – forward speed sides; B – reverse speed sides; 1 – correct tooth-contact pattern; 2 – tooth-contact pattern is located at the tooth tip – to correct, move the drive gear towards the driven gear; 3 – tooth-contact pattern is located at the tooth root – to correct, move the drive gear away from the driven gear; 4 – tooth-contact pattern is located at the narrow tooth end – to correct, move the driven gear away from the drive gear; 5 – tooth-contact pattern is located at the wide tooth end – to correct, move the driven gear towards the drive gear.

Rear axle hub part assembly

To assemble the rear axle hub part, follow the procedure below:

- screw-in breather;

- install parking brakes (left and right) complete with shoes to the axle housing flanges as shown in Fig.3.33 and fasten with screws. Prior to screwing in the mounting screws, apply sealant on the threaded screw portion. No sealant getting on the parking brake shoes and disk working surfaces shall be allowed. (For the parking brake repair and assembly, see supplier's documentation);

- assemble hubs with brake disks and bearings.

In case of thread wear and wheel mounting bolt loosening in the hub (due to bolt wear), press a new bolt in the hub to the stop to ensure tight fit, or replace the hub in case of hub bolt hole wear.

Install the brake disk to the hub and fasten with screws. Prior to screwing in the mounting screws, apply sealant on the threaded screw portion.

In case of replacement, press the double-row taper bearing in the hub to the stop applying force to the outer bearing race.

ATTENTION
When pressing the bearing in, the collar seal shall face toward the hub as shown in Fig. 3.34.

Install retaining ring, press ABS rotor in hub to the stop;

- install the hub with brake disk and bearing to the axle trunnion with new sealing rings 8 (see Fig. 3.34) previously installed, install thrust and lock washers, screw on the slotted nut and adjust the tightness.

Tighten the slotted nut to torque of 353-392 N·m (36-40 kgf·m). Rotate the hub while tightening to ensure proper positioning of rollers. Bend one lock washer tab into the nearest nut slot. It is allowed to tighten up the nut until one of the slots coincides with the nearest lock washer tab.

- insert axle shafts, install washers and tighten the axle shaft mounting bolts with sealant previously applied uniformly on the axle shaft surface adjacent to the hub. No sealant getting on the hub bearing, in the hub threaded holes, on the hub mounting nut shall be allowed;

- install the drain plug in the axle housing with sealant previously applied on thread;

- install the right and left disk brakes as shown in Fig. 3.31. Bleeding valve 7 shall be on top. Tighten mounting bolts uniformly with sealant previously applied on the threaded bolt portion;

- fill the axle with oil according to the Vehicle operation manual and tighten the fill plug;
- adjust the parking brake system linkage levers positions (see "Brakes" section);
- install the assembled axle on the running-in rig and check the noise level, heating and the oil leaks through the joints at forward and reverse gears at the drive gear speed of 1000, 1500, 3000 min^{-1}.

Noise generated by the axle shall be uniform without sudden changes, wailing, knocking and scraping noise

To inspect the axle, follow the procedure below:

- no-load test at drive gear speed 1000 min^{-1};
- electromechanically actuated parking brake system adjustment (see "Brakes" section);
- differential operation check;
- check with simultaneous braking of both axle shafts at drive gear load of 20-30 N·m (2-3 kgf·m) with a smooth drive gear speed increase and decrease at all speeds in both directions.

Differential operation shall be checked at the drive gear speed of 1000 min^{-1} while alternately smoothly braking the brake disks. Test duration - minimum 1 min. No differential seizures and jamming shall be allowed.

The total test axle and running-in duration shall be at least 3 min. The best test results are obtained with the oil heated to temperature of 50-70°C and axle pressurized to 20-30 kPa (0.2 0.3 kgf/cm^2).

During axle leak-tightness test, no grease expelling and leakage shall be allowed. "Sweating" and oil stains not impairing normal axle operation shall be allowed at the collar seals areas and breather area.

During the check, the temperature of the hub outer surface and final drive case heating at the bearing areas after the axle running-in shall not exceed 70ºC (not endured by hand).

After running-in, drain oil through the drain hole to clean the magnet and fill fresh oil according to the Vehicle operation manual. Apply sealant to the threaded plug surface prior to installation

When assembling the rear axle, observe the dimensions of the rear axle mating parts (Table 3.5).

Drive gear collar seal replacement

To replace the collar seal, follow the procedure below:

- drain the oil from the rear axle housing;
- disconnect driveline, remove axle shafts, dismantle reduction gear cover and gasket where necessary;
- use a torque wrench to measure the drive gear antitorque moment;
- unstake and unscrew the nut and remove the drive gear flange;
- dismantle the collar seal and spacer bushing with the front bearing inner cage;
- install new spacer bushing and install the bearing inner cage;
- press new drive gear collar seal in the housing without misalignment using a mandrel (see "Drive gear bearing preload adjustment" sub-section);
- install the drive gear flange;
- tighten the drive gear nut to the drive gear antitorque moment equal to previously measured value plus 0.1-0.3 N·m (0.01-0.03 kgf·m). When tightening the nut, periodically measure the drive gear antitorque moment. When the antitorque moment exceeds the required value, remove the differential, replace the spacer bushing and readjust (see "Axle reduction part assembly" sub-section);
- install reduction gear cover and gasket, axle shafts, propeller shaft (see "Axle assembly" sub-section);
- fill the axle with oil (see "Axle assembly" sub-section).

Table 3.5

Dimensions of rear axle mating parts, mm

Mating parts	Hole	Shaft	Fit
Reduction case – drive gear front bearing	$Ø72^{-0.021}_{-0.051}$	$Ø72_{-0.011}$	$\text{Preload}^{0.010}_{0.051}$
Drive gear – front bearing	$Ø30_{-0.008}$	$Ø30^{-0.007}_{-0.020}$	Clearance 0.020 Preload 0.001
Reduction case – drive gear rear bearing:	$Ø90^{-0.024}_{-0.059}$	$Ø90_{-0.013}$	$\text{Preload}^{0.011}_{0.059}$
Drive gear – rear bearing:	$Ø40_{-0.010}$	$Ø40^{+0.033}_{+0.017}$	$\text{Preload}^{0.017}_{0.043}$
Reduction case – differential bearing	$Ø90^{+0.035}$	$Ø90_{-0.013}$	$\text{Clearance}^{0,000}_{0.048}$
Differential spider – bearing	$Ø50_{-0.010}$	$Ø50^{+0.033}_{+0.017}$	$\text{Preload}^{0.017}_{0.043}$

Mating parts	Hole	Shaft	Fit
Differential spider RH and LH	$Ø118^{+0.035}$	$Ø118_{-0.035}$	Clearance$^{0,000}_{0.070}$
Differential spider – side gear	$Ø42^{+0.039}$	$Ø42^{-0.050}_{-0.085}$	Clearance$^{0.050}_{0.124}$
Differential compensating case – spider pin	$Ø20^{+0.021}$	$Ø20_{-0.021}$	Clearance$^{0,000}_{0.042}$
Differential compensating case – driven gear	$Ø125^{+0.016}$	$Ø125^{+0.028}_{+0.003}$	Clearance 0.013 Preload 0.028
Pinion gear – spider pin	$Ø20^{+0.145}_{+0.100}$	$Ø20_{-0.021}$	Clearance$^{0,100}_{0.166}$
Axle housing trunnion – hub bearing	$Ø55_{-0.015}$	$55^{-0.025}_{-0.050}$	Clearance$^{0.010}_{0.050}$
Hub – bearing	$Ø90^{-0.058}_{-0.093}$	$Ø90_{-0.018}$	Preload $^{0.040}_{0.093}$
Hub – ABS sensor rotor	$Ø100^{+0.035}$	$Ø100^{+0.093}_{+0.071}$	Preload $^{0.036}_{0.093}$

3.4.2.Rear axle
(gross vehicle weight up to 4.6 tons)

The vehicle is equipped with a non-demountable rear axle with hypoid final drive (Fig. 3.69).

The final drive and differential are installed in the axle housing cavity and closed with a cover after adjustment.

Rear axle housing consists of a cast reduction case made of high-strength cast iron with pressed and welded steel axle casings. Spring pads, shock absorber brackets and trunnions with flanges for hubs and disk brakes installation are welded to the axle casings.

The rear axle reduction part structure is shown in Fig. 3.70.

Drive and driven gears of the final drive are paired based on contact and noise, numbered with the same serial number, so in case of either gear damage, these shall be replaced as a set.

Spacer bushing located between inner races of the drive gear bearings is deformed as the drive gear nut is tightened, thus providing bearings preload. Adjustment ring 8 is installed between the drive gear end face and the inner bearing; correct drive gear position relative to the driven gear is defined through the ring thickness selection.

Differential assembled with taper bearings is installed in the rear axle housing sockets closed with bolted covers.

The vehicle can be equipped with following differentials: demountable or non-demountable.

Some vehicles may be equipped with rear axles with locking differential.

Final drive gear backlash and differential bearings preload are adjusted by nuts 10 (Fig. 3.70). Nuts are locked with retainer plates 15. Pinion gears and side gears are enclosed in the differential housing consisting of left and right cases bolted together. Support washers are installed Under the pinion gears and side gears. The cross-piece where the pinion gears are mounted is composed of two axes.

Driven gear is installed to the left differential case and bolted.

To prevent pressure build-up inside the axle, breather 5 is installed on the top of left axle casing (see Fig. 3.69).

The rear axle hub part structure is shown in Figure 3.71.

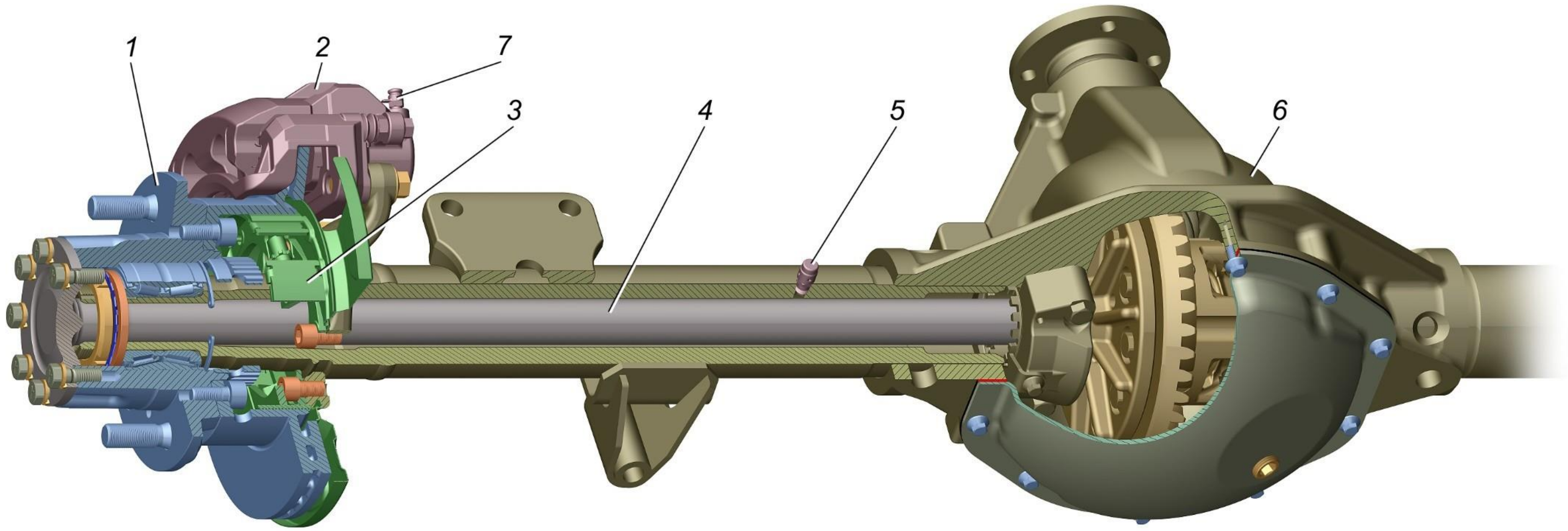


Fig. 3.69. Rear axle: 1 – rear axle hub with brake disk and bearing; 2– left disk brake; 3 – left parking brake; 4 – rear axle shaft; 5 – breather; 6 – rear axle reduction gear with axle casings; 7 – bleeding valve.

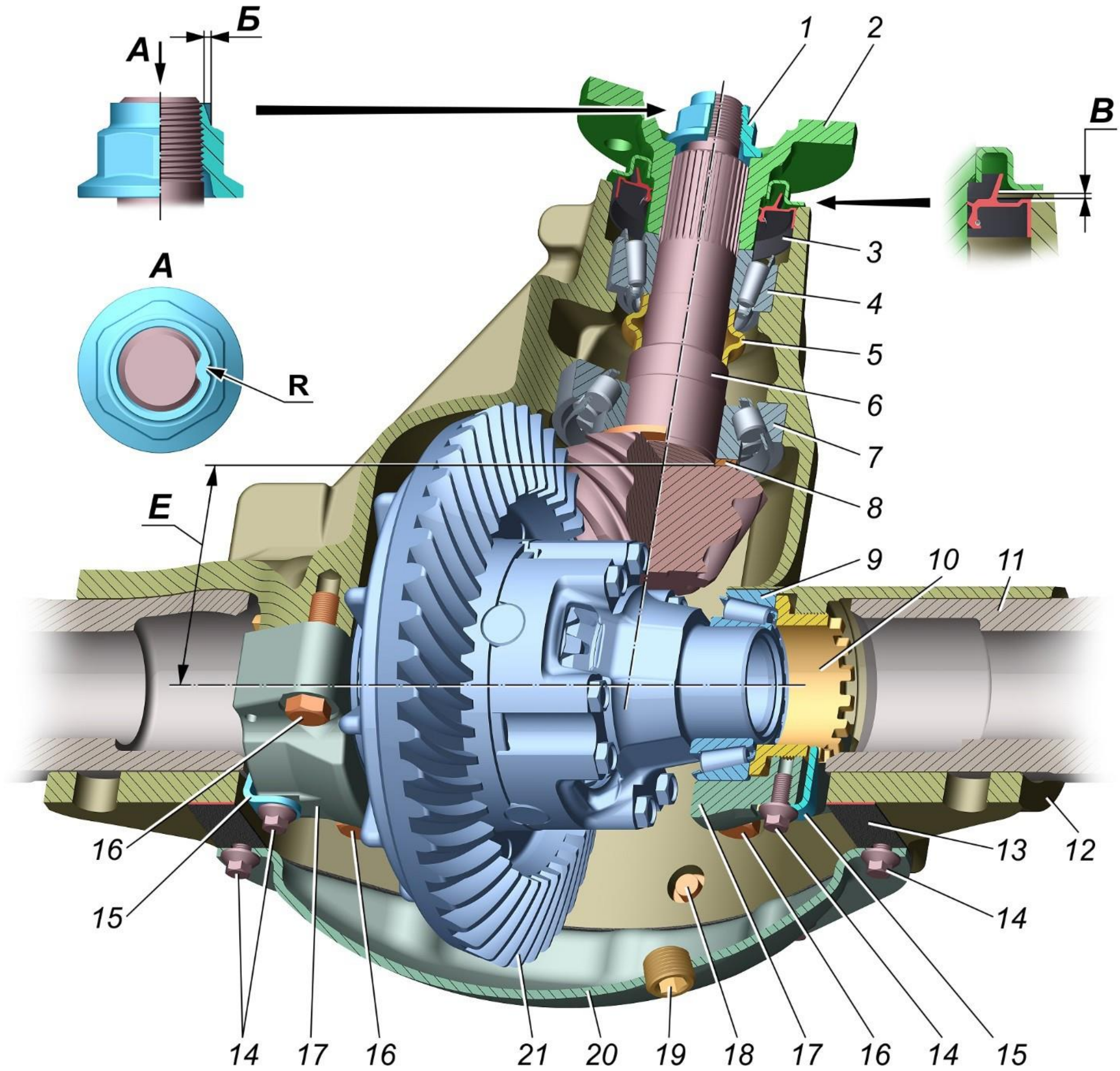
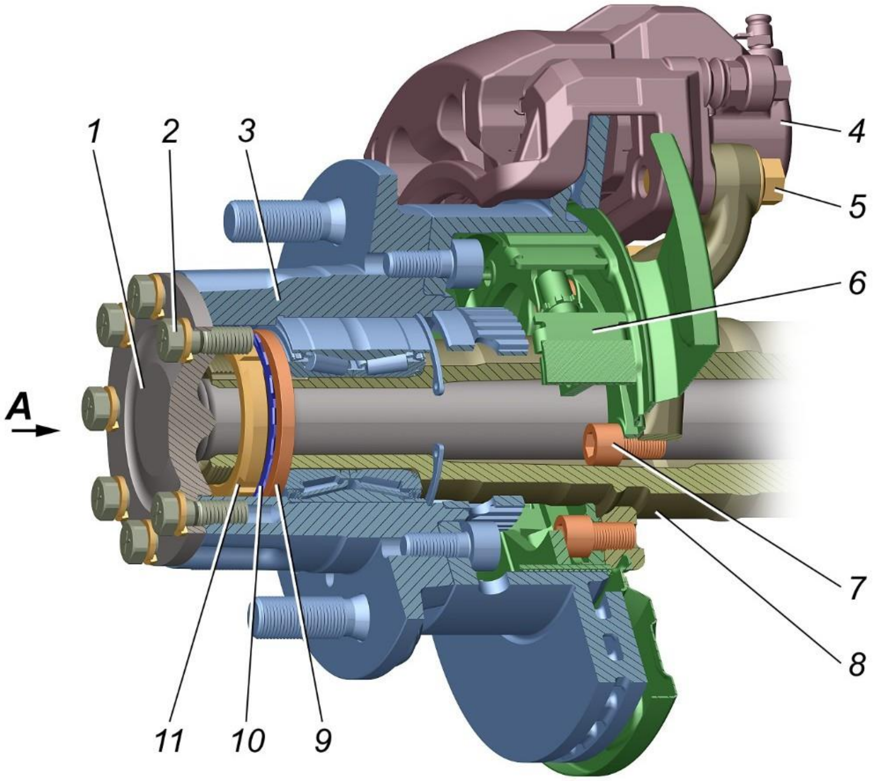


Fig. 3.70. Rear axle reduction gear with axle casings: B=0.8mm, min.; B=0.9-1.5mm; R=1.2mm, min.; 1 – nut; 2 – drive gear flange; 3 – collar seal; 4,7,9 – bearings; 5 – spacer bushing; 6 – drive gear; 8 – adjustment ring; 10 – differential bearing nut; 11 – axle shaft casing; 12 – rear axle housing; 13 – gasket; 14,16 – bolts; 15 – retainer plate; 17 – differential bearing cover; 18 – magnetic plug; 19 – oil filler plug; 20 – housing cover; 21 – differential with driven gear



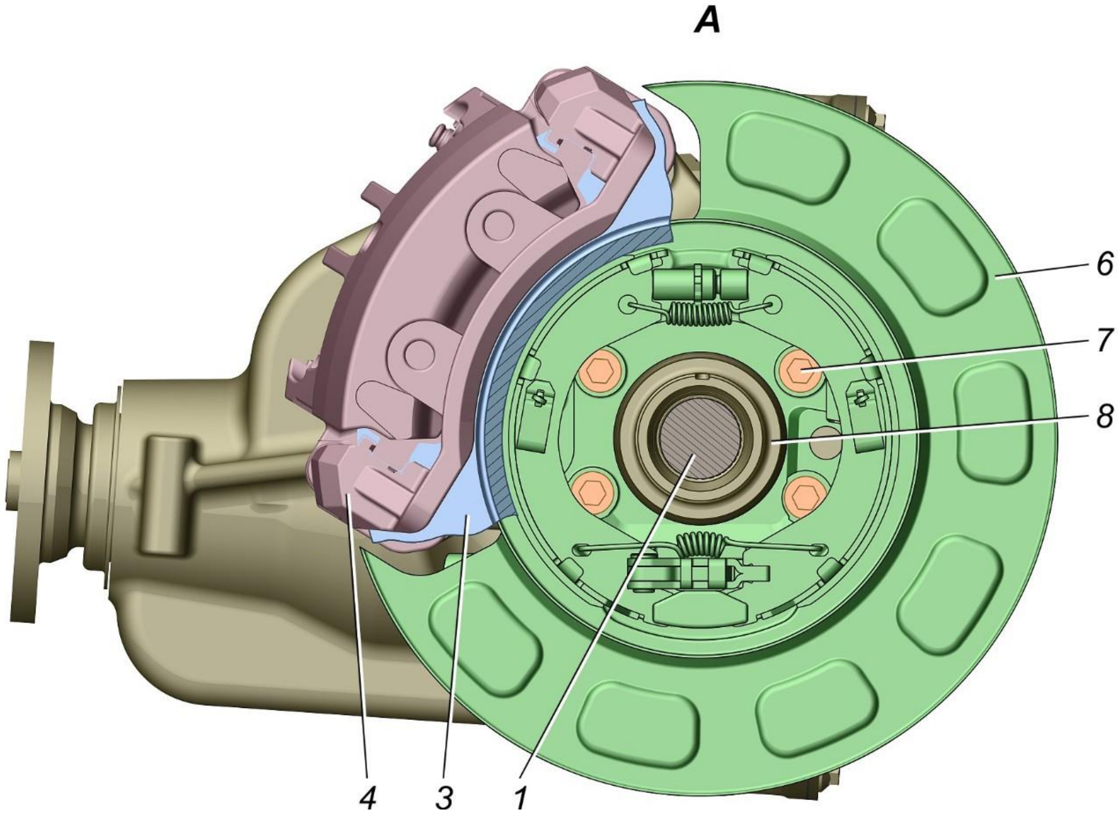


Fig. 3.53. Rear axle (hub part) 1 – rear axle shaft; 2,5 – bolts; 3 – rear wheel hub with brake disk and bearing; 4 – left disk brake; 6 – left parking brake; 7 – screws; 8 – axle shaft casing 9 – thrust washer; 10 – lock washer; 11 – slotted nut.

Axle shafts 1 are installed in the splined bores of the side gears with flanges attached to the wheel hub 3 with bolts 2.

The rear wheel hubs 1 (Fig. 3.72) rotate on double-row taper roller bearings 3 mounted on the axle trunnions. Non-adjustable and maintenance-free double-row taper roller bearing is sealed on both sides: collar seal is installed on one bearing side, and cassette is installed on the other side.

The bearing is pressed with the outer ring in the hub and locked against axial movement with retaining ring 7, while the inner rings are freely mounted on the trunnion.

ATTENTION
When pressing the bearing in, the collar seal shall face the hub as shown in the figure.

The bearing is packed with grease, so no grease filling or replacement is required during operation.

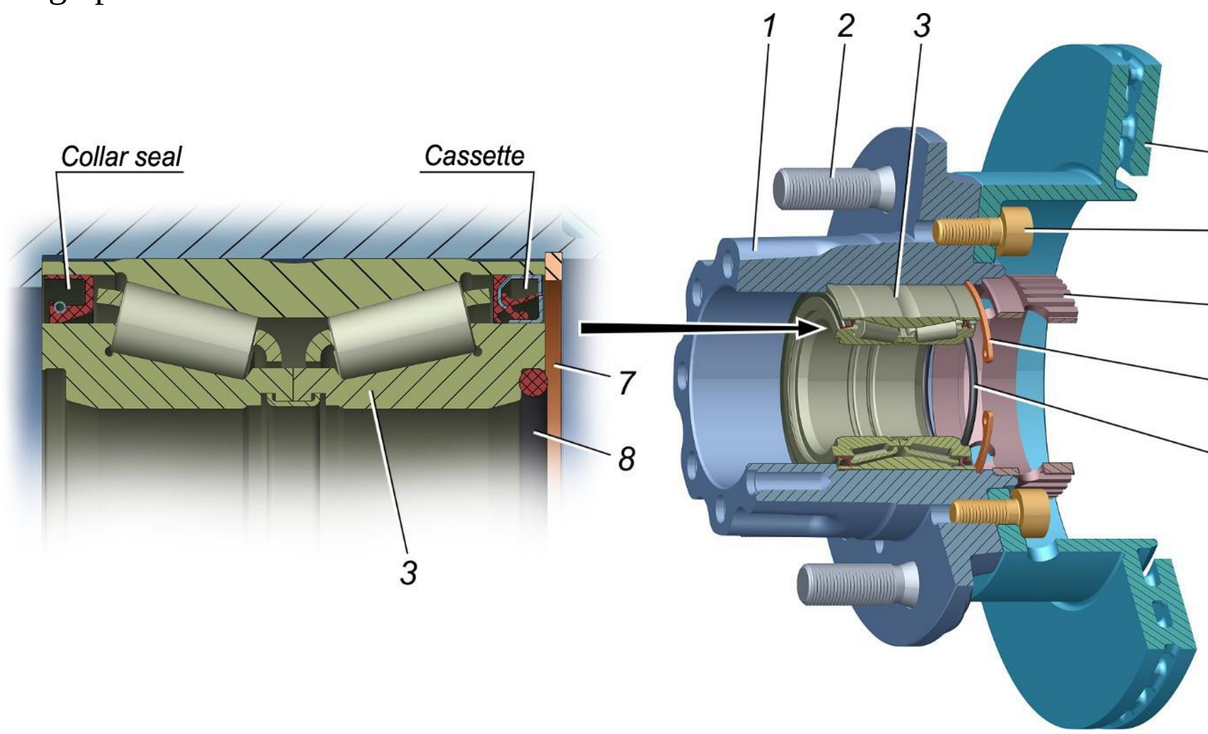


Fig. 3.72. Rear wheel hub with brake disk and bearing: 1 – rear wheel hub; 2 – wheel hub bolt; 3 – double-row taper roller bearing; 4 – brake disk; 5 – screw; 6 – rear ABS rotor; 7 – retaining ring; 8 – sealing ring.

Six wheel mounting bolts 2 are pressed in the hub flange holes.
The bolt seating surface is spline-rolled.

The hub 3 (see Fig. 3.71) is attached with thrust washer 9 and slotted nut 11 screwed onto the threaded trunnion end. The slotted nut is locked by bending the washer 10 tab.

On the inner hub side, the bearing to axle trunnion connection is sealed with rubber ring 8 (see Fig. 3.72) preventing grease from escaping from the hub.

Brake disks 4 are attached to the rear hubs with screws 5 locked with sealant.

Disk brakes (left and right) of the service brake system are attached with flange bolts 5 (see Fig. 3.71) to the flanges welded to the axle housing trunnions. Disk brake mounting bolts are locked with sealant.

Drum-type parking shoe brakes 6 are built in the rear wheel brake disks. The disk surface acts as the parking brake drum.

The parking shoe brakes (right and left) are attached to the welded housing flanges with screws 7. Parking brake mounting screws are locked with sealant.

ABS speed sensor is installed in the parking brake base hole and secured with a screw. ABS rotor 6 (see Fig. 3.72) is pressed onto the wheel hub from the inside.

Structural features of rear axle with locking differential

Some vehicles may be equipped with a locking differential (Fig. 3.73, 3.74) with electric locking control. The differential lock is activated through the dashboard switch with the dashboard indicator lighting up. When the switch is pressed again, or the vehicle reaches a speed of 30 km/h, the differential lock is disabled, and the dashboard indicator light goes out.

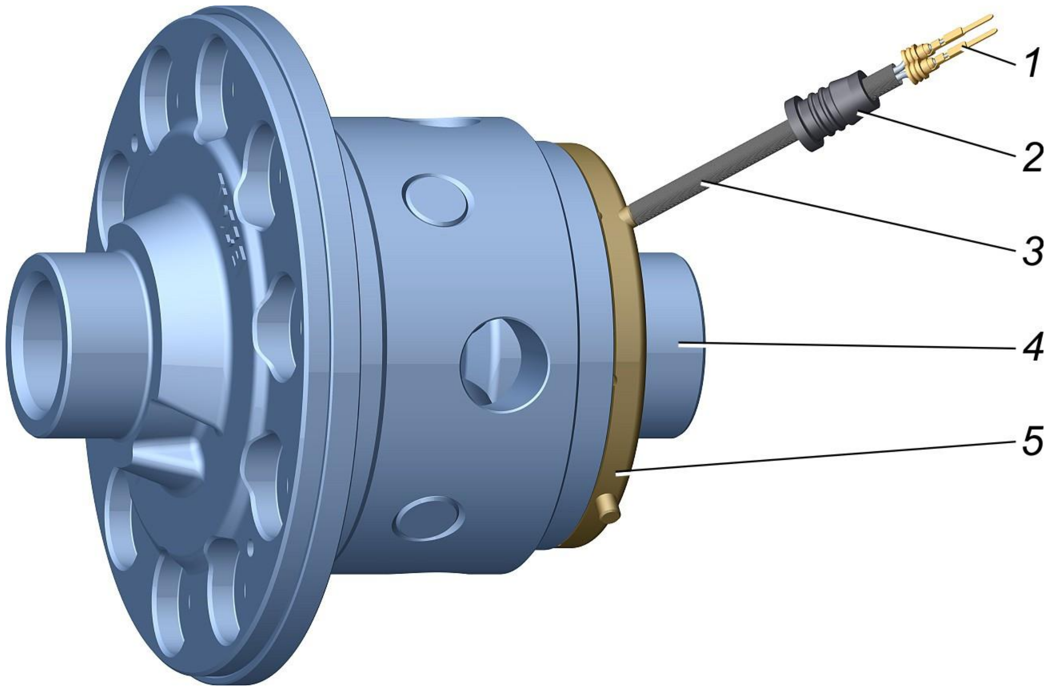


Fig. 3.73. Locking differential with electric locking control: 1 – wiring harness contacts; 2 – wiring harness seal; 3 – differential solenoid wiring harness; 4 – differential; 5 – solenoid

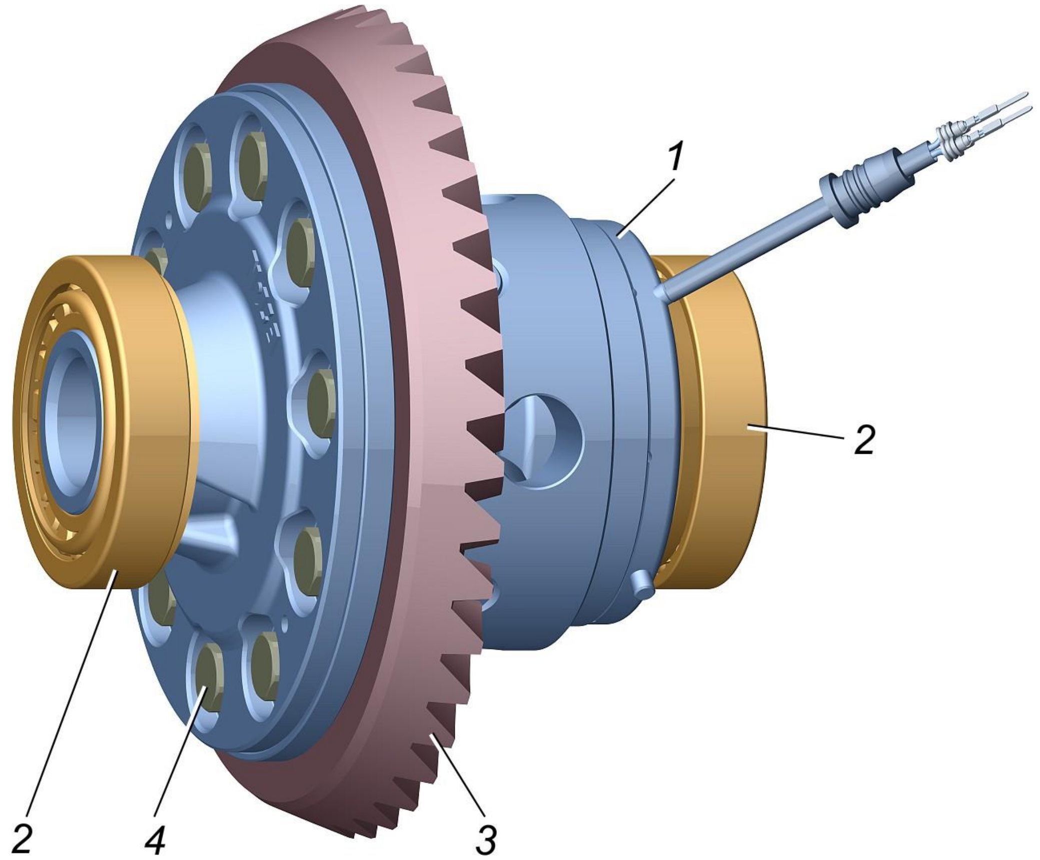


Fig. 3.74. Locking differential complete with bearings and driven gear of the final drive: 1 - differential; 2 - bearings; 3 - driven gear; 4 - bolt

When the lock is actuated, voltage is applied to the differential solenoid electrical contacts, and the clutch installed inside the differential connects rigidly the differential body and the left side gear allowing rigid connection of the rear axle left and right wheels with total engine torque transferring to these.

When the differential 23 (Fig. 3.75) rotates, the solenoid located on the differential housing remains stationary due to the use of a retainer plate 20 bolted to the right differential bearing cover and retaining the solenoid cage pin 21 in the slot.

The differential solenoid wiring harness 5 (Fig. 3.76) is led through an additional hole in the reduction case and connected to the vehicle harness through the terminal strips. Rubber seal is installed in the hole to protect the axle cavity from water and dirt. The bracket 1 is used to attach electromagnet harness terminal strip is to the axle housing.

The locking differential is non-repairable; in case of failure, replace it with a new one.

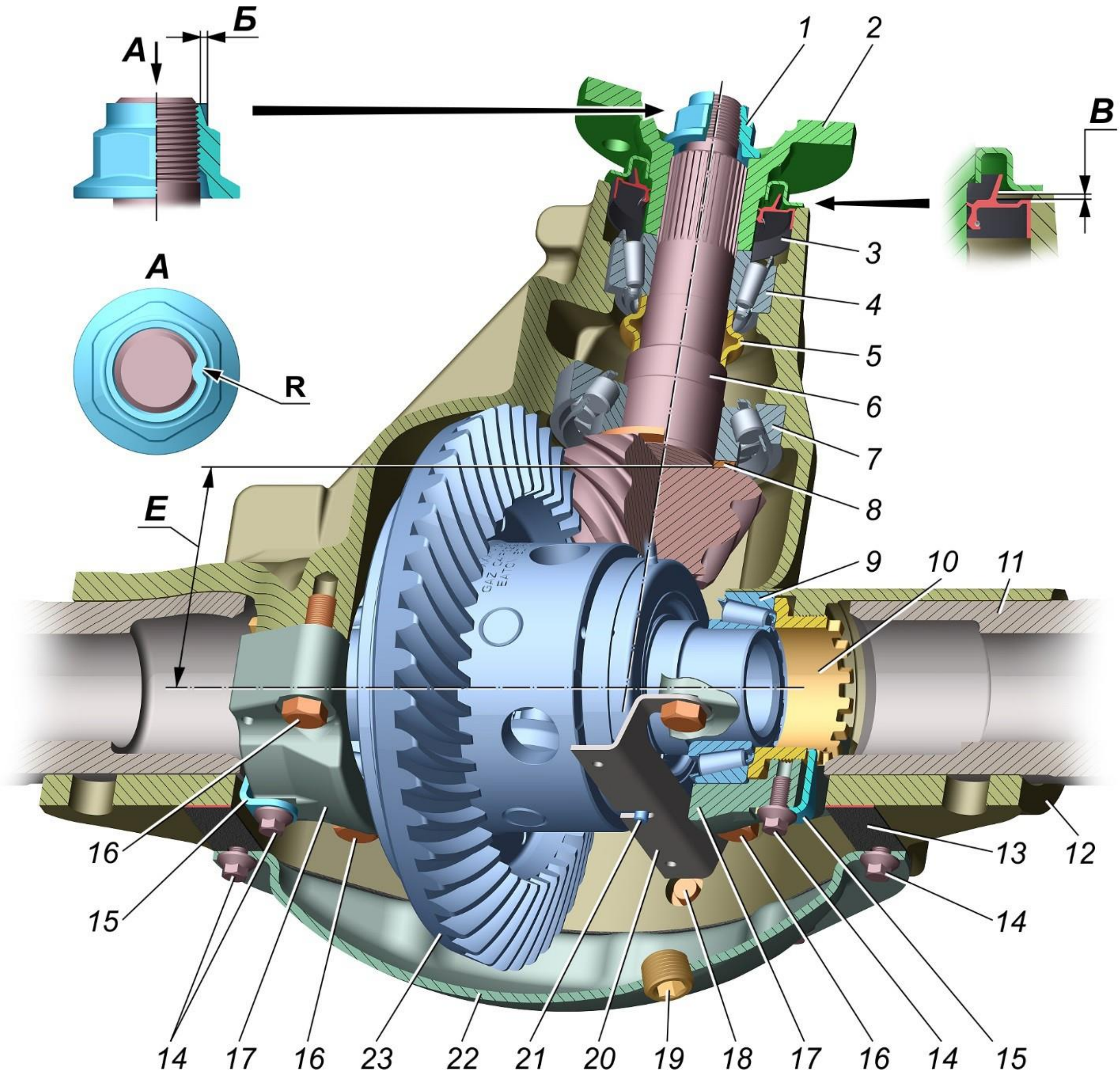


Fig. 3.75. Rear axle gearbox with locking differential: B=0.8mm, min.; B=0.9-1.5mm; R=1.2mm, min.; 1 – nut; 2 – drive gear flange; 3 – collar seal; 4, 7, 9 – bearings; 5 – spacer bushing; 6 – drive gear; 8 – adjustment ring; 10 – differential bearing nut; 11 axle shaft casing; 12 – rear axle housing; 13– gasket; 14, 16 – bolts; 15 – retaining plate; 17 – differential bearing cover; 18– magnetic plug; 19 – oil filler plug; 20 – retainer plate; 21 – solenoid cage pin; 22 – housing cover; 23 – locking differential with driven gear

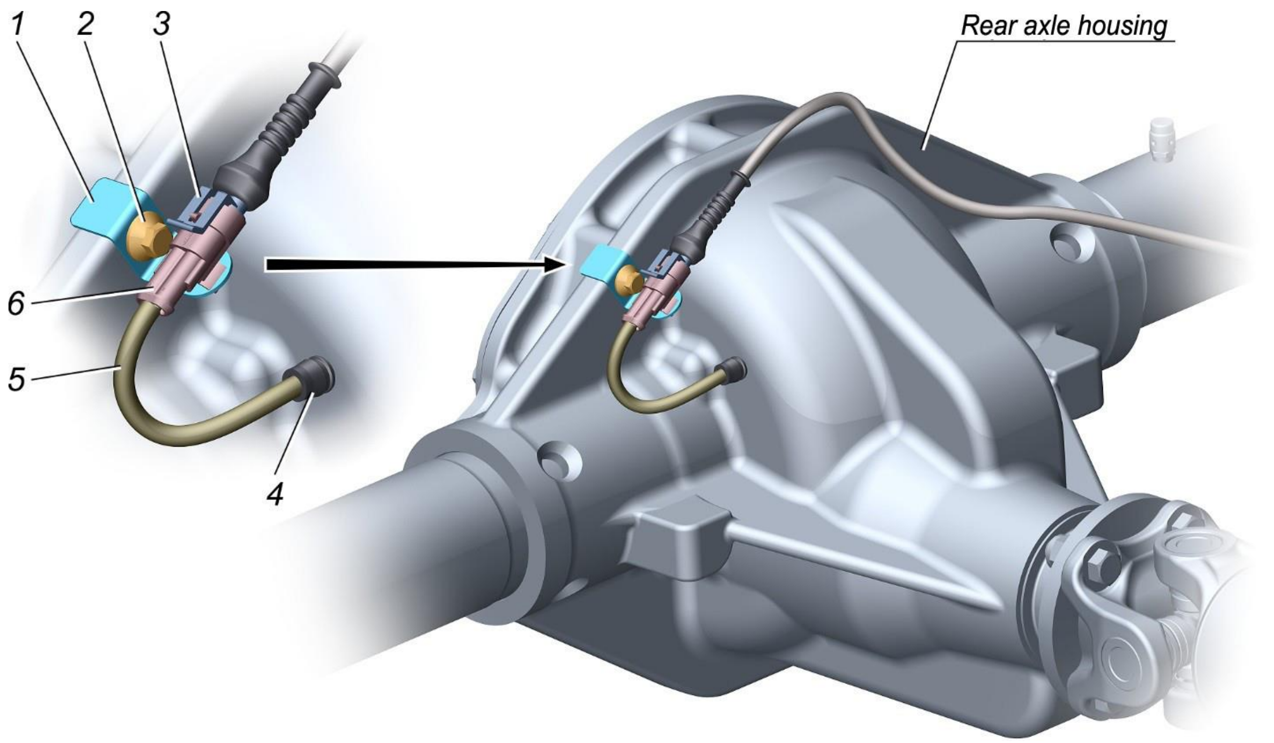


Fig. 3.58. Differential control wiring harness terminal attachment: 1 – bracket; 2 – bolt; 3 – car wiring harness receptacle; 4 – wiring harness seal; 5 – differential solenoid harness; 6 – pin shoe

Rear axle maintenance

During operation:

- check for oil leakage through final drive gear collar seal and wheel hub bearing seals, gearbox housing cover gaskets and axle shaft flanges, fill and drain plugs. Sweating at these areas is not a sign of leaking, when there is no dripping;
- clean the rear axle breather from dirt;
- check the axle housing oil level; fill the oil as necessary, change the oil according to the Vehicle operation manual;
- check axle shaft mounting bolts tightness.

Final drive bearings, backlash and final drive tooth bearing position are factory-adjusted; generally, adjustment is not required during operation. Adjustment is only required after the axle reassembly and parts replacement, or when the bearings are heavily worn. Do not reduce final drive gear backlash increased due to teeth wear by adjustment, as this will result in mesh failure causing increase in rear axle noise or teeth breakage. The taper bearing play shall be eliminated without disturbing the mutual position of the driven and driving gears.

To adjust the drive gear and differential bearing preload, backlash and tooth-contact pattern, disconnected propeller shaft, remove the axle shafts, remove the rear housing cover and perform necessary operations through the open hatch as outlined in the "Rear axle repair” subsection.

To assess the technical condition of rear axle reduction gear parts without disassembling, measure the total axle play.

Total axle play measurement

To measure the rear axle drive gear flange total play, proceed as follows:

- Place chocks under the vehicle rear wheels;
- disengage speed gear and brake the vehicle with parking brake;
- turn the propeller shaft by hand until effort is felt;
- apply marks (lines) on the flange deflector and reduction case (marks shall be aligned);
- turn the propeller shaft in the opposite direction by hand until effort is felt and apply mark on the housing aligned with the deflector mark;
- measure the distance between the housing marks. When this distance exceeds 12mm, it indicates excessive teeth wear of the drive and driven gears of the final drive, differential gears or splines of side gears and axle shafts.

Potential rear axle faults and remedies

Fault cause	Remedy
Increased axle noise (hum)	
Play or chipped working surfaces of the drive gear or differential bearings.	Check the bearing working surfaces; replace bearings as necessary. Adjust the bearing preload
Pulsating axle noise ("reeling")	
Loose driven gear mounting, or it is installed with a misalignment	Tighten driven gear mounting bolts with sealant and check driven gear tail runout
High-tone axle noise ("wailing")	
Abnormal oil level Non-recommended oil is used Improperly adjusted final drive gears teeth contact Scored working surface of the final drive teeth	Restore normal oil level Replace oil Check and adjust the tooth-contact pattern Replace final drive gears as a set
Heavy axle knock when pressing the throttle pedal sharply after coasting or turning	
Worn differential parts	Replace worn parts or differential assembly
Locking device actuation failure (for locking differential)	
Faulty electric actuator or worn differential parts	Troubleshoot the electrical actuator or replace the differential assembly (see "Locking differential wiring diagram")
Continuous axle knock or crunching	
Spalled or chipped gear teeth or bearings	Replace worn parts

Fault cause	Remedy
Axle knocks and intermittent noise from the wheels side	
Increased antitorque moment, rotation jamming or increased axial clearance in wheel hub bearings	Replace worn bearing
Oil leakage through the drive gear collar seal or sealing ring of the hub bearing to axle trunnion connection, and in the gearbox to cover, axle shaft flange to hub parting planes	
Damaged sealing lip of the drive gear collar seal, or the collar misalignment. Damaged sealing ring Dirty breather Damaged gearbox cover gasket, loose gearbox cover or axle shaft mounting bolts	Replace collar seal Remove sealing ring Clean breather Replace the defective reduction case cover gasket, or tighten mounting bolts with sealant previously applied on the axle shaft flange surface.

Rear axle repair

Tightening torques for rear axle threaded connections and sealants used

When assembling and installing the rear axle, maintain the following tightening torques:

- spider mounting bolts – 27.3-35.3 N·m (2.8-3.6 kgf·m). Prior to tightening the bolts, apply Loctite 243 (Henkel) or Weicon AN 302-43 (Weicon) sealant on the 3/4 of bolt thread length.

- bolts fastening the driven gear to the differential case – 67-74 N·m (6.8-7.5 kgf·m). Prior to tightening the bolts, apply Loctite 243 (Henkel) or Weicon AN 302-43 (Weicon) sealant to the bolt threaded portion on ¾ length.

- rear axle hub mounting nuts – 353-392 N·m (36-40 kgf·m);
- rear axle shaft mounting bolts – 90-125 N·m (9.0-12.5 kgf·m);
- rear axle parking brake base mounting screws – 98-122 N·m (10.0-12.5 kgf·m). Prior to tightening, apply Loctite 243 (Henkel) or Weicon AN 302-43 (Weicon) sealant to the screw threaded portion on 3-5 threads from screw face. No sealant getting on the parking brake working surfaces (brake shoes and brake disk surfaces) shall be allowed;
- rear axle disk brake mounting bolts – 157-196 N·m (16-20 kgf·m). Prior to tightening, apply Loctite 243 (Henkel) or Weicon AN 302-43 (Weicon) sealant on the bolt threaded portion over length of 3-5 threads from the bolt end;
- rear axle brake disk mounting screws – 88-108 N·m (9-11 kgf·m). Prior to tightening the screws, apply Loctite 243 (Henkel) or Weicon AN 302-43 (Weicon) sealant on the screw threaded portion end over length of 3-5 threads;

- bolts fastening the cover to the reduction case – 23.5-27.4 N·m (2.4-2.8 kgf·m);
- differential bearing cover mounting bolts – 90-110 N·m (9-11 kgf·m). Prior to tightening the bolts, apply Loctite 243 (Henkel) or Weicon AN 302-43 (Weicon) sealant to the bolt threaded portion on 3/4 length.
- differential bearing nut locking plate mounting bolts – 23.5-27.4 N·m (2.4-2.8 kgf·m).

Axle removal from vehicle

To remove the axle from vehicle, follow the procedure below:

- place the vehicle on trestle or inspection pit and place chocks under the front wheels
- apply the parking brake and set the gear-shift lever to neutral position;
- disconnect leads from the battery;
- unscrew the fill and drain plugs and drain oil from the axle housing;
- loosen mounting nuts of rear wheels and spring U-bolts;
- disconnect shock absorbers from axle brackets;
- unscrew nuts of bolts fastening the driveline to the rear axle drive gear flange and disconnect the propeller shaft from the rear axle by sliding it forward;
- raise the rear vehicle part, place temporary stand under the frame and lower the vehicle on it to provide the wheels raising off ground;
- unscrew wheel mounting nuts and remove the wheels;
- disconnect the rear parking brake control cables from the rear axle parking brake linkages; to do this:
    - loosen the parking brake control cables tension as much as possible by unscrewing the cable sheath end adjustment nuts;
    - disconnect cable and brake hose mounting brackets from the rear axle (these will hang on the cables);
    - unlock cables at brake linkage brackets by removing fixing clips;
    - pulling the sheath end, pull the cable through the slot out of the brake linkage bracket and further out of engagement with the expanding link lever (perform the same operation for the other cable);
- disconnect and remove rear axle flexible brake hoses (see instructions in "Brakes" section);
- disconnect ABS sensors from the axle (see "Electrical equipment" section);
- disconnect the differential solenoid wiring harness receptacle from the vehicle harness [1)];
- bring the trolley-hoist under the rear axle and lift the axle;
- unscrew the spring U-bolt mounting nuts, disconnect the rear suspension stabilizer brackets and remove the U-bolts;
- lower the rear axle and slide it out from under the vehicle.

Rear axle installation to vehicle

To install the axle to vehicle, follow the procedure below:

- place the rear axle on the trolley-hoist to ensure its stable position;
- place the trolley-hoist with the rear axle under the vehicle with the rear frame part resting on the temporary stand.
- lift the axle and place it under the springs exactly at the mounting location so that the spring tie bolt heads enter the holes in the axle spring pads;
- install U-bolts, rear suspension stabilizer brackets, shock absorbers, pre-tighten the U-bolt nuts. Remove the trolley-hoist from under the axle;
- connect the differential solenoid wiring harness receptacle to the vehicle harness[1)];
- connect ABS sensors to the axle (see "Electrical equipment" section);
- install and secure rear axle flexible brake hoses (see instructions in "Brakes" section);
- connect rear parking brake control cables to rear axle parking brake linkages in reverse order to removal;
- install the wheels and pre-tighten the mounting nuts. When installing the wheels, the valves shall be diametrically opposed to each other with valve extension screwed on tightly
- remove the temporary stand from under the frame and lower the vehicle
- finally tighten the spring U-bolt and wheel mounting nuts;
- connect propeller shaft to drive gear flange;
- fill oil into the axle housing
- test for functioning and bleed the brake system;
- test parking brake for functioning (see "Brakes" section).

[1)] - For vehicles with locking rear axle differential

Rear axle disassembly

Rear axle hub part disassembly

To disassemble the axle, follow the procedure below:

- remove disk brakes by loosening two mounting bolts per each (see "Brakes" section);
- unscrew eight axle shaft mounting bolts per each and remove axle shafts using the puller (Fig. 3.77). To make sure that the legs 1 enter the hub recessions, bring legs together to the stop when unscrewing the bolt 2 from the axle 4. By turning screw 3, disengage axle shaft 5 from side gear;

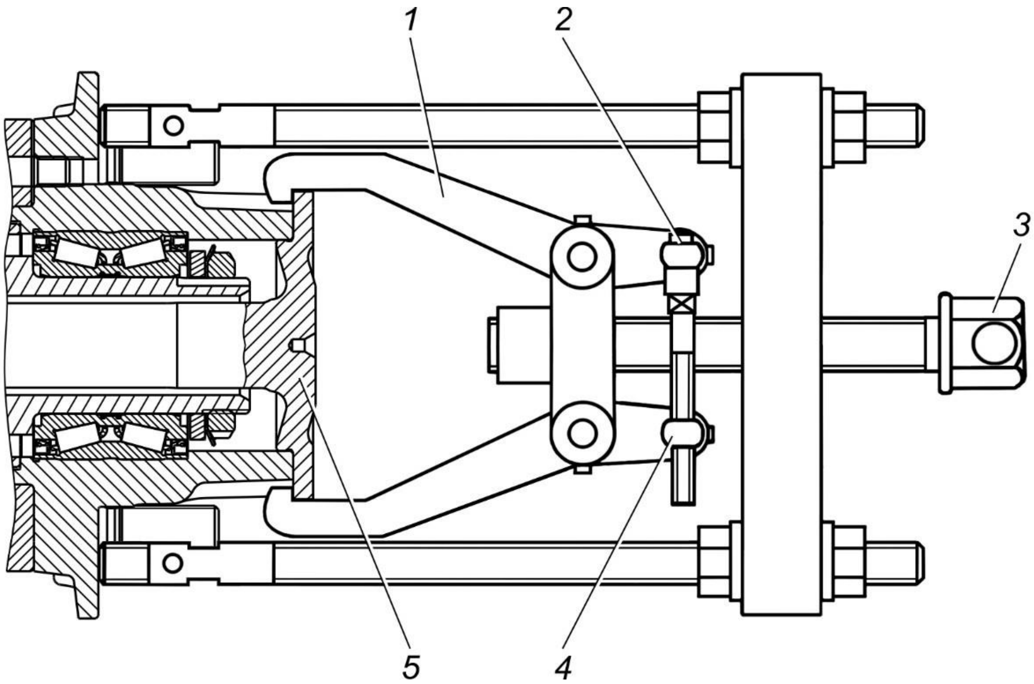


Fig. 3.77. Rear axle shaft removal: 1 – legs; 2 – bolt; 3 – screw; 4 – axle; 5 – axle shaft

- bend the lock washer tab out of the nut slot, unscrew the hub bearing mounting nut, remove the lock washer and thrust washer;
- remove the hubs with brake disks and bearings, remove the sealing rings.

To replace brake disk, unscrew six mounting screws and remove the disk from the hub.

To replace ABS rotor, press the rotor from the hub using the puller with puller legs inserted into the rotor holes (Φ10mm).

To replace double-row bearing, press the rotor from the hub, remove the retaining ring and press the bearing out of the hub using a mandrel.

- unscrew four screws per each fastening parking brake base to housing flange and remove parking brakes complete with shoes.
- unscrew breather.

Rear axle reduction part disassembly

To disassemble the axle reduction part, follow the procedure below:

- unscrew the bolts fastening the cover to the reduction case (23.5-27.4 N·m (2.4-2.8 kgf·m) and remove the cover and gasket;
- unscrew the differential bearing nut retainer plate mounting bolts, remove retainer plates;
- push the solenoid wiring harness seal from the outside into the housing[1)];
- unscrew the differential bearing cover mounting bolts, remove the solenoid retainer plate[1)], remove covers, remove the bearing nuts and the differential assembled with driven gear. Mark the bearing covers and outer races, so that to install to original positions when reassembling;
- unstake and unscrew the drive gear flange mounting nut, remove the flange, remove the drive gear;
- remove the drive gear outer bearing collar seal and inner race from the housing;
- remove the bearing spacer bushing and press the drive gear rear bearing inner race out using the puller as shown in Fig. 3.78. To fit insert 4 shoulders tightly between the bearing cage and gear, squeeze supports 2 with bolts and nuts 3. Remove the bearing inner race by turning the screw 1;
- remove the adjustment ring;
- in case of replacement, press the drive gear bearing outer races out of the reduction case.

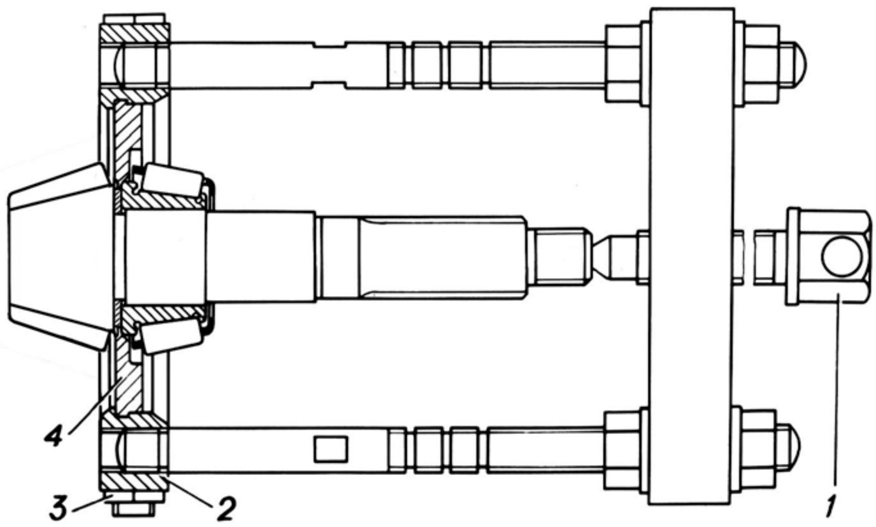


Fig. 3.78. Bearing removal from the final drive gear: 1 – puller screw; 2 – support; 3 – nut; 4 – insert

[1)] - For vehicles with locking rear axle differential

Differential disassembly

ATTENTION
(For vehicles with locking rear axle differential)
When dismantling the locking differential driven gear and bearings, take care not to damage the solenoid wiring harness and seal.
Due to the restricted distance from the solenoid 5 (see Fig. 3.73) to the locking differential bearing, differential bearings shall be dismantled with great care avoiding the puller insert 1 (Fig. 3.79) impact on the solenoid to prevent its breaking.

To disassemble the differential, follow the procedure below:

- unscrew the driven gear mounting bolts, remove the driven gear;
- in case of replacement, press the bearing inner races from the differential cases complete with inserts using the puller as shown in Fig. 3.79. To fit insert 1 shoulders tightly in the differential case recesses, squeeze supports 2 with bolts and nuts 3; press the bearing race by turning the screw 5;

For non-locking differential

- unscrew differential case mounting bolts, separate cases, remove support washers, pinion gears, side gears and pinion gear axes.

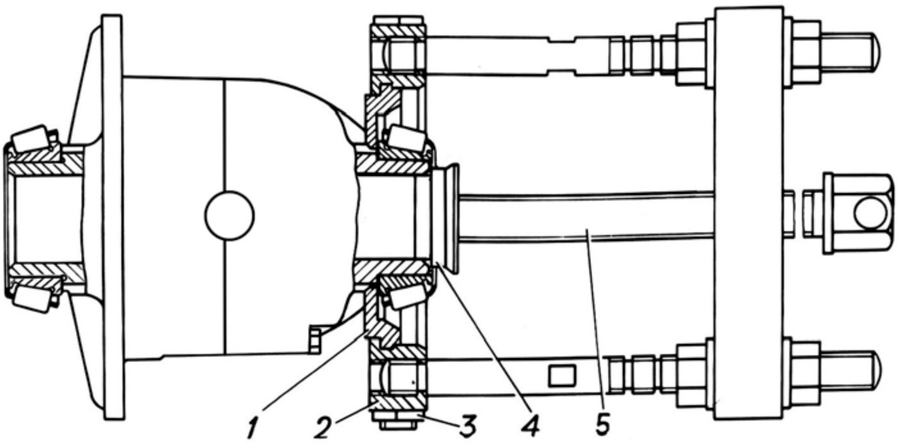


Fig. 3.79. Removing the bearing inner race from the differential compensating case:
1 – insert; 2 – support; 3 – nut; 4 – thrust block; 5 – puller screw

Rear axle parts inspection and control

Disassembled rear axle parts (except bearings) shall be thoroughly washed and dried. Wash bearings in clean washing solution and blown with compressed air. After washing, thoroughly inspected parts for:

- gasket tears;
- nicks and scores on the machined surfaces;
- scoring, chipping and spalling on the gear teeth surfaces;
- pitting, wear of running surfaces of bearing rollers and races;
- step wear of roller ends, burn marks;
- - wear and galling on thrust washers and mating surfaces of differential cases, side gears and pinion gears, mating surfaces of the pinion gear axes and pinion gears (for dismountable differential), axle housing trunnions, the drive gear flange surface at the collar seating area;
- damage to threads of adjustment nuts of differential bearings and hubs, reduction case and rear axle trunnions;
- damage to threaded holes;
- damage on the drive gear flange end and seat face (driveline flange mating surfaces);
- bent axle shafts (when checking at the centers, maximum hub seat face runout – 0.05mm, maximum flange end runout – 0.08mm);
- thread wear and loose fit of wheel to hub mounting bolts.

Remove all irregularities and burrs from the seating and mounting faces. In case of excessive wear, parts shall be replaced with new ones. Parts to be replaced as a set:

- drive and driven gears of the final drive;
- right and left spiders (for demountable differential);
- side gears and pinion gears (for demountable differential).

The collar seals shall be replaced in case of damaged or worn lip.
Re-installation of dismantled collar seals shall not be allowed.

Rear axle assembly

When assembling rear axle:

- Apply Loctite 5900 (Henkel) or Loctite 5699 (Henkel) sealant on oil fill and oil drain plugs, and the cover gasket;

- Apply uniform layer of Loctite 518 sealant on the axle shaft flange surface adjacent to the hub.

CAUTION
1. Tightening of threaded connections shall be completed in the screw-in stroke.
2. Prior to installation, lubricate the reduction gear taper bearings with the oil used in the axle.
3. Threaded joints installed with sealant shall be cleaned, degreased and dried prior to applying sealant.

C41R92 – 2403011 differential assembly

Prior to assembly, lubricate all rubbing surfaces of differential parts with oil used in the axle. To assemble the differential, follow the procedure below:

- install side gear washer 4 and side gear 5 to one of spiders 2 or 10 (Fig. 3.80). Install the washer with extrusions facing the side gear;

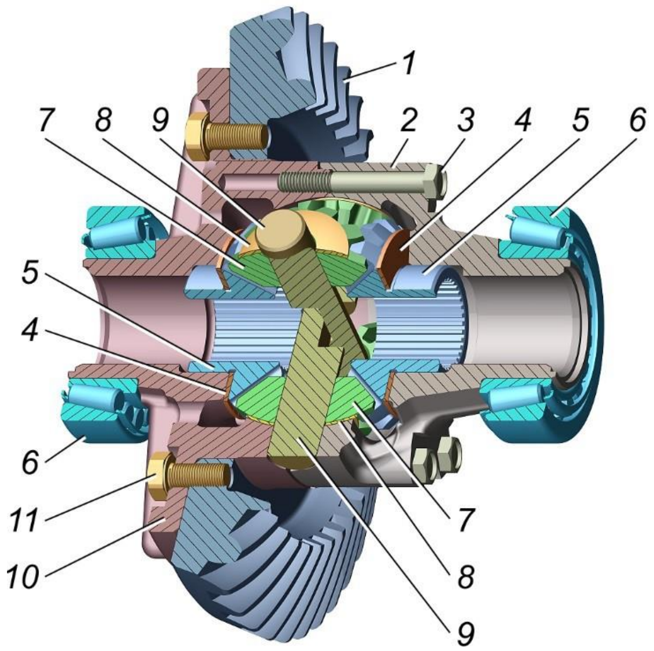


Fig. 3.80. Differential assembly with driven gear: 1 – driven gear; 2– right differential spider; 3,11 – bolts; 4 – side gear washer; 5 – side gear; 6 – bearing; 7 – pinion gear; 8 – pinion gear washer; 9 – pinion gear axis; 10 – left differential spider.

- install pinion gears 7 and pinion gear support washers 8 to the pinion gear axis 9;
- install the pinion gear axis with pinion gears and washers to the spider with the slot upwards;
- assemble the second pinion gear axis as above;

- install the second pinion gear axis with the slot down and install the second side gear and washer on top. Install the washer with extrusions facing the side gear;

- install the second spider so that the marks on the right and left spiders are opposite to each other;

- screw and tighten the spider mounting bolts 3 with anaerobic sealant previously applied to the threaded bolt portion. Prior to applying the sealant, clean the part surfaces from the old sealant and degrease;

- check the differential gears free rotation by rotating one of the side gears using splined mandrel with the stationary differential housing.

The rotation shall be smooth, without jamming. The torque required to start the differential gears shall not exceed 15 N·m (1.5 kgf·m).

Installation of differential and driven gear bearings [1)]

To assemble the differential, follow the procedure below:

ATTENTION
(For vehicles with locking rear axle differential)

When assembling the locking differential driven gear and bearings, take care not to damage the solenoid wiring harness and seal.

- press driven pinion 1 on the left spider and fasten it with bolts 11. Prior to tightening the bolts, apply anaerobic sealant on the threaded end;

- to check the driven gear tail runout, install the differential to the fixture (Fig. 3.81); runout shall not exceed 0.06mm. When it exceeds this value, remove the driven gear, turn by half a turn and reinstall to the spider, then recheck runout;

[1)] - For C41R92-2403011, C41R92.2403011 and C45R92-2403011 rear axle differentials

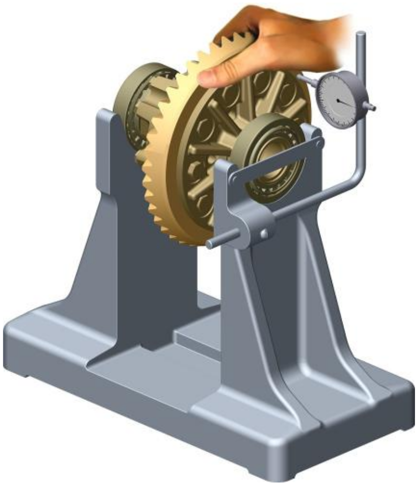


Fig. 3.81. Driven gear tail runout check

- press inner races of bearings 6 on the right and left differential spider journals up to the stop at the shoulder. The 0.03mm feeler gauge shall not enter between the bearing end faces and spider support shoulders.

Axle reduction part assembly

To the axle reduction part, follow the procedure below:

- install the adjustment ring 8 (see Fig. 3.70) on the drive gear and press-on the rear bearing 7 inner race to the stop.

When installing new drive gear, final drive gear or axle housing bearings, adjust the drive gear position by selecting the adjustment ring of proper thickness.

To adjust the drive gear position, follow the procedure below:

- press the outer races of drive gear bearings 4 and 7 in the housing neck to the stop. The 0.03mm feeler gauge shall not enter between the housing end face and the race;
- install special mandrel #1 (Fig. 3.82) with the drive gear bearing inner races in the reduction case;
- to make special mandrel, use substandard drive gear grinding the neck D for the rear bearing to a diameter of $45^{-0,010}_{-0,025}$mm and the rear face B with the end runout tolerance relative to the C and D surfaces of 0.02mm, and measure the actual size A;

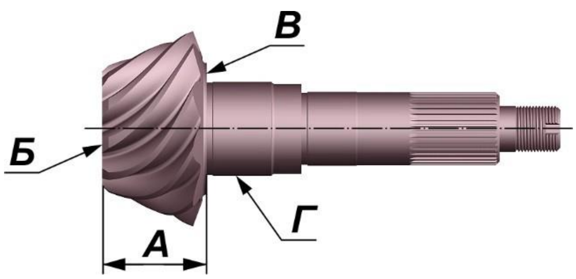


Fig. 3.82. Special-purpose mandrel #1

- install flange 2 (see Fig. 3.70) and tighten the mounting nut to the mandrel antitorque moment 1.5-2.5 N·m (0.15-0.25 kgf·m) for new bearings and 0.5-1.0 N·m (0.05-0.10 kgf·m) for used bearings (mileage of over 50km). When tightening the nut, rotate the mandrel for correct positioning of bearing rollers;
- install special mandrel #2 (Fig. 3.83) in the reduction gear case sockets for differential bearings, install and fasten differential bearing covers;

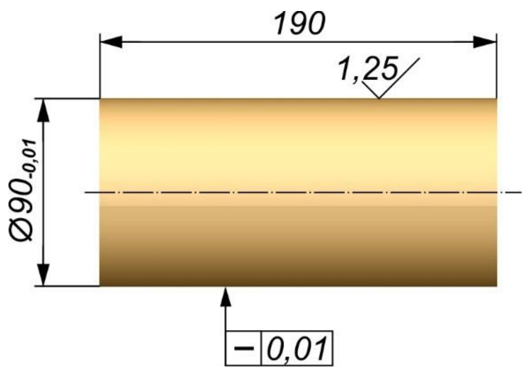


Fig. 3.83. Special-purpose mandrel #2

- measure dimension B (Fig. 3.84) from the rear face of mandrel #1 to mandrel #2;

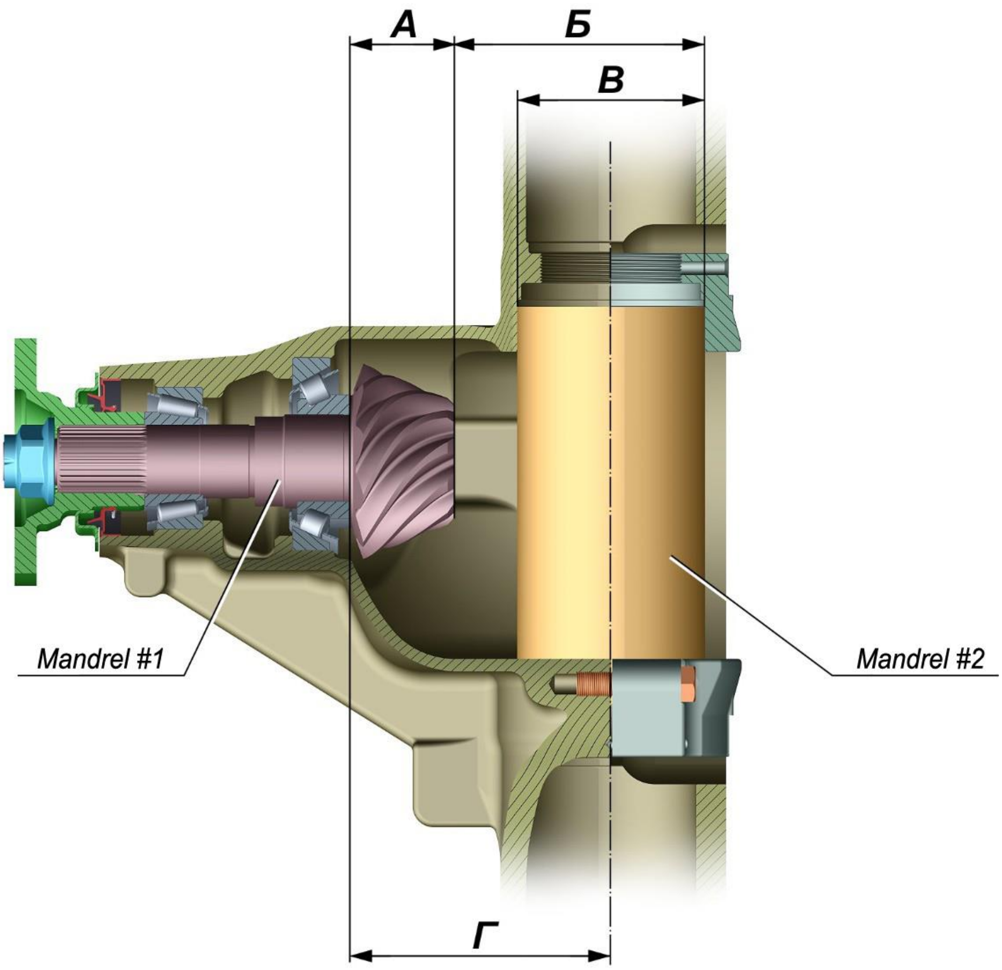


Fig. 3.84. Drive gear position adjustment diagram

- determine the dimension G from the differential axis to the end face of the drive gear rear bearing; D = A + B - C/2;

- determine the adjustment ring thickness H = D - F, where the dimension F = 121.98-122.02mm (see Fig. 3.70) - the distance between the differential axis and the drive gear end face adjacent to the adjustment ring;

- select the adjustment ring of the required thickness $H_{-0.01}$ (see Table 3.6);

Table 3.6

Adjustment rings for the drive gear mounting

Group number	Adjustment ring thickness	Group number	Adjustment ring thickness
1	3.37	12	3.15
2	3.35	13	3.13
3	3.33	14	3.11
4	3.31	15	3.09

Group number	Adjustment ring thickness	Group number	Adjustment ring thickness
5	3.29	16	3.07
6	3.27	17	3.05
7	3.25	18	3.03
8	3.23	19	3.01
9	3.21	20	2.99
10	3.19	21	2.97
11	3.17	22	2.95
		23	2.93

- remove temporary mandrels #1 and #2 and bearing inner races;
- install the selected adjustment ring to the drive gear and press-on the rear bearing inner race.

To adjust the drive gear bearing preload, follow the procedure below:
- install the drive gear front bearing inner race in the housing;
- press new four-lip drive gear collar seal in the housing without misalignment using a special mandrel taking are not to damage the collar end dust boot. After pressing, the collar end face shall be at most 0.6mm lower the housing face and parallel to it with tolerance of 0.15 mm. The collar face shall not protrude above the housing face.

ATTENTION
Do not remove the factory-applied lubricant between the two radial dust boots of collar seal. Do not apply any grease or gear oil on the collar working surfaces and drive gear flange prior to collar pressing-in.

- install drive gear with new spacer bushing to the housing and tighten the nut to the drive gear antitorque moment of 1.5-2.5 N·m (0.15-0.25 kgf·m) for new bearings and 0.5-1.0 N·m (0.05-0.10 kgf·m) for used bearings (mileage of over 50km). Replace the flange nut with a new one to ensure the necessary adjustment accuracy. When tightening the nut, periodically measure the drive gear antitorque moment. After the final adjustment, the drive gear bearing antitorque moment increase to 3.0 N·m (0.3 kgf·m) for new bearings and to 1.5 N·m (0.15 kgf·m) for used bearings shall be allowed. When the drive gear bearing antitorque moment exceeds 3.0 N·m (0.3 kgf·m) for new bearings and 1.5 N·m (0.15 kgf·m) for used bearings, replace the spacer bushing and readjust.

To adjust the bearing preload, tooth-contact pattern and final drive gears backlash, follow the procedure below:

ATTENTION
(For vehicles with locking rear axle differential)

When installing the locking differential in the rear axle reduction case, take care not to damage the solenoid wiring harness and seal.
After installation, insert the wire with the seal into the reduction case hole and install the seal until the seal shoulder stops at the case inner surface.
Prior to screwing in the differential bearing cover mounting bolts, install the solenoid retainer plate under the bolt heads. The solenoid protrusion shall fit into the retainer plate groove. Contact between retainer plate and the solenoid surface shall not be allowed.

- install differential complete with driven gear and bearings, and differential bearing adjustment nuts to the housing. The bearing outer races shall be tightly pressed against the inner races;
- install the differential bearing covers, tighten mounting bolts to maximum torque ensuring the tightening of the differential bearing adjustment nuts. Prior to installation, apply Loctite 243 (Henkel) or Weicon AN 302 43 (Weicon) anaerobic sealant on 2/3 of the bolt thread length. Prior to applying the sealant, clean the part surfaces from the old sealant and degrease;
- install the indicator fixture No.87334757 by screwing in the bearing cover holes for the adjustment nut retainer plate bolts as shown in Fig. 3.85;

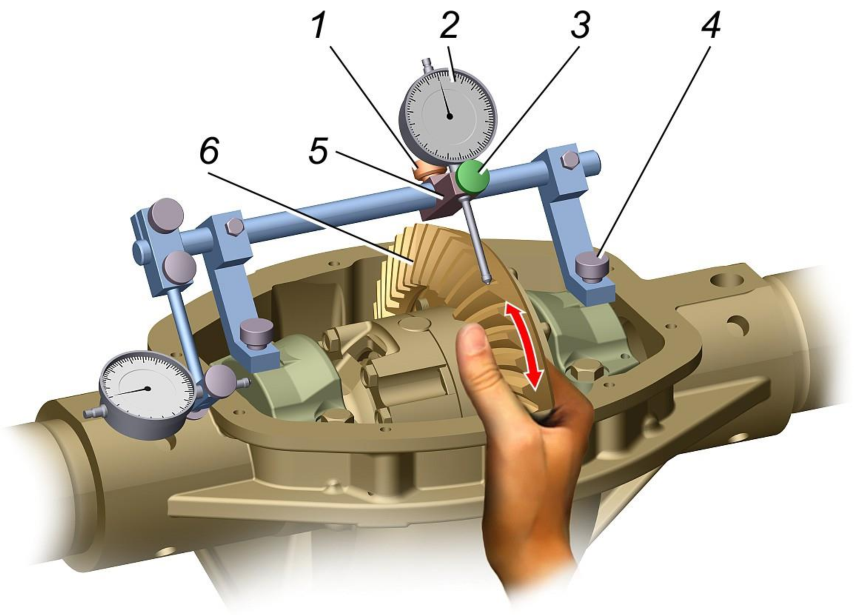


Fig. 3.85. Final drive gears backlash check with indicator fixture: 1 – bracket tightening screw: 2 – indicator for checking the driving and driven gears backlash; 3 – indicator rod mounting screw: 4 – indicator bracket; 5 – mounting screw; 6 – driven gear

- press differential bearing adjustment nuts with a slight force and set the backlash of 0.19-0.21 mm (for new gears). Perform measurement (at least three points evenly spaced around the driven gear circumference) with indicator perpendicular to the driven gear tooth at large pitch by rocking driven gear in both directions until the driven gear tooth contacts with the drive gear tooth. When adjusting the bearings, rotate the drive gear for correct positioning of bearing rollers;

- alternately tighten the differential bearing adjustment nuts to the drive gear antitorque moment increase by 1.5-3.0 N·m (0.15-0.30 kgf·m) for new bearings and 0.5-1.0 N·m (0.05-0.10 kgf·m) for used bearings (mileage of over 50km).

When tightening the nuts, periodically measure the drive gear antitorque moment. Do not loosen the differential bearing adjustment nuts to meet the backlash and bearing preload requirements. To adjust, first loosen the nuts by 2-3 notches and then tighten.

Then tighten the differential bearing cover bolts and recheck the backlash;

- check the tooth-contact pattern at the gears. To do this, apply thick red-lead putty on the teeth, then rotate the drive gear with slight effort first in one direction, and then oppositely. In case of wrong tooth contact pattern, change the drive and driven gears positions to achieve the required pattern. Then recheck the differential bearings preload, backlash amount and tooth contact pattern (Fig. 3.86.);

- lock the drive gear nut by pushing the nut neck dent into the drive gear groove;

- install the retainer plates of the differential bearing nuts and secure with bolts;

- install the housing cover and gasket and tighten the bolts. Prior to installation, apply sealant on both gasket sides.

ATTENTION
(For vehicles with locking rear axle differential)

Connect the differential solenoid wiring harness to the differential solenoid pin shoe.

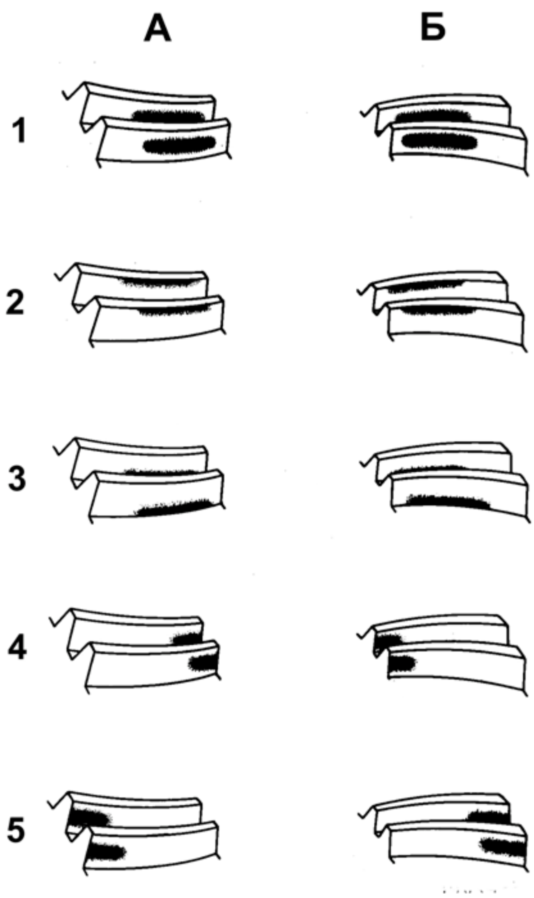


Fig. 3.86. Final drive gears tooth-contact pattern: A – forward speed sides; B – reverse speed sides; 1 – correct tooth-contact pattern; 2 – tooth-contact pattern is located at the tooth tip – to correct, move the drive gear towards the driven gear; 3 – tooth-contact pattern is located at the tooth root – to correct, move the drive gear away from the driven gear; 4 – tooth-contact pattern is located at the narrow tooth end – to correct, move the driven gear away from the drive gear; 5 – tooth-contact pattern is located at the wide tooth end – to correct, move the driven gear towards the drive gear.

Rear axle hub part assembly

To assemble the rear axle hub part, follow the procedure below:

- screw-in breather;
- install parking brakes (left and right) complete with shoes to the axle housing flanges as shown in Fig.3.71 and fasten with screws. Prior to screwing in the mounting screws, apply sealant on the threaded screw portion. No sealant getting on the parking brake shoes and disk working surfaces shall be allowed. (For the parking brake repair and assembly, see supplier's documentation);
- assemble hubs with brake disks and bearings.

In case of thread wear and wheel mounting bolt loosening in the hub (due to bolt wear), press a new bolt in the hub to the stop to ensure tight fit, or replace the hub in case of hub bolt hole wear.

Install the brake disk to the hub and fasten with screws. Prior to screwing in the mounting screws, apply sealant on the threaded screw portion.

In case of replacement, press the double-row taper bearing in the hub to the stop applying force to the outer bearing race.

ATTENTION
When pressing the bearing in, the collar seal shall face toward the hub as shown in Fig. 3,72.

Install retaining ring, press ABS rotor in hub to the stop;

- install the hub with brake disk and bearing to the axle trunnion with new sealing rings 8 (see Fig. 3.54) previously installed, install thrust and lock washers, screw on the slotted nut and adjust the tightness.

Tighten the slotted nut to torque of 353-392 N·m (36-40 kgf·m). Rotate the hub while tightening to ensure proper positioning of rollers. Bend one lock washer tab into the nearest nut slot. It is allowed to tighten up the nut until one of the slots coincides with the nearest lock washer tab.

- insert axle shafts, install washers and tighten the axle shaft mounting bolts with sealant previously applied uniformly on the axle shaft surface adjacent to the hub. No sealant getting on the hub bearing, in the hub threaded holes, on the hub mounting nut shall be allowed;
- install the drain plug in the axle housing with sealant previously applied on thread;
- install the right and left disk brakes as shown in Fig. 3.69. Bleeding valve 7 shall be on top. Tighten mounting bolts uniformly with sealant previously applied on the threaded bolt portion;

- fill the axle with oil according to the Vehicle operation manual and tighten the fill plug;
- adjust the parking brake system linkage levers positions (see "Brakes" section);
- install the assembled axle on the running-in rig and check the noise level, heating and the oil leaks through the joints at forward and reverse gears at the drive gear speed of 1000, 1500, 3000 min^{-1}.

Noise generated by the axle shall be uniform without sudden changes, wailing, knocking and scraping noise The sound pressure level shall not exceed the sound pressure level of the control sample approved in accordance with the established procedure.

To inspect the axle, follow the procedure below:

- no-load test at drive gear speed 1000 min^{-1};
- electromechanically actuated parking brake system adjustment (see "Brakes" section);
- differential operation check;
- check with simultaneous braking of both axle shafts at drive gear load of 20-30 N·m (2-3 kgf·m) with a smooth drive gear speed increase and decrease at all speeds in both directions.

Differential operation shall be checked at the drive gear speed of 1000 min^{-1} while alternately smoothly braking the brake disks. Test duration - minimum 1 min. No differential seizures and jamming shall be allowed.

The total test axle and running-in duration shall be at least 3 min. The best test results are obtained with the oil heated to temperature of 50-70°C and axle pressurized to 20-30 kPa (0.2 0.3 kgf/cm^2).

During axle leak-tightness test, no grease expelling and leakage shall be allowed. "Sweating" and oil stains not impairing normal axle operation shall be allowed at the collar seals areas and breather area.

During the check, the temperature of the hub outer surface and final drive case heating at the bearing areas after the axle running-in shall not exceed 70ºC (not endured by hand).

After running-in, drain oil through the drain hole to clean the magnet and fill fresh oil according to the Vehicle operation manual. Apply sealant to the threaded plug surface prior to installation

When assembling the rear axle, observe the dimensions of the rear axle mating parts (Table 3.7).

Drive gear collar seal replacement

To replace the collar seal, follow the procedure below:

- drain the oil from the rear axle housing;

- disconnect driveline, remove axle shafts, dismantle reduction gear cover and gasket where necessary;
- use a torque wrench to measure the drive gear antitorque moment;
- unstake and unscrew the nut and remove the drive gear flange;
- dismantle the collar seal and spacer bushing with the front bearing inner cage;
- install new spacer bushing and install the bearing inner cage;
- press new drive gear collar seal in the housing without misalignment using a mandrel (see "Drive gear bearing preload adjustment" sub-section);
- install the drive gear flange;
- tighten the drive gear nut to the drive gear antitorque moment equal to previously measured value plus 0.1-0.3 N·m (0.01-0.03 kgf·m). When tightening the nut, periodically measure the drive gear antitorque moment. When the antitorque moment exceeds the required value, remove the differential, replace the spacer bushing and readjust (see "Axle reduction part assembly" sub-section);
- install reduction gear cover and gasket, axle shafts, propeller shaft (see "Axle assembly" sub-section);
- fill the axle with oil (see "Axle assembly" sub-section).

Table 3.7

Dimensions of rear axle mating parts, mm

Mating parts	Hole	Shaft	Fit
Reduction case – drive gear front bearing	$Ø72^{-0.021}_{-0.051}$	$Ø72_{-0.016}$	$\text{Preload}^{0.005}_{0.051}$
Drive gear – front bearing	$Ø35_{-0.012}$	$Ø35^{-0.009}_{-0.025}$	Clearance 0.025 Preload 0.003
Reduction case – drive gear rear bearing:	$Ø100^{-0.024}_{-0.059}$	$Ø100_{-0.018}$	Preload $_{0.059}{}^{0.006}$
Drive gear – rear bearing:	$Ø45_{-0.012}$	$Ø45^{+0.033}_{+0.017}$	$\text{Preload}^{0.017}_{0.045}$
Reduction case – differential bearing	$Ø90^{+0.035}$	$Ø90_{-0.018}$	$\text{Clearance}^{0.000}_{0.053}$
Differential spider – bearing	$Ø50_{-0.012}$	$Ø50^{+0.039}_{+0.020}$	$\text{Preload}^{0.020}_{0.051}$ $\text{Preload}^{0.020}_{0.051}$

Mating parts	Hole	Shaft	Fit
Differential spider (optional) – bearing	$Ø50_{-0.012}$	$Ø50^{+0.033}_{+0.017}$	
Differential spider RH and LH	$Ø118^{+0.035}$	$Ø118_{-0.035}$	$\text{Clearance}^{0.000}_{0.070}$
Differential spider – side gear	$Ø45^{+0.039}$	$Ø45^{-0.050}_{-0.085}$	$\text{Clearance}^{0.050}_{0.124}$
Differential compensating case – spider pin	$Ø20^{+0.021}$	$Ø20_{-0.021}$	$\text{Clearance}^{0.000}_{0.042}$
Differential compensating case – driven gear	$Ø125^{+0.016}$	$Ø125^{+0.028}_{+0.003}$	Clearance 0.013 Preload 0.028
Pinion gear – spider pin	$Ø20^{+0.145}_{+0.100}$	$Ø20_{-0.021}$	$\text{Clearance}^{0.100}_{0.166}$
Axle housing trunnion – hub bearing	$Ø55_{-0.015}$	$55^{-0.025}_{-0.050}$	$\text{Clearance}^{0.010}_{0.050}$
Hub – bearing	$Ø90^{-0.058}_{-0.093}$	$Ø90_{-0.018}$	$\text{Preload}\ ^{0.040}_{0.093}$
Hub – ABS sensor rotor	$Ø100^{+0.035}$	$Ø100^{+0.093}_{+0.071}$	$\text{Preload}\ ^{0.036}_{0.093}$

4. Chassis

4.1. Front suspension

The front vehicle suspension is independent spring-loaded wishbone suspension (with transverse arms arrangement) with hydraulic single-tube gas-filled double-acting shock absorbers and antisway bar; it is designed as a single unit with steering gear and steering links.

4.1.1. Front suspension structure

Front suspension installation to the vehicle is shown in Figure 4.1.
The front suspension installed to the vehicle is shown in Fig. 4.2.

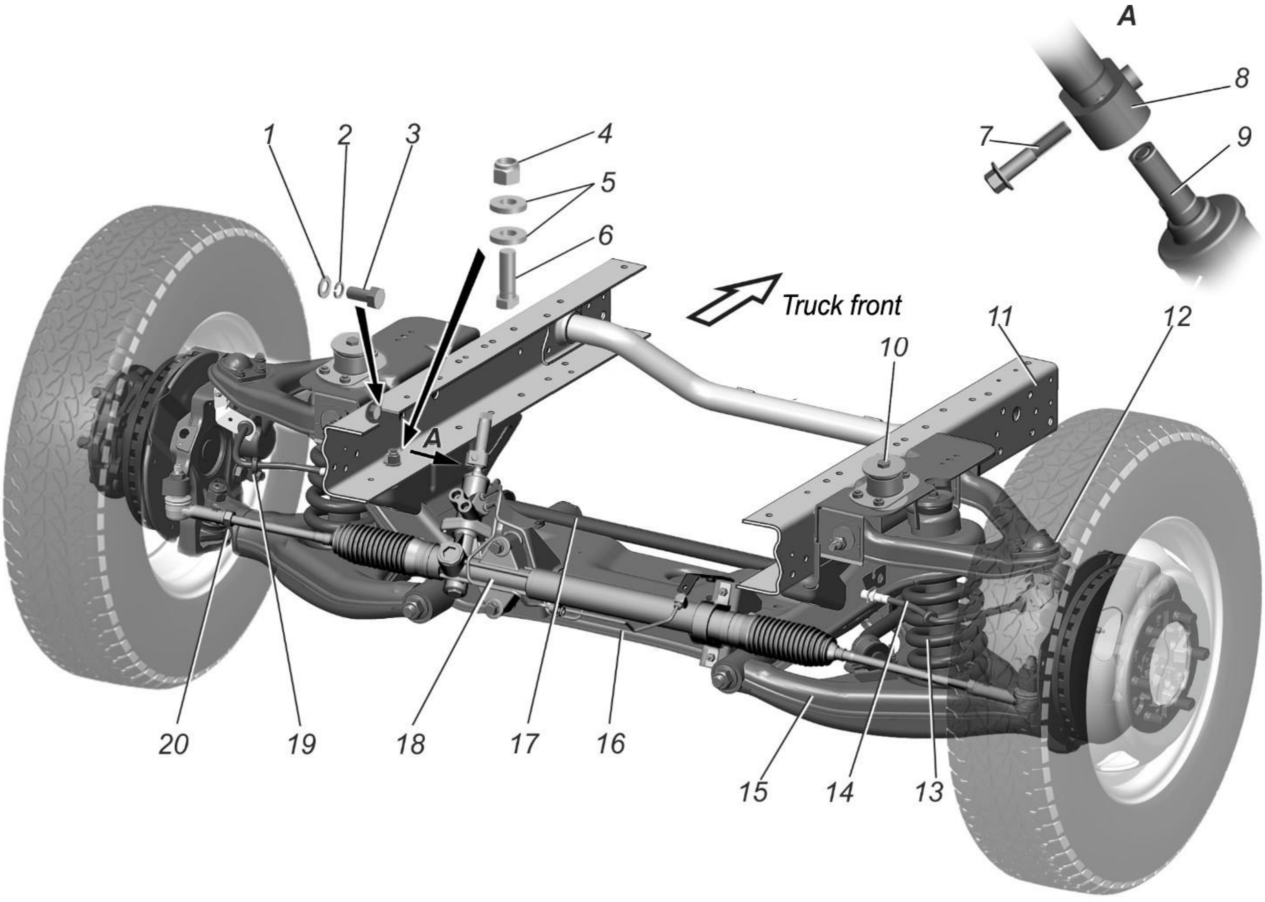


Fig. 4.1. Installation of front suspension with steering gear: 1, 2, 5 – washers; 3, 6, 7 – bolts; 4 – nut; 8 – steering universal joint; 9 – steering gear input shaft; 10 – front body support mounting bolt; 11 – frame; 12 – upper ball joint; 13 – spring; 14 – front brake hose; 15 – lower arm; 16 – subframe; 17 – antisway bar; 18 – steering gear; 19 – brake caliper mounting bolt; 20 – lower ball joint.

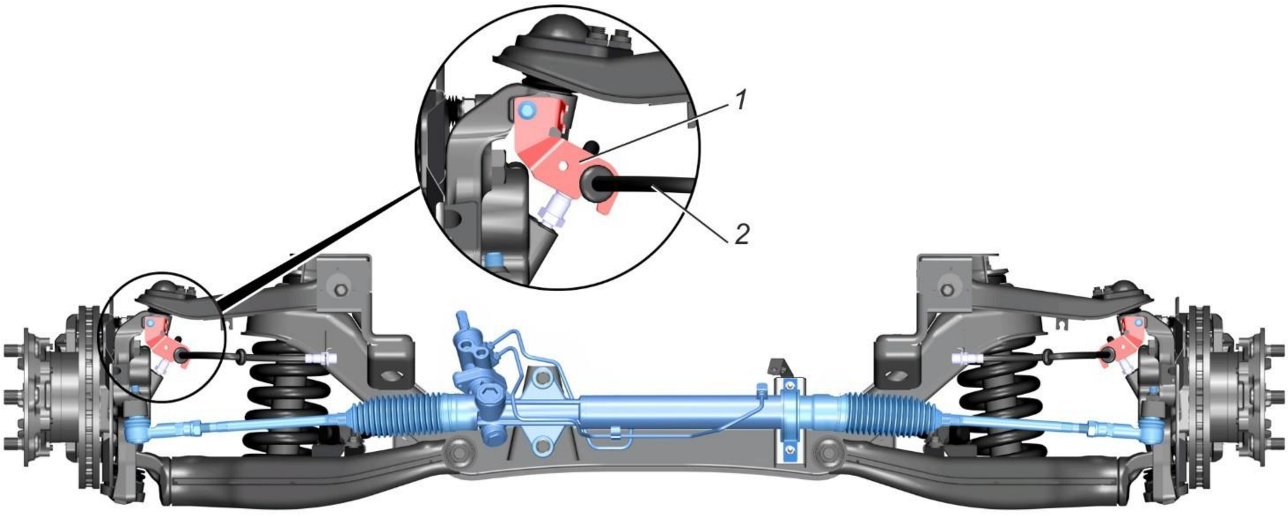


Fig. 4.2. Front suspension with brake hoses: 1 – left brake hose bracket; 2 – front brake flexible hose

Front suspension (Fig. 4.3 and 4.4) is an independent unit assembled on a detachable subframe.

The suspension subframe is bolted to the vertical and lower horizontal flanges of the vehicle frame girders.

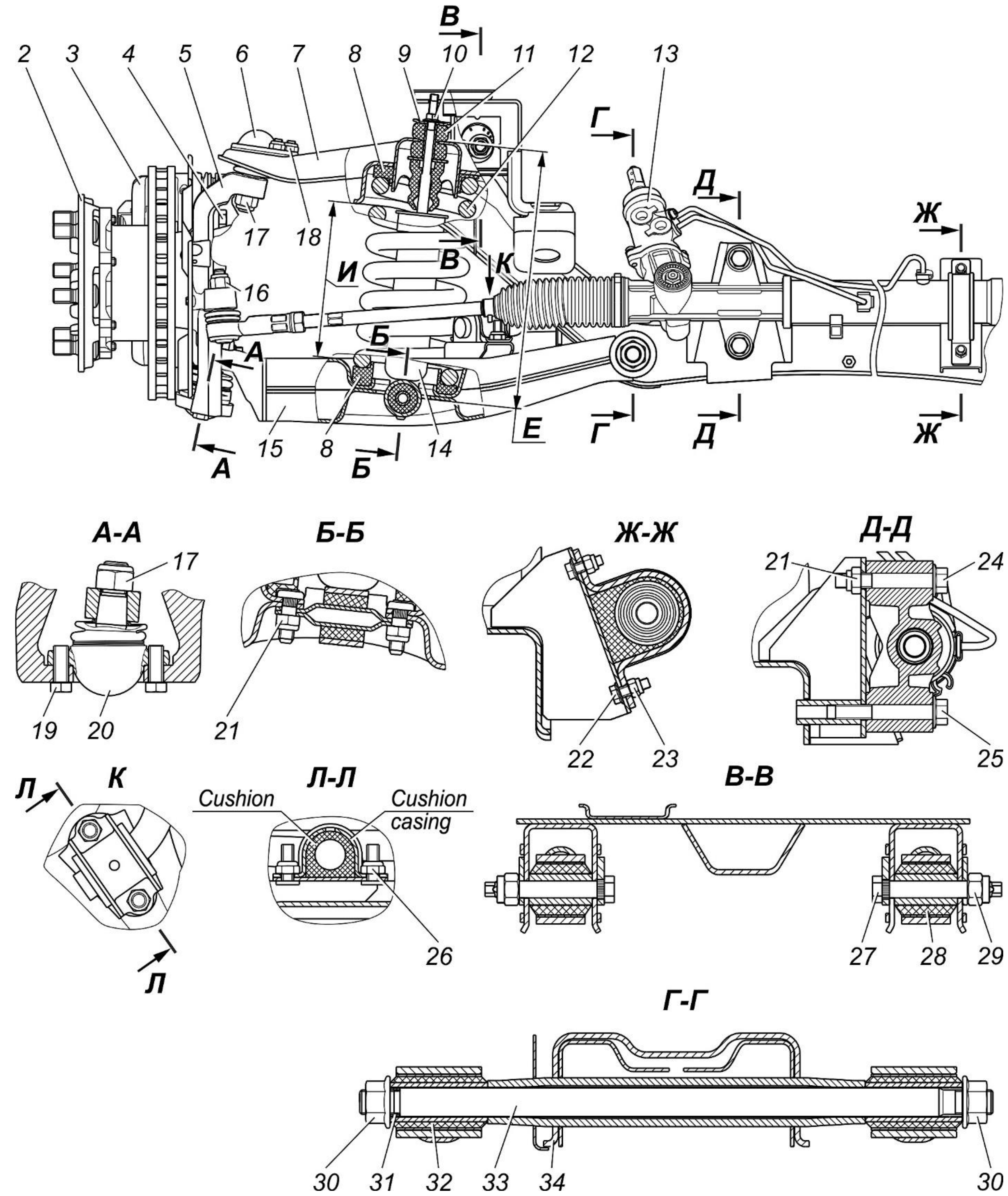


Fig. 4.3. Front suspension with steering gear: 1 – wheel cap mounting bracket; 2 – strut with hub and brake disk; 3 – brake caliper; 4 – brake caliper to strut mounting bolt; 5 – strut; 6 – upper ball joint; 7 – upper arm; 8 – spring gasket; 9 – washer; 10, 16, 17, 18 ,21, 23, 26, 29, 30 – nuts; 11 – cushion; 12 – spring; 13 – steering gear; 14 – shock absorber; 15 – lower arm; 19, 22, 24, 25 – bolts; 20 – lower ball joint; 27 – adjustment bolt complete with eccentric washer; 28 – upper arms silent–block; 31 – bushing; 32 – lower arms silent–block; 33 – lower arms axis, 34 – subframe.

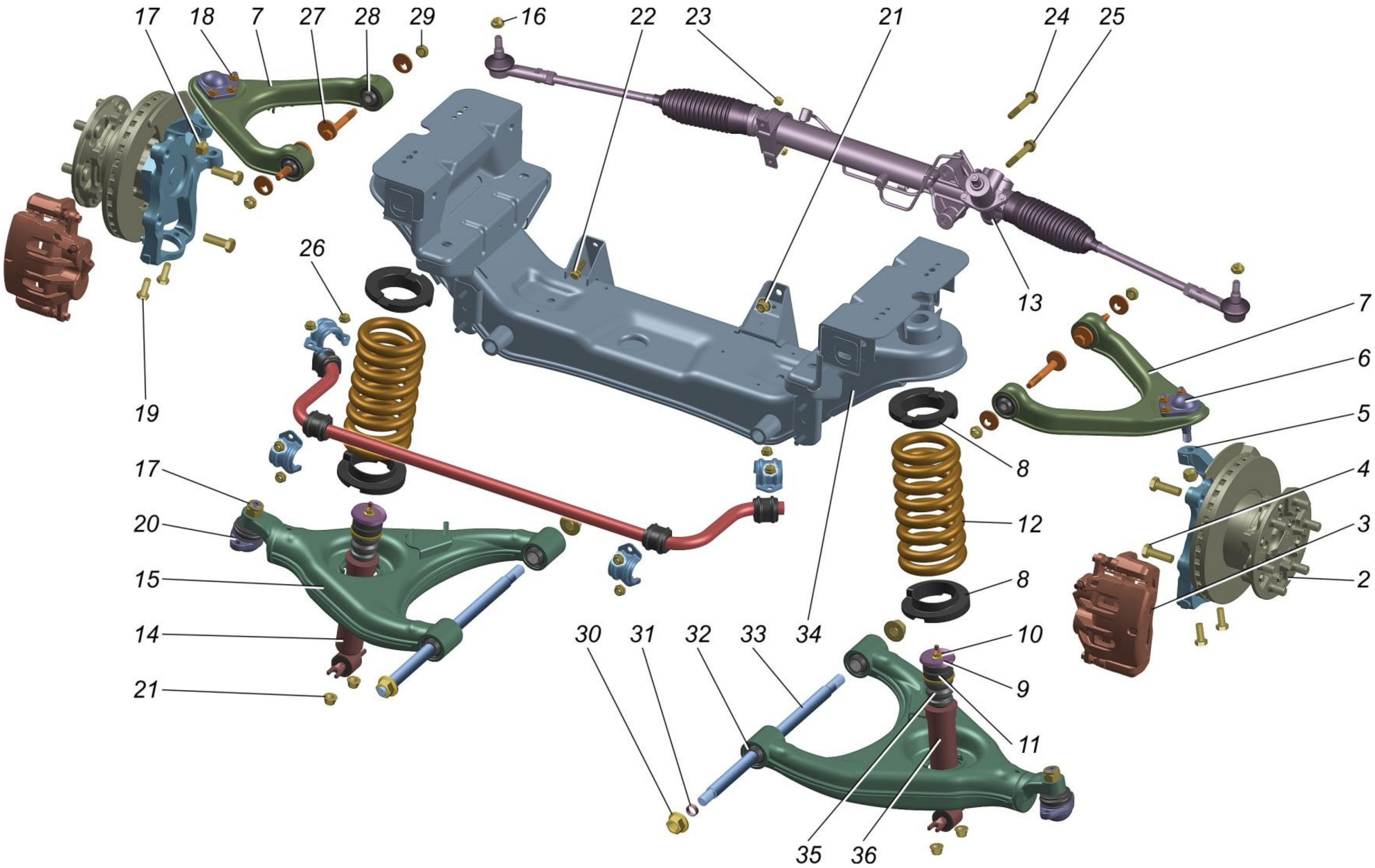


Fig. 4.4. Front suspension parts: 1 – wheel cap mounting bracket; 2 – strut with hub and brake disk; 3 – brake caliper; 4 – bolt fastening the brake caliper to the strut; 5 – strut; 6 – upper ball joint; 7 – upper arm; 8 – spring gasket; 9 – washer; 10, 16, 17, 18, 21, 23, 26, 29, 30 – nuts; 11 – cushion; 12 – spring; 13 – steering gear; 14 – shock absorber; 15 – lower arm; 19, 22, 24, 25 – bolts; 20 – lower ball joint; 27 – adjustment bolt complete with eccentric washer; 28 – upper arm silent block; 31 – bushing; 32 – lower arm silent block; 33 – lower arm axle, 34 – subframe; 35 – buffer; 36 – boot.

The suspension includes: subframe, upper and lower transverse arms swinging around their axles on silent blocks, struts with hubs and brake discs, springs with mounting parts, shock absorbers with joints and buffers and antisway bar.

The suspension also includes front wheel brake gears and rack-and-pinion steering gear.

The front cab supports are attached to the suspension subframe.

Suspension **subframe** (Fig. 4.5) is a module, on which the suspension members, and rack-and-pinion steering gear and antisway bar are mounted.

The subframe is of welded design and consists of stamped parts. Brackets providing the subframe mounting to the vehicle frame are welded on the left and right sides to the cross-member designed as integral item with upper spring supports.

Lower suspension arms axes bushings are welded to the cross-member bottom part.

Two upper suspension arm mounting brackets each are welded to the cross-member brackets on the left and right sides.

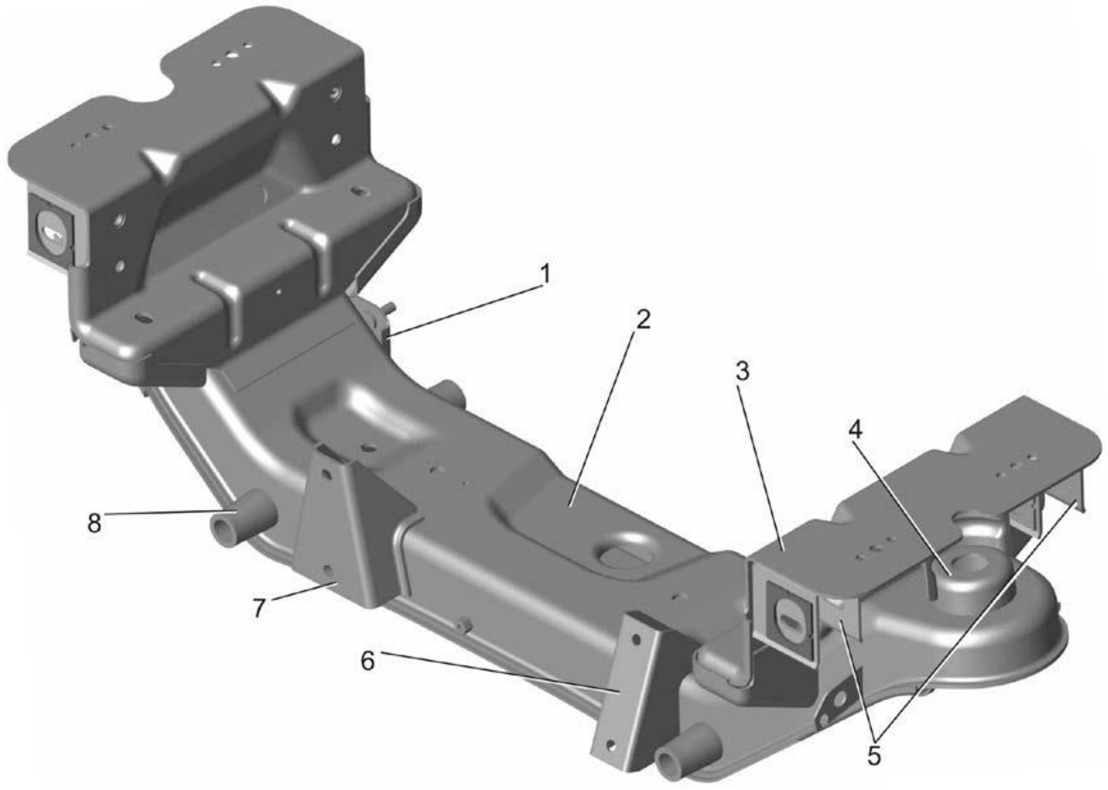


Fig. 4.5. Subframe: 1 – antisway bar mounting brackets; 2 – cross-member; 3 – cross-member mounting brackets; 4 – shock absorber cups; 5 – upper arm mounting brackets; 6, 7 – right and left steering gear mounting brackets; 8 – lower arm axis bushings.

Shock absorber cups are welded into the spring supports to provide shock absorber mounting and fixed suspension spring radial position.

Right and left rack-and-pinion steering gear mounting brackets and antisway bar middle part mounting brackets are welded to the cross-member.

The rack-and-pinion steering gear with built-in hydraulic power steering is bolted to two subframe brackets; it is rigidly attached to the left bracket while to the right one, it is attached through a rubber cushion with a clamp.

The gear tie-rod arms are connected to the suspension strut pivot arms through ball joints. Wheel toe-in is adjusted by changing the tie-rod arm length. The tie-rod arm length is changed by arm turning with lock nut released and the end held with a wrench; for this purpose, wrench flat are provided at the ends and arms.

The steering gear input shaft is bolted to the steering universal joint.

The HPS discharge and drain hoses are connected to the steering gear hydraulic distributor.

Strut assembled with hub (Fig. 4.6) is connected to the upper and lower suspension arms through non-demountable ball joints.

Suspension ball joints do not require adjustment and lubricant filling throughout the joint life.

The front brake back plate and hub assembly consisting of the hub with brake disk pressed in double-row taper bearing and fastened with central bolt with a thrust ring are attached to the strut.

ABS rotor teeth are cut on the thrust ring outer surface. The ABS sensor is mounted in the strut bore and fastened with bolt.

The non-adjustable and maintenance-free double-row taper roller bearing sealed on both sides is packed with grease, so no grease filling or replacement is required during operation. Mounting tool access to the screws fastening the hub assembly to the strut is through the hub flange holes.

The brake disk is bolted to the hub.

Wheel mounting bolts are pressed in the hub flange holes. The bolt seating surface is spline-rolled.

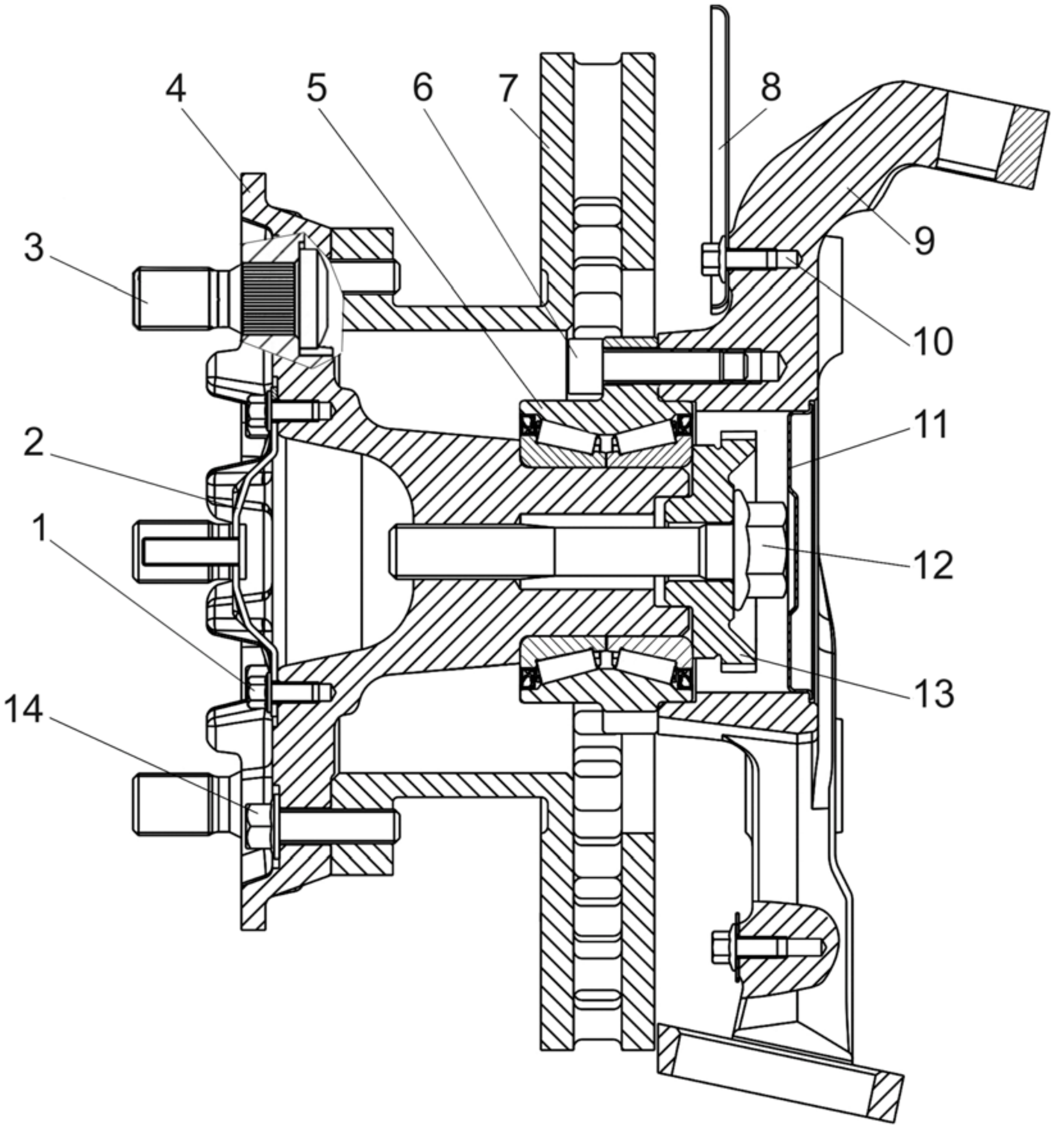


Fig. 4.6. Strut with hub: 1, 10, 12, 14 – bolts; 2 – wheel cap bracket; 3 – hub bolt; 4 – hub; 5 – double-row taper roller bearing; 6 – screws; 7 – brake disk; 8 – front brake back plate; 9 – strut; 11 – plug; 13 – ABS rotor

The front suspension arms (Fig. 4.7) swing relative to their axes on the silent-blocks. Silent-blocks have outer and inner metal bushings. Durability of the silent blocks is significantly improved due to outer bushing crimping after vulcanization.

The upper arm is stamped with welded bushings for the silent blocks. Nuts and two special eccentric bolts with washers are used for the upper arm mounting to the subframe brackets and for adjustment of toe-in and caster angles.

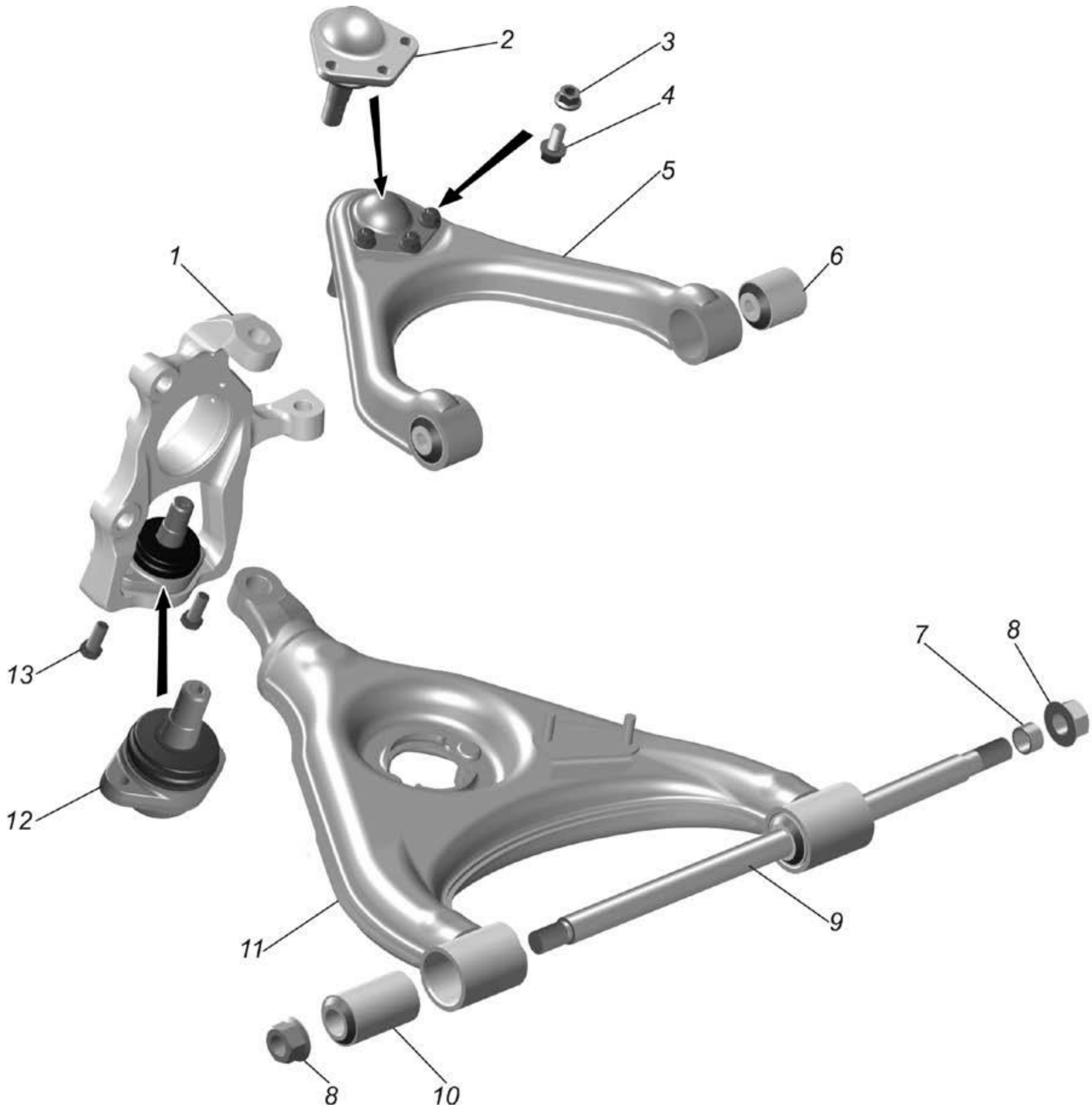


Fig. 4.7. Suspension guide apparatus: 1 – strut; 2 – upper ball joint; 3, 8 – nuts; 4, 13 – bolts; 6 – upper arm silent–block; 7 – bushing; 9 – lower arm axis; 10 – lower arm silent–block; 11 – lower arm; 12 – lower ball joint

The ball joint connecting the strut and upper arm is bolted to the arm.

The lower arm is a welded box piece consisting of upper and lower stamped shells, forged end, two bushings, and antisway bar bracket.

The lower ball joint is attached to the strut with two bolts locked with sealant.

The suspension spring inactive coils are unpolished. The spring rests with its upper end on the subframe cross-member support pad and with its lower end on the lower arm cup through rubber spacers.

Shock absorbers with rebound rubber built inside the body and compression buffer mounted to the stem are installed inside the suspension springs. Metal-rubber joint is pressed in the shock absorber lower eye; the joint axis is attached to the lower suspension arm with two bolts. The shock absorber rod upper end is attached to the suspension subframe bracket through rubber pads and washers.

Wheel alignment device of suspension (Fig. 4.8) includes a bracket with sockets for eccentrics, in which the upper suspension arm is installed, adjustment bolt with eccentric washer fixed to it, axially movable eccentric washer and nut. The eccentric washer is pressed onto the spline-rolled bolt neck. The threaded bolt end has a shank with two wrench flats;

The eccentric washers bear the marks allowing movement of the adjustment bolt to the same amount along the oblong hole in the bracket when turning the bolt from one mark to another.

Suspension adjustment and bolt tightening with nut can be done not only on both sides of the bracket, in which the upper suspension arm is installed, but also on either side. Adjustment bolt stroke during its rotation can be controlled visually. Adjustment bolt can be turned when adjusted and held when tightened both at the head and at the shank.

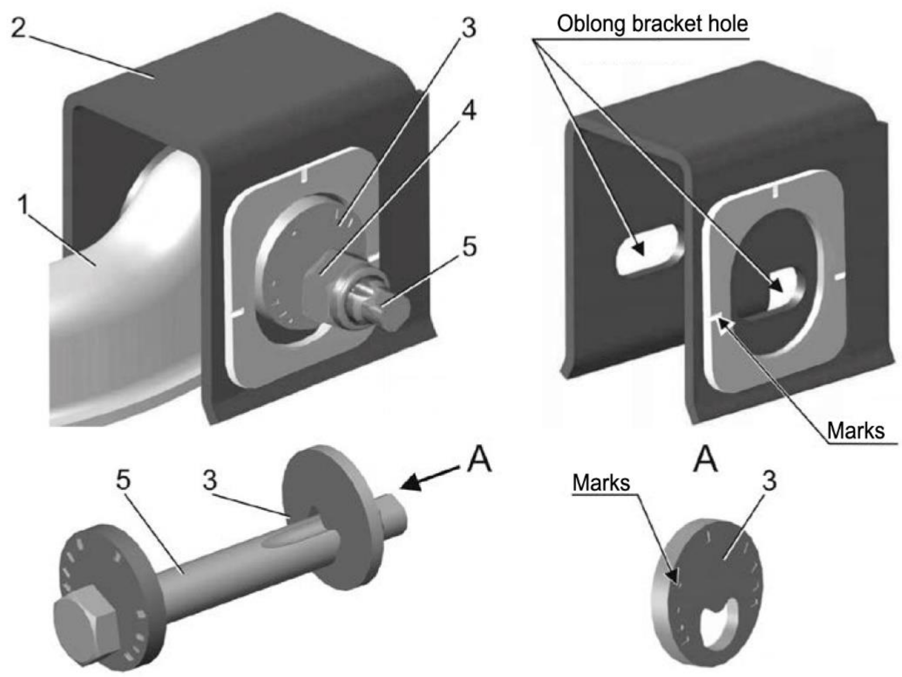


Fig. 4.8. Wheel alignment device: 1 – upper suspension arm; 2 – upper subframe arm bracket; 3 – eccentric washer; 4 – nut; 5 – adjustment bolt complete with eccentric washer.

4.1.2. Front suspension maintenance

The front suspension maintenance includes the following basic operations:

- suspension ball joint protective boot condition inspection.
- suspension parts technical condition inspection;
- front wheel alignment check and adjustment;
- front wheel toe-in angle check and adjustment
- check of tightening of the following threaded joints: nuts of upper arm joint pins; bolts of upper arm metal-rubber joints; nuts of shock absorber metal-rubber joints axes and shock absorber rod nuts.

Threaded joints shall be tightened to torques specified in the "Front suspension repair" sub-section.

ATTENTION
Do not check tightening torque and retighten threaded joints locked using sealant (for a list of specified threaded connections, see "Front suspension repair"sub-section). Bolt (nut) breaking will result in sealant failure and thus joint loosening.

Suspension ball joints technical condition inspection

The suspension joints technical condition inspection is to check the condition of the joints and their protective caps, and joint wear.

Joints with torn or cracked seals, grease expelling when squeezing the seal, and dents, cracks, corrosion on the joint machined surfaces, galled, worn or broken pin thread are subject to replacement.

When checking the joint wear:

- brake the vehicle with a parking brake and install wheel chocks under the rear wheels;
- remove the cap and loosen the front wheel fasteners;
- raise the front wheel and remove it;
- place a stand under the lower suspension arm within the ball joint area and rest the vehicle on it.

In case that the joint play or knock is felt when rocking actively the upper and lower parts of the brake disk, joint shall be removed from the vehicle, and total axial pin displacement relative to the body under load of $\pm$1000 N ($\pm$100 kgf) applied along its axis shall be measured at dedicated device.

When the axial pin displacement relative to the body exceeds 0.4mm, joints shall be replaced.

Front wheel alignment check and adjustment

This operations shall be performed during maintenance, as well as after replacement or repair of suspension parts affecting the wheel alignment angles, in case of severe impact of suspension components due to careless driving, and in case of external signs of improper wheel alignment (uneven tire tread wear, vehicle drifts sideways when driving on a flat horizontal road).

Wheel alignment angles (Fig. 4.9) shall be checked and adjusted at special rigs according to rig instructions with unladed vehicle (the vehicle is fully equipped and fueled, but without passengers and cargo). When checking and adjusting the wheel alignment and wheel toe-in angles, the steering wheels shall be set in the position corresponding to the vehicle straight forward motion.

The values of the wheel alignment angles for the unladen weight vehicle are given in Table 4.1.

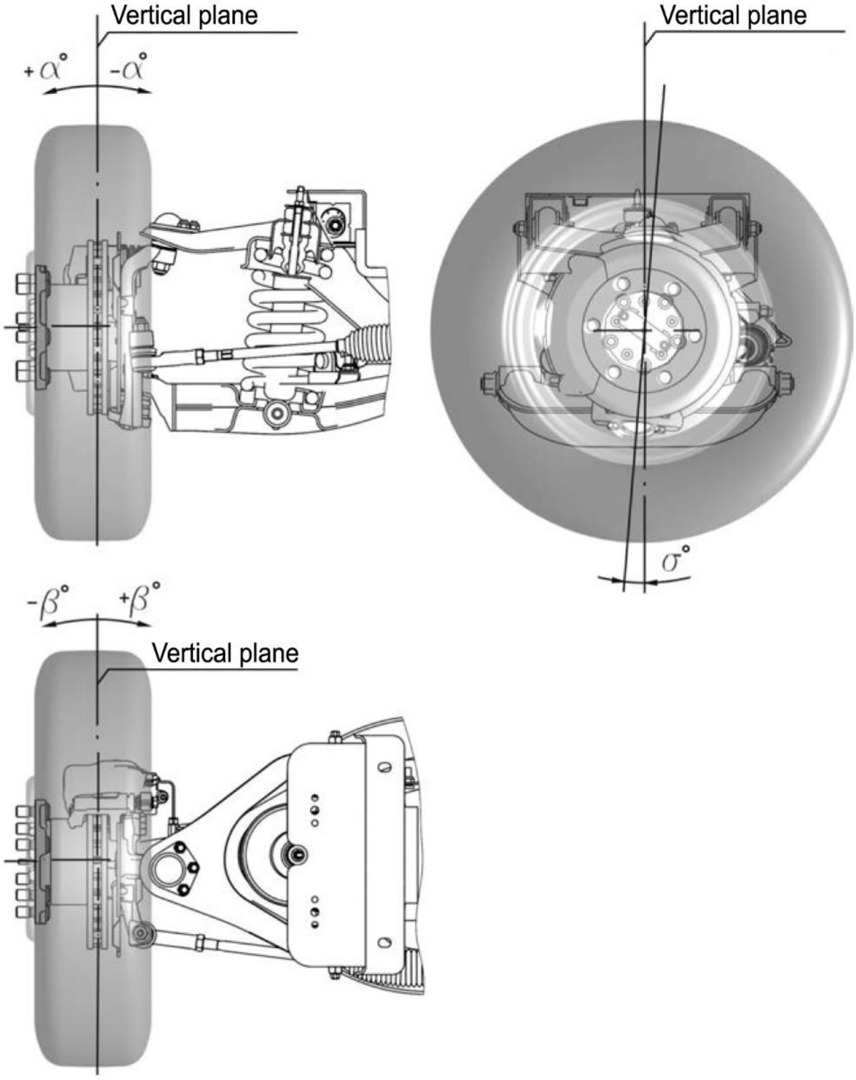


Fig. 4.9. Front wheel alignment angles: α - camber angle; β – wheel toe-in; σ – caster angle

Table 4.1

Front wheel alignment angles

Parameter	**Values of wheel alignment angles for unladen weight vehicle**
1) Range of wheel alignment angle adjustment by service enterprise operator	
Caster angle	+3°±1°
Difference in left/right caster angles	max. 30′
Camber angle of each wheel	-0°12'…-0°7'
Toe-in of each wheel	-0°4′…-0°1′

Parameter	Values of wheel alignment angles for unladen weight vehicle
2) Service interval range	
Caster angle	+3°±1°
Difference in left/right caster angles	max. 30′
Camber angle of each wheel	-0°22'…+0°3'
Toe-in of each wheel	-0°4′…+0°1′

If, when checking the wheel alignment angles, their values go beyond the range specified in p. 2 (Table 4.1), it is necessary to adjust them in accordance with the range in p. 1.

Before adjusting the suspension check:

– tire air pressure;

– total play in steering system;

– serviceability of parts of the front suspension and steering gear.

Troubleshoot if necessary.

After the vehicle is installed on the bench stands, immediately before measuring the wheel alignment angles, it is necessary to squeeze the suspension by applying a force of 600-700 N (60-70 kgf) downward for a short time.

ATTENTION
The rotation of the eccentric washer from any combined mark (Fig. 4.10) to the adjacent one changes the camber angle and the caster angle by the same value.

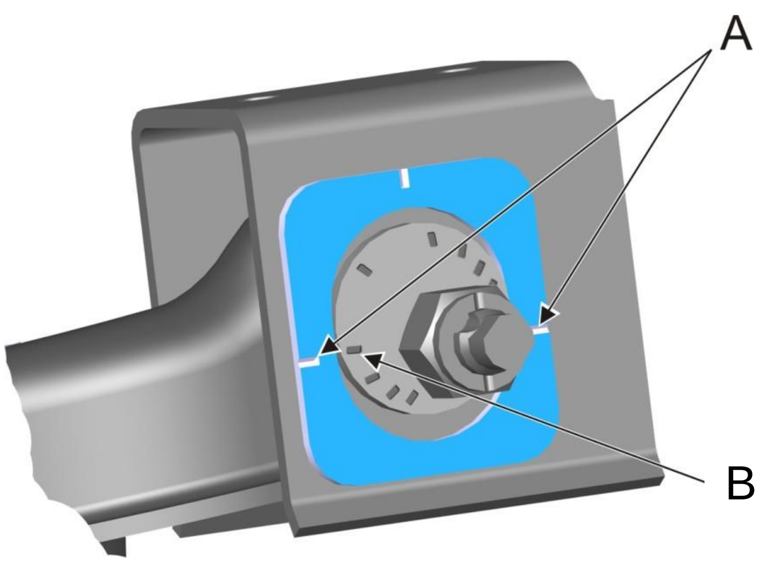


Fig. 4.10. Position of eccentric washer and bracket marks: A - bracket marks; B - eccentric washer mark, combined with bracket mark

The **caster angle** is adjusted by changing the position of the front and rear adjusting bolts of the upper arm in the subframe brackets when they are rotated in different directions by the same number of marks (or parts of marks) on the eccentric washers (see Table 4.2).

To carry out the adjustment, loosen the nuts of the adjusting bolts.

The main condition for adjustment is to ensure that the difference in the angles of the left and right sides is max. 30'. If it is impossible to set the caster angle specified in Table 4.1, only this condition is allowed to be met.

The **camber angle** is adjusted by changing the position of the front and rear adjusting bolts of the upper arm in the subframe brackets when they are rotated in one direction by the same number of marks (or parts of marks) on the eccentric washers (see Table 4.2).

When turning only one adjusting bolt or both bolts in one or different directions, but by a different number of marks (or parts of marks), both the camber angle and the caster angle change

After adjusting the caster angle and the camber angle, tighten the nuts of the adjusting bolts of the upper arms to a torque of 118-157 N·m (12.0-16.0 kgf·m).

Table 4.2

Changing wheel alignment angles by turning adjusting bolts

Turning adjusting bolt by 1 mark + turning in the arrow direction (Fig. 4.11) - turning against the arrow		**Changing caster angle**	**Changing camber angle**
Front bolt	**Rear bolt**		
+1	0	+21′	+10′
0	+1	-21′	+14′
+1	+1	0	+24′
-1	-1	0	-24′
-1	+1	-42′	+3′
+1	-1	+42′	-4′

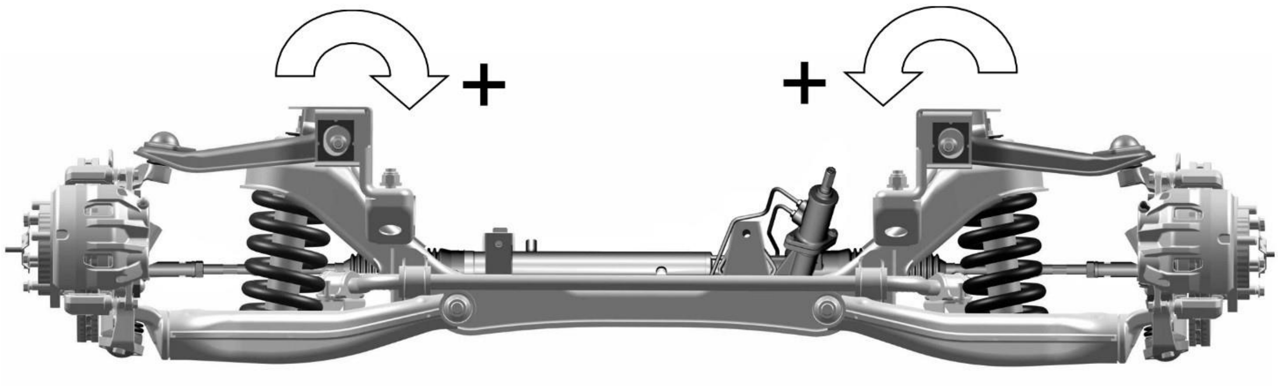


Fig. 4.11. Front suspension (front view)

The **wheel toe-in** shall be adjusted separately for the left and right wheels in the next sequence:

- fix the steering wheel in the middle position (two spokes are located horizontally), while the steering gear must also be set to the middle position (arrow B (Fig. 4.12) on the steering input shaft cover must coincide with arrow A, cast on the distributor housing);
- loosen the nuts A (Fig. 4.13) and with rotation of rods B achieve the required toe-in. Then tighten the nuts A of the ends to the required torque (see "Tightening torques for threaded joints").

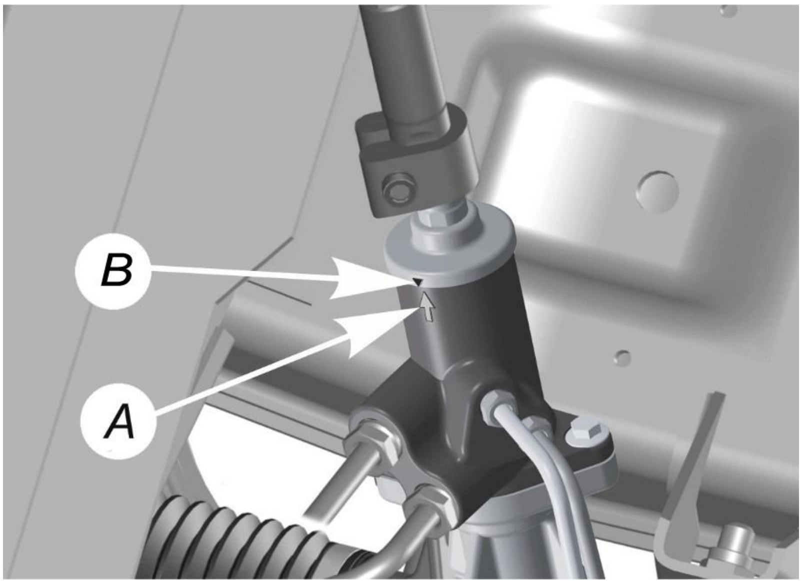


Fig. 4.12. Adjustment marks on the steering gear: A – mark on the distributor housing (arrow cast on the distributor housing); B – mark on the input shaft cover

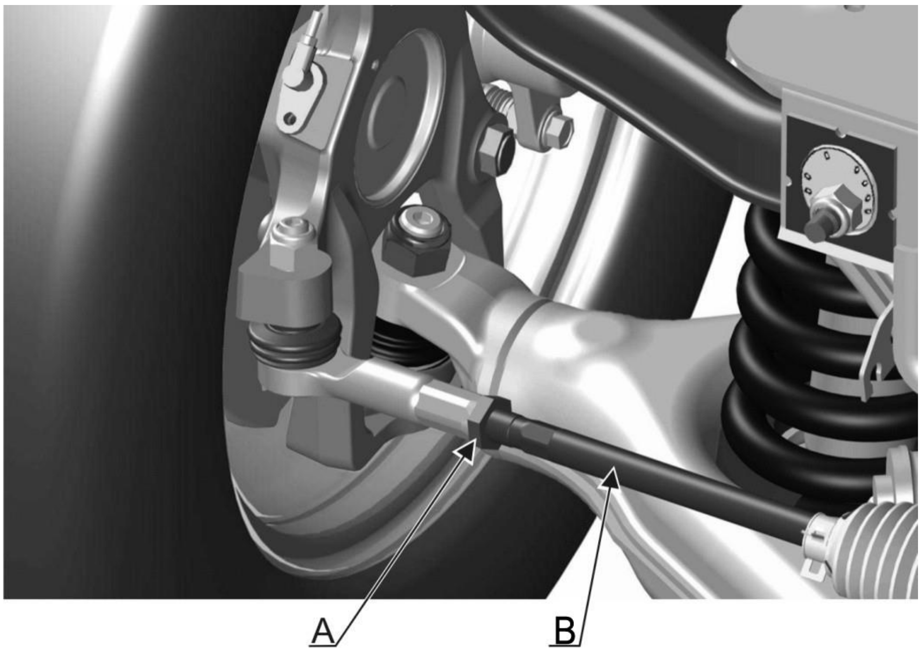


Fig. 4.13. Wheel toe-in adjustment

Possible malfunctions of front suspension and remedies

Malfunction cause	Remedy
1. Noise and knocking in suspension during vehicle movement	
1.1. Worn ball pivots of suspension or tie-rod arms	Replace the suspension pivots or the ends and inner pivots of the tie-rod arms
1.2. Loose fasteners of suspension ball pivot pins or tie-rod arms in conical holes	Tighten pin nuts or replace suspension pivots or tie-rod arm ends and mating parts when tapered surfaces are worn
1.3. Worn suspension arm silent blocks	Replace the silent blocks
1.4. Loose bar stabilizer fasteners	Tighten the fasteners
1.5. Faulty shock absorber	Replace the shock absorber
1.6. Loose or worn rubber pads or pivot of shock absorber	Tighten the fasteners or replace the worn pads. In case of worn pivot, replace the shock absorber
1.7. Compressed or broken suspension spring	Replace the spring
1.8. Increased rotation resistance torque, jamming during rotation, or increased axial clearance in wheel hub bearings	Replace worn bearing
1.9. Increased wheel imbalance	Dynamically balance the wheels
1.10. Deformed wheel rim or web	Replace the web assembly with rim
1.11. Loosening of the front suspension fastening to the side members	Tighten the suspension bolts and nuts
2. Vehicle drift	
2.1. Abnormal tire air pressure	Bring tire pressure to normal
2.2. Incomplete release of the brake	Troubleshoot (see “Brakes” section)
2.3. Incorrect front wheel alignment angles	Adjust the wheel alignment angles
2.4. Deformed tire cord, big difference in tire wear	Replace the tires

Malfunction cause	Remedy
2.5. Sagging or breaking of one of the springs. Unequal size group of suspension springs	Replace the worn spring. Install springs of the same size group
2.6. Increased rotation resistance torque, jamming during wheel hub bearing rotation	Replace worn bearing
3. Front wheel shimmy	
See subparagraphs 1.1, 1.2, 1.3, 1.8, 1.9, 1.10, 2.1, 2.3, 2.4	
4. Cannot adjust wheel alignment angles	
4.1. Worn ball pivots of suspension, tie-rod arms or silent blocks of suspension arms	Replace the worn suspension pivots or the ends and inner pivots of the tie-rod arms or silent blocks of suspension arms
4.2. Deformed suspension arms	Replace the arms
4.3. Deformed suspension subframe	Replace the subframe
5. Spotty tire tread wear	
5.1. Wheel imbalance	Dynamically balance the wheels
5.2. Incorrect caster angle	Adjust the caster angle
5.3. Faulty shock absorber	Replace the shock absorber
5.4. Increased axial clearance in wheel hub bearings	Replace worn bearing
5.5. Play in tie-rod arm pivots	Replace the tie-rod arm ends
5.6. Loosening of the front suspension fastening to the side members	Tighten the suspension bolts and nuts
6. One-sided front wheel tire wear	
6.1. Incorrect wheel alignment angles	Adjust the wheel alignment angles
6.2. Worn parts of suspension or tie-rod arms, affecting wheel alignment angles	Replace the worn parts
7. Frequent hard impacts (breakdowns) when moving over bumps	
7.1. Compressed or broken suspension spring	Replace the spring
7.2. Faulty shock absorber	Replace the shock absorber
7.3. Shock absorption compression buffer destroyed	Replace the buffer

Malfunction cause	Remedy
8. Long vehicle sway while driving	
8.1. Faulty shock absorber	Replace the shock absorber

Front suspension health determination

The condition of the parts shall be checked visually and by measurements:

- cracks are not allowed on parts and welds;
- threaded mounting joints subject to check must be securely tightened;
- subframe and suspension arms must not be deformed. Indirectly, the bending of parts can be detected by the inability to adjust the wheel alignment angles;
- silent blocks and rubber bushings of shock absorbers and stabilizer bar must not have breaks and must not be deformed;
- suspension springs should not have cracks and compression exceeding the allowable.

Vehicle spring sagging check is carried out by determining the distance **I** between the subframe cross-member and the lower suspension arm (see Fig. 4.3). If the dimension **I** is below 205 mm, the spring must be replaced.

4.1.3. Front suspension repair

4.1.3.1. General requirements

Before disconnecting the pipelines from the brake system and power steering system assemblies, it is necessary to clean the joints from dirt, and after disconnecting the pipelines, it is necessary to close the openings of the pipelines and assemblies with plugs to prevent dust and dirt from entering the systems and fluid leakage. Remove plugs immediately before connecting pipelines.

The ingress of mineral oils and other liquids inside and on the threaded surfaces of brake hoses and pipelines is not allowed.

The brake hoses must not be twisted during installation.

Pipelines must be securely fastened in retaining clips.

When assembling the front suspension, the threaded joints must be tightened to the torques indicated below.

Tightening torques for threaded joints of front suspension

When assembling the suspension and its assemblies, it is necessary to observe the tightening torques for:

- bolts securing the lower ball pivot to the suspension strut - 78-98 N·m (8.0-10.0 kgf·m);
- screws securing the wheel hub bearings to the suspension strut – 52-59 N·m (5.3-6.0 kgf·m);
- rear nuts securing the lower arms on the pin - 392-491 N·m (40-50 kgf·m);
- front nuts securing the lower arms on the pin - 78-98 N·m (8-10 kgf·m);
- bolt securing the hub to the bearing - 274-314 N·m (28-32 kgf·m);
- bolts securing the brake calipers to the suspension strut - 230-310 N·m (23.5-31.5 kgf·m);
- lower bolt securing the steering gear to the left subframe bracket - 108-123 N·m (11.0-12.5 kgf·m);
- bolts securing the brake disc to the hub - 54-69 N·m (5.5-7.0 kgf·m);
- bolts securing the subframe to the vertical flanges of side members – 98-123 N·m (10.0-12.5 kgf·m);
- nuts of bolts securing the subframe to the lower horizontal flanges of side members - 176-196 N·m (18-20 kgf·m);
- nuts securing the adjusting bolts of the upper arms - 118-157 N·m (12-16 kgf·m);
- nuts securing the tie-rod arm ends – 63-77 N·m (6.5-7.8 kgf·m);
- nuts securing the upper end of the shock absorber rod - 19-25 N·m (2.0-2.5 kgf·m);
- nuts of bolts securing the steering gear to the right subframe bracket – 27.5-35 N·m (2.8-3.6 kgf·m);

- nuts securing the stabilizer bar bolts to the subframe brackets and lower arms - 43-55 N·m (4.4-5.6 kgf·m);
- nuts of upper bolt securing the steering gear to the left subframe bracket - 98-123 N·m (10.0-12.5 kgf·m);
- nuts of bolts securing the shock absorber lower eye pivot pin to the lower suspension arm - 98-123 N·m (10.0-12.5 kgf·m);
- nuts securing the tie-rod arm pivot pins to the strut rods - 100-120 N·m (10.2-12.2 kgf·m);
- nuts securing the suspension pivot pins to the struts and lower arms - 123-137 N·m (12.5-14.0 kgf·m);
- nuts of bolts securing the suspension pivot to the upper arm - 54-69 N·m (5.5-7.0 kgf·m);
- nuts securing the wheel caps – 6.4-7.9 N·m (0.65-0.8 kgf·m);
- nuts securing the wheels – 290-370 N·m (30-38 kgf·m);
- bolts securing the cap bracket – 5.1-9.0 N·m (0.52-0.92 kgf·m);
- bolt securing the front brake flexible brake hose bracket – 5-9 N·m (0.5-0.9 kgf·m);
- flexible brake hose nozzle to the brake caliper – 14-21 N·m (1.4-2.1 kgf·m);
- nuts of hydraulic brake pipelines mounted on a subframe – 15-25 N·m (1.5-2.5 kgf·m);

List of front suspension threaded joints locking with sealant

When assembling the suspension on the threaded part of the bolts listed below (for a length of 3-5 threads from the end), it is necessary to apply anaerobic sealant Loctite 243 from Henkel or Weicon AN 302-43 from Weicon:

- bolts securing the lower ball pivot to the suspension strut;
- screws securing the wheel hub bearings to the suspension strut;
- nuts securing the lower arms on the pin;
- bolt securing the hub to the bearing;
- bolts securing the brake calipers to the suspension strut;
- lower bolt securing the steering gear to the left subframe bracket;
- bolts securing the brake disc to the hub.

Before applying the sealant, clean the part surfaces from the old sealant and degrease them.

4.1.3.2. Suspension pivot removal and installation

Suspension pivot removal and installation without suspension removal shall be carried out as follows:

- Brake the vehicle with a parking brake and install wheel chocks under the rear wheels;

- remove the cap and loosen the front wheel fasteners;
- raise the vehicle front, place a stand under the lower arm and remove the wheel;
- disconnect the ABS sensor from the suspension;

When removing the upper suspension pivot, it is necessary to:

- unscrew the nut securing the upper pivot pin to the strut;
- press out the pivot pin with a puller (Fig. 4.14), turning the bolt 2;
- unscrew the nuts of the bolts securing the upper pivot to the arm, remove and, if necessary, replace the pivot;

ATTENTION
The lower pivot can only be removed and installed with the upper pivot disconnected.

When removing the lower suspension pivot, after disconnecting the upper pivot, additionally perform the following operations:

- disconnect the brake hose from the strut support bracket;
- unscrew the nut securing the tie-rod arm pivot pin to the strut knuckle arm;
- press out the pivot pin from the strut knuckle arm conical hole with a puller (see Fig. 4.14), turning the bolt 2;
- unscrew the bolts securing the lower pivot housing to the suspension strut and remove the strut assembly with the hub and brake from the lower arm pivot and put it near without disconnecting the hose from the brake;
- unscrew the nut securing the lower pivot pin to the lower arm and press out the pivot pin with a puller.

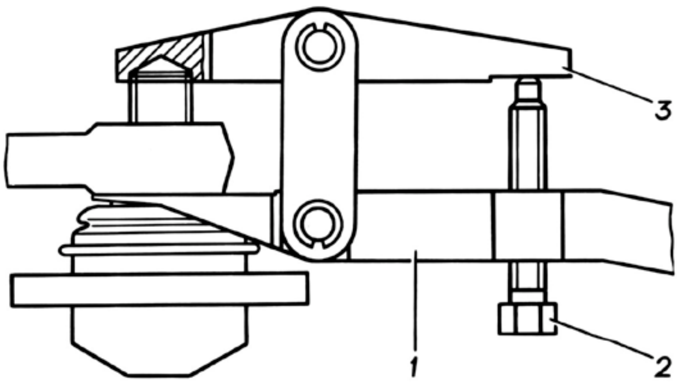


Fig. 4.14. Suspension ball pin puller: 1 and 3 - arms; 2 - bolt

If necessary, replace the pivot and assemble the suspension in the reverse order of disassembly, tightening the fasteners to the required torques (see "Tightening torques for threaded joints").

4.1.3.3. Front wheel hub repair

Service maintenance of the front hub bearing (inspection methods for detecting possible malfunctions, the bearing replacement procedure) is described in the supplier's documentation.

Hub bearing dismantling

The hub bearing dismantling procedure is described in the supplier's documentation.

If the inner race was not pressed out the hub during the bearing dismantling, it must be pressed out on a press or using a puller (Fig. 4.15);

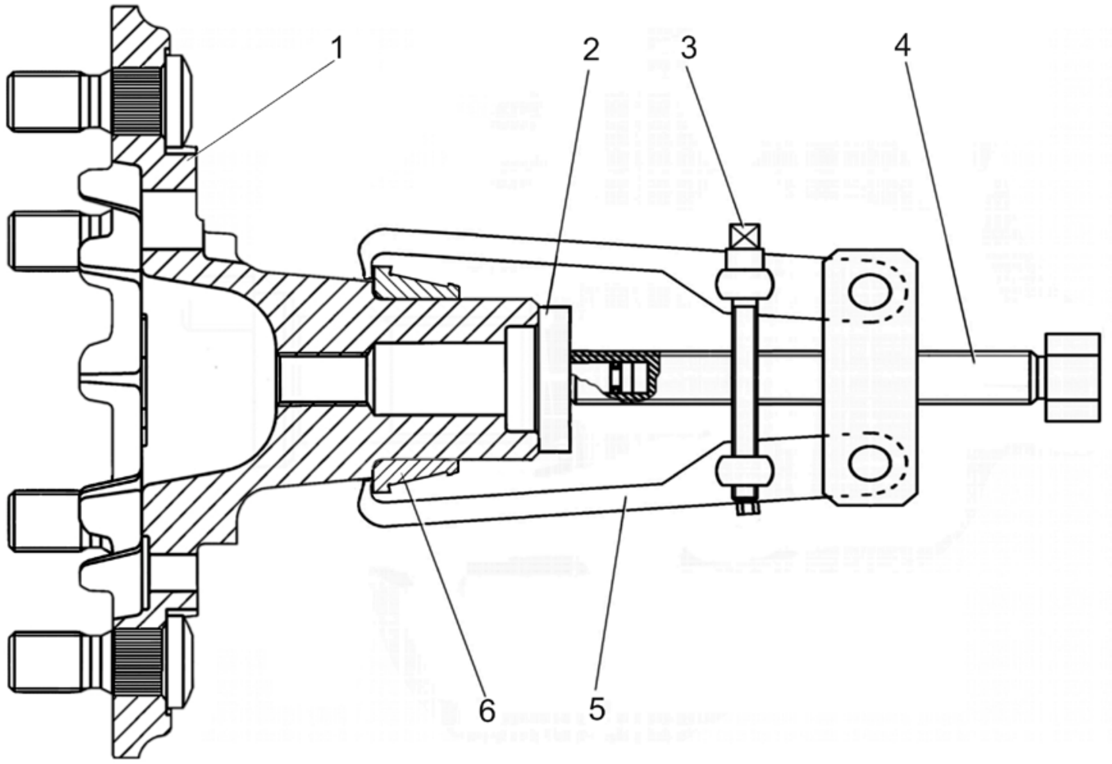


Fig. 4.15. Removing the bearing inner race from the hub: 1 - hub; 2 - thrust bearing; 3 - bolt; 4 - screw; 5 - claw; 6 - bearing inner race

Repair of the front wheel hubs (replacement of the wheel mounting bolt) is carried out similarly to the repair of the rear wheel hubs (see "Rear axle" subsection).

Assemble and install the hub on the vehicle in the reverse order of disassembly and removal, observing the requirements for tightening torques and locking of joints given in the "General requirements" subsection.

The dimensions of the front wheel hub mating parts are given in Table 4.3.

Table 4.3

Dimensions of front wheel hub mating parts, mm

Mating parts	Hole	Shaft	Fit
Double-row bearing outer race - strut	$87{,}5^{+0{,}22}_{+0{,}10}$	$87.5_{-0.1}$	Clearance$^{0{,}32}_{0{,}10}$
Double-row bearing inner race – hub	$49.1_{-0.012}$	$49{,}1^{+0{,}018}_{+0{,}002}$	Preload $^{0{,}002}_{0{,}030}$

4.1.3.4. Front suspension removal and installation

Removing the front suspension from the vehicle must be carried out as follows:

- place the vehicle on the inspection pit, brake with a parking brake and install wheel chocks under the rear wheels;
- drain the fluid from the brake system;
- disconnect the brake pipes from the front wheel brake hoses and the brake pipes (from the hydraulic unit to the front and rear right circuit hoses) from the holding clips located on the subframe. Disconnect the ABS sensors from the front suspension;
- unscrew the nuts securing the wheel caps, remove the caps and loosen the front wheels;
- raise the vehicle front, place stands under the lower arms and remove the wheels;
- unscrew the nuts securing the tie-rod arm pivot pins to the strut knuckle arms;
- press out the pivot pins of the tie-rod arms from the strut knuckle arm conical holes with a puller (see Fig. 4.14), turning the bolt 2;
- disconnect and remove the protective screen of the steering gear;
- remove the steering gear from the front suspension by unscrewing the bolt and nuts of the bolts securing the steering gear to the two subframe brackets, and hang the steering gear on the vehicle frame without disconnecting the steering cardan shaft and power steering hoses;
- disconnect the front cab (body) supports from the subframe by unscrewing the nuts of the mounting bolts. To keep the right support bolt from turning, it is necessary to remove the air filter;
- raise the front of the cab, install the stops between the side members of the cab and the frame, and lower the cab onto them, unloading the subframe;
- raise the vehicle front and place stands under the frame;
- unscrew the bolts and nuts of the bolts securing the front suspension to the vehicle frame;
- remove the front suspension mounting bolts, remove the stands from under the lower arms, lower and remove the suspension from under the vehicle.

Installation of the front suspension on the vehicle (the front part of the vehicle frame is installed on stands, and the front part of the cab is on the stops installed between the side members of the cab and the frame) must be carried out in the reverse order of removal:

- bring the subassembled front suspension under the vehicle and install stands under the lower arms;
- attach the hanger to the frame.

The bolts and nuts of the bolts securing the suspension to the frame must be tightened as follows:

- pre-tighten the nuts 4 (see Fig. 4.1) of the mounting bolts, then the mounting bolts 3 on the right and then on the left side of the vehicle. Preliminary tightening torque 30-40 N·m (3.0-4.0 kgf·m);
- finally tighten the bolts 3 first on the right and then on the left side of the vehicle. Then finally tighten nuts 4. See tightening torques above.
- lower the vehicle on stands installed under the lower arms, removing the stands from under the frame front;
- raise the front of the cab, remove the stops installed between the side members of the cab and the frame, and lower the front of the cab onto the subframe;
- connect the front cab (body) supports to the subframe by screwing the nuts of the mounting bolts;
- fasten the steering gear, suspended on the frame during the suspension removal, to the suspension brackets. When assembling, it is necessary to apply to the threaded part of the lower bolt securing the steering gear to the left subframe bracket (at a length of 3-5 threads from the end face) a thin layer of anaerobic sealant Loctite 243 from Henkel or Weicon AN 302-43 from Weicon:
- install and secure the protective screen of the steering gear after installing the bracket on the subframe;
- install the tie-rod arm pivot pins in the conical holes of the strut knuckle arms and tighten the pin nuts;
- connect the brake pipes to the front wheel brake hoses and secure the brake pipes (from the hydraulic unit to the front and rear right circuit hoses) in the holding clips located on the subframe. Connect the ABS sensors to the front suspension;
- install the wheels and pre-tighten the retaining nuts;
- remove the stands from under the lower arms and lower the vehicle;
- finally tighten the wheel nuts and install the caps. After installing the suspension, check and, if necessary,

adjust the wheel alignment angles and toe-in, pour the fluid and pump the brake system.

4.1.3.5. Front suspension disassembly and assembly

The **front suspension disassembly** must be carried out as follows:

- set the suspension on the bench for disassembly and assembly;
- remove the brake hoses by disconnecting them from the brackets and brakes;
- remove the brakes by unscrewing the bolts securing them to the struts;
- remove the stabilizer bar by unscrewing the bolts securing the saddle clips to the lower arms and subframe;
- disconnect and remove the shock absorbers (see “Front shock absorber removal and installation” subsection) and install in their place spring removal and installation tools (Fig. 4.16) as follows:
  - through the hole in the lower suspension arm, install the screw 1 of the tool into the upper socket of the shock absorber and screw the nut with washer 6 onto its upper threaded end;
  - put the support ring 2 on the lower end of the screw 1 until it stops against the lower suspension arm;
  - put on bearing 3, tighten nut 4 with tap wrench 5 until the spring begins to compress;

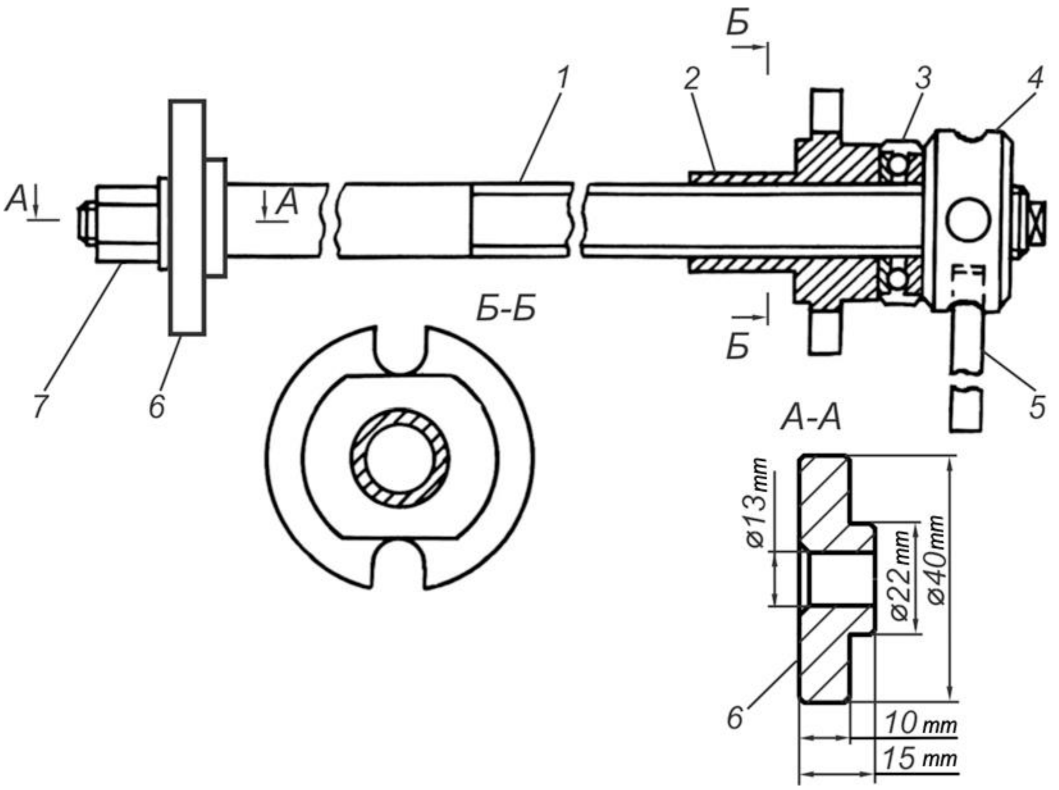


Fig. 4.16. Spring removal and installation tool: 1 - screw; 2 - support ring; 3 - bearing; 4,7 - nuts; 5 - tap wrench; 6 – washer

- to remove the spring, proceed as follows:
  - unscrew the nut of the pin securing the upper ball pivot to the strut, using the tool, press the pin out of the strut and move the strut away from the suspension;
  - unscrew the bolts securing the lower pivot housing to the suspension strut (if the spring is removed from the vehicle, it is necessary to disconnect the stabilizer bar from the lower arm) and remove the strut assembly with the hub and brake disc;
  - unscrew the tool nut 4 (see Fig. 4.16) and remove the spring with gaskets;

- unscrew the nuts securing the ball pivot pins of the lower arms. Using a puller (see Fig. 4.14), press out the pivot pins from the arm conical holes;

- unscrew the rear nuts of the lower arm pins, remove the pins and the lower arms;

- disconnect the upper arms from the subframe brackets by unscrewing the nuts of the adjusting eccentric bolts, removing the bolts and eccentric washers;

- disconnect the ball pivots from the upper arms by unscrewing the nuts of the mounting bolts.

Health inspection and repair of front suspension arms

The condition of the arms shall be checked visually and by measurements:

– cracks are not allowed on stamped parts and welded seams of suspension arms;

– suspension arms must not be deformed. The presence of deformation can be checked by installing the arms in the inspection tools. Indirectly, the bending of parts can be detected by the inability to adjust the wheel alignment angles;

The silent blocks of the upper and lower arms must be replaced if they sag in the radial direction by more than 3 mm, if the rubber breaks, cracks or hardens, if the bushings detach from the rubber.

Silent blocks must be pressed out and pressed (Fig. 4.17) into the arms on the press using mandrels (Fig. 4.18), applying force to the outer bushings of the silent blocks. After pressing in, the end face of the silent block outer bushing must be flush with the end face of the arm bushing.

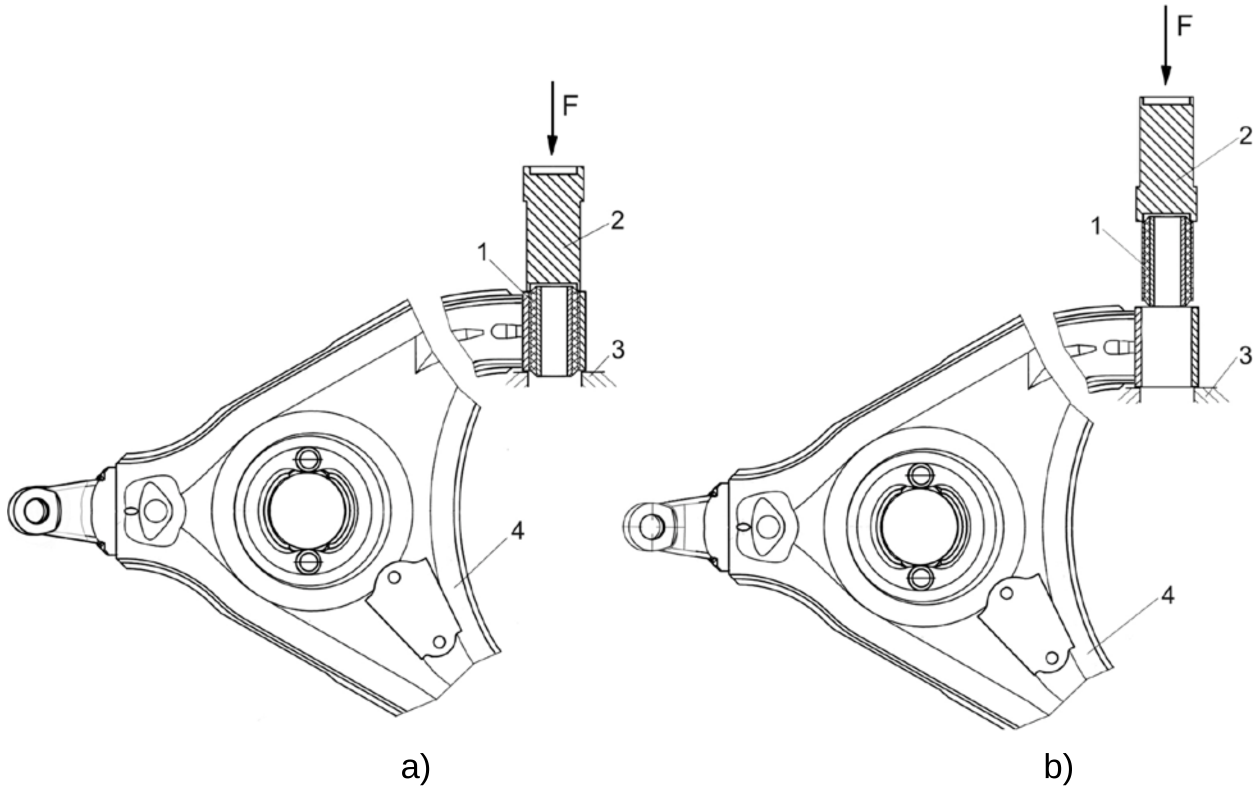


Fig. 4.17. Pressing out and pressing in the lower suspension arm silent block: a - pressing out the silent block; b - pressing in the silent block; 1 - silent block; 2 - mandrel; 3 - support; 4 - lower suspension arm

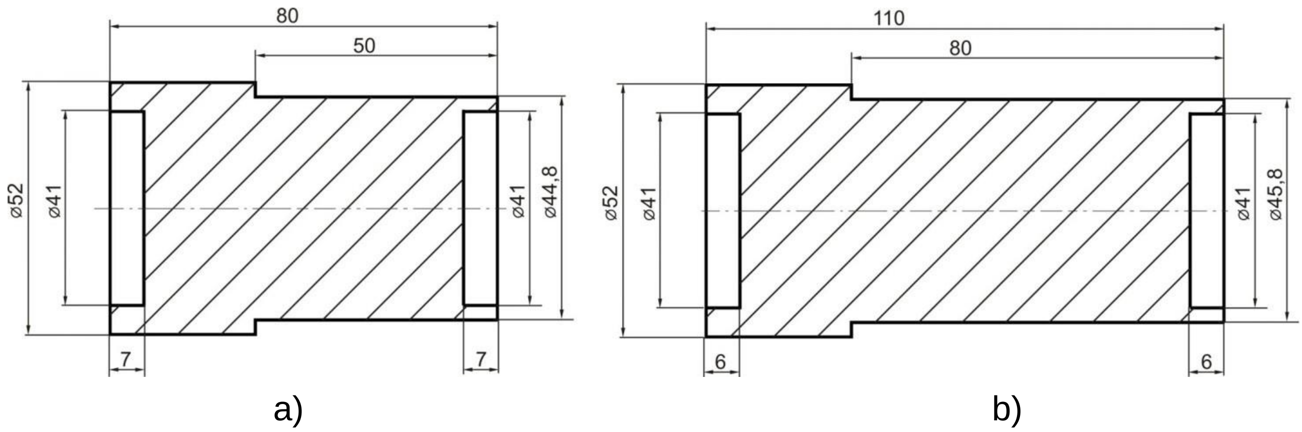


Fig. 4.18. Mandrels for pressing out and pressing in the suspension arm silent blocks: a) – upper arm; b) - lower arm

Checking front suspension springs

Clean the spring from dirt and inspect. If there are cracks or coils are deformed, replace the spring.

Check the spring compression by compressing it to a height of 278 mm.

Force F_1 (Fig. 4.19) determines whether the spring belongs to one group or another (Table 4.4) and suitability for further operation.

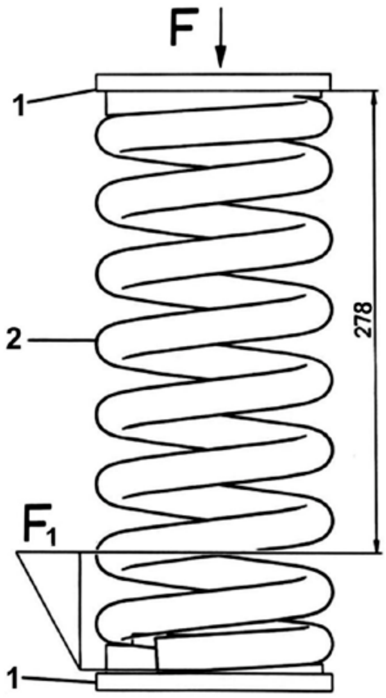


Fig. 4.19. Spring calibration: 1 - end abutments; 2 - spring

When checking, the supporting coils of the spring must rest on the end abutments with a helical surface (helix rise 16.5 mm over a length of 2/3 of the circumference, internal bore diameter 87 mm).

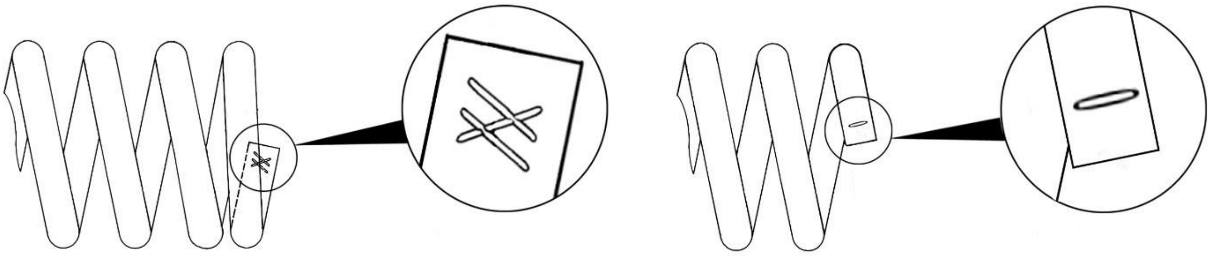
Table 4.4

Spring characteristics

Force F_1 (for new springs), kN (kgf)	Force F_1 maximum permissible (for used springs), min., kN (kgf)	Group number	Inactive coil marking
For springs A32R32-2902712			
13.59…13.98 (1386…1426)	11.17 (1138)	1	one transverse notch
13.98…14.37 (1426…1466)	11.49 (11.71)	2	two transverse notches
For springs A21R23-2902712			
10.8…11.24 (1106…1146)	8.86 (903)	1	one notch
11.24…11.6 (1146…1186)	9.24 (942)	2	two notches
11.6…12.02 (1186…1226)	9.53(971)	3	three notches

Springs A32R32-2902712 are installed in the vehicle suspension, having a division into two height groups, or A21R23-2902712, having a division into three height groups. The marking of springs in the form of notches applied with an emery grinder is shown in Fig. 4.20.

It is necessary to install springs of the same group in the vehicle suspension. In this case, the difference in the compression force F_1 of the used springs installed on one vehicle should not exceed 392 N (40 kgf).



a) b)

Fig. 4.20. Spring group marking: a) - springs A21R23-2902712; b) - springs A32R32-2902712

The **suspension assembly** must be carried out in the reverse order of disassembly in compliance with the requirements specified in the “General requirements” subsection.

For the correct installation of silent blocks, the rear nuts of the lower arm pins must be tightened after installing the spring with a fixed dimension F (see Fig. 4.3) of 319-321 mm between the lower end of the lower arm (in the shock absorber mounting area) and the upper end of the subframe shock absorber cup.

4.1.3.6. Shock absorbers

Shock absorbers are designed to dampen vibrations of the vehicle body that occur when driving on rough roads. The comfort of the vehicle and the durability of body parts and chassis largely depend on the operability of shock absorbers. Normally working shock absorbers should dampen the vehicle vibrations after crossing the obstacle in 1-2 rolls. Shock absorbers (Fig. 4.21) of the front and rear suspension are gas-filled, telescopic, double-acting, non-separable.

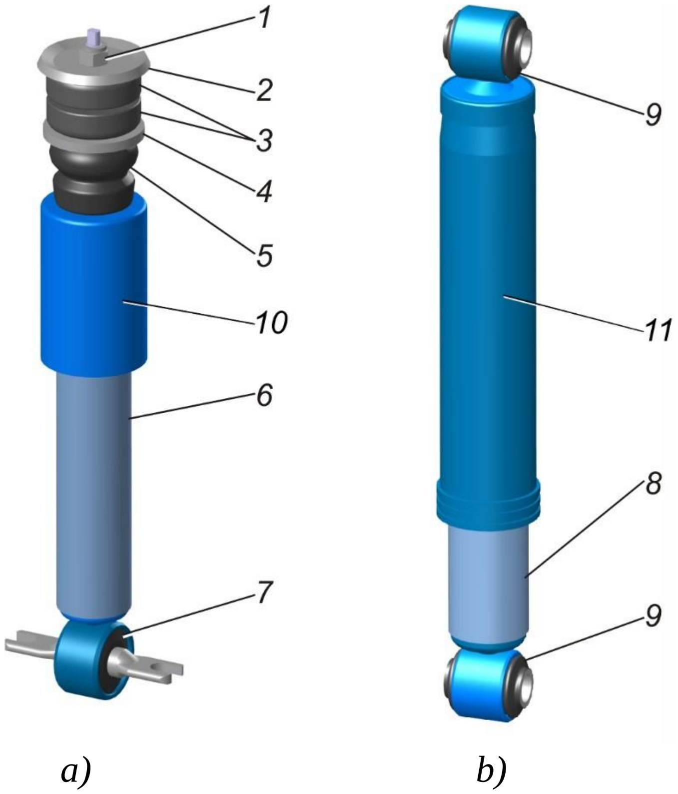


Fig. 4.21. Shock absorbers: a - front; b - rear; 1 - nut; 2, 4 - washers; 3 - pads; 5 - compression buffer; 6, 8 - shock absorbers; 7, 9 - silent blocks; 10, 11 - casings

Shock absorber care consists in checking and tightening the shock absorber fasteners.

During the inspection, check the following:

- condition of the compression buffers, pads and shock absorber pivots;
- absence of fluid leakage from shock absorbers.

Check procedure for the usability of shock absorbers is given in the supplier's documentation. The shock absorber cannot be repaired and, if a malfunction is found, must be replaced with a new one.

Possible malfunctions of shock absorbers and remedies

Malfunction cause	Remedy
Fluid leaks, dents on shock absorber reservoir surface	
	Replace the shock absorber
Scratches, notches, damage or discontinuity in rod coating	
	Replace the shock absorber

Malfunction cause	Remedy
Unsatisfactory operation of shock absorber (frequent suspension "breakdowns", vehicle sway), insufficient forces on compression/rebound strokes	
	Replace the shock absorber
Knocks and squeals during shock absorber operation	
Loose retaining nut, wear or destruction of front shock absorber upper mount pads	Tighten the nuts or replace the shock absorber
Loose retaining nuts, wear or destruction of rear shock absorber silent blocks	Tighten the nuts or replace the shock absorber
Wear or destruction of silent block in front shock absorber lower eye Wear or destruction of compression buffer	Replace the shock absorber
Insufficient force (or "dips") during compression stroke	Replace the shock absorber

Front shock absorber removal and installation

To remove the shock absorber, it is necessary to place the vehicle on the inspection pit, bringing the wheel inner part as close as possible to the inspection pit edge, or elevate the vehicle on a lift and install a strut under the wheel.

The shock absorber removal must be carried out as follows:

- unscrew the nut securing the upper end of the rod and remove the pad and end abutment;
- unscrew the two nuts of the bolts securing the shock absorber pivot pin to the lower arm;
- remove the shock absorber through the hole in the lower arm.

Installing the shock absorber on the vehicle must be carried out in the reverse order of removal. Tighten the pivot bolt nuts and a rod top end nut to the required torques.

4.1.3.7. Stabilizer bar

The front suspension stabilizer bar reduces the vehicle roll when cornering and improve handling. Through rubber pads 3 (Fig. 4.22), the middle part of the stabilizer bar 4 is attached to the subframe, and the bar ends to the lower suspension arms.

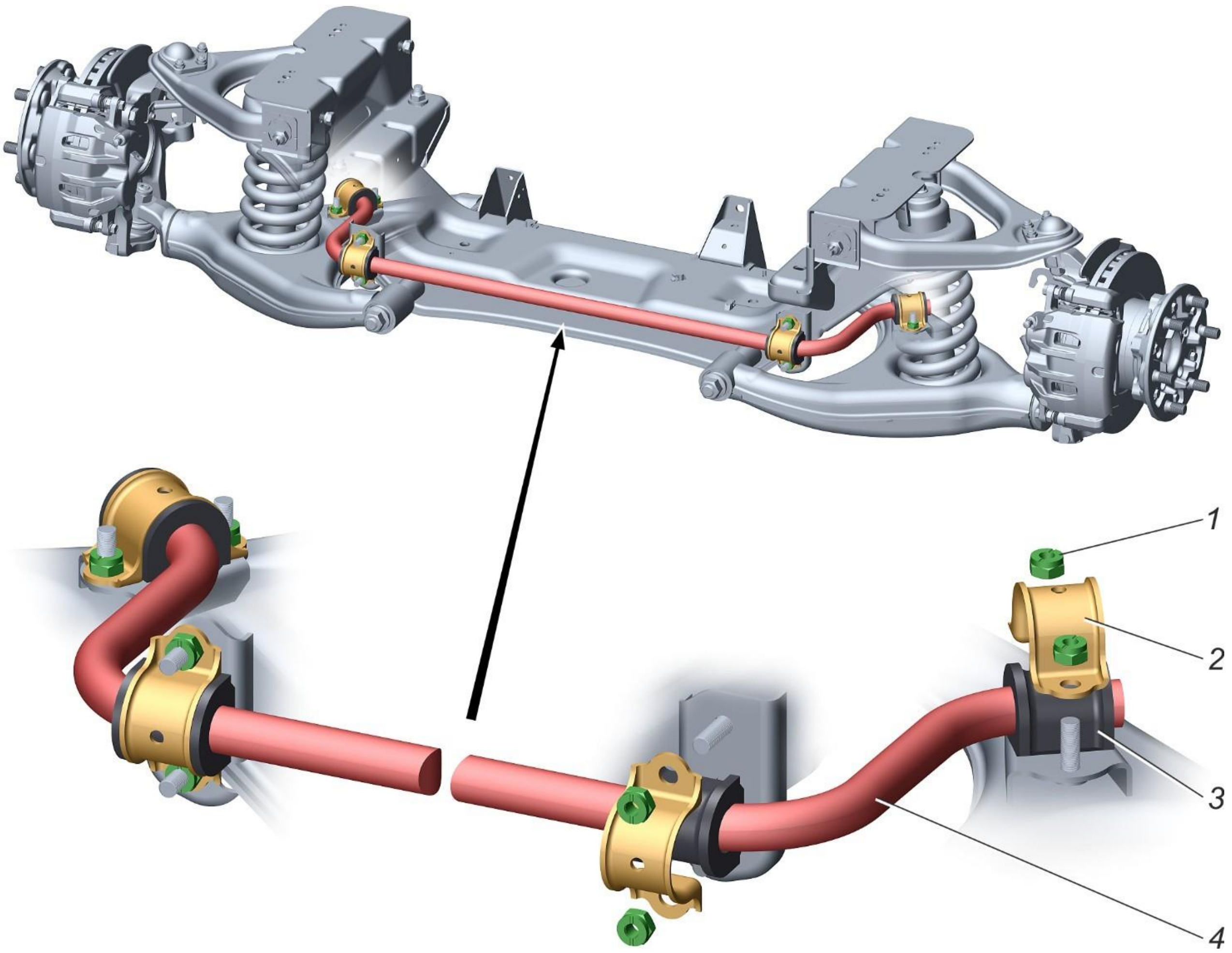


Fig. 4.22. Stabilizer bar installation: 1 – nut; 2 – saddle clip; 3 – pad; 4 – stabilizer bar

Maintenance of the stabilizer consists in periodically checking its fastenings and the condition of the stabilizer parts.

In case of slight bar deformation (the bar ends are not in the same plane), it is necessary to straighten the bar, in case of significant deformation, cracks or breakage, the bar must be replaced.

If the rubber pads are worn out, they should be replaced with new ones.

4.2. Rear suspension

4.2.1. Rear suspension (gross vehicle weight up to 4.6 tons)

4.2.1.1. Rear suspension design

The vehicle rear suspension (Fig. 4.23) is made on longitudinal springs, working in conjunction with telescopic gas-filled shock absorbers.

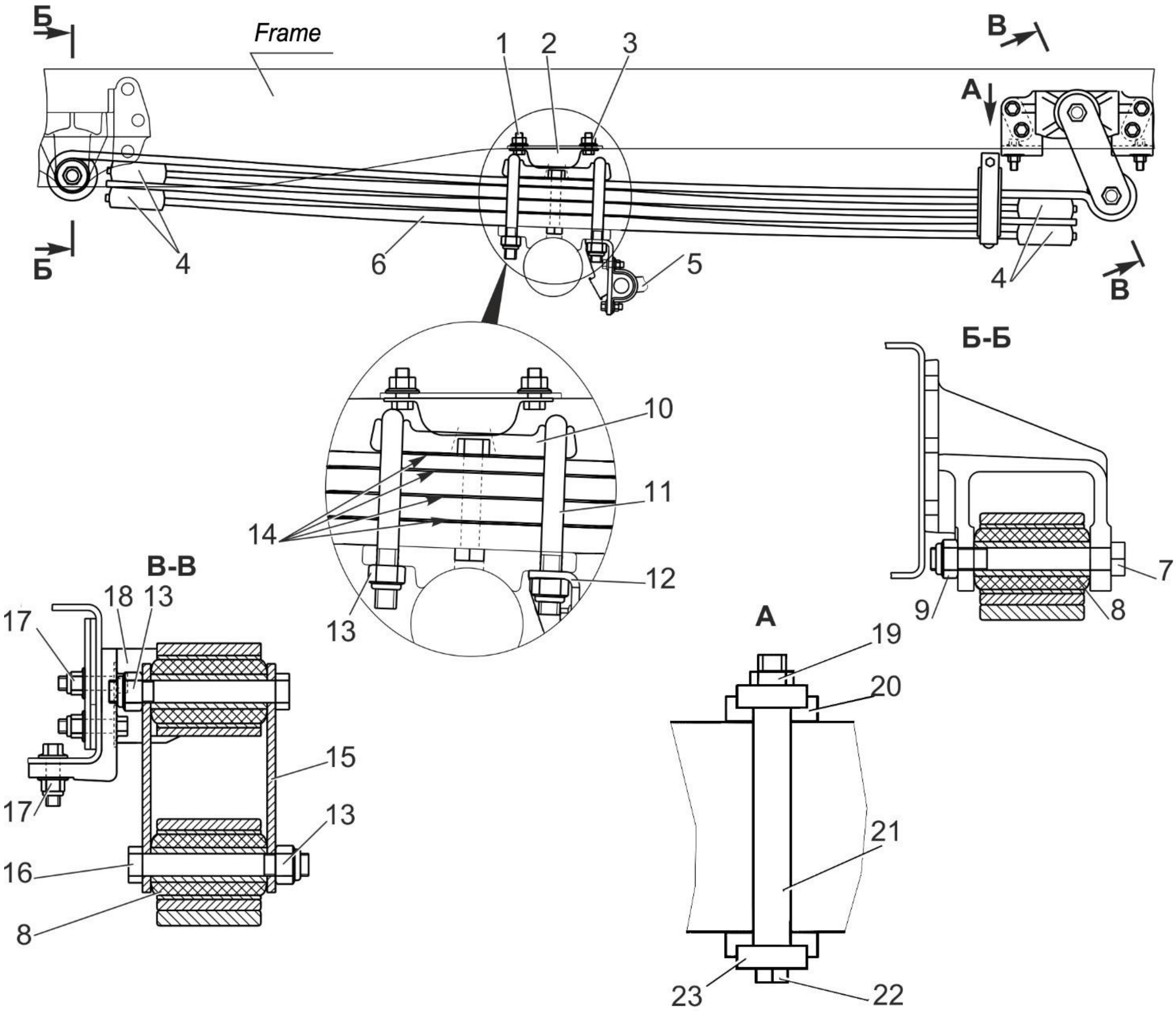


Fig. 4.23. Rear suspension: 1, 7, 16, 22 – bolts; 2 – buffer; 3, 9, 13, 17, 19 – nuts; 4 – gaskets; 5 – stabilizer bar; 6 – dual-rate spring; 8 – silent blocks; 10 – clamp plate; 11 – U-bolt; 12 – bracket; 14 – interleaf spacers; 15 – shackles; 18 – rear spring bracket; 20 – clamp gasket; 21 – distance bushing; 23 – clamp

The vehicle rear spring is three-leaf with a spring helper located below the third leaf of the spring. Rubber spacers are installed at the ends of the spring helper and the spring second leaf.

The springs are asymmetrical in length against the central bolt. When mounting the springs, the short end must face forward.

The front ends of the springs are fastened to the frame with the silent blocks, the rear ends of the springs - with the silent blocks and shackles. For the correct operation of these silent blocks, their mounting bolts should be tightened with the springs straightened. The rear spring travel is limited by a rubber buffer and axle beam.

4.2.1.2. Rear suspension maintenance

During the routine maintenance of the suspension, it is necessary to periodically check and, if necessary, tighten the nuts of the U-bolts, nuts of the shock absorber mounting bolts, silent blocks and spring brackets.

Checking residual deformation of springs removed from vehicle

An objective classification of the “spring sagging” defect can only be carried out on a spring removed from the vehicle under the control load (Fig. 4.25).

The criterion for spring sagging (reduction of the spring camber) is the reduction of the spring camber under the control load by more than 20% of the spring deformation when the load changes from static to maximum. When addressing the issue of claim for replacement of springs due to sagging defect, it is necessary to be guided by Table 4.5.

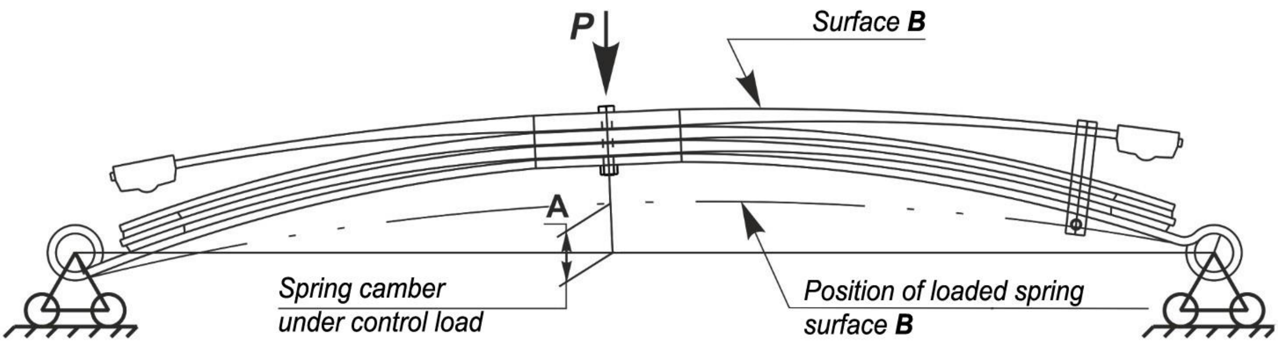


Fig. 4.25. Diagram for checking camber of rear spring removed from vehicle:
P - control load

Table 4.5

Dual-rate spring	Number of leaves	Minimum spring camber (mm) taking into account allowable sag under control load (kgf)	
		Without spring helper	With spring helper
C41R92-2912010-10	Spring - 3 leaves, spring helper - 1 leaf	116/400±10	37/1500±15

Possible malfunctions of rear suspension and remedies

Malfunction cause	Remedy
Frequent suspension breakdowns	
Vehicle overloaded	Avoid vehicle overload
Breakage of spring or spring helper leaves	Replace the spring or broken leaves of spring or spring helper
Permanent deformation of the spring leaves or one of the springs (springs “sagged”)	Replace the spring or springs
Breakdowns accompanied by metallic knock	
Lost or damaged limit buffer or spacers of second leaf or spring helper	Install new buffer or spacers
Vehicle pulls to the side	
Main leaf displacement in case of center bolt destruction	Replace the center bolt

Malfunction cause	Remedy
Main leaf breakage	Replace the main leaf
Vehicle rolls to one side	
Breakage of spring or spring helper leaves Residual spring deformation	Replace the spring or broken leaves of spring or spring helper Replace the spring

4.2.1.3. Rear suspension repair

To eliminate malfunctions, replace parts and assemblies, the suspension is subjected to complete or partial disassembly.

Tightening torques for threaded joints of rear suspension

When assembling the rear suspension, it is necessary to observe the tightening torques for:

- spring center bolt nuts - 43-61 N·m (4.4-6.2 kgf·m);
- nut of the spring clip bolt - 27-35 N·m (2.8-3.6 kgf·m);
- nut of the spring front pivot bolt - 274-314 N·m (28-32 kgf·m);
- spring rear pivot mounting bolt nuts - 177-196 N·m (18-20 kgf·m);
- spring U-bolt nuts - 177-196 N·m (18-20 kgf·m);
- spring buffer mounting bolt nuts - 28-36 N·m (2.8-3.6 kgf·m);
- spring rear bracket mounting bolt nuts - 59-69 N·m (6.0-7.0 kgf·m);
- rear shock absorber pivot mounting bolt nuts - 110-140 N·m (11.4-14.3 kgf·m);
- nuts of bolts securing the stabilizer bar saddle clips and the upper stabilizer bracket to the frame - 50-64 N·m (5.2-6.5 kgf);
- nut of the stabilizer strut pivot bolt – 69-98 N·m (7-10 kgf).

4.2.1.3.1. Spring removal and installation

Spring removal

The springs must be removed as follows:

- install wheel chocks under the front axle wheels;
- loosen the U-bolt nuts;
- disconnect the lower end of the shock absorber;

- raise the rear of the vehicle with a jack so that the springs are unloaded;
- place process stands of the appropriate height under the raised end of the frame and lower the vehicle onto them;
- unscrew the spring silent block mounting bolt nuts. Remove the bolts, if necessary, knock out with a copper rod so as not to damage the thread;
- unscrew the nuts of the U-bolts, remove the stabilizer lower bracket, U-bolts, spring clamp plate and interleaf spacer;
- raise the vehicle with a jack so that the front end of the spring comes out of its bracket, and the rear bracket out of the shackle. Remove the spring.

Spring installation

When mounting the springs, it is important to orient them correctly. The short end of the spring must face forward. For the correct operation of silent blocks, the bolt nuts should be tightened with springs straightened. This operation can be carried out using a standard jack and tool (Fig. 4.26).

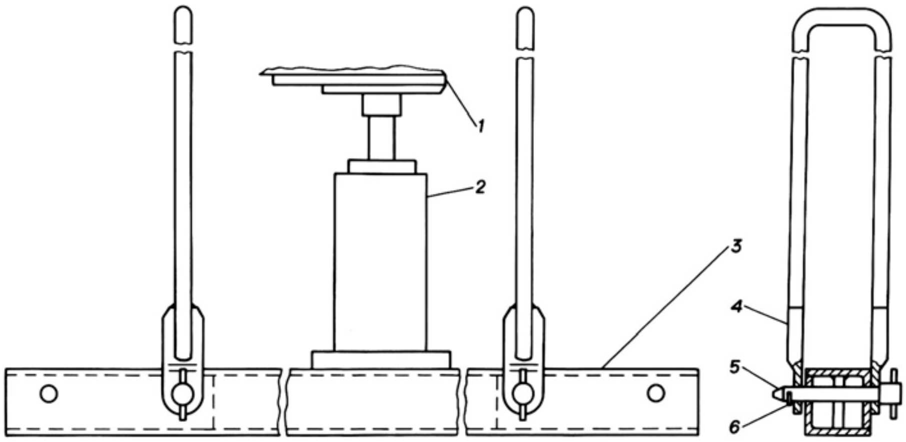


Fig. 4.26. Spring installation tool: 1 - spring; 2 - jack; 3 - beam; 4 - U-bolt; 5 - pin; 6 – latch

The spring installation on the vehicle should be carried out as follows:
- lower the vehicle so that the front end of the spring enters its bracket, and the rear end enters the lower end of the shackles;
- insert bolt 9 (see Fig. 4.23) securing the front end of the spring and screw a nut onto it;
- insert the bolts into the shackles and the rear eye of the spring and screw the nuts onto the bolts;
- straighten the spring using the tool, tighten the front pivot bolt and the nuts of the rear pivot bolts and remove the tool;
- on top of the spring put an interleaf spacer and a clamp plate, then put U-bolts on it, the threaded ends of the U-bolts shall be inserted into the axle pad holes.

Install the lower stabilizer bracket. Screw nuts onto the threaded parts of the U-bolts;

- if the vehicle has wheels, remove the stands and the jack;
- finally tighten the U-bolt nuts;
- connect the lower end of the shock absorber.

4.2.1.3.2. Spring disassembly and assembly

Spring disassembly

Before disassembly, clean the springs of dirt and determine their health. If all parts are suitable for further operation, it is necessary to check the spring camber in order to determine the value of spring sagging (permanent deformation) in accordance with Table 4.5.

If, as a result of a preliminary inspection, breaks are found, the spring must be disassembled as follows:

- clamp the spring in a vice in the immediate vicinity of the center bolt;
- unscrew the clamp bolt nut, remove the bolt and remove the distance bushing and clamp gaskets;
- unscrew the nut of the center bolt and carefully release the vise, since the leaves in the tightened spring are in a stressed state.

Rinse the spring leaves with kerosene, wipe and inspect for cracks.
Replace broken and cracked leaves.

In case of rubber detachment from metal fittings in silent blocks, they must be replaced.

The pivots must be pressed out and pressed in using a mandrel (Fig. 4.27). When installing silent blocks, they should be pre-lubricated with liquid soap.

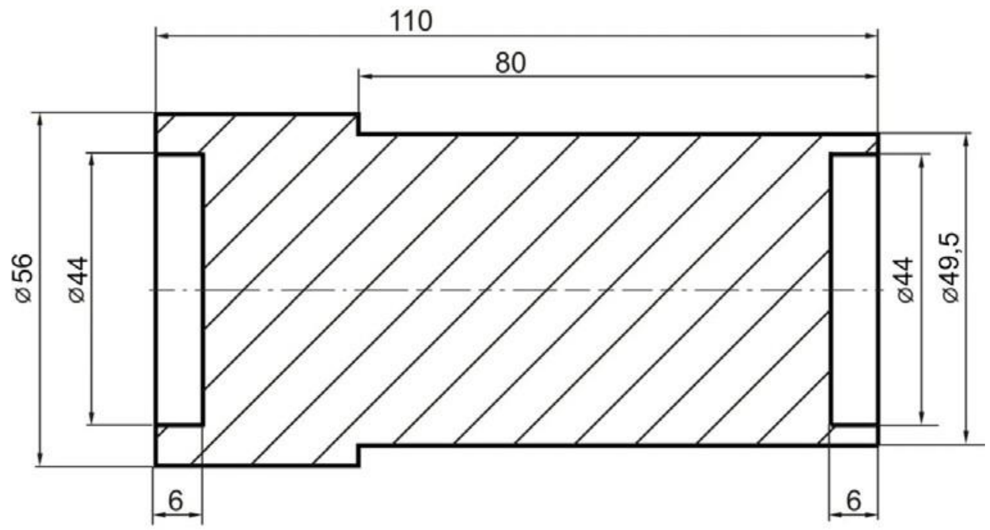


Fig. 4.27. Mandrel for pressing out and pressing in silent blocks of rear springs and brackets (Material - steel 40X (HRC 30-34))

When pressing in the silent block, the force must be applied to the outer bushing of the silent block. Press in the silent blocks in such a way that the outer bushing of the silent block is flush with the end face of the spring leaf or bracket.
Re-rivet the loosened clamp rivets.

Spring assembly

To increase the camber of the spring leaves, it is unacceptable to straighten them with hammer or sledgehammer blows (this leads to a quick leaf breakage). It is allowed to straighten the leaves by rolling between the rollers.

Install new rubber spacers (Fig. 4.28) on the ends of the spring helper and the second leaf of the spring, so that the protrusions B on the seating surfaces of the spacer enter the hole in the leaf. Install the spring helper spacers so that the protrusion D on the outer surface of the spacer is located on the side of the concave leaf surface.

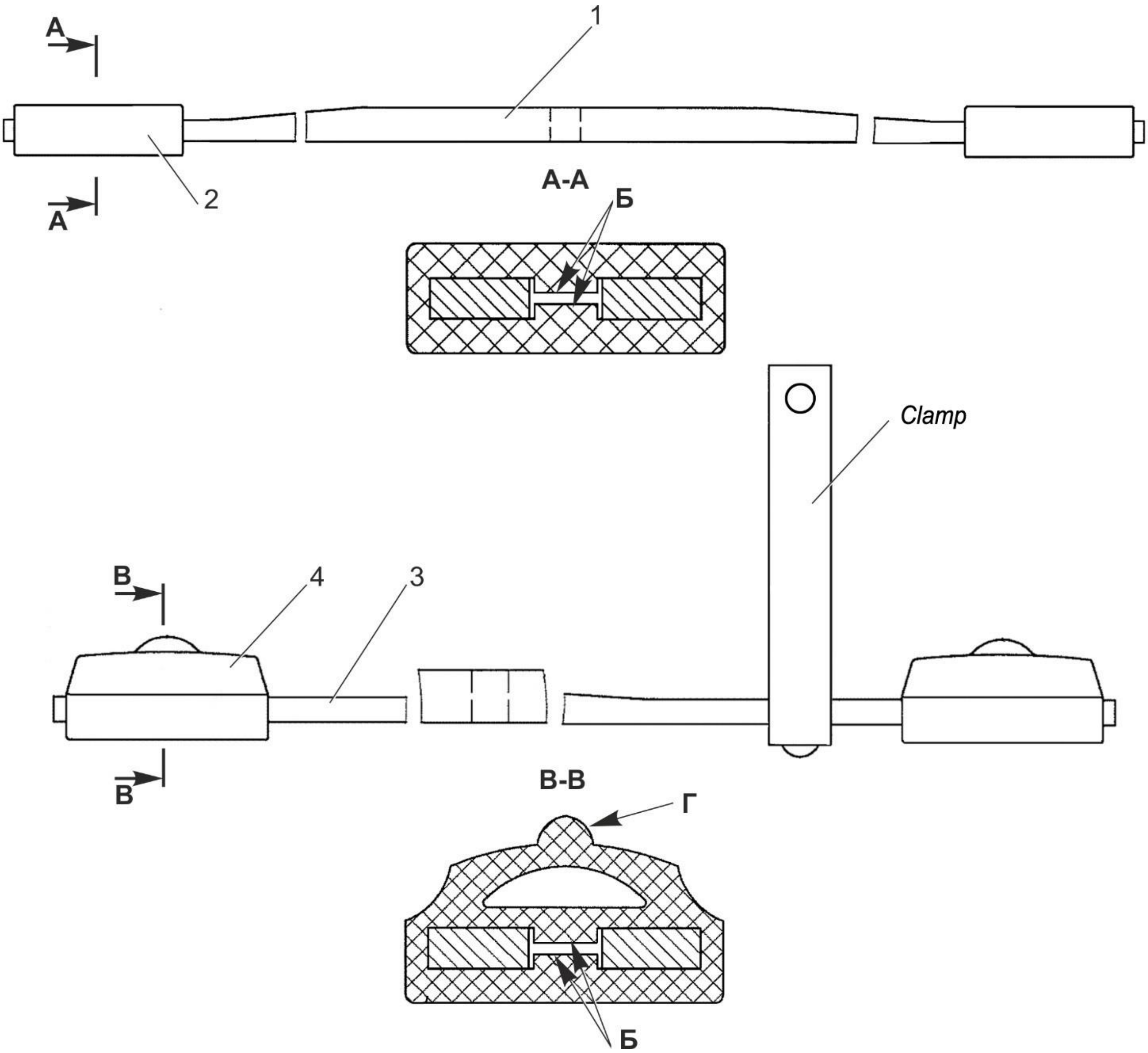


Fig. 4.28. Installing spacers on the leaves of the spring and spring helper: 1 - spring leaf; 2, 4 - spacers; 3 - spring helper leaf

The spring assembly must be carried out in the following sequence:

- leaf-by-leaf paint coating of each leaf;
- select the required set of leaves and interleaf spacers of the spring;
- subassemble the leaves in the appropriate order, installing gaskets between them, and insert a process rod into the hole for the center bolt with a diameter equal to the center bolt diameter;
- squeeze the central part of the spring in a vice as close as possible to the rod and remove it;
- insert the center bolt instead of the rod with the head down and tighten the retaining nut;
- install gaskets, distance bushing and bolt of the clamp and tighten the retaining nut;
- release the spring from the vice;
- check the spring camber as described above.

4.2.2. Rear suspension (gross vehicle weight up to 3.5 tons)

4.2.2.1. Rear suspension design

The vehicle rear suspension (Fig. 4.29) is made on longitudinal springs, working in conjunction with telescopic gas-filled shock absorbers.

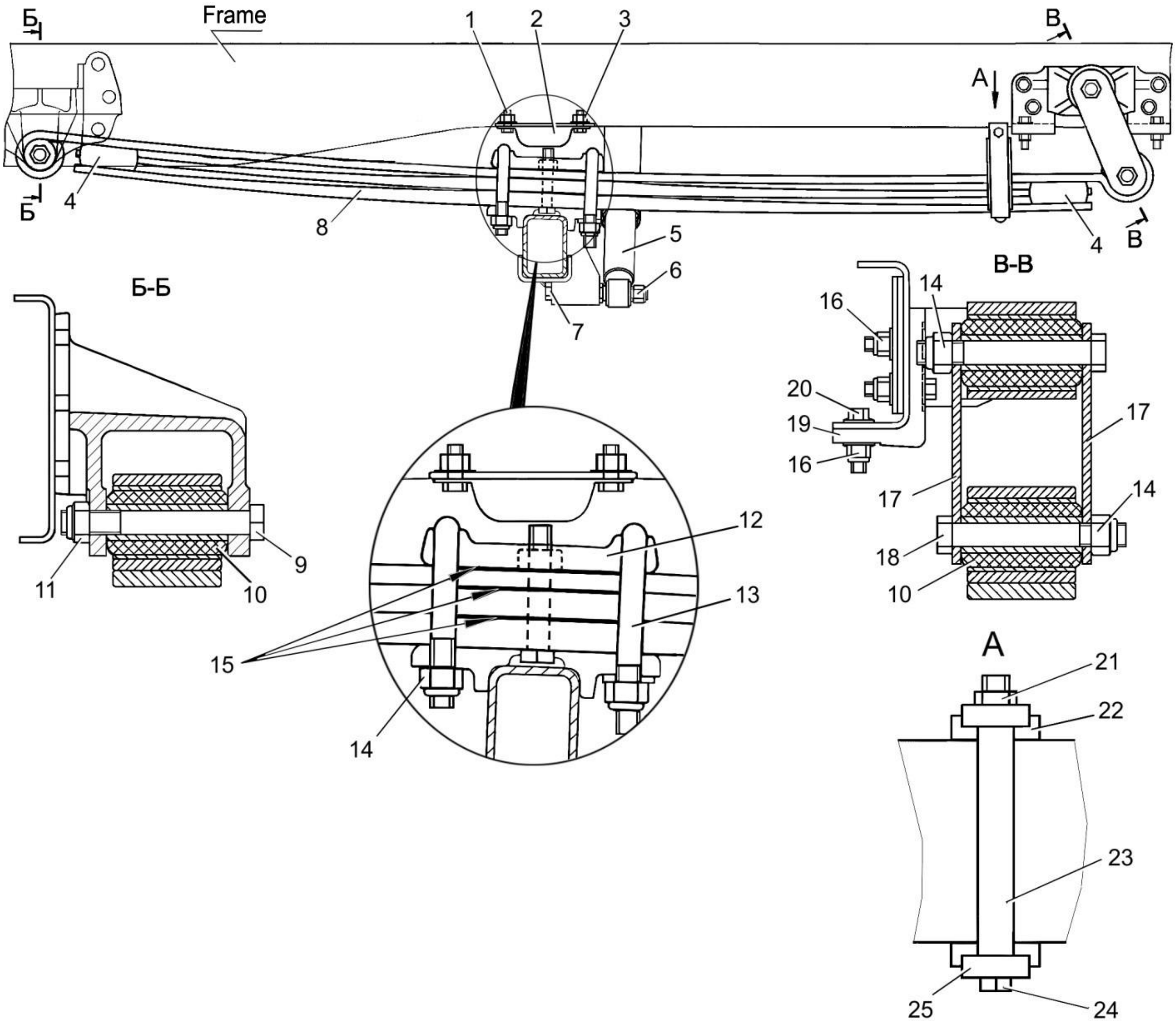


Fig. 4.29. Rear suspension: 1, 7, 9, 18, 20, 24 – bolts; 2 – buffer; 3, 6, 11, 14, 16, 21 – nuts; 4 – pads; 5 – shock absorber; 8 – dual-rate spring; 10 – silent blocks; 12 – clamp plate; 13 – U-bolt; 15 – interleaf spacers; 17 – shackles; 19 - bracket; 22- clamp gasket; 23 - distance bushing; 25 - clamp

The vehicle rear spring is two-leaf with a spring helper located below the second leaf of the spring. Rubber pads, fixed at the ends of the second leaf of the spring, are installed above the spring helper.

The springs are asymmetrical in length against the central bolt. When mounting the springs, the short end must face forward.

The front ends of the springs are fastened to the frame with the silent blocks, the rear ends of the springs - with the silent blocks and shackles. For the correct operation of these silent blocks, their mounting bolts should be tightened with the springs straightened. The rear spring travel is limited by a rubber buffer and axle beam.

4.2.2.2. Rear suspension maintenance

During the routine maintenance of the suspension, it is necessary to periodically check and, if necessary, tighten the nuts of the U-bolts, nuts of the shock absorber mounting bolts, silent blocks and spring brackets.

Checking springs in vehicle for sagging

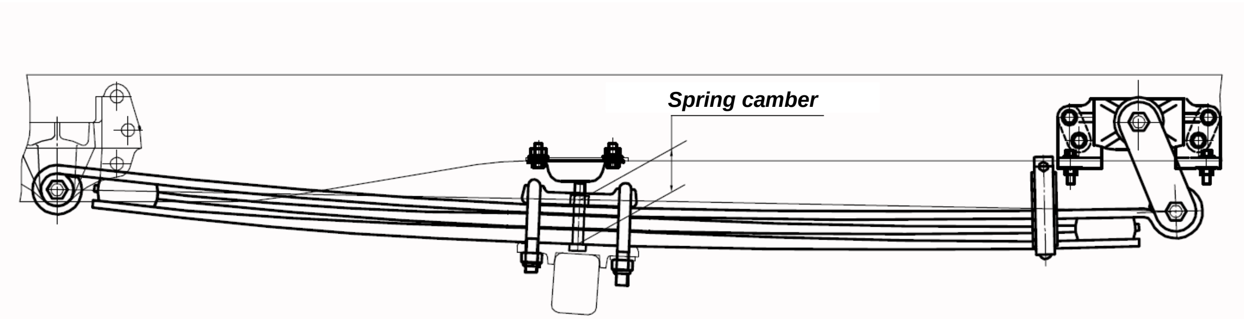
The vehicle presented for checking the condition of the springs must be unloaded.

Checking the springs in the vehicle for sagging at a service station must be carried out in the following sequence:

- loosen the nuts securing the front and rear ends of the spring and disconnect the stabilizer from the lower mounting bracket to the rear axle;
- place the vehicle on the scales to determine the load on each wheel. Measurement error 0.2%;
- measure the spring camber as per Fig. 4.30. Measurement error 0.5 mm. The spring camber is measured between the line passing through the axes of the bolt heads of the front and rear ends of the spring and the lower surface of the spring helper.

The difference in the camber values of the same name springs installed on one vehicle should not exceed 10 mm;

- graph (Fig. 4.30) shows the dependence of the spring camber on the vehicle weight falling on the wheel from the inspected spring side. Use the graph to determine the spring condition. The spring is considered sagging and must be replaced if, after performing the above operations, the spring camber value lies below the boundary line.



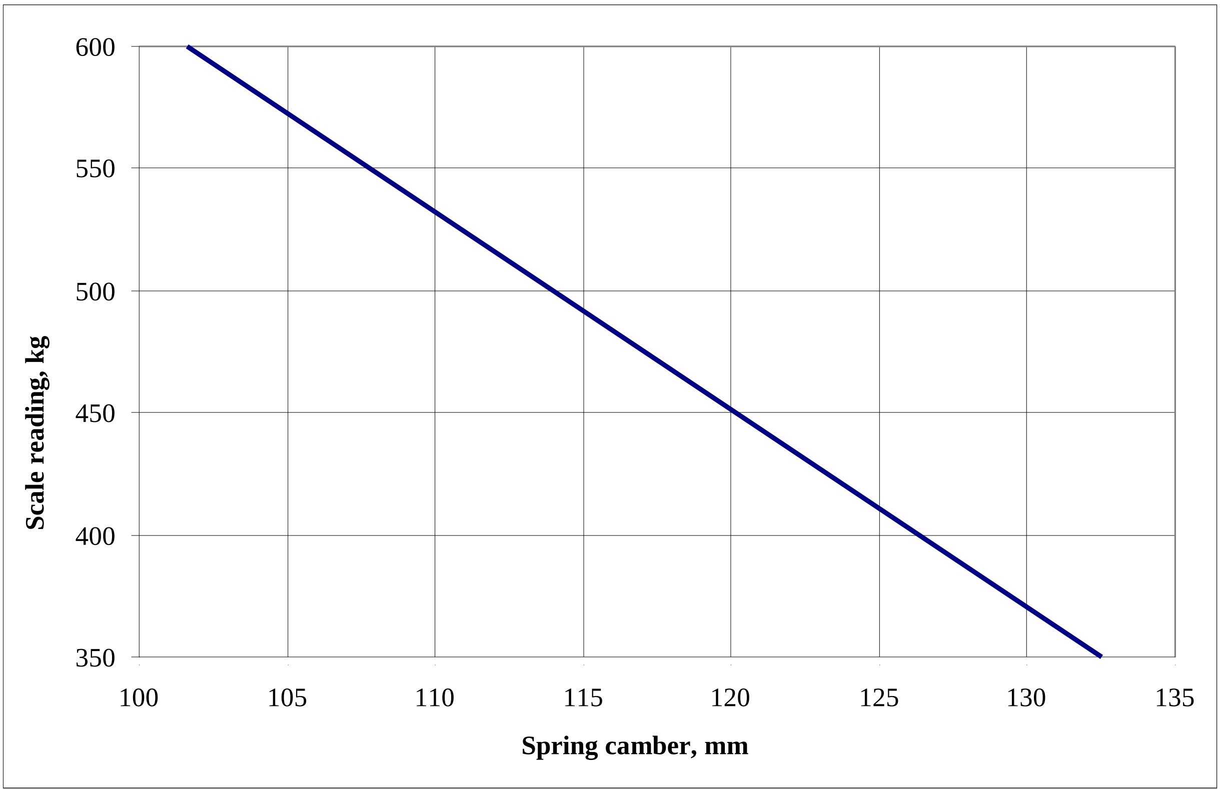


Fig. 4.30. Checking camber of rear spring in vehicle

Checking residual deformation of springs removed from vehicle

An objective classification of the "spring sagging" defect can only be carried out on a spring removed from the vehicle under the control load (Fig. 4.31).

The criterion for spring sagging (reduction of the spring camber) is the reduction of the spring camber under the control load by more than 20% of the spring deformation when the load changes from static to maximum. When addressing the issue of claim for replacement of springs due to sagging defect, it is necessary to be guided by Table 4.5.

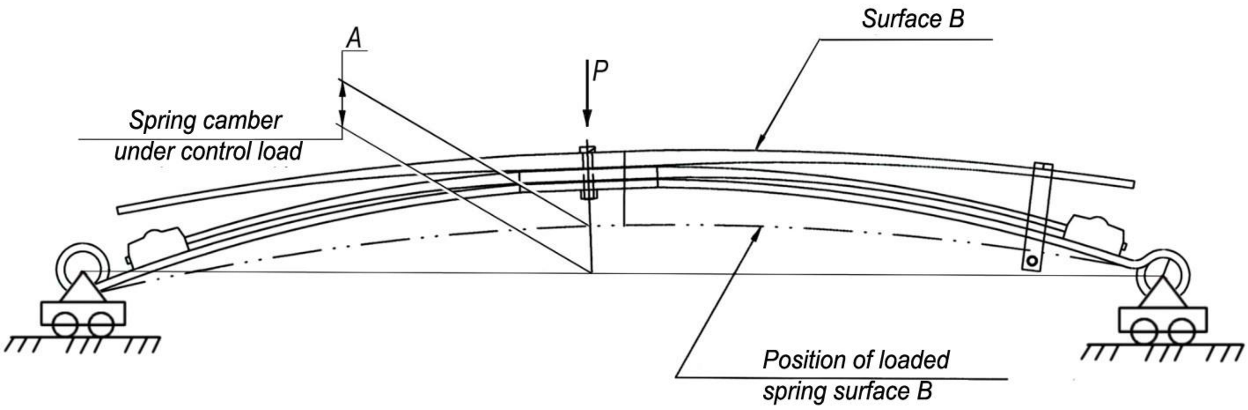


Fig. 4.31. Diagram for checking camber of rear spring removed from vehicle:
P - control load

Table 4.5

Dual-rate spring	Number of leaves	Minimum spring camber (mm) taking into account allowable sag under control load (kgf)	
		Without spring helper	With spring helper
A31R32-2912010-10	Spring - 2 leaves, spring helper - 1 leaf	85/296±10	16/1000±15

Possible malfunctions of rear suspension and remedies

Malfunction cause	Remedy
Frequent suspension breakdowns	
Vehicle overloaded	Avoid vehicle overload
Breakage of spring or spring helper leaves	Replace the spring or broken leaves of spring or spring helper
Permanent deformation of the spring leaves or one of the springs (springs “sagged”)	Replace the spring or springs
Breakdowns accompanied by metallic knock	
Lost or damaged limit buffer or second leaf pads	Install new buffer or second leaf pads
Vehicle pulls to the side	
Main leaf displacement in case of center bolt destruction	Replace the center bolt

Malfunction cause	Remedy
Main leaf breakage	Replace the main leaf
Vehicle rolls to one side	
Breakage of spring or spring helper leaves Residual spring deformation	Replace the spring or broken leaves of spring or spring helper Replace the spring

4.2.2.3. Rear suspension repair

To eliminate malfunctions, replace parts and assemblies, the suspension is subjected to complete or partial disassembly.

Tightening torques for threaded joints of rear suspension

When assembling the rear suspension, it is necessary to observe the tightening torques for:

- spring center bolt nuts - 43-61 N·m (4.4-6.2 kgf·m);
- nut of the spring clip bolt - 27-35 N·m (2.8-3.6 kgf·m);
- spring front pivot bolt - 274-314 N·m (28-32 kgf·m);
- spring rear pivot mounting bolt nuts - 177-196 N·m (18-20 kgf·m);
- spring U-bolt nuts - 177-196 N·m (18-20 kgf·m);
- spring buffer mounting bolt nuts - 28-36 N·m (2.8-3.6 kgf·m);
- spring rear bracket mounting bolt nuts - 59-69 N·m (6.0-7.0 kgf·m);
- rear shock absorber pivot mounting bolt nuts - 110-140 N·m (11.4-14.3 kgf·m);
- nuts of bolts securing the stabilizer bar saddle clips and the upper stabilizer bracket to the frame - 51-64 N·m (5.2-6.5 kgf);
- nut of the stabilizer strut pivot bolt - 69-98 N·m (7-10 kgf).

4.2.2.3.1. Spring removal and installation

Spring removal

The springs must be removed as follows:

- install wheel chocks under the front axle wheels;
- loosen the U-bolt nuts;
- disconnect the lower end of the shock absorber;
- raise the rear of the vehicle with a jack so that the springs are unloaded;

- place process stands of the appropriate height under the raised end of the frame and lower the vehicle onto them;
- unscrew the spring silent block mounting bolt nuts. Remove the bolts, if necessary, knock out with a copper rod so as not to damage the thread;
- unscrew the nuts of the U-bolts, remove the stabilizer lower bracket, U-bolts, spring clamp plate and spacer;
- raise the vehicle with a jack so that the front end of the spring comes out of its bracket, and the rear bracket out of the shackle. Remove the spring.

Spring installation

When mounting the springs, it is important to orient them correctly. The short end of the spring must face forward. For the correct operation of silent blocks, the bolt nuts should be tightened with springs straightened. This operation can be carried out using a standard jack and tool (Fig. 4.32).

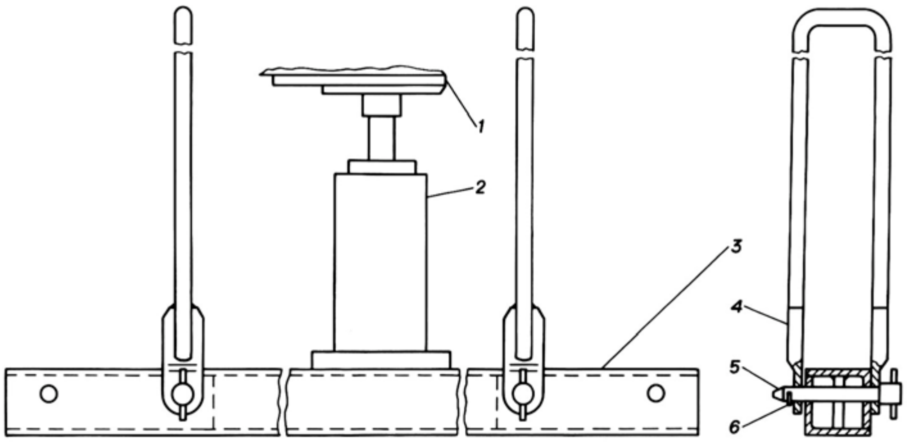


Fig. 4.32. Spring installation tool: 1 - spring; 2 - jack; 3 - beam; 4 - U-bolt; 5 - pin; 6 – latch

The spring installation on the vehicle should be carried out as follows:
- lower the vehicle so that the front end of the spring enters its bracket, and the rear end enters the lower end of the shackles;
- insert bolt 9 (see Fig. 4.29) securing the front end of the spring and screw a nut onto it;
- insert the bolts into the shackles and the rear eye of the spring and screw the nuts onto the bolts;
- straighten the spring using the tool, tighten the front pivot bolt and the nuts of the rear pivot bolts and remove the tool;
- on top of the spring put a clamp plate, then put U-bolts on it, the threaded ends of the U-bolts shall be inserted into the axle pad holes. Install the lower stabilizer bracket. Screw nuts onto the threaded parts of the U-bolts;

- if the vehicle has wheels, remove the stands and the jack;
- finally tighten the U-bolt nuts;
- connect the lower end of the shock absorber.

4.2.2.3.2. Spring disassembly and assembly

Spring disassembly

Before disassembly, clean the springs of dirt and determine their health. If all parts are suitable for further operation, it is necessary to check the spring camber in order to determine the value of spring sagging (permanent deformation) in accordance with Table 4.5.

If, as a result of a preliminary inspection, breaks are found, the spring must be disassembled as follows:

- clamp the spring in a vice in the immediate vicinity of the center bolt;
- unscrew the clamp bolt nut, remove the bolt and remove the distance bushing and clamp gaskets;
- unscrew the nut of the center bolt and carefully release the vise, since the leaves in the tightened spring are in a stressed state.

Rinse the spring leaves with kerosene, wipe and inspect for cracks.
Replace broken and cracked leaves.

In case of rubber detachment from metal fittings in silent blocks, they must be replaced.

The pivots must be pressed out and pressed in using a mandrel (Fig. 4.33). When installing silent blocks, they should be pre-lubricated with liquid soap.

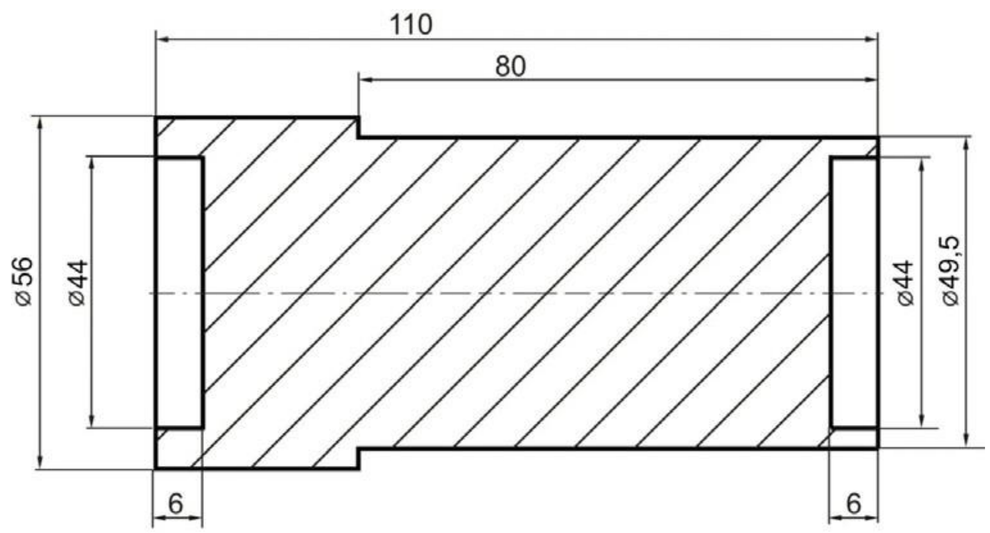


Fig. 4.33. Mandrel for pressing out and pressing in silent blocks of rear springs and brackets
(Material - steel 40X (HRC 30-34))

When pressing in the silent block, the force must be applied to the outer bushing of the silent block. Press in the silent blocks in such a way that the outer bushing of the silent block is flush with the end face of the spring leaf or bracket.
Re-rivet the loosened clamp rivets.

Spring assembly

To increase the camber of the spring leaves, it is unacceptable to straighten them with hammer or sledgehammer blows (this leads to a quick leaf breakage). It is allowed to straighten the leaves by rolling between the rollers.

Install new rubber pads on the spring second leaf ends so that the protrusion on the pad fits into the spring leaf hole.

The spring assembly must be carried out in the following sequence:

- leaf-by-leaf paint coating of each leaf;
- select the required set of leaves and interleaf spacers of the spring;
- subassemble the leaves in the appropriate order, installing gaskets between them, and insert a process rod into the hole for the center bolt with a diameter equal to the center bolt diameter;
- squeeze the central part of the spring in a vice as close as possible to the rod and remove it;
- insert the center bolt instead of the rod with the head down and tighten the retaining nut;
- install gaskets, distance bushing and bolt of the clamp and tighten the retaining nut;
- release the spring from the vice;
- check the spring camber as described above.

4.2.3. Rear suspension shock absorbers

Care of shock absorbers, possible malfunctions of rear suspension shock absorbers and remedies are given in the “Front suspension. Shock absorbers” subsection.

Check procedure for the usability of shock absorbers is given in the supplier’s documentation.

The shock absorber cannot be repaired and, if a malfunction is found, must be replaced with a new one.

Rear shock absorber removal and installation

To remove the shock absorber:

- unscrew the nut 1 (Fig. 4.34) of the bolt securing the lower pivot of the shock absorber;
- unscrew the nut of the bolt securing the upper pivot;
- remove the shock absorber from the vehicle.

The shock absorber shall be installed in the reverse order of removal.

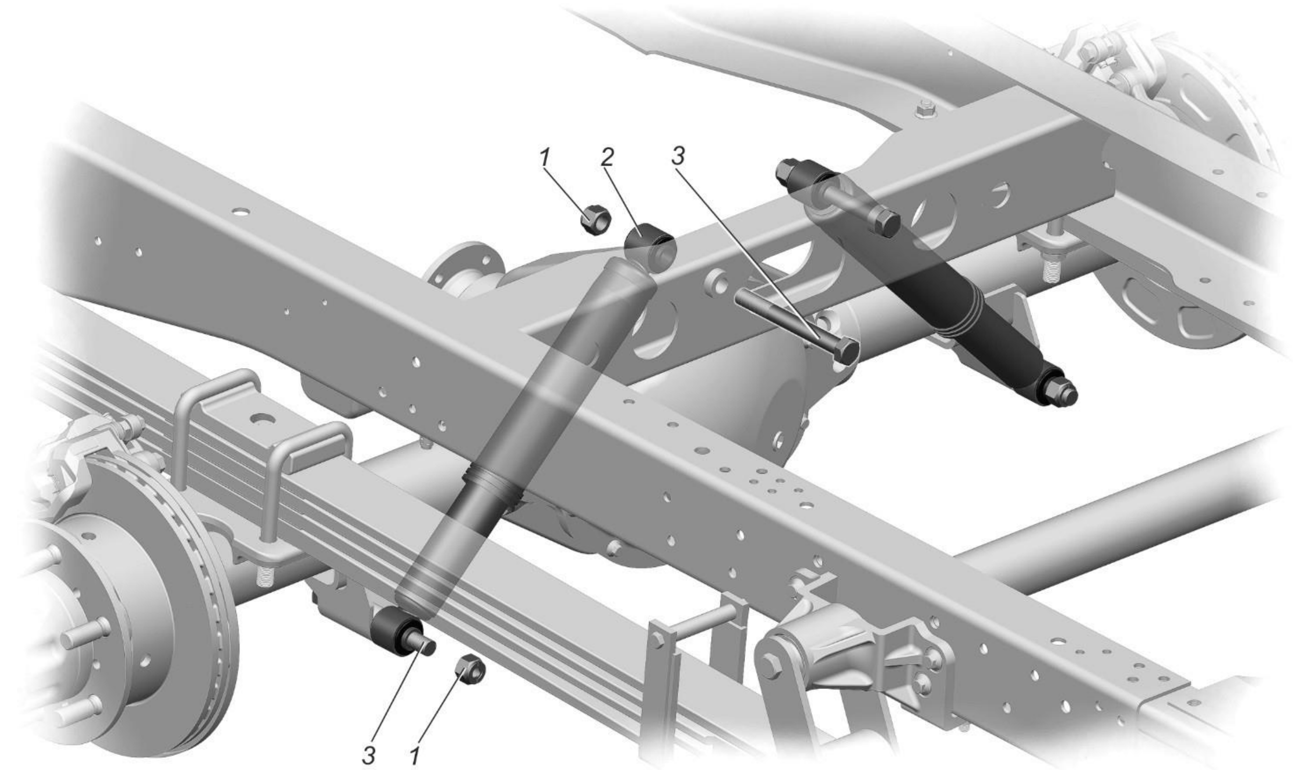


Fig. 4.34. Rear suspension shock absorber installation: 1 - nut; 2 - shock absorber; 3 - bolt

4.2.4. Rear suspension stabilizer

The stabilizer (Fig. 4.35) increases the vehicle roll stability. Maintenance of the stabilizer consists in periodically checking its fastenings and the condition of the stabilizer parts.

In case of the bar deformation, cracks and breakage of the bar, struts and brackets, as well as wear of the rubber bushings, they should be replaced with new ones.

When replacing, press the silent block into the strut using a soap solution.

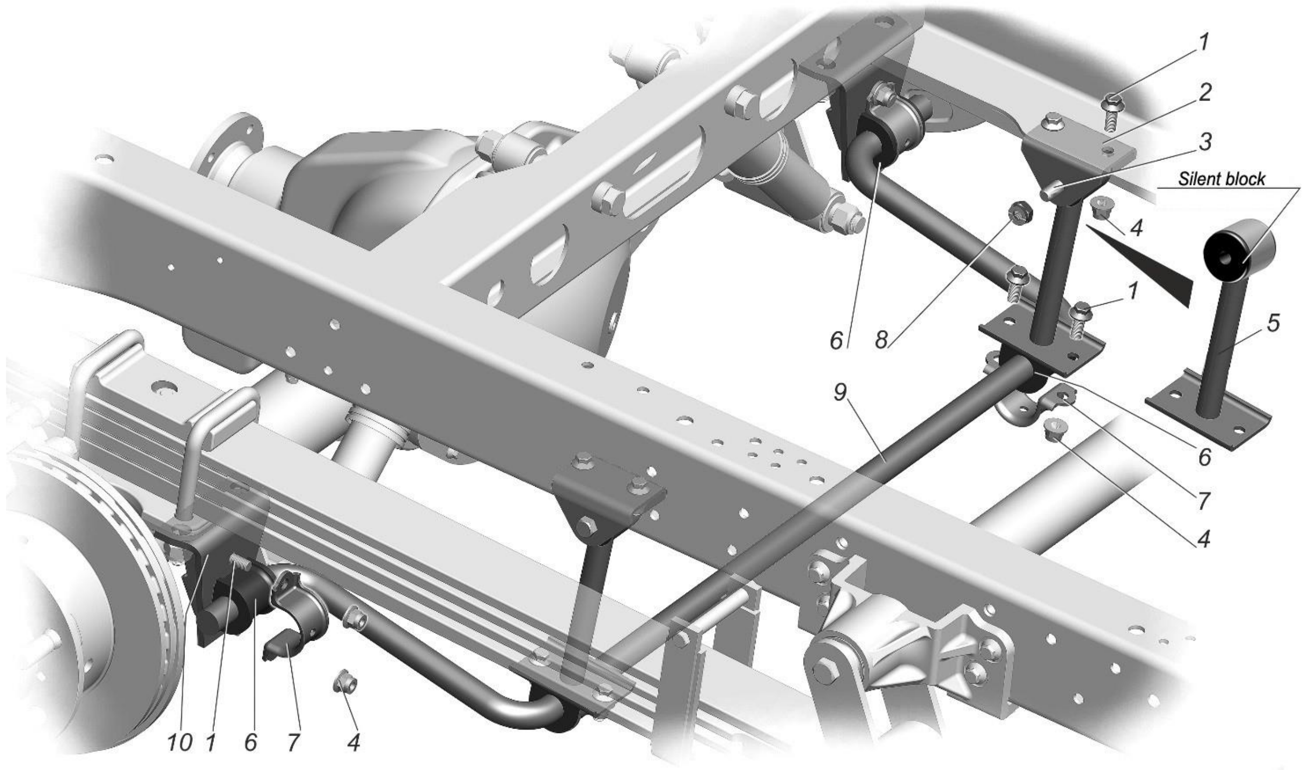


Fig. 4.35. Rear suspension stabilizer installation: 1, 3 – bolts; 2 – upper stabilizer bracket; 4, 8 – nuts; 5 – pivoted bench; 6 – pad; 7 – saddle clip; 9 – bar; 10 – lower stabilizer bracket

4.3. Wheels and tires

The vehicle is equipped with stamped steel wheels $5^1/_2$Jx16H2 with a non-separable deep rim, with a disc having ventilation holes. The spare wheel is located on a holder under the van frame.

The wheels are centered on the hub along the central hole of the disc, and the front and rear dual wheels are fastened using six nuts with moving washers (on each hub).

Tire 185/75R16C 104/102Q is mounted on the wheel rim. The manufacturer completes the vehicle with tubeless tires.

Tire designation

The model and designation of the tire is given on its sidewall.

The tire designation includes:

185 - conditional tire section width in millimeters;

75 - tires series, the ratio of the height of the section to its width expressed as a percentage;

R - radial tire;

16 - seat wheel rim diameter, in inches;

C - tire for light commercial vehicle;

104 - bearing capacity index indicating the maximum allowable load on the tire (for single wheels), 900 kg in this case;

102 - bearing capacity index indicating the maximum allowable load on the tire (for dual wheels), 850 kg in this case;

Q - speed category index indicating the maximum tire speed, 160 km/h.

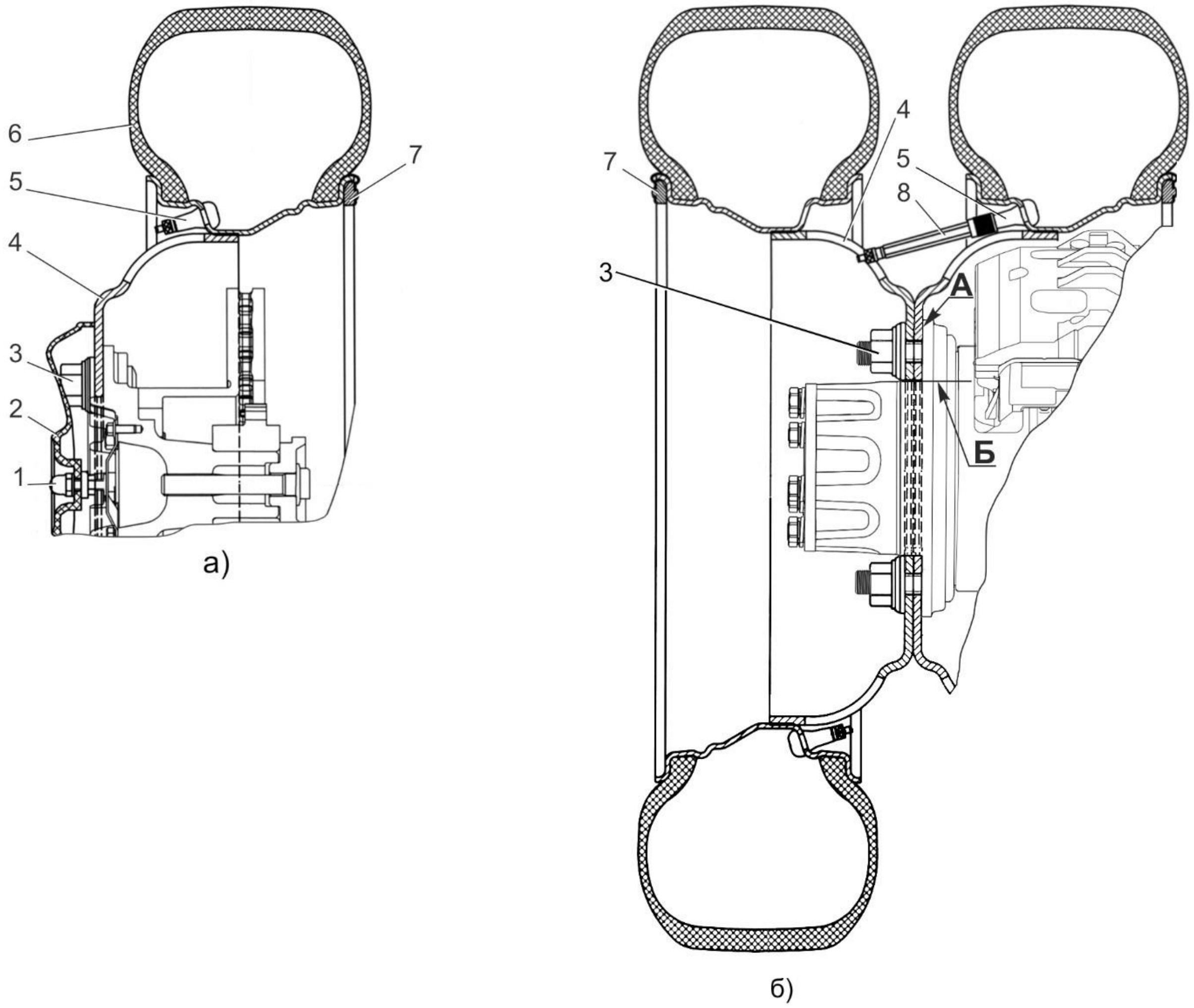


Fig. 4.36. Wheel installation: a – front wheel; b – rear wheels; 1 – nut; 2 – wheel cap; 3 – nut with wheel washer; 4 – wheel; 5 – valve; 6 – tire; 7 – balancing weight; 8 – valve extension

For the convenience of checking the air pressure and inflating the tires of the rear inner wheels, an extension valve 8 is installed (Fig. 4.36). Screw the extension tightly.

Maintenance

During the vehicle operation, it is necessary to tighten the wheel nuts in a timely manner in order to avoid breaking the mounting holes, remove rust and tint the wheels. Tightening torque for wheel nuts 290-370 N·m (30-38 kgf·m).

To ensure the longest tire life, the following rules should be followed:

- **maintain the required pressure in the tires.** The pressure shall be checked on cold tires before driving. Tire pressures are given in the “Specifications and controls” section. At stops along the way, inspect the tires and visually check the air pressure in them. Do not drive with reduced tire pressure, even for short distances. Do not reduce the pressure in heated tires by releasing air from them, since during movement an increase in pressure is inevitable due to heating of the air in them. In motion, watch if the vehicle "drifts" in any direction. Such a drift may indicate a decrease in pressure in one of the tires or incorrect wheel alignment angles;

- **balance the wheels.** The wheel assembly with tires shall be dynamically balanced by placing weights on the rim shoulders on both sides. It is allowed to install no more than five weights per wheel and no more than three weights on one side of the wheel . Wheels with tires should be checked and balanced on a special bench, installing the wheel on mounting hole **B** (see Fig. 4.31) under the hub and end surface **A**. The permissible residual imbalance should not exceed 20 g on the wheel rim. Before balancing, the wheel must be washed and cleaned of dirt and foreign objects;

- when returning to the park and at stops, park the vehicle in a clean and dry place. Do not allow oil, gasoline, oil paint to get on the tires;

- when parked for more than 10 days, periodically move the vehicle or put it on stands to relieve the tires. Do not park your vehicle on flat tires;

- **observe the rules for mounting and dismounting tires.**

Tires should be inspected regularly and fine gravel stuck in the tread grooves should be removed. If there are cuts, blisters or cracks, replace the faulty tire in a timely manner. Do not damage tires and wheels during mounting and dismounting.

- **tires should be rearranged together with wheels**, if necessary, according to the tire rearrangement scheme (Fig. 4.37). The swap may be caused by the need to obtain uniform wear of all tires, including the spare one, as well as to ensure the correct selection of tires along the axles. Tires with the same tread wear should be installed on one axle, and more reliable tires should be installed on the front axle of the vehicle.

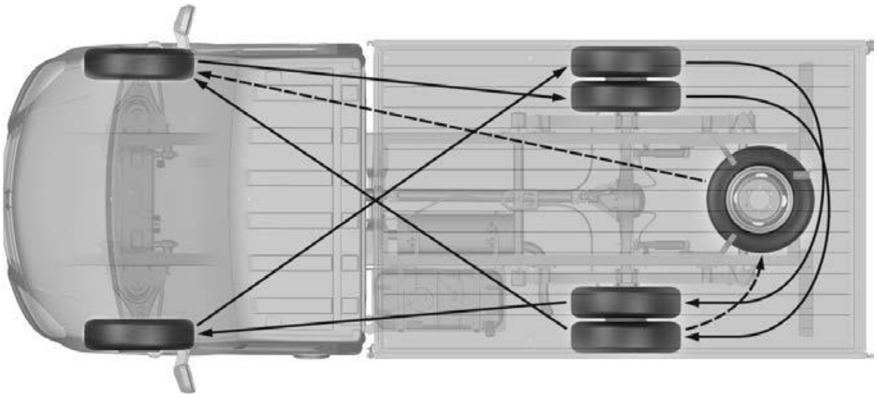


Fig. 4.37. Tire rearrangement scheme

Wear indicators. At the base of the tread, there are 1.6 mm high wear indicators of the tires located across the tread at the same distance along the circumference. The location of the wear indicators is indicated by marks on the sidewall of the tire (for example, the designation TWI or pictograms). Wear indicators appear as solid areas of rubber and correspond to the wear limit of the tire, with a pattern depth of 1.6 mm. In this case, the tire must be replaced.

It is recommended to replace worn tires with a whole set of new tires.

Tire mounting

Before mounting tires, check the condition of the rims and treads.

Tubeless tires can only be mounted on wheels with rims in good working order. The wheel rim must be of the correct shape and have even and smooth bead seats (surfaces) to which the tires are adjacent. Dents, nicks, cracks, corrosion, chipped paint, and deformed rims can cause tubeless tires to lose pressure and become out of balance.

Tire beads must be clean, free of damage and burrs.

Mounting and dismounting of tires is recommended to be carried out using special equipment.

The procedure for mounting tires on a wheel is as follows:

- install the valve in the wheel rim valve hole;
- put the wheel on the floor with the disc down, partially put the tire on the wheel so that the tire bead is in the rim recess and, using mounting blades, gradually drive the tire bead into the wheel rim. Turn the tire on the wheel so that the tire light part mark (if any) is near the valve (the mark is made on the tire sidewall in the form of a circle with a diameter of 5-10 mm, applied with indelible paint);
- place part of the upper tire bead, located on the opposite side from the valve, into the rim recess, and then, using mounting blades, place the entire tire bead on the rim in the same way as the first bead;
- inflate the tire.

Tire dismounting

Before removing the tire from the wheel, clean it from dust, dirt and foreign objects, and then, using a jack or a special tool, remove both tire beads from the rim bead seats. The lower bearing surface of the jack should be installed on the tire sidewall as close as possible to the wheel rim, and the upper one under the frame side member. It is allowed to apply light blows with a hammer on the tire bead or press it out with mounting blades.

Dismount the tire in the reverse order of mounting. At the same time, it should be remembered that the tire bead is removed from the rim only if the opposite part of this bead is in the rim recess.

Wheel and tire malfunctions and remedies

Usually, damaged wheels are not repaired, but replaced with new ones. It is forbidden to use wheels with cracks, broken mounting holes, bent discs. It is acceptable to repair small dents of the rim flange in a cold state without heating. After the repair, the wheel runout should be checked. The radial and lateral runout of the rim seating surfaces in the profile sections adjacent to the tire should not exceed 1.2 mm. The runout shall be checked when installing the wheel on the mounting hole **B** (see Fig. 4.36) under the hub and end surface **A**. Usually, increased and uneven tread wear is caused by a violation of operating standards or abnormal operation of the vehicle undercarriage and steering assemblies. It is possible to determine the cause of wear by the tread wear nature (Fig. 4.38). For example, on tire 1, wear is caused by prolonged driving with high pressure, and on tire 2 - with low pressure.

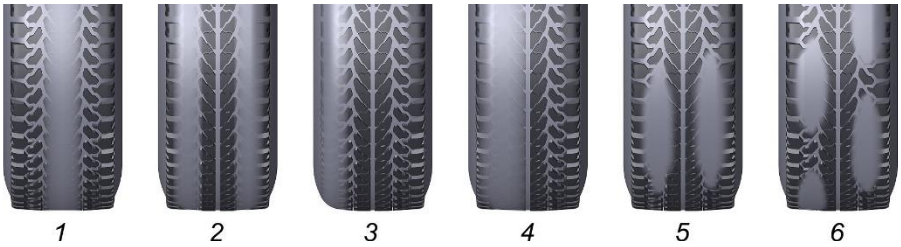


Fig. 4.38. Types of abnormal tire wear: 1 - overpressure; 2 - underpressure; 3 - incorrect wheel toe-in; 4 - incorrect wheel camber; 5 - increased wheel runout; 6 - front wheel shimmy

Wear of tire 3 with characteristic rounded edges on one side of the tread pattern and acute edges on the other is caused by incorrect wheel toe-in. With gross deviations from the recommended toe-in, the tires may be worn out after a run of less than 1000 km.

Tire 4 has uneven tread wear due to incorrect camber.

Wear 5 in the form of one or two “bald spots” appears as a result of increased runout of the brake drum or disc working surface. A less pronounced “bald spot” may result from emergency braking on a concrete highway.

Tire 6 shows spotty wear. The main causes of spotty tire wear are as follows: play in the pivots of tie-rod arms and suspension, malfunction of the front shock absorbers or one of them, incorrect caster angle, increased axial clearance in the wheel hub bearings, gross imbalance of the front wheels, increased runout of the brake drum or disc, loose fastening of the front suspension to the frame side members or the steering gear to the subframe and other causes of shimmy.

Methods for repairing damaged and worn tires are well known. Usually, repairs are carried out at tire repair plants or tire shops.

5. Steering

Steering is used to change the vehicle direction by turning the front steered wheels.

To ensure vehicle control, reduce the transmission of shocks to the steering wheel and improve traffic safety, a hydraulic booster (HB) is used in steering.

The steering system (Fig. 5.1) consists of a steering wheel, a steering column with an intermediate shaft and a support, a cardan shaft, an integral rack and pinion steering gear, a power steering pump with a pulley, an oil tank, a power steering radiator and pipelines.

The torque applied by the driver to the steering wheel is transmitted to the steering input shaft through the steering column shaft, intermediate shaft and cardan shaft.

The **rack and pinion steering gear** is used to convert the torque on the input shaft into a force on the tie-rod arms, which through the steering drive elements creates the necessary torque to turn the steered wheels.

The **steering gear** is fixed on two subframe brackets, the gear is rigidly bolted to the left bracket, and to the right one through a rubber pad with a clamp.

The tie-rod arm includes an internal ball pivot attached to the strut with a threaded joint.

The tie-rod arms are connected to the knuckle arms of the suspension struts using ball pivots.

The steering gear (Fig. 5.2) is integral, i.e. it includes a power hydraulic cylinder and a rotary distributor and a mechanical gearbox with a gear-rack transmission.

The distributor, connected by cardan and intermediate shafts and the steering column shaft to the steering wheel, controls the oil flow supplied by the power steering pump, directing it under pressure into one or another cavity of the power cylinder, depending on the steering wheel rotation direction. The pressure of the oil entering the power cylinder cavity creates an additional force on the tie-rod arms, which reduces the driver’s force applied to the steering wheel to overcome the steered wheel turning resistance. Due to the distributor design, the force applied by the driver to the steering wheel is proportional to the wheel turning resistance force.

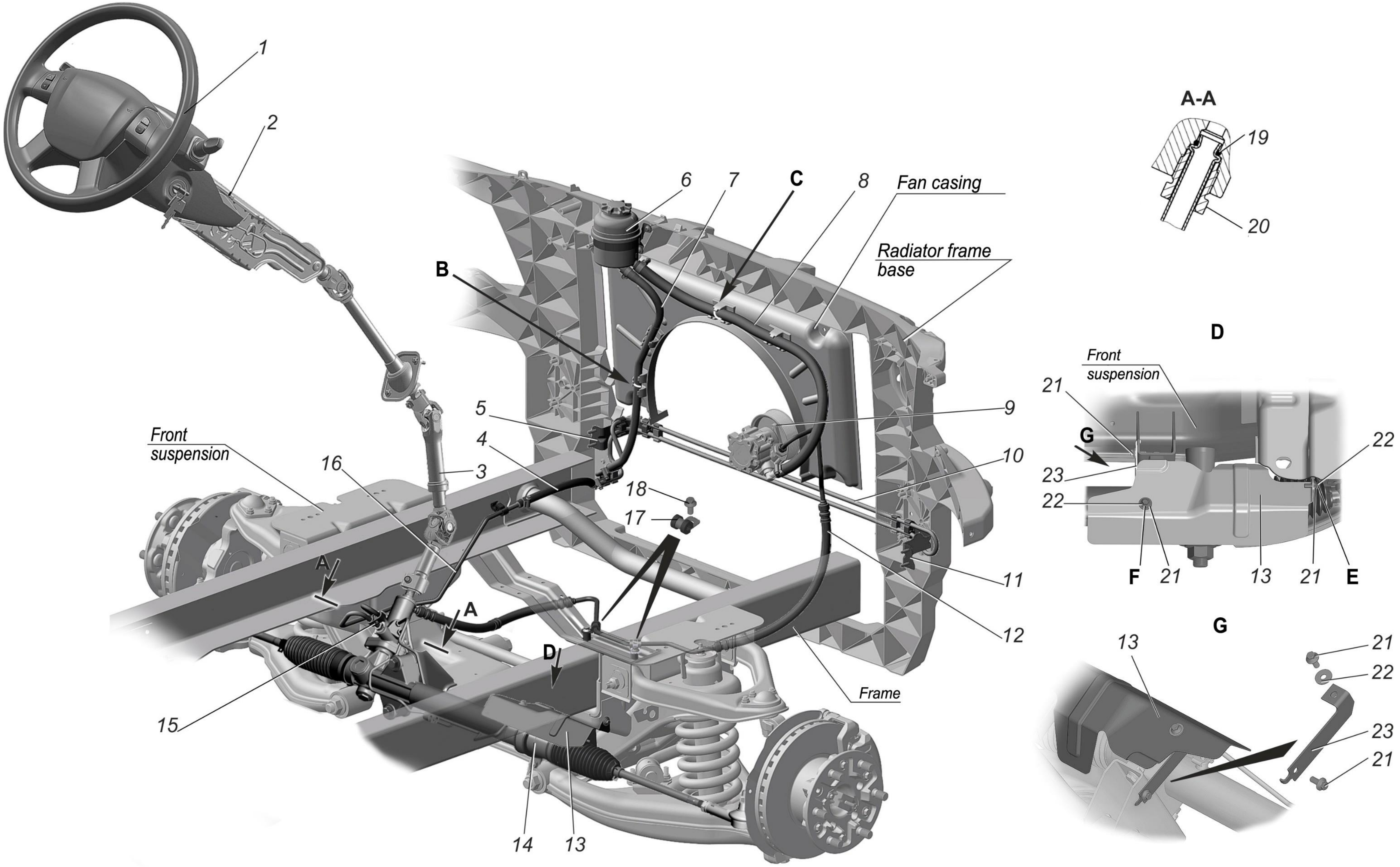


Fig. 5.1. Vehicle steering: 1 – steering wheel; 2 – steering column with intermediate shaft and support; 3 – cardan shaft; 4, 7 – drain hoses; 5, 11 – power steering radiator brackets, 6 – oil tank; 8 – suction hose; 9 – power steering pump with pulley; 10 – power steering radiator; 12 – discharge hose; 13 – steering gear screen; 14 – steering gear; 15, 17 – clips; 16 – drain pipe; 18,21 – bolts; 19 – O-ring Ø 7.8x1.7 (mm); 20 – nut; 22 – washer; 23 – screen bracket

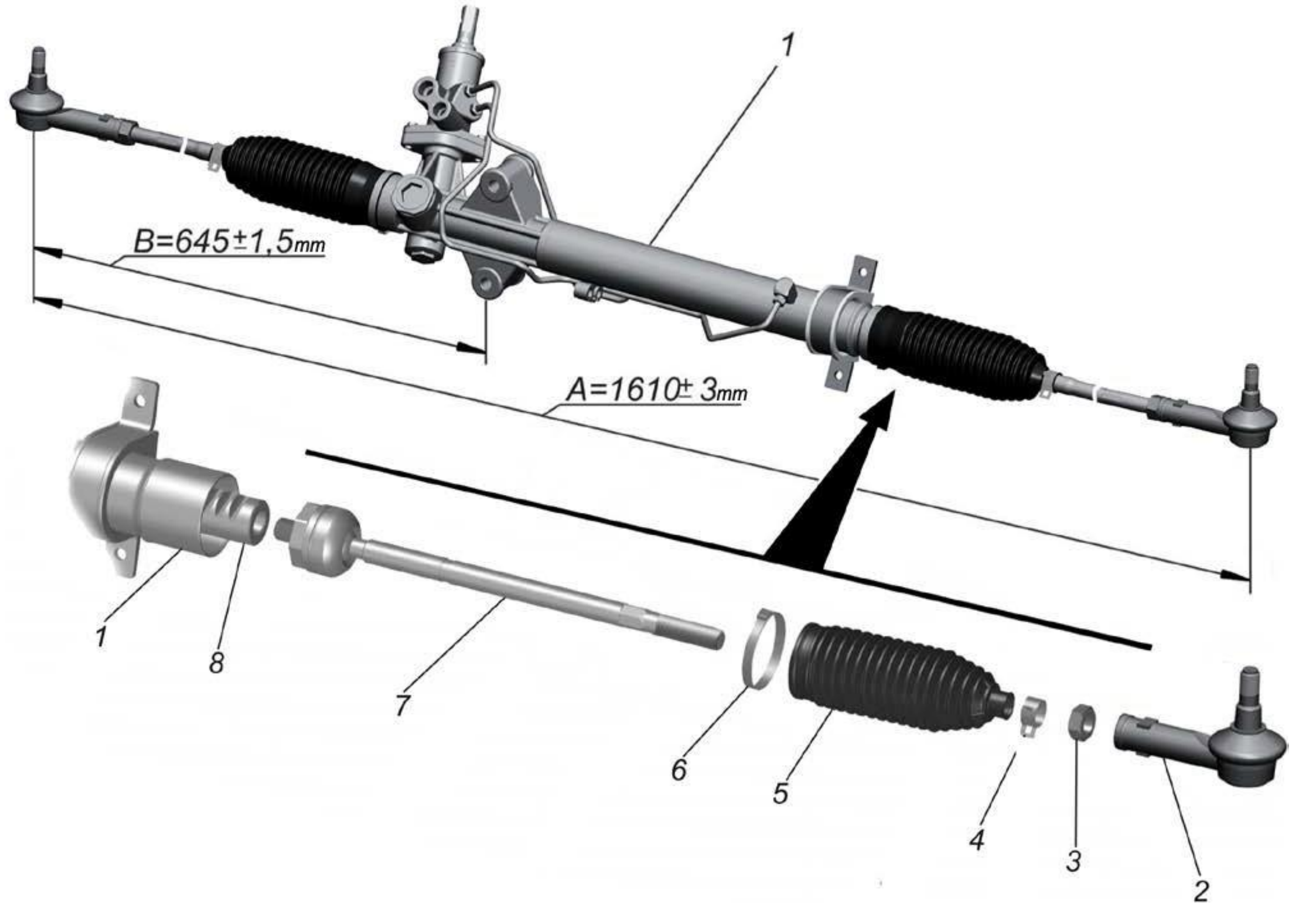


Fig. 5.2. Steering gear: 1 – steering gear; 2 – pivoted tie rod end; 3 – nut; 4, 6 – clamps; 5 – protective casing of internal pivot; 7 – internal pivot assembly with tie-rod arm; 8 – steering rack

Steering gear specifications

Full rack stroke, mm………………………………………………….…….. 160

Gear ratio
(rack stroke per input shaft revolution), mm/rev……………….............. 47

Force at rack ends with oil
pressure of 11.5 MPa (115 kgf/cm^2), N (kgf)……………..………….. 12900 (1290)

Steering column 2 (Fig. 5.3) with intermediate shaft includes a column consisting of a pipe oscillating against the column mounting bracket and rotating in the pipe on two shaft bearings, as well as an intermediate shaft with a support connected to the steering column shaft using a cardan pivot

The steering column with an intermediate shaft provides the transfer of the driver's control action from the steering wheel to the steering cardan shaft.

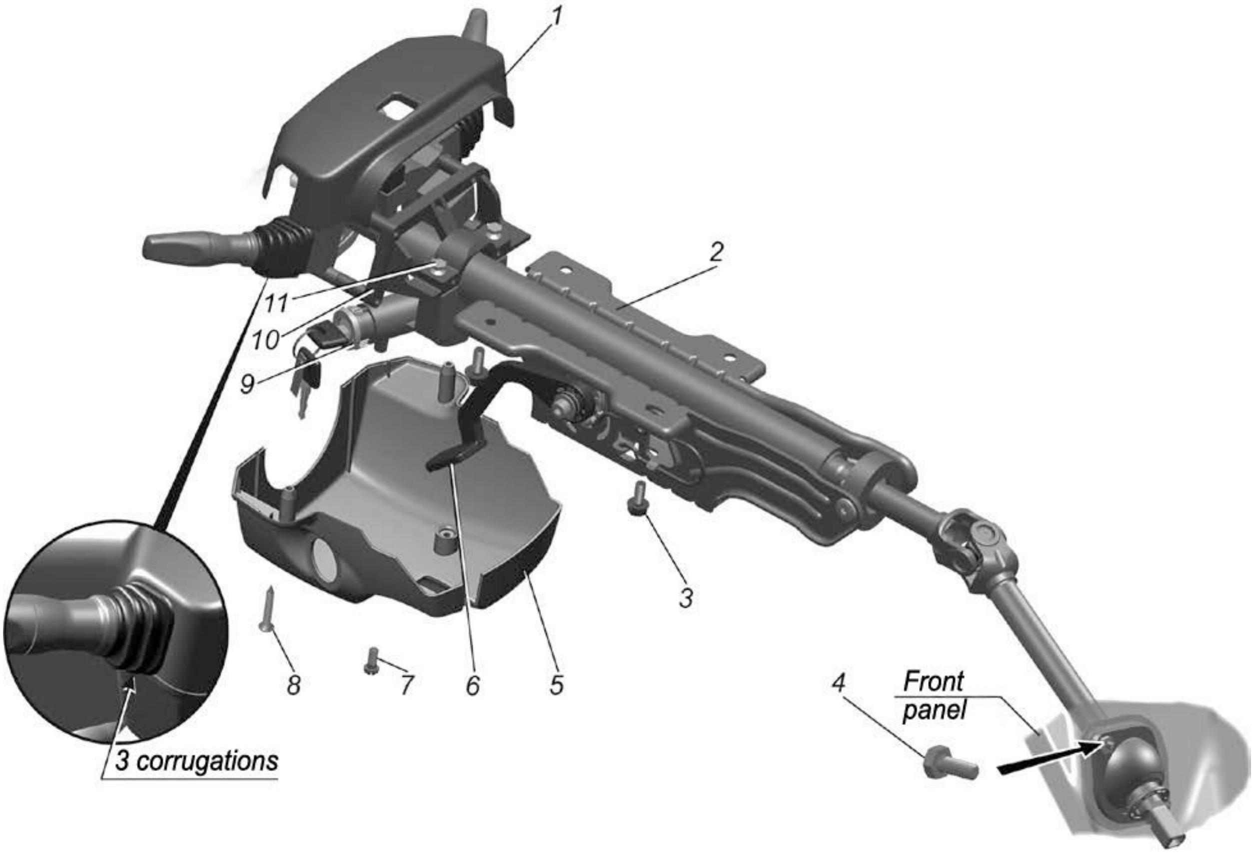


Fig. 5.3. Steering column installation: 1 – upper casing; 2 – steering column; 3, 4 – bolts; 5 – lower casing; 6 – lever; 7, 8 – screws; 9 – instrument and starter switch; 10 – understeering switch base; 11 – bolt with detachable head

The column is attached to the dashboard base with four bolts 3.

The upper part of the steering column tube has a base for understeering switches, a current transfer device and an instrument and starter switch with an anti-theft device, the locking device of which in the locked position enters the steering column shaft groove. The steering column casing is fixed to the column with screws.

The steering wheel is mounted on the upper end of the steering shaft, which has a cone and splines, and is fastened with a nut.

The steering column design allows changing the column shaft angle to adjust the steering wheel position.

A support is installed on the lower part of the intermediate shaft, the body of which is attached to the cab front panel with two bolts 4.

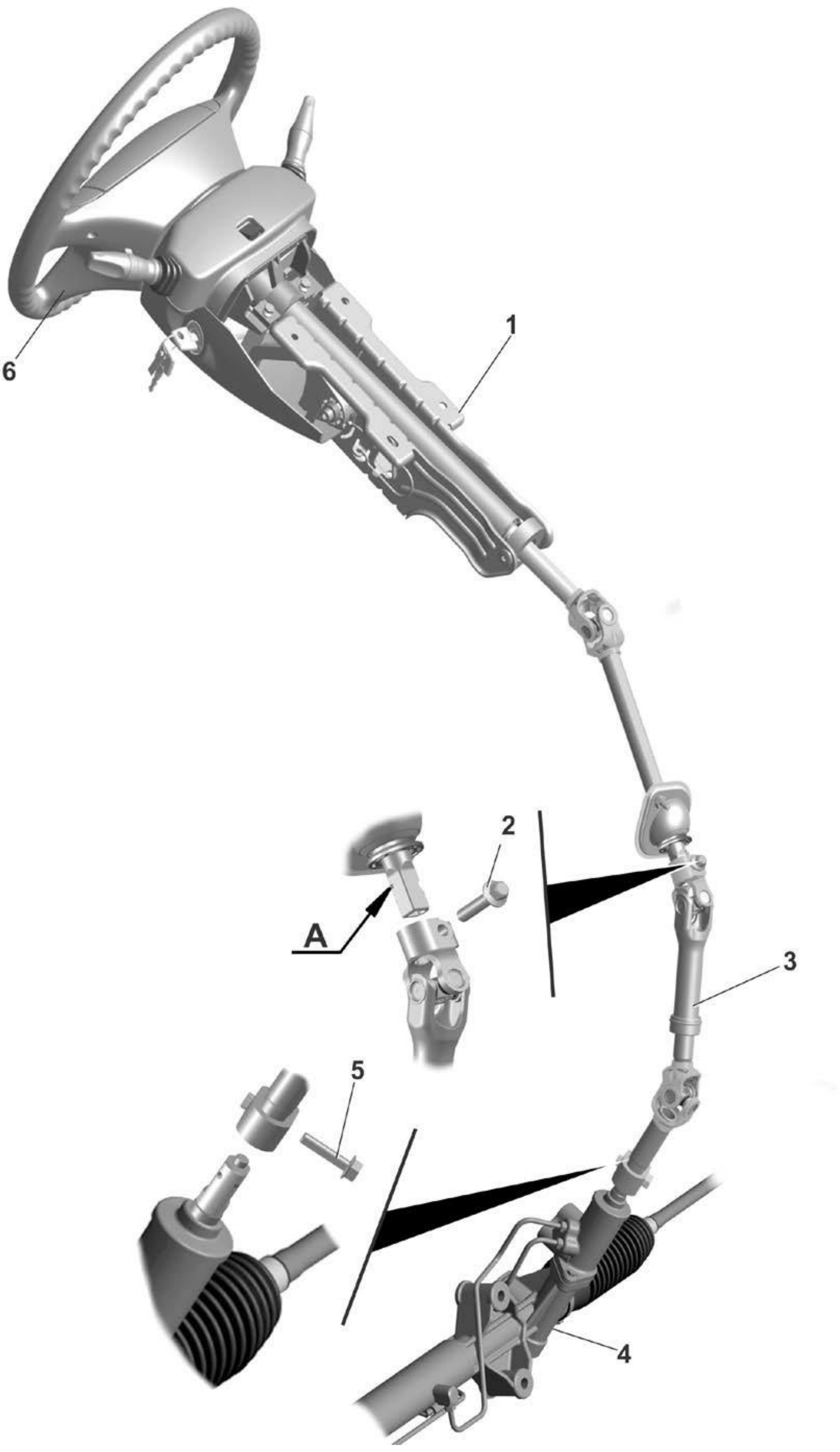


Fig. 5.4. Steering cardan shaft installation: 1 – steering column; 2, 5 – bolts; 3 – cardan shaft; 4 – steering gear; 6 – steering wheel

The **steering cardan shaft 3** (Fig. 5.4) includes a splined telescopic compensator and two U-joints and connects the input shaft of the steering gear to the intermediate shaft of the steering column using yokes and tie bolts.

To compensate for the mutual movement of the column and the steering gear while the vehicle is moving and when adjusting the column shaft angle, the splined telescopic compensator allows the upper part of the shaft to move against the lower part along the shaft axis.

Steering column and cardan shaft specifications

Steering column shaft and cardan shaft rotation resistance torque, N·m (kgf·m), max.	0.5 (0.05)
The total circumferential play of the cardan shaft assembly with the steering column at Mcs= ±1 N·m, max.	
- new	0°20'
- used (limit)	0°30'
Telescopic compensator movement force, N (kgf), max.	80 (8.15)
Support intermediate shaft rotation resistance torque, N·m (kgf·m), max.	0.2 (0.02)
Axial force of intermediate shaft movement in support, N (kgf), max.	50(5)
Torque of resistance to steering column rotation against pivot axis with locking mechanism unlocked, N·m (kgf·m), max.	33.5(3.35)
Locking mechanism in locked position must keep steering column from rotating against pivot axis under force moment action on steering column shaft, N·m (kgf·m), min.	350(35)

Steering column and cardan shaft failures are:

- wear of the steering column bearings (play, uneven steering column shaft rotation torque, bearing jamming);
- wear of the telescopic compensator (increased circumferential play in the compensator, knocking in the compensator when changing the shaft rotation direction and when the vehicle is moving);

- wear of U-joints (joint play, uneven joint rotation torque, cross-piece and yoke breakage);
- destruction of the steering column shaft and cardan shaft.

In case of failure of the steering column or cardan shaft, they shall be replaced with new ones.

Power steering pump

The pump provides the necessary pressure and displacement in the hydraulic system.

Pump specifications

Pump displacement at pressure
1 MPa (10 kgf/cm^2) and oil temperature 50 °C
within speed range
of pump shaft, l/min:
960-3000 min^{-1} 7.8-9.2
Actuation pressure
of relief valve, MPa (kgf/cm^2).. 11.5-12.5 (115-125)

The vane-type power steering pump is mounted on the attachment bracket at the front of the engine and is driven by the crankshaft pulley using a V-ribbed belt.

The pulley is fixed to the pump shaft with three bolts.

The pump has two valves: safety and flow. The safety valve limits the pressure in the power steering system. When the maximum pressure is reached, the valve opens and the discharge line communicates with the suction line. The flow valve limits the oil supply to the system as the shaft speed increases.

In case of failure of the pump or its pulley, it is necessary to replace them with new ones (see the supplier’s documentation).

Power steering tank

Oil tank 2 (Fig. 5.5) serves as a tank for filling, storing and filtering the oil of the power steering system, and also compensates for volumetric fluctuations in the system oil level.

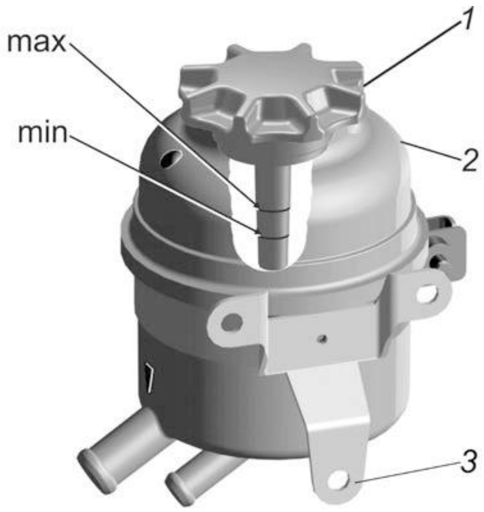


Fig. 5.5. Power steering tank: 1 - tank cap with dipstick; 2 - oil tank body; 3 - bracket

The oil tank cap 1 has a dipstick with marks for monitoring the tank oil level during vehicle operation.

The tank is installed under the hood on bracket 3, fixed on the radiator frame base.

A filter element is installed inside the tank.

The tank must be replaced in the following cases:

- tank malfunction;
- oil change;
- pump replacement;
- steering gear replacement.

Power steering radiator

Radiator 10 (see Fig. 5.1) cools the oil in the hydraulic steering system and is a curved pipe fixed with two brackets 5 and 11 and clips on the radiator frame base.

Possible malfunctions of steering and remedies

Malfunction cause	Remedy
Unstable vehicle movement on road (regular additional correction of set movement direction with steering wheel is required) *Increased steering wheel play*	
Worn tie-rod arm pivots	Replace the ends or inner pivot assemblies with tie-rod arms
Loose fasteners of tie-rod arm pivot pins in conical holes	Tighten pin nuts or replace tie-rod arm ends and mating parts when tapered surfaces are worn
Increased clearance in the wheel hub bearings	Replace worn bearings
Loose steering gear mount to subframe brackets	Tighten the fasteners (except for the lower bolt securing the steering gear to the subframe bracket on the left in the vehicle direction. In case of loosening, unscrew the specified bolt, install it on the sealant (see the “Installing steering gear on vehicle” section) and tighten)
Increased clearance in gear-rack engagement	Replace the steering gear
Weak steering column fixation	
Column cannot be fixed in the required position	Replace the column
Increased force on steering wheel when turning in both directions	
Loose tension of accessory drive V-ribbed belt	Replace drive belt and/or tensioner
Faulty pump	Replace the pump
Faulty steering gear (internal leakage)	Replace the steering gear
Increased force on steering wheel when turning in one direction	
Faulty steering gear	Replace the steering gear
Noise in hydraulic system	
Insufficient oil level in power steering tank	Top up oil to the normal

Malfunction cause	Remedy
Air in hydraulic system (characterized by oil foaming) due to insufficient bleeding of power steering system or air inflow through hose connections	Remove air from the hydraulic system
Suction hose kink	Eliminate the kink
Worn pump	Replace the pump
Oil ejection from tank through cap hole	
Permissible oil level exceeded	Bring oil level up to normal

Steering maintenance

During maintenance, check:

- joints between the tie rod pivot pins and the strut knuckle arms and, if necessary, tighten the joints. Replace the mating parts if the play is not eliminated after tightening;

- play of the tie rod pivots and, if necessary, replace the tie rod end assemblies with outer pivots or the rod inner pivot assemblies with tie-rod arms;

- condition of the protective caps of the outer and inner pivots of the tie rods. Protective caps must not have through damage. If necessary, replace the ends or caps of the inner pivots;

- condition of the accessory drive V-ribbed belt and the tensioner, and, if necessary, replace the faulty parts;

- operability of the mechanism securing the steering column and, if necessary, replace the column;

- total play in the steering system and, if necessary, replace assemblies and parts that have reached the limit state.

– joints between the U-joint yokes and the steering shafts and, if necessary, tighten the yoke bolts;

- tightening of the upper bolt securing the steering gear housing to the subframe and, if necessary, tighten the joint[28]);

- tightening of the nuts securing the steering gear clip to the subframe and, if necessary, tighten the joint.

During operation, it is necessary to check the tightness of the power steering system, the oil level in the tank, change the oil in the system in accordance with the Vehicle Operation Manual.

---

[28]) Sealant was used to lock the lower bolt of the steering gear housing to the subframe. Checking the tightening torque and tightening the specified joint is not allowed, because the bolt shift leads to the sealant destruction and the subsequent loosening of the joint

ATTENTION

1. Mixing (topping up) oils of the power steering system of different brands and different companies is prohibited.

2. When assembling the steering, the self-locking nuts, screws, sealing elements and fastening elements must be replaced with new ones.

3. Self-locking retaining nuts are allowed to be unscrewed and screwed onto the mating part no more than four times due to the decrease in the locking properties of the polymer ring insert.

If cracks, blisters and visible abrasion are found on the hoses, replace the hoses with new ones. The hoses must be securely fastened in the clips.

It is also necessary to check the total steering play (the free rotation angle of the steering wheel) in the position of the front wheels, corresponding to the straight-line vehicle movement. The total steering wheel play must be max. 25º. The steering system health can be assessed by the steering wheel play.

When repairing the steering after disconnecting the pipelines from the assemblies, it is necessary to close the openings of the pipelines and assemblies with plugs to prevent fluid leakage and dust and dirt from entering the system.

During transportation and storage, the internal cavities of the steering system assemblies must be protected by plugs from dirt. The plugs must be removed immediately before connecting pipelines.

Steering column tilt adjustment

This operation shall be performed after adjusting the driver’s seat position against the control pedals. To adjust the column, it is necessary to:

- lower the lever 1 (see Fig. 5.6) of the steering column locking mechanism down (position II);
- set the steering wheel in a comfortable position and fix the column by lifting the lever up to the stop (in the initial position I).

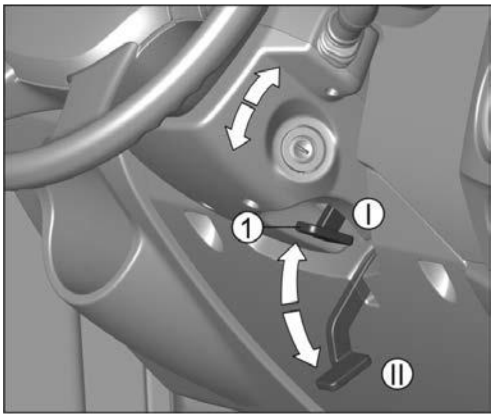


Fig. 5.6. Steering column adjustment: 1 - lever

Oil change and power steering system bleed procedure

The oil replacement must be carried out in the following sequence:

- elevate the front wheels;
- unscrew the power steering tank cap;
- disconnect the drain and suction hoses from the tank and the upper casing of the fan and lower the free ends of the hoses into a container to drain the oil. Disconnect the drain and pressure hoses from the steering gear and lower the ends of the hoses into a container for draining the oil (do not allow dirt to enter the steering gear holes for attaching these hoses), turn on the engine for no more than 10 s and collect the drained oil.
- turning the steering wheel from the extreme left to the extreme right position and back two or three times, run the oil out of the steering gear through the drain hose into the container;
- loosen the clamp bolt nut and remove the tank;
- install a new tank and connect the hoses to the tank and to the steering gear (see the “Installing tank on vehicle” and “Installing steering gear on vehicle” subsections);
- pour oil into the tank to the upper level according to the tank cap dipstick;
- with the engine off and the elevated front wheels, turn the steered wheels of the vehicle to the full angle to the right and left 3-4 times;
- add oil to the upper level of the tank;
- start the engine and, at idle speed of the engine (750-850 min $^{-1}$), bleed the power steering system by turning the steering wheel 2-3 times to the stop in both directions without delay in the extreme positions and preventing air from entering the system due to a sharp drop in the tank oil level during bleeding.

The system is considered bled after the cessation of air from the tank oil. Stop the engine, and after removing surface foam by settling, add oil to the normal level of the tank. The tank oil level must be between the “max” and “min” marks on the dipstick of the tank cap screwed up to the stop at a power steering tank oil temperature of 20 ºC;

- install and tighten the tank cap.

The presence of air in the hydraulic system is not allowed, it is characterized by the “wedging” of the steering wheel during its rotation and the presence of foam in the oil.

Leaks at the hose connections, as well as from under the tank cap, are not allowed.

With abundant foaming of oil in the power steering tank, in order to avoid the pump failure, stop the engine immediately. Abundant foaming of oil and noise during power steering operation indicate air leakage into the system, insufficient oil level, or a kinked hose from the tank to the pump.

Abundant foaming is also possible if the power steering system refill procedure is not followed.

Start the engine after abundant foaming of oil in the power steering tank after eliminating the causes of air inflow and removing foam by settling for 20-30 minutes.

When changing the oil to oil of another brand (from those listed in the Vehicle Operation Manual), it is necessary, after draining the old oil, to flush the power steering system, filling it with new oil and turning the steering wheel from the extreme left to the extreme right position and back two or three times. Drain the oil from the hydraulic system and replace the oil tank. Fill the hydraulic system with new oil as described above.

Replacement of end assemblies with outer pivots, inner pivot assemblies with tie-rod arms and protective caps of the steering gear inner pivots

If there is play in the inner pivot of the tie-rod arm or if its protective cap is torn, the inner pivot assembly with the tie-rod arm or the protective cap shall be replaced in accordance with the supplier's documentation.

When unscrewing and tightening the inner pivot assembly with the rod (right and left), it is necessary to keep the steering rack from rotating using a special tool (Fig. 5.7). The tool must be installed on the rack in the position shown in Fig. 5.7.

When unscrewing and tightening the inner pivot assembly with the rod (right and left), it is also necessary to use a special tool that is installed on the hexagonal end of the inner pivot.

For tightening the threaded joint of the inner pivot assembly with the rod to the rack - see the supplier's documentation.

If play appears in the outer pivot or if its protective cap is torn, the end assembly shall be replaced.

The end can be replaced without removing the steering gear as follows:

- unscrew the nut securing the pivot pin to the strut knuckle arm;
- press out the pivot pin from the strut knuckle arm conical hole with a puller;
- loosen the retaining nut on the rod and unscrew the end after marking its position on the tie-rod arm. Replace the end in the reverse order of removal, reinstalling it in its original position. Attach the pivot pin to the strut knuckle arm and tighten the pin retaining nut to a torque of 100-120 N·m (10.2-12.2 kgf·m), use a new nut, use a hex wrench to keep the pivot pin from rotating when loosening and tightening the nut S=6mm, which is inserted into the pin end recess;

Adjust the wheel toe-in and tighten the nut securing the end to the rod with a torque of 63-77 N·m (6.5-7.8 kgf·m).

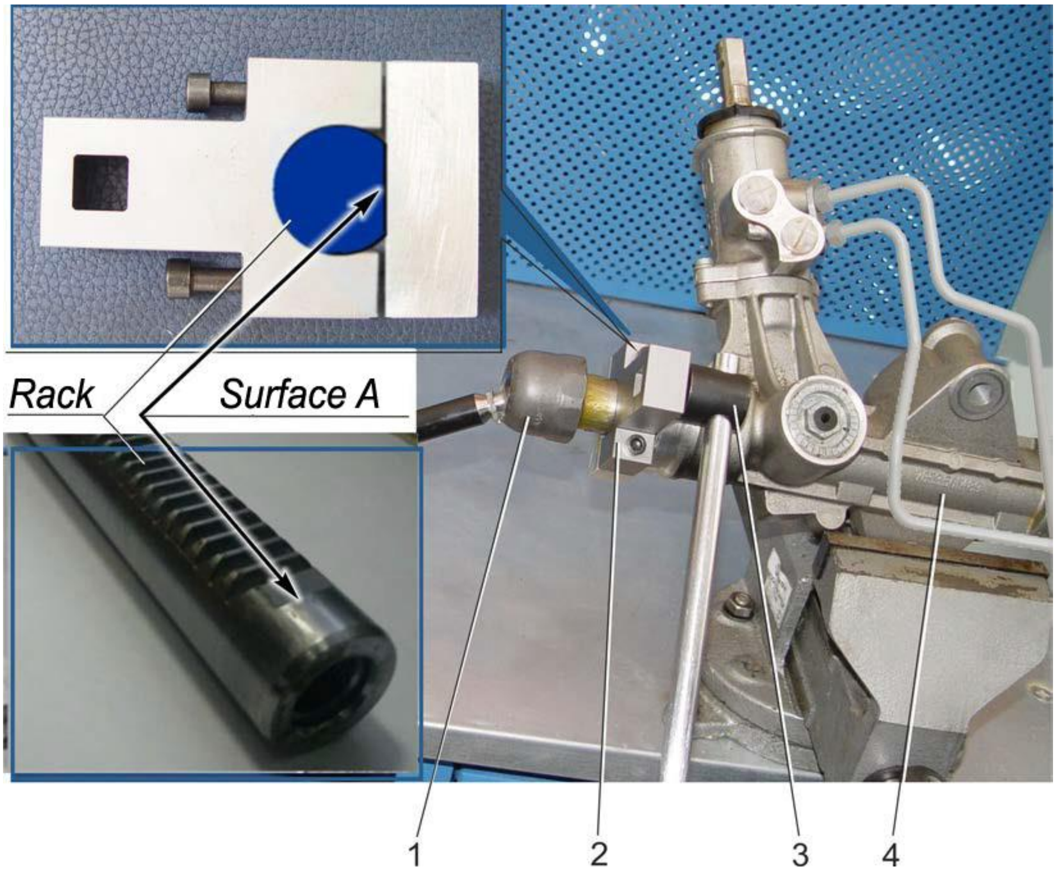


Fig. 5.7. Tool for mounting and dismounting the inner pivot assembly with rod: 1 - internal ball pivot; 2 - mounting and dismounting tool for internal pivot assembly with a rod; 3 - tap wrench; 4 - steering gear

Steering gear removal

In case of failure, the steering gear shall not be repaired, but replaced with a new one (except for the replacement of end assemblies, internal pivots and their protective caps).

Steering gear failures are:

- jerking and jamming during the steering input shaft rotation;
- absence or deterioration of the input shaft self-return;
- broken internal tightness (maximum oil pressure reduction);
- broken external tightness (dripping), which cannot be eliminated by tightening the joints;

- increased clearance in gear-rack engagement;

The steering gear removal must be carried out as follows:

- drain the oil from the power steering system as described above, and connect the hoses to the tank;

- disconnect the pipes of the drain and discharge hoses from the steering gear hydraulic distributor by unscrewing the nuts of the ends and drain the remaining oil;

- set the steering gear in the middle position (arrow B (Fig. 5.9) on the steering input shaft cover must coincide with the mark A of the injection mold connector on the distributor housing. At the same time, the steered wheels must be in the straight movement position);

- fix the steering wheel from turning, prevent the power supply device cover rotation;

- unscrew and remove the bolt securing the steering cardan shaft yoke to the steering input shaft, and disengage the yoke from the input shaft;

- unscrew the nuts securing the tie-rod arm pivot pins to the strut knuckle arms;

- press out the pivot pins from the strut knuckle arm conical holes with a puller (Fig. 5.8), turning the bolt 2;

- disconnect and remove the protective screen of the steering gear;

- remove the steering gear from the front suspension by unscrewing the bolt and nuts securing the steering gear to the two subframe brackets.

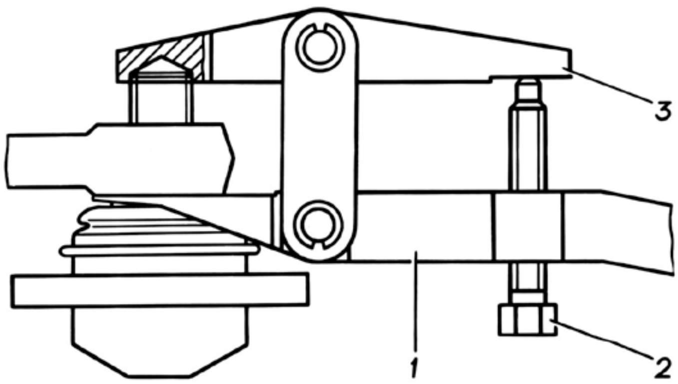


Fig. 5.8. Ball pin puller: 1 and 3 - arms; 2 - bolt

Installing steering gear on vehicle

Before installing on the vehicle, fix the steering input shaft in the middle position, in which the arrow B (Fig. 5.9) on the steering input shaft cover must coincide with the mark A of the injection mold connector on the distributor housing, and the dimension C=645±1.5 mm is maintained (see Fig. 5.2).

WARNING
Before installing the steering gear on the vehicle, the input shaft rotation is not allowed.

The steering gear installation must be carried out in the following sequence:

- set the steered wheels in a position corresponding to the straight-line vehicle movement;
- set the steering gear on the front suspension and fix it on the brackets by tightening the lower bolt and nut of the upper bolt securing the steering gear to the left subframe bracket with a torque of 108-123 N·m (11.0-12.5 kgf·m); nuts of the bolts securing the steering gear to the right subframe bracket – 21.5-24.5 N·m (2.2-2.5 kgf·m). When assembling, it is necessary to apply to the threaded part of the lower bolt securing the steering gear to the left subframe bracket (at a length of 3-5 threads from the end face) a layer of anaerobic sealant Loctite 243 from Henkel) or Weicon AN 302-43 (from Weicon);

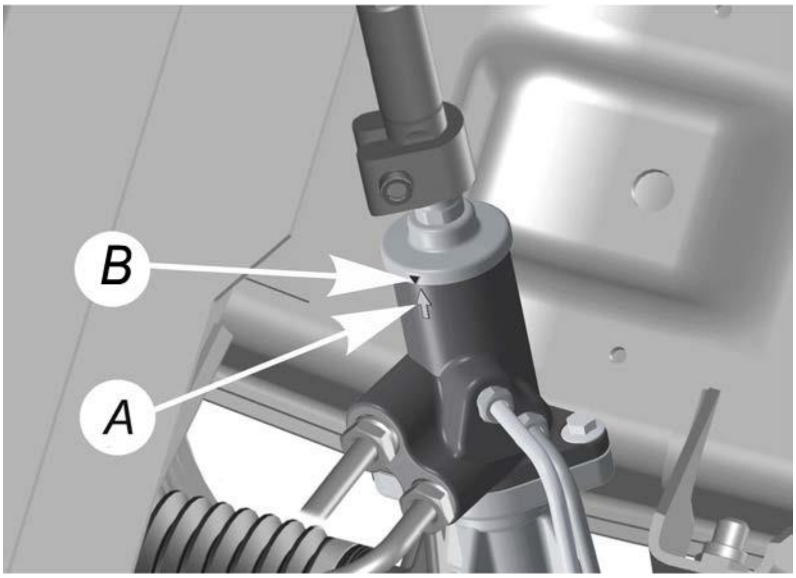


Fig. 5.9. Adjustment marks on the steering gear: A – mark on steering gear boss; B – mark on input shaft cover

- install and secure the protective screen (see Fig. 5.1) of the steering gear after installing the screen bracket 23 on the subframe. When installing the screen, first tighten the bolt F, and then the bolt E. The tightening torque of the screen and bracket mounting bolts is 6.9-8.8 N·m (0.7-0.9 kgf·m).
- install the tie-rod arm pivot pins in the conical holes of the strut knuckle arms and tighten the pin nuts with a torque of 100-120 N·m (10.2-12.2 kgf·m);
- unlock the steering wheel;

- install the lower cardan shaft yoke on the steering input shaft, aligning the yoke hole with the groove on the input shaft, insert the bolt into the yoke hole by hand and tighten to a torque of 26-30 N·m (2.6-3.0 kgf·m);

- connect the drain and discharge hoses to the steering gear hydraulic distributor, tightening the nuts of the ends with a torque of 28-32 N·m (2.9-3.2 kgf·m).

The final tightening of the nut 20 (Fig. 5.1) securing the drain hose pipe 16 shall be carried out after the pipe is fixed in the clip 15;

- fill the hydraulic system with oil and bleed. Check tightness of connections;

- adjust the wheel toe-in.

- if the steering wheel symmetry plane deviates from the vertical plane passing through the steering column axis by more than 5° (in this case, the steering gear must be in the middle position, and the steered wheels in the position corresponding to the vehicle straight movement), remove and install the steering wheel so that the above deviation was no more than 5° (see “Steering wheel removal”, “Steering wheel installation” subsections).

Power steering tank removal

The tank removal must be carried out in the following sequence:

- drain the oil from the system after removing the tank cap;
- disconnect hoses;
- loosen the clamp bolt nut and remove the tank.

Installing power steering tank on vehicle

The tank installation (Fig. 5.10) must be carried out in the following sequence:

- install the tank until the lower end of the flange stops in the bracket clamp after orienting the tank in the position required for connecting hoses and tighten the clamp mounting bolt to a torque of 3.5-4.9 N·m (0.36-0.50 kgf·m);

- connect the hoses to the tank, and tighten the hose clamps to a torque of 2.5-3.5 N·m (0.26-0.36 kgf·m). Install the clamps at a distance of 3-5 mm from the hose end;

- fill the system with oil, install the tank cap and tighten, bleed the system.

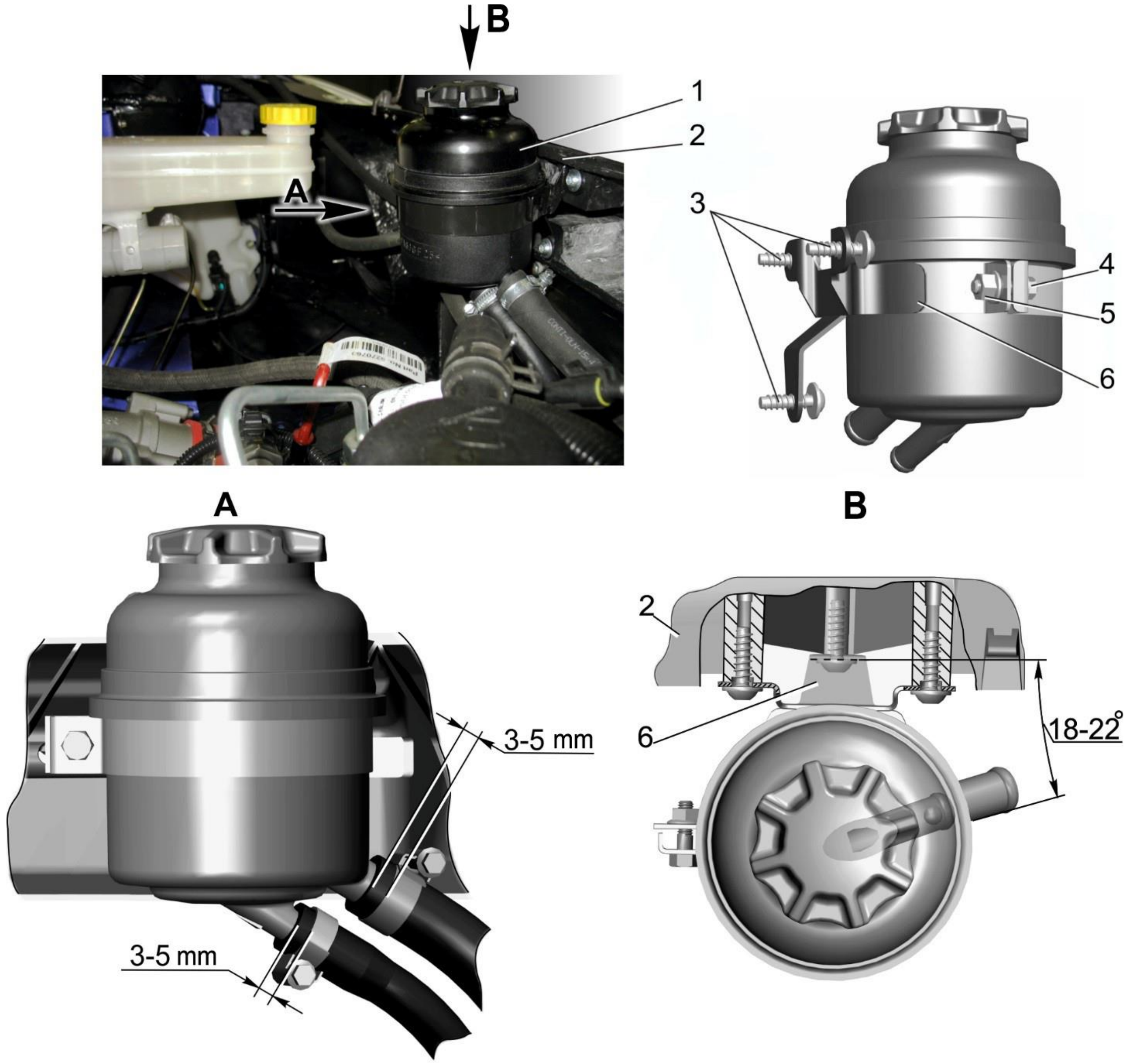


Fig. 5.10. Power steering tank installation: 1 – power steering tank; 2 – frontend; 3 – screws; 4 – bolt; 5 – nut; 6 – bracket

If the tank hoses are replaced, the following requirements must be met when installing them:

- install the hoses on the tank branch pipes with the ends closest to the white ring marks on the hoses;
- drain and suction hoses must be fixed in the clamps on the upper casing of the fan so that the white ring marks on the hoses are aligned with the claws B and C (Fig. 5.1), respectively;
- install the suction hose all the way to the end of the pump branch pipe, and the drain hose to the end of the power steering radiator pipe protrusion as far as it will go.

In case of replacement of drain hoses 4 and 7, the following requirement must be met: install the hoses all the way to the end of the protrusion of the power steering radiator pipe and the drain hose pipe 16.

Install the fastening clamps at a distance of 5-7 mm from the hose end.
Clamping and twisting of hoses are not allowed.

Power steering pump removal and installation

The **power steering pump removal** must be carried out in the following sequence:

- drain the oil from the power steering system;
- disconnect the pump oil supply hose and the discharge hose from the pump;
- loosen tension and remove the accessory drive belt. Disconnect the pulley from the pump by unscrewing the pulley mounting bolts. Unscrew the pump mounting bolts and remove the pump (see maintenance and repair documentation for F 2.8 engine).

The **power steering pump installation** must be carried out in the following sequence:

- install the pump on the engine, install the pulley on the pump shaft and fasten, then install the drive belt (see maintenance and repair documentation for F 2.8 engine);
- connect the suction 1 (Fig. 5.11) and discharge 2 hoses to the pump, and tighten the fasteners. Install the suction hose until it stops at the pump branch pipe end D, install the fastening clamp at a distance of 5-7 mm from the hose end. Tighten the nut of the discharge hose nozzle to a torque of 35-42 N·m (3.6-4.2 kgf·m);
- fill the hydraulic system with oil and bleed. Check tightness of connections.

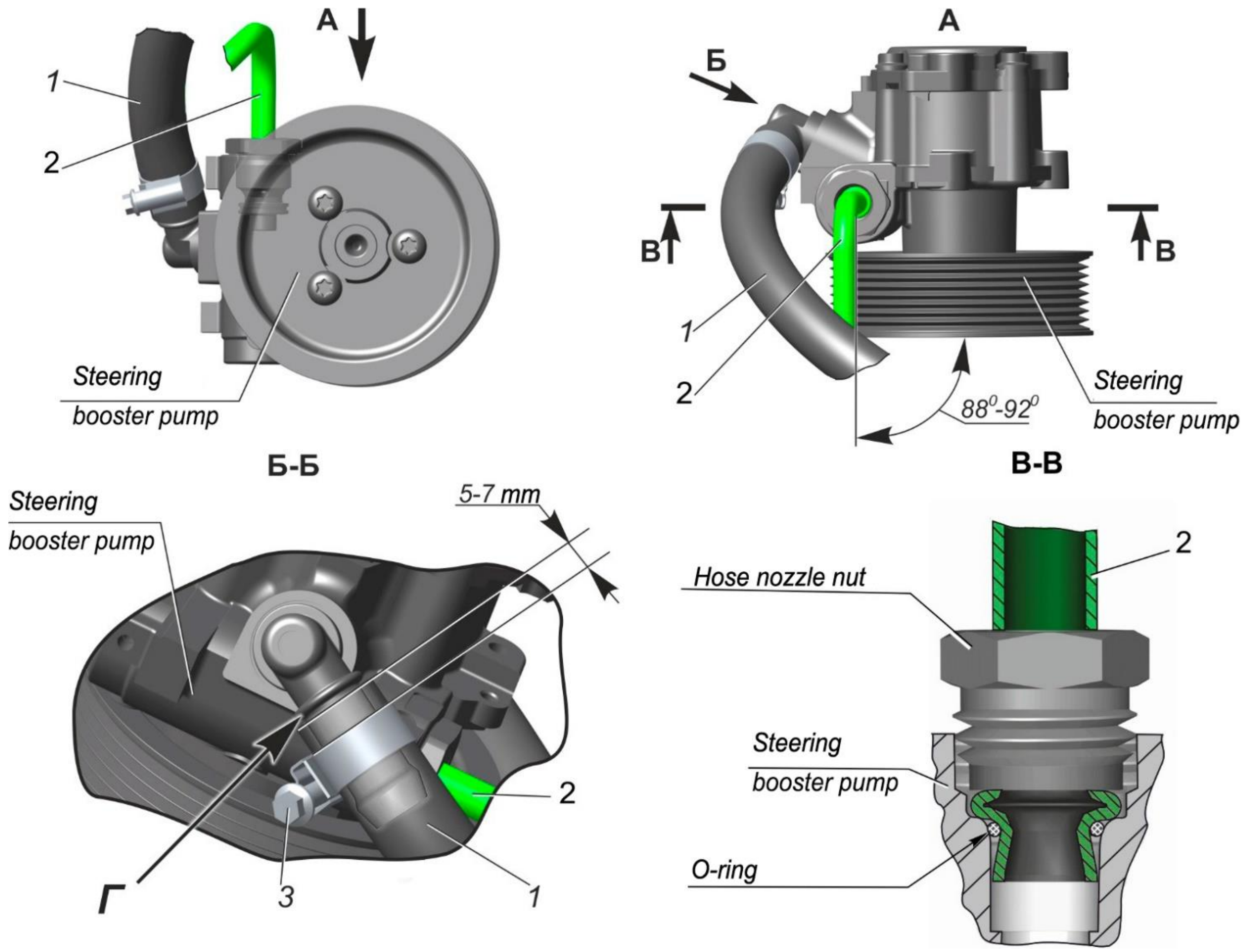


Fig. 5.11. Installation of pump hoses: 1 – suction hose; 2 – discharge hose; 3 – clamp

Steering column removal

The steering column removal must be carried out in the following sequence:

- install and fix the steering input shaft in the middle position (arrow B (Fig. 5.9) on the steering input shaft cover must coincide with the mark A of the injection mold connector on the distributor housing. At the same time, the steered wheels must be in the straight movement position);
- disconnect the battery;
- remove the steering wheel from the steering column (see “Steering wheel removal” subsection);
- unscrew the tie bolt and disconnect the upper yoke of the cardan shaft from the steering column intermediate shaft;
- raise the floor mat and disconnect the steering column intermediate cardan shaft support housing from the front panel by unscrewing the two mounting bolts;
- open the fuse box cover by disengaging the two spring holders located on the cover sides from the panel, and remove the cover by disengaging the cover axes from the pivot axes;

- remove the upper and lower casings of the steering column by unscrewing the four fixing screws;

- disconnect the wire connectors of the ignition lock, current transfer device, light alarm and wiper switches;

- disconnect the steering column from the dashboard base by unscrewing the four mounting bolts;

- remove the steering column assembly with the intermediate shaft from the vehicle. If necessary, remove the current transfer device, the light alarm and wiper switches, the instrument and starter switch from the column.

WARNING
With the steering column removed, the steering input shaft rotation is not allowed.

Steering column installation

If necessary, install the current transfer device, the light alarm and wiper switches, the instrument and starter switch on a new column (see “Electrical equipment” section).

The **steering column installation** must be carried out in the following sequence:

- install the steering column assembly with the intermediate shaft on the vehicle and attach it to the dashboard base, tightening the four mounting bolts with a torque of 18-25 N·m (1.8-2.5 kgf·m);

- connect the wire connectors of the instrument and starter switch, current transfer device, light alarm and wiper switches;

- install the upper and lower casings of the steering column by tightening the four fixing screws and install the fuse box cover;

- connect the steering column intermediate cardan shaft support housing to the front panel by tightening the two mounting bolts with a torque of 5.5-8.0 N·m (0.55-0.80 kgf·m);

- install the upper yoke of the cardan shaft on the steering column intermediate shaft until it stops against protrusion A (Fig. 5.4) of the intermediate shaft, insert the bolt into the yoke hole and tighten to a torque of 28-32 N·m (2.8-3.2 kgf·m);

- install the steering wheel on the steering column in a position so that the steering wheel symmetry plane coincides with the vertical plane passing through the steering column axis, the deviation is max. 5°. Installation procedure (see “Steering wheel installation” subsection);

- connect the battery;

- unlock the steering input shaft.

Cardan shaft removal and installation

The **cardan shaft removal** must be carried out in the following sequence:

- install and fix the steering input shaft in the middle position (arrow B (Fig. 5.9) on the steering input shaft cover must coincide with the mark A of the injection mold connector on the distributor housing. At the same time, the steered wheels must be in the straight movement position);
- fix the steering wheel from turning;
- unscrew the bolts securing the cardan shaft yokes on the steering gear and the steering column intermediate shaft, remove the bolts and the cardan shaft from the steering input shaft and the steering column intermediate shaft.

WARNING
With the cardan shaft removed, rotation of the steering input shaft and the steering wheel is not allowed.

The **cardan shaft installation** must be carried out in the following sequence:

- install the lower cardan shaft yoke on the steering input shaft, aligning the yoke hole with the groove on the input shaft, insert the bolt into the yoke hole by hand and tighten to a torque of 26-30 N·m (2.6-3.0 kgf·m);
- install the upper yoke of the cardan shaft on the steering column intermediate shaft until it stops against protrusion A (Fig. 5.4), insert the bolt into the yoke hole and tighten to a torque of 28-32 N·m (2.8-3.2 kgf·m);
- unlock the steering wheel and steering input shaft.

Checking total circumferential play of cardan shaft

Checking the total circumferential play of the cardan shaft shall be carried out on the shaft removed from the vehicle as follows:

- set the steering cardan shaft on the bench in a straight position, the length of the telescopic compensator must correspond to the distance between the pivot centers of 190 mm;
- fix one of the shaft ends;
- measure the total circumferential play of the cardan shaft when a torque of ±1 N·m (±0.1 kgf·m) is applied to the free end of the shaft.

The total circumferential play of the new cardan shaft must not exceed 0°20'. The cardan shaft limit state is determined by the increase in the total circumferential play to a value of 0°30'.

The steering cardan shaft is a non-repairable product and, in case of failure, shall be replaced with a new one.

Steering wheel removal

Remove the steering wheel as follows:

- disconnect the battery;
- remove the steering wheel molding 5 (Fig. 5.12);

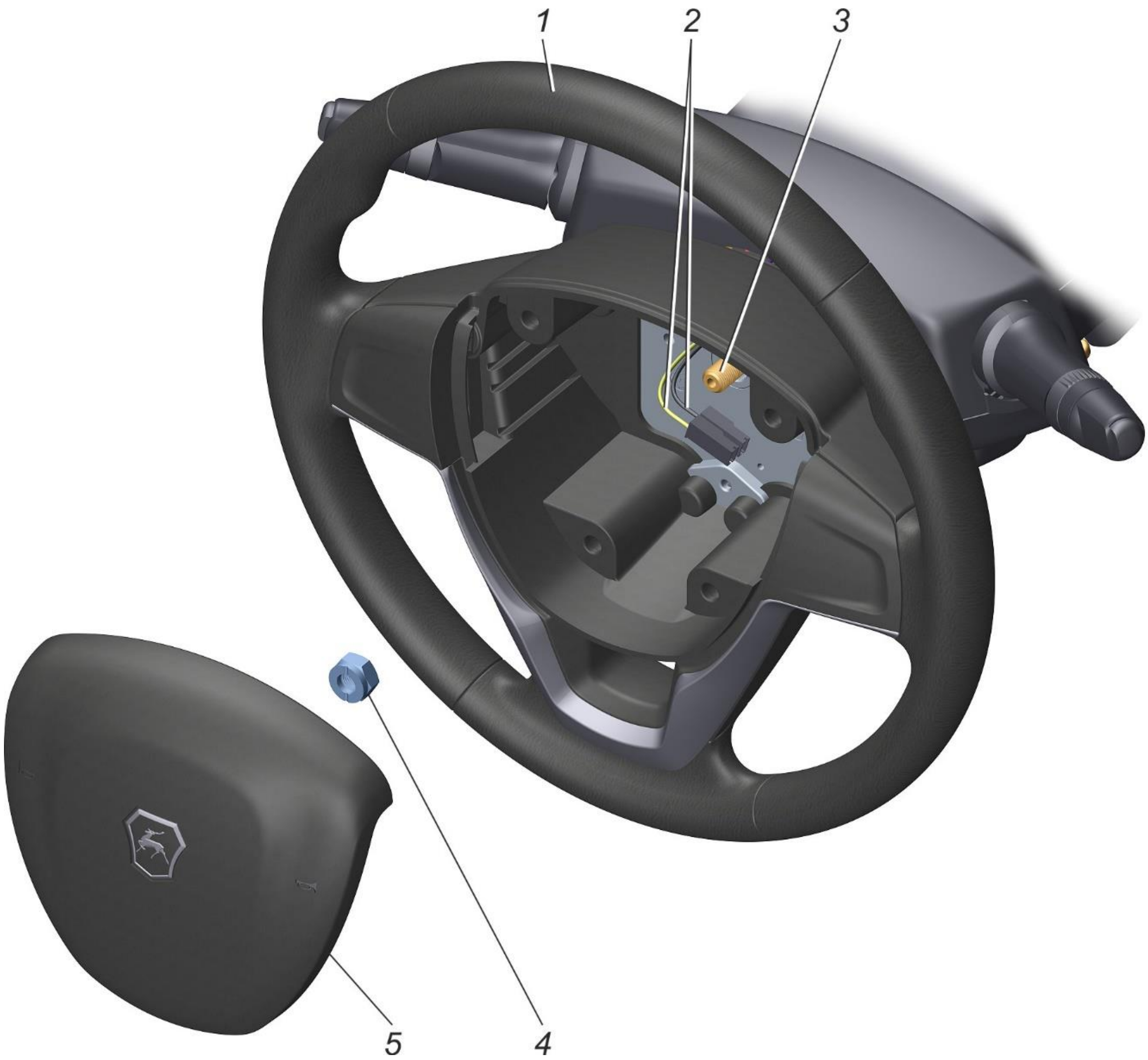


Fig. 5.12. Steering wheel: 1 – steering wheel; 2 – current transfer device wires to horn switch; 3 – steering column shaft; 4 – nut; 5 – decorative molding

- disconnect the wires from the horn switch button;

- unscrew the steering wheel nut;

- apply a mark to the steering wheel hub and on the shaft end to maintain their relative position during installation;
- fix the current transfer device cover 5 (Fig. 5.13) from turning;
- wiggle to remove the steering wheel.

WARNING
When the steering wheel is removed, the current transfer device cover rotation is not allowed.

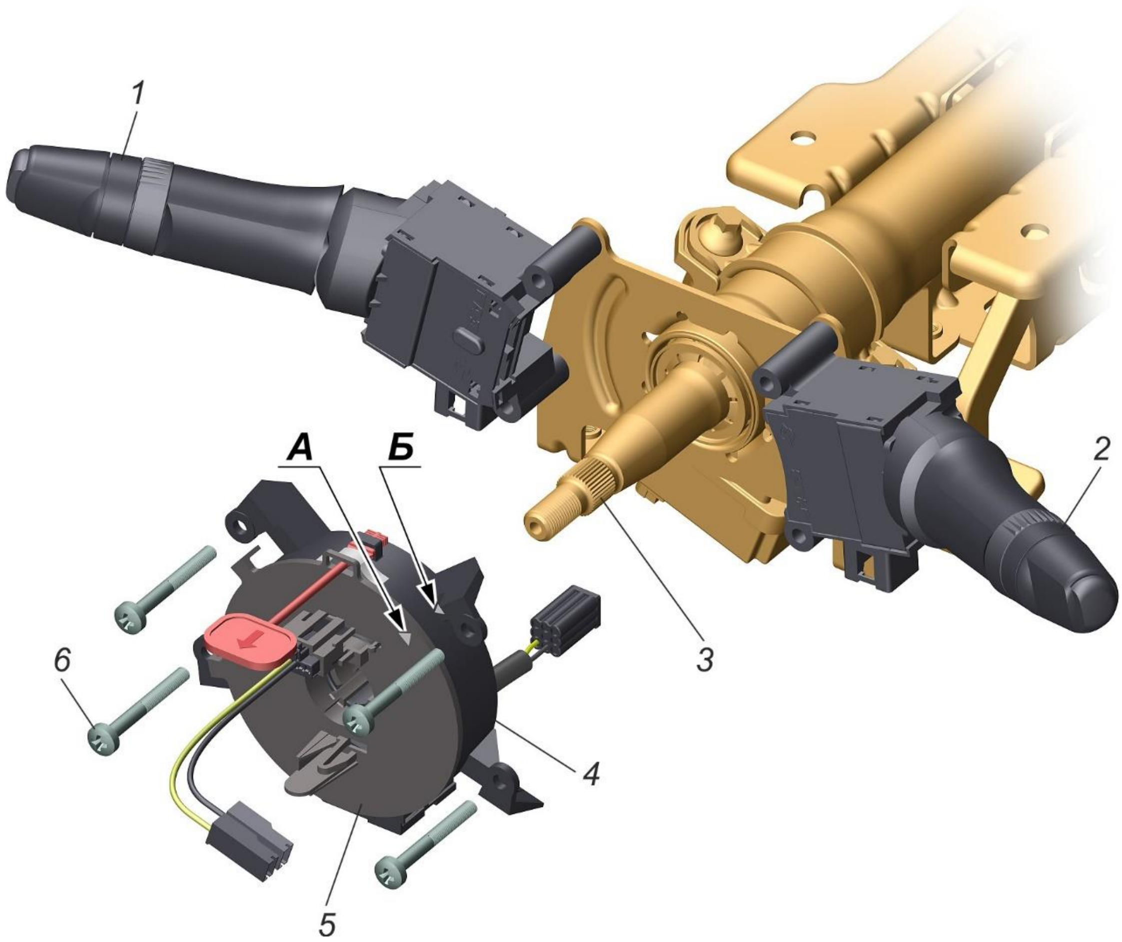


Fig. 5.13. Installation of switches and current transfer device on the steering column: A and B – marks; 1 – light alarm switch; 2 – wiper switch; 3 – steering column; 4 – current transfer device; 5 – current transfer device cover; 6 – screws;

Steering wheel installation

The steering wheel installation must be carried out as follows:

- install the steering wheel according to the marks on the steering wheel hub and shaft end. When installing the steering wheel, the direction indicator switch lever must be in the neutral position;
- unlock the current transfer device cover;
- fasten the steering wheel with a nut. Nut tightening torque 49-61 N·m (5.0-6.2 kgf·m);
- connect the wires to the horn switch button;

- install the molding on the steering wheel;
- connect the battery.

6. Brakes

The vehicle has three brake systems:

– primary, with a double-circuit hydraulic actuator and diagonal circuit separation (Fig. 6.1). One hydraulic actuator circuit ensures the operation of the right front and left rear brake mechanisms, the other – the left front and right rear.

If one of the primary brake system circuits fails, the second circuit is used to ensure that the vehicle stops with sufficient efficiency;

– emergency, the function of which is performed by each circuit of the primary brake system;

– parking, acting on the parking brakes of the rear wheels.

Primary brake system

The primary brake system consists of disc brakes on all wheels and a hydraulic actuator. The drive is controlled by suspended pedal located on the cab front panel, mechanically connected to the vacuum booster of the brake module.

Hydraulic brake actuator includes:

- brake module (with brake master cylinder and tank);

- hydraulic control valve with ABS sensors installed in the wheel assemblies. Hydraulic control valve as delivered – not filled with brake fluid.

- pipelines.

A float sensor is installed in the master cylinder tank to indicate an emergency drop in the brake fluid level.

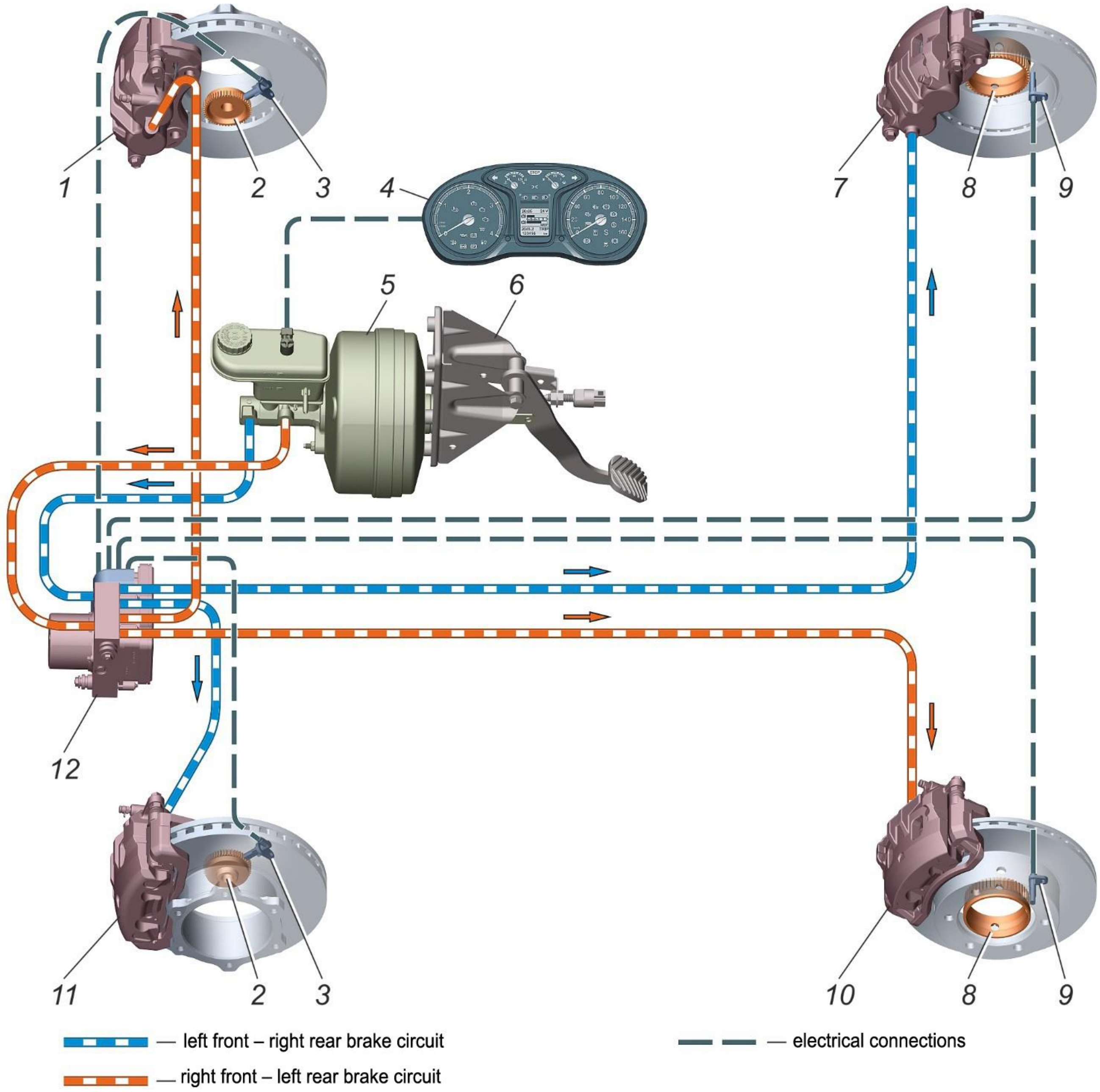


Fig. 6.1. Primary brake system drive diagram: 1 - front right disc brake; 2 – front ABS rotor; 3 – front ABS sensor; 4 – instrument cluster; 5 – vacuum booster with brake master cylinder and tank; 6 – bracket with brake pedal; 7 – rear right disc brake; 8 – rear ABS rotor; 9 – rear ABS sensor; 10 – rear left disc brake; 11– front left disc brake; 12 – hydraulic control valve;

Spare brake system

In the event of a depressurization of one of the primary brake system circuits and fluid leakage, a red indicator lights up on the instrument cluster (it is turned on by the fluid level emergency drop float switch).

The remaining serviceable circuit provides sufficiently effective braking of the vehicle, while the pedal stroke increases and braking begins at the beginning of the second half of the full stroke.

Main assemblies of primary brake system

Brake pedal

Brake pedal 2 (Fig. 6.2) is pivotally mounted on the distance bushing 10 of the pedal bracket 3, which is attached to the front panel. The bracket is fastened with six nuts, four of which simultaneously fasten the brake module 1.

The vacuum booster push rod is pivotally attached to the pedal. The brake light switch 11 is fixed on the bracket. The pivot connection between the pedal and the distance bushing is equipped with plastic bushings 8 to reduce friction.

Vacuum booster with brake master cylinder and tank

The vacuum booster with the brake master cylinder and tank (brake module) is installed under the hood on the left and fixed to the front panel with four nuts. A gasket 15 is installed between the vacuum booster and the front panel (included in the module kit).

The brake module is connected to the brake pedal 2 by means of a push rod through the pin 13, which is locked by the stopper 12.

Technical data of brake module

Vacuum booster: two-chamber with a chamber dimension of 9+9 ", the full stroke of the push rod of the booster assembly with the brake master cylinder is 41.3-43.5 mm.

Master cylinder: nominal stroke of the primary cavity piston – 21 mm, secondary cavity piston – 21 mm, the cylinder working diameter is 27 mm, the thread of the outlet holes for hydraulic pipelines is M10x1.

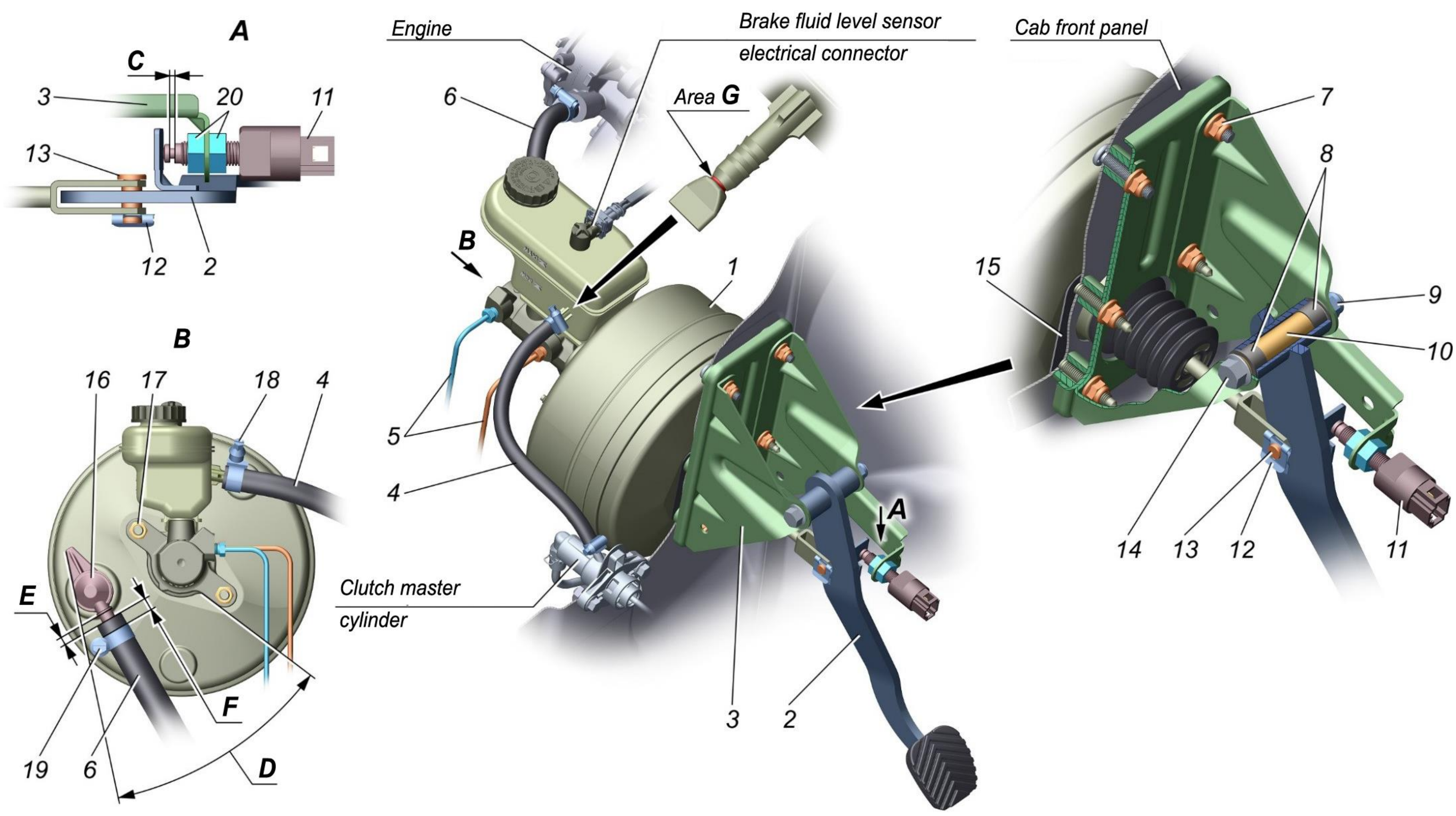


Fig. 6.2. Installing the brake module and brake pedal: 1 – brake module; 2 – brake pedal; 3 – brake pedal bracket; 4 – hose; 5 – pipelines; 6 – vacuum supply hose; 7,9,17 – nuts; 8 – pedal shaft bushings; 10 – distance bushing; 11 – brake light switch; 12 – push rod pin stopper; 13 – push rod pin; 14 – bolt; 15 – gasket; 16 – brake booster check valve; 18, 19 [1] – clamps; 20 – adjusting nuts

---

[1] - For diesel vehicles

Electrical characteristics of brake fluid level sensor:

voltage, V…...12

current, max., A 1

Vacuum booster tightness:

allowable vacuum leaks for 15 s at ambient temperature, mbar:

for new booster with force on rod of 400 N (40 kgf)…...20

for worn amplifier (limit value) with force on rod of 400 N (40 kgf)... 200

Tightness of new master cylinder:

pressure drop during 60 s, max., MPa:

at low pressure (0.3 MPa)... 0.05

at medium pressure (7 MPa)......................................0.3

at high pressure (14 MPa)….......................................0.3

Tightness of worn master cylinder:

pressure drop during 60 s, max., MPa:

at low pressure (0.3 MPa)... 0.1

at medium pressure (7 MPa)......................................0.6

at high pressure (14 MPa)….......................................0.6

The vacuum booster and the brake master cylinder are shown on Fig. 6.3 and 6.4.

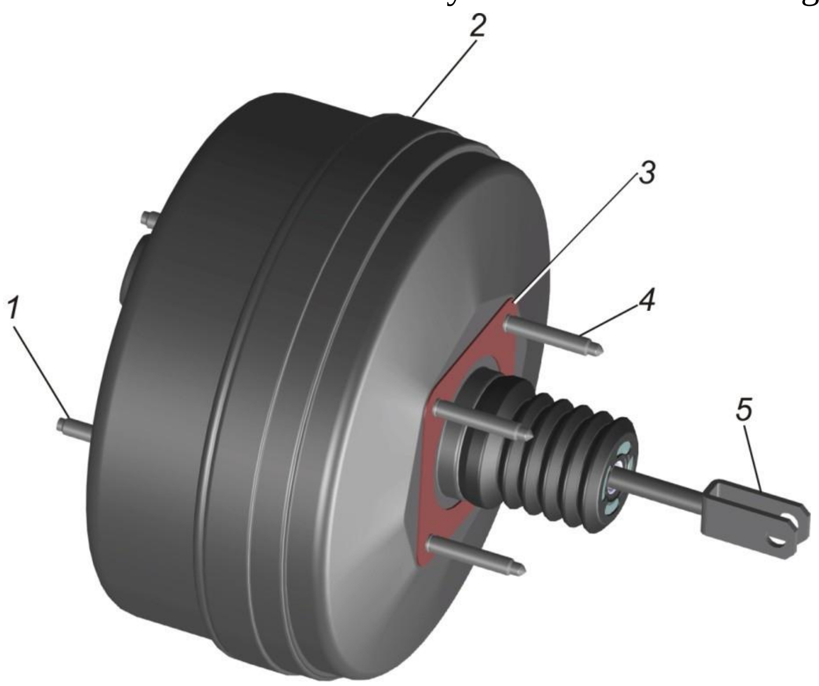


Fig. 6.3. Vacuum booster: 1 - front stud (for securing brake master cylinder); 2 - vacuum booster housing; 3 - gasket; 4 - rear stud (for securing module to front panel); 5 - piston push rod

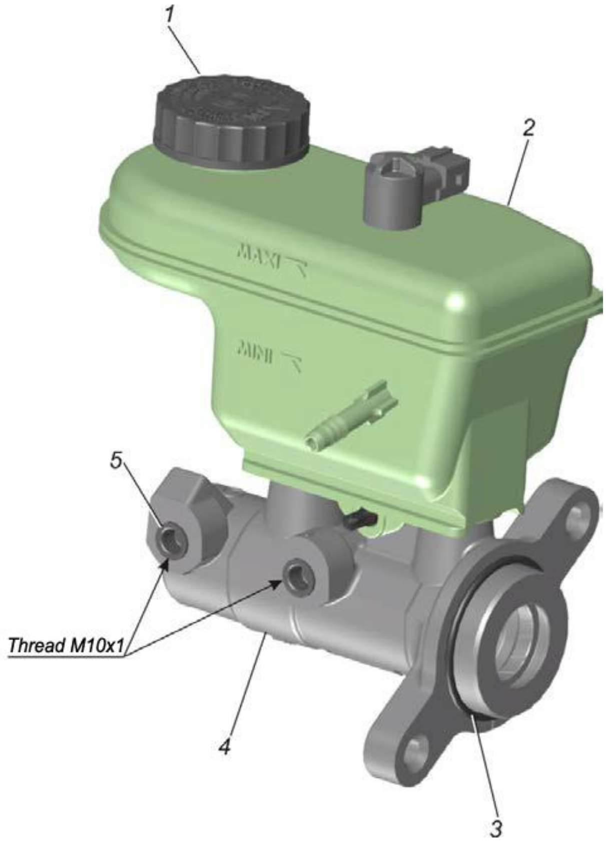


Fig. 6.4. Brake master cylinder assembly with tank: 1 – tank cap; 2 – tank; 3 – O-ring; 4 – brake master cylinder; 5 – plugs

Front and rear wheel brakes

The brakes (Fig. 6.5 and 6.6) of the front and rear wheels are disc with a floating caliper, they are the same in design and differ in dimension.

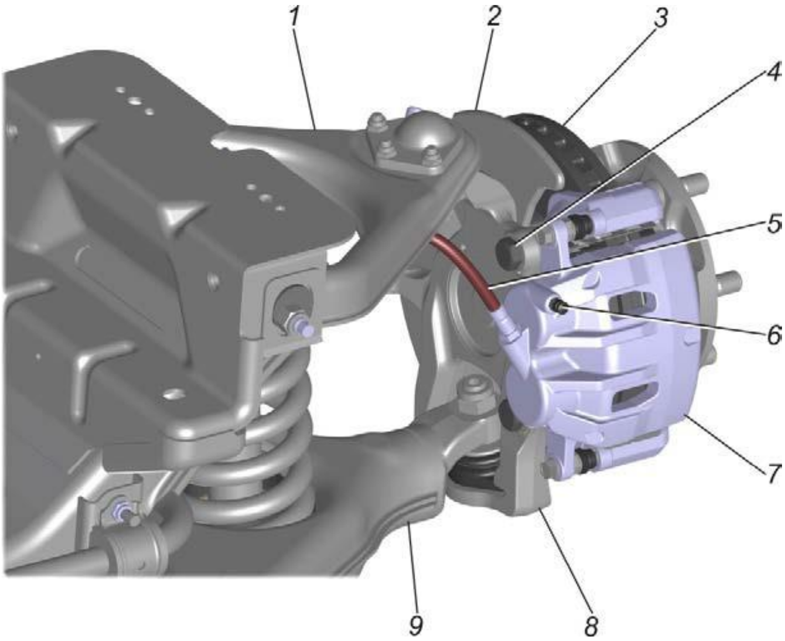


Fig. 6.5. Front wheel brake installation: 1 – upper suspension arm; 2 – front brake backplate; 3 – brake disc; 4 – bolts; 5 – brake hose; 6 – bypass valve with cap; 7 – left disc brake; 8 – suspension strut; 9 – lower suspension arm

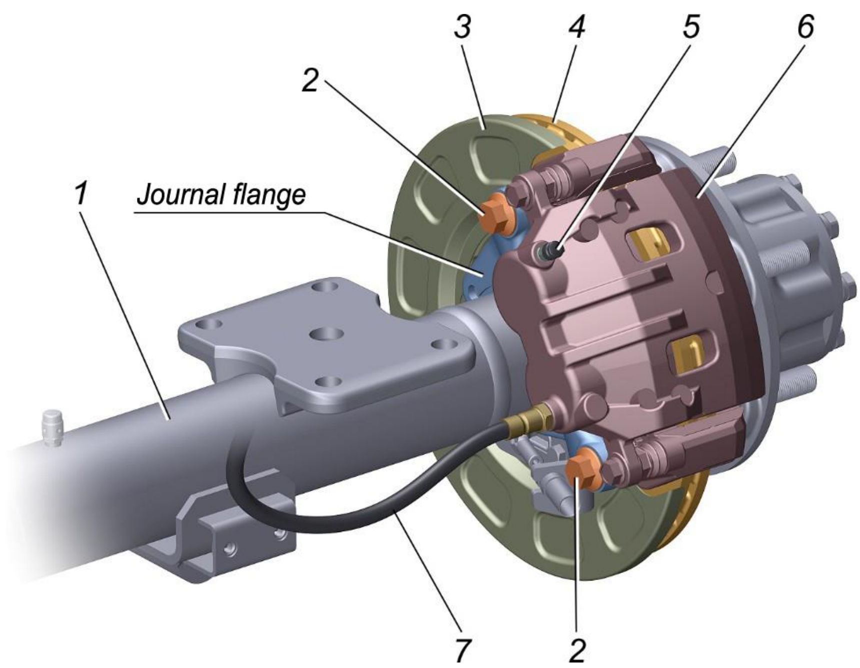


Fig. 6.6. Rear wheel brake installation: 1 – rear axle housing; 2 – bolts; 3 – left parking brake; 4 – brake disc; 5 – bypass valve with cap; 6 – left disc brake; 7 – brake hose;

On both axles, the left brake is installed on the left side (Table 6.1), on the right side - the right one.

Table 6.1

Designation	Name
A65R32.3501136 or A65R32.3501136-01[1)]	Front right disc brake
A65R32.3501137 or A65R32.3501137-01[1)]	Front left disc brake
A65R32.3502137 or A65R32.3502137-01 [1)]	Rear right disc brake
A65R32.3502136 or A65R32.3502136-01[1)]	Rear left disc brake

The brake disc has ventilation channels to reduce heating during braking and is
base.
bolted (screwed – for the rear wheels) to the wheel hub. The mounting bolts (screws) shall be installed on the sealant.

The front wheel brake caliper base is bolted to the suspension strut, the rear wheel brake caliper base is bolted to the flange of the axle housing journal flange. The mounting bolts shall be installed on the sealant.

The front brake design is shown in Fig. 6.8, the rear - in Fig. 6.8.

The brake caliper body is movably connected to the base through the guide pins.

Protective boots protect fingers from dirt and moisture. The body contains pistons and

[1)] – The brakes from the same manufacturer shall be installed on the vehicle. It is not allowed to install brakes from different manufacturers parts of their seal: rings and protective caps. To remove air from the cylinder, a bypass valve with a cap is provided. Brake shoes are located in the base and are pressed against the base ledges by springs fixed on the brake caliper

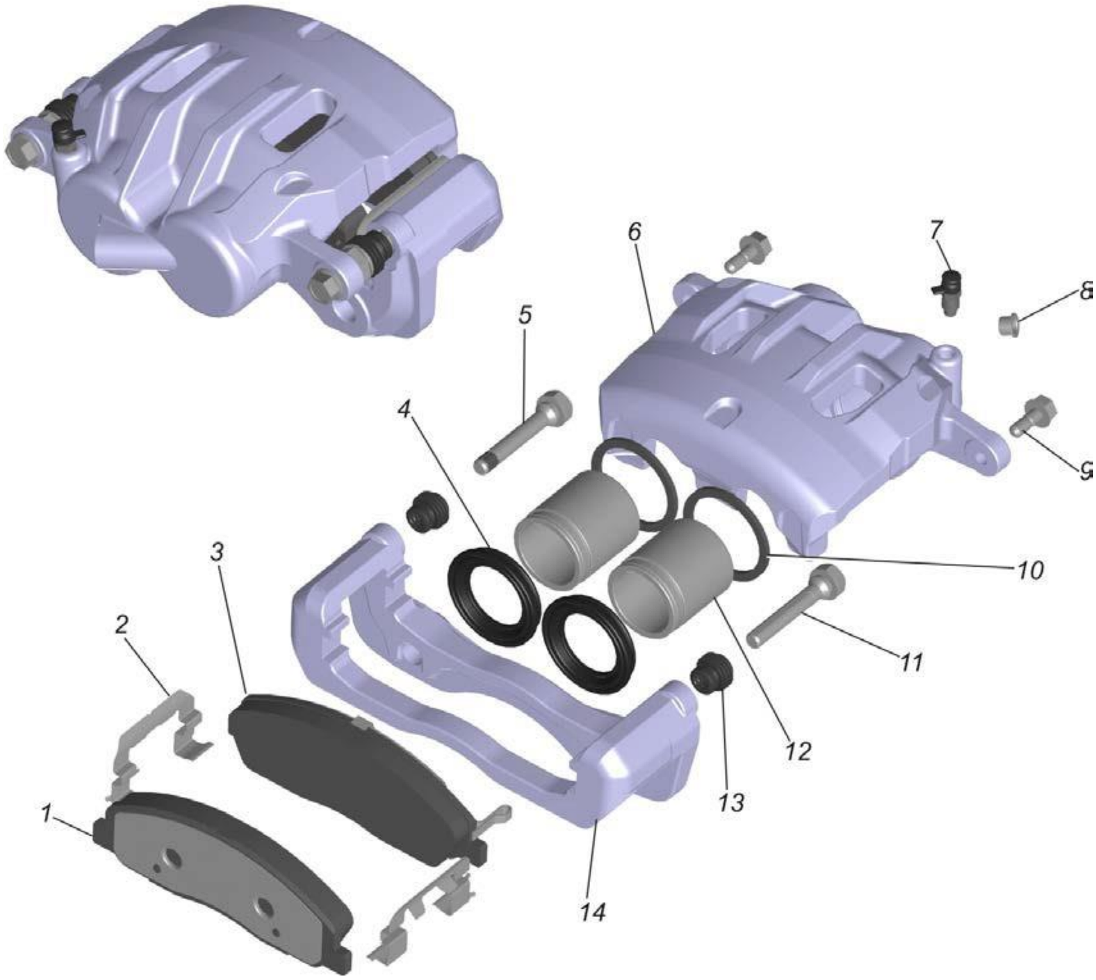


Fig. 6.7. Front brake composition: 1 – external brake shoe assembly; 2 – brake shoe springs; 3 – internal brake shoe assembly; 4 – piston protective cap; 5 – lower guide pin; 6 – brake caliper body; 7 – bypass valve with cap; 8 – protective plug; 9 – guide pin bolt; 10 – O-ring; 11 – upper guide pin; 12 – piston; 13 – pin boot; 14 – base

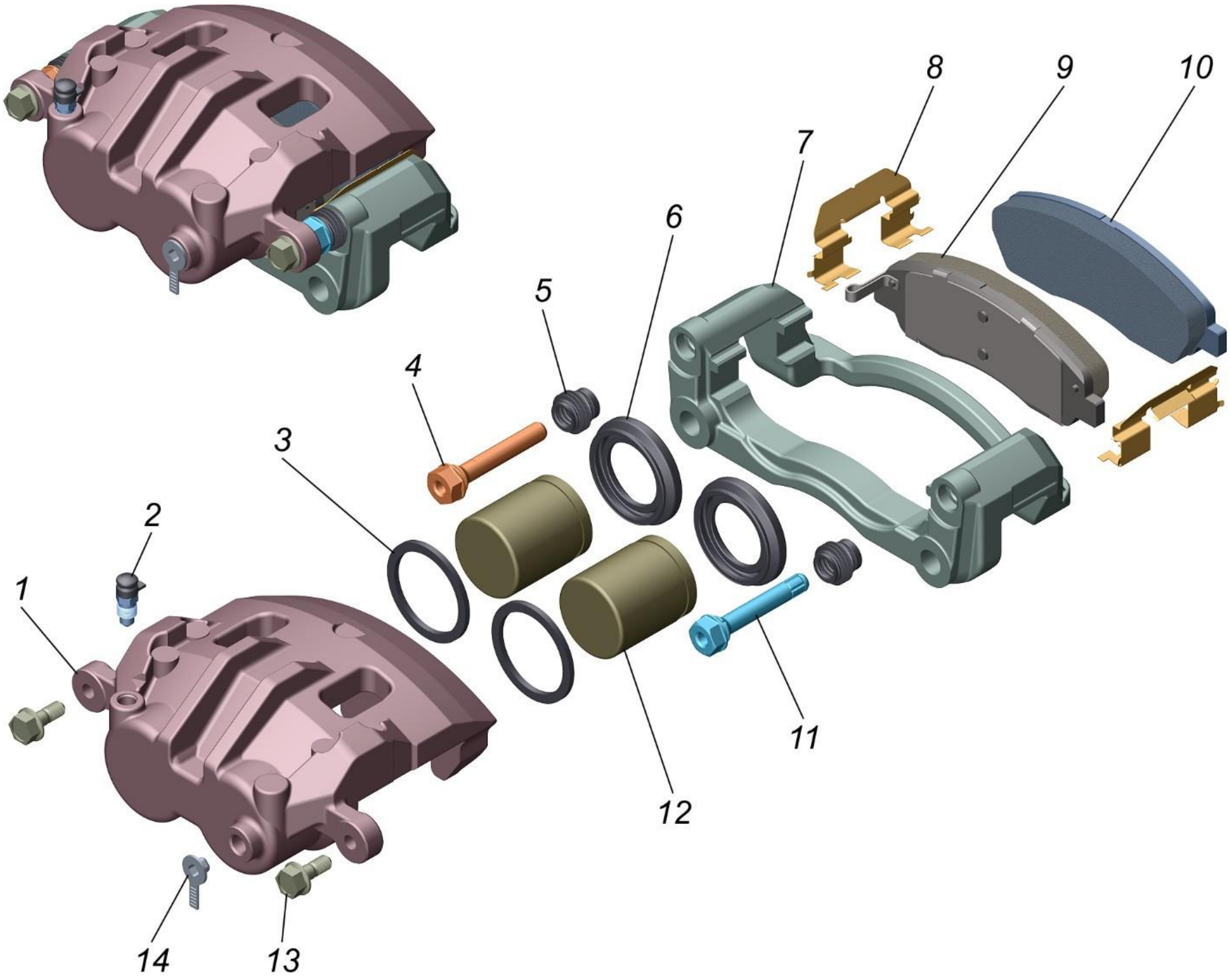


Fig. 6.8. Rear brake composition: 1 – brake caliper body; 2 – bypass valve with cap; 3 – O-ring; 4 – upper guide pin; 5 – pin boot; 6 – piston protective cap; 7 – brake caliper base; 8 – brake shoe springs; 9 – internal brake shoe assembly; 10 – external brake shoe assembly; 11 – lower guide pin; 12 – piston; 13 – guide pin bolt; 14 – protective plug;

When braking under fluid pressure in the hydraulic actuator, the piston, moving in the housing, presses the internal brake shoe against the disc; and the housing itself, moving on the pins in the direction opposite to the piston movement, presses the external brake shoe against the disc. The pressure of both shoes on the disc is the same and is directly proportional to the hydraulic actuator pressure.

When released, the brake shoes move away from the disc at a distance determined by the elasticity of the O-ring and the size of the chamfer in the housing groove, which ensures automatic adjustment of the clearance between the brake shoes and the disc and compensates for pad wear.

Parking brake system

The parking brake system (Fig. 6.9) has a mechanical drive acting on the parking brakes of the rear wheels.

Parking drum brakes (right, left) are built into the wheel assemblies of the rear axle and are screwed to the axle housing journal flanges. The parking brake screws are installed on sealant. The primary brake disc inner surface is used as the parking brake drum.

The left parking brake is installed on the left side of the rear axle (Table 6.2), on the right side - the right one.

Table 6.2

Designation	Name
A65R32.3507010 or A65R32.3507010-011)[1]	Right parking brake
A65R32.3507011 or A65R32.3507011-011)	Left parking brake

The parking brake design is shown in Fig. 6.10.

The drive consists of a lever 18 (Fig. 6.9), a front cable 23 and rear cables 24, interconnected by an equalizer 7 and fixed on a bracket welded to the frame cross-member. The rear cables act on the arms 1, which are part of the expansion links of the rear wheel parking brake shoes.

When lever 18 is moved up, the brake shoes are pressed against the drums, slowing down the vehicle. The lever 18 is fixed by means of a ratchet mechanism consisting of a toothed sector and a pawl. If the ignition is on, the red indicator on the instrument cluster lights up with intermittent light.

To release the brake, slightly pull the lever up, press the button on the handle end and move the lever completely down, the indicator on the instrument cluster will go out.

[1)] The brakes from the same manufacturer shall be installed on the vehicle. It is not allowed to install brakes from different manufacturers

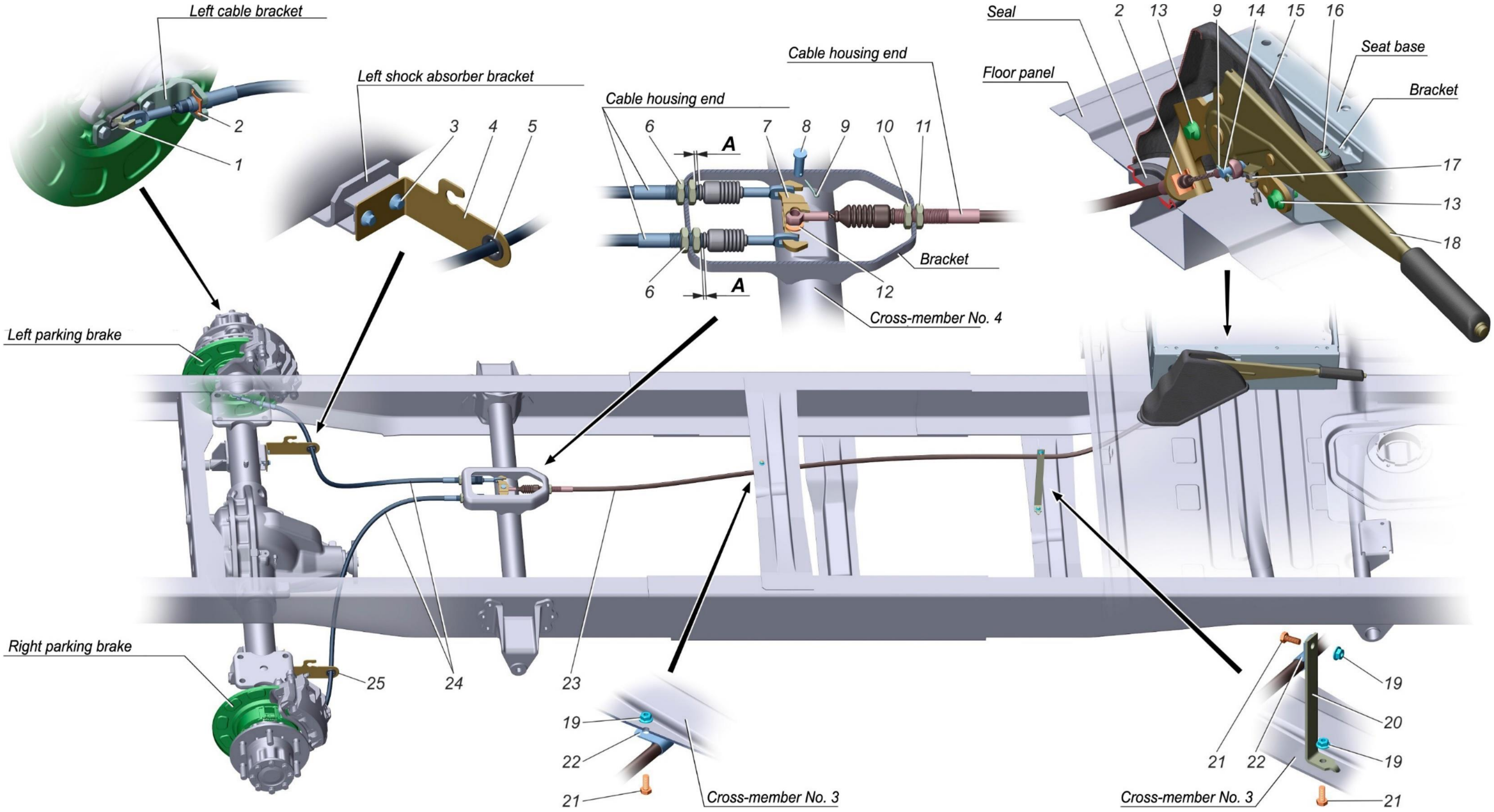


Fig. 6.9. Parking brake system: dimension A corresponds to 1-2 threads; 1 - drive arm; 2, 22 - cable fastening clips; 3, 13, 21 - bolts; 4 - left cable housing bracket; 5 - bushing; 6, 10, 11, 19 - nuts; 7 - equalizer; 8, 14 - pins; 9 - cotter pin; 12 - washer; 15 - casing; 16 - special screw; 17 - hand brake indicator light switch; 18 – parking brake lever; 20 - cable housing support; 23 - front cable; 24 - rear cables; 25 - right cable housing bracket

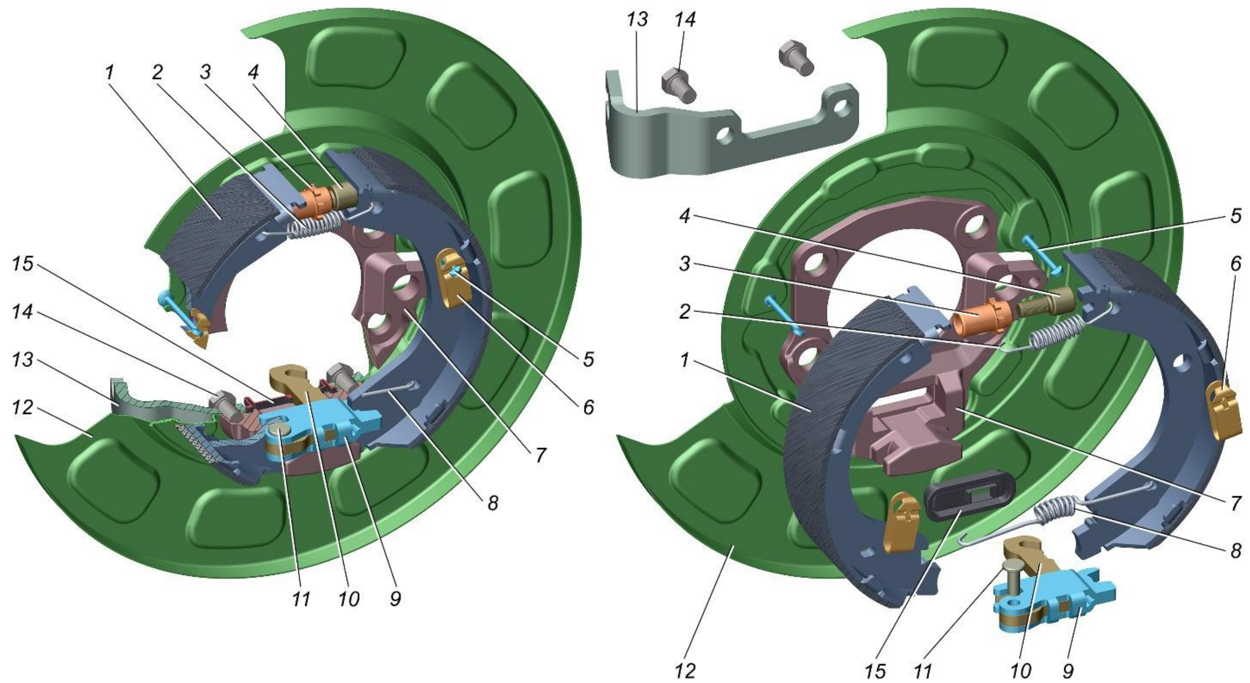


Fig. 6.10. Parking brake (right/left): 1 - block with friction facing; 2,8 - coupling springs; 3 - adjustment link sleeve; 4 - adjusting screw; 5 - rod; 6 - clamping spring; 7 - base (right/left); 9 - expansion link body; 10 - drive arm; 11 - expansion link pin; 12 - support backplate assembly, (right/left); 13 - cable bracket (right/left), 14 - bolt; 15 - protective boot

Possible malfunctions of brake systems and remedies

Malfunction cause	Remedy
Increased brake pedal stroke	
Air in hydraulic actuator Broken brake system tightness (liquid leak)	Bleed the system Tighten the threaded joints or replace the damaged parts.
Brake pedal slowly moves down with constant force on it and applied parking brake	
The master cylinder sleeve brake fluid is bypassed	Replace the brake master cylinder assembly with tank or the brake module if the master cylinder tightness standards are not met
Brakes of all wheels or axles are not completely released (elevated wheels turn tightly)	
Incomplete return of the brake pedal after braking due to incorrect installation of the brake light switch	Set the brake light switch to the desired position

Malfunction cause	Remedy
Faulty brake master cylinder. No brake fluid flow into the tank from the brake master cylinder cavities	Replace the brake master cylinder assembly with tank or the brake module
One brake does not release (elevated wheel turns tightly)	
Guide pins jammed at the brake caliper base	Replace the brake caliper
Brake caliper pistons jammed	Replace the brake caliper
Lost elasticity of brake caliper piston O-rings	Replace the brake caliper
Jammed disc brake shoes due to deformation or breakage of the springs, or severe contamination of the mating seating surfaces of the shoes and base	Replace the springs or clean the seating surfaces of the shoes and the base from corrosion and dirt, if it is impossible to replace the brake caliper
Vehicle skidding or drifting when braking	
Inconsistent air pressure in tires. Oily friction pads in one of the brakes	Bring tire pressure to normal. Replace the brake shoes or wash the brake pads with gasoline, followed by sanding with fine sandpaper and careful removal of abrasive dust
Burrs or deep notches on the disc surface	Replace the brake disc
Brake fluid leak in one of the brake calipers	Eliminate the leak
See "One brake does not release (elevated wheel turns tightly)"	
Insufficient braking efficiency (increased force on brake pedal)	
Worn or oily brake pads	Replace the brake shoes or wash the brake pads
Loose vacuum hose connection	Restore the connection tightness
Faulty brake booster check valve	Replace the check valve

Malfunction cause	Remedy
Broken vacuum booster tightness	Replace the vacuum booster or the brake module
Broken tightness in the vacuum booster connection with the master cylinder body	Replace the O-ring in the connection between the vacuum booster and the master cylinder or brake module if the tightness limit for a worn booster is exceeded
Faulty brake master cylinder. Leaky cylinder	Replace the brake master cylinder assembly with tank or the brake module
Rattles, knocks in the brakes	
Broken disc brake shoe spring	Replace the brake shoe spring
Worn brake caliper guide pins	Replace the brake caliper
Worn holes for the guide pins in the brake caliper base	Replace the brake caliper
Breakage or loss of elasticity of the coupling or clamping springs of the parking brake shoes	Replace the springs
High force on the parking brake handle is needed to hold the vehicle	
Jamming cables in the guide housings	Disconnect the cables, clean them of dirt, lubricate the cables and their connections with HUSKEY 350 Silicone Grease (from HUSKEY). If the rubber boots are damaged, replace the cable assemblies.
Oily parking brake pads	Rinse the brake pads or replace the brake shoes with pads
Parking brake incorrectly adjusted	Adjust the parking brake drive (see “Parking brake drive adjustment” subsection)
Large stroke of the parking brake lever handle	
Large free play of the parking brake drive expansion link in the rear wheel brakes	Adjust the parking brake drive (see “Parking brake drive adjustment” subsection)
Heating of the brake discs when driving without braking	
Incorrect adjustment of the parking brakes or cable drive	Adjust the parking brake drive (see “Parking brake drive adjustment” subsection)

Malfunction cause	Remedy
Reduced level of brake fluid in the brake master cylinder tank in the absence of external leakage in the hydraulic actuator	
Faulty brake master cylinder. Broken cylinder tightness (fluid may enter the vacuum booster)	Replace the brake module

Brake system maintenance and repair

Maintenance of the brake system includes carrying out scheduled work provided for in the warranty and service book and the vehicle operation manual, and performing work related to maintaining the vehicle's performance.

In operation, the serviceability of the alarm system is periodically checked (emergency drop in the level of brake fluid in the brake master cylinder tank), the tightness of the hydraulic brake actuator, as well as the serviceability of the primary brake system and the operability of the parking brake. Leakage of brake fluid is not allowed.

General requirements for brake system repair

Tightening torques for:

- nuts of hydraulic pipelines - 15-25 N·m (1.5-2.5 kgf·m);
- vacuum hose clamps - 1.5-3.5 N·m (0.15-0.35 kgf·m).

Pipelines must be securely fastened in retaining clips.

If cracks, blisters and visible abrasion are found on the brake hoses, replace the hoses with new ones. Protective boots must not have through damage.

When repairing the brake system after disconnecting the pipelines from the brake system assemblies, it is necessary to close the openings of the pipelines and assemblies with plugs to prevent fluid leakage and dust and dirt from entering the system.

Before performing repair work, the components of the brake system removed from the vehicle must be thoroughly washed with warm water and detergents and dried with compressed air. The use of gasoline, diesel fuel, trichlorethylene or other mineral solvents is unacceptable as they will damage the rubber parts. For lubrication of rubbing parts during assembly, class DOT-4 brake fluid is used.

Checking primary brake system

The vacuum booster operability is checked as follows. When the engine is not running, first press the brake pedal 3-4 times, then press the pedal and, holding it with a force of 300-400 N (30-40 kgf), start the engine. With a booster in good working order, the pedal will move to the floor. If the pedal does not move or movement is difficult, the problem is with the booster or vacuum pump[1)].

It is also necessary to make sure that the vacuum booster and the check valve are tight. To do this, turn off the engine, hold for 1-2 minutes and press the pedal several times. During the first three presses, you should hear the sound of air entering the booster. If this does not happen, the vacuum booster or check valve is faulty.

The serviceability of the alarm system for an emergency drop in the fluid level in the master cylinder tank is checked as follows: when the brake fluid level in the master cylinder tank is below the minimum level on the instrument cluster (with the ignition on), the red indicator should light up.

Check the brake system efficiency and the anti-lock brake system health on the bench.

The braking force on each front wheel must be at least 1170 N (120 kgf), on each rear wheel – at least 1170 N (120 kgf), with a force on the brake pedal of 420-440 N (43-45 kgf) with the engine off and 45-65 N (4.5-6.5 kgf) with the engine running.

The difference in braking forces on the wheels of the front axle should not exceed 20%, on the wheels of the rear axle – 20% of the maximum braking force value. The fluctuation of the braking force on each wheel, with a constant force on the brake pedal, should not exceed 30% of the maximum braking force value.

Filling the brake system with fluid (bleeding)

The brake system shall be bled when changing the brake fluid, when air enters the hydraulic actuator, when carrying out repairs related to system depressurization.

The hydraulic actuator consists of two independent circuits, each of which shall be bled separately. It is necessary to start bleeding from the brake more remote from the master cylinder.

The brake bleeding sequence:

rear right, front left, rear left, front right. You need to work with an assistant.

Bleeding sequence:

- fill the brake fluid according to the vehicle operation manual into the master brake cylinder tank up to the “MAX” mark;

- clean the front and rear brake bleed valves from dirt, remove the rubber protective caps from the bleed valves;

---

[1] - For diesel vehicles

- attach the brake fluid drain hose to the right rear brake valve head. Lower the free end of the hose into the brake fluid poured into a clean transparent container;

- depress the brake pedal, unscrew the bleed valve by 1/2-3/4 turn. After the bubbles stop coming out of the hose, close the bleed valve. Release the brake pedal. Press the pedal sharply and release slowly. Perform the specified sequence of actions until the release of air bubbles from the hose stops;

- after the bleeding, close the rear brake valve. The tightening torque of the bleed valve is 8-13 N·m (0.8-1.3 kgf·m). Remove the hose and put on the protective cap;

- in accordance with the specified bleeding sequence, bleed the remaining brakes. After the bleeding, close the brake valves.

During the bleeding, timely refill the brake master cylinder tank with fluid to prevent the tank level dropping by more than 2/3 of its volume. Check the brake fluid level in the translucent tank of the brake master cylinder visually using the marks on the tank body. After bleeding the hydraulic actuator, add brake fluid to the master cylinder tank. With new brake pads, the fluid level should be at the MAX mark.

- tighten the master cylinder tank cap with a torque of 2.0-2.6 N·m (0.20-0.26 kgf·m);

To check the quality of the operation to remove air from the hydraulic brake actuator, press the brake pedal with a force of 294-343 N (30-35 kgf) with the engine off, the pedal should not move more than 70 mm.

Replacing brake fluid in hydraulic actuator of brakes and clutch

Brake fluid needs to be replaced because it absorbs moisture from the atmosphere during operation, lowering its boiling point and corroding cylinders and pistons. Replace the fluid in the hydraulic actuator of the brakes and clutch at intervals according to the “Warranty and Service Book”.

To change the brake fluid, proceed as follows:

– unscrew the master cylinder tank cap, remove the protective caps from the brake bleeder valves and the clutch slave cylinder;

– put rubber hoses on the valve heads, lower their free ends into transparent vessels, and then unscrew all valves by 1/2-3/4 turn;

– drain the spent fluid from the hydraulic brake actuator by sharply depressing the brake pedal and slowly releasing it. After the spent fluid has run out, close the bleed valves. Similarly, drain the spent fluid from the hydraulic clutch actuator by pressing the clutch pedal;

– drain the spent fluid from the containers and put them in place under the rubber hoses;

– pour fresh brake fluid into the master cylinder tank and unscrew all bleeder valves.

Sharply pressing and smoothly releasing the brake pedal, as well as refilling the tank with brake fluid in a timely manner, fill the system with fresh brake fluid. Similarly, fill the clutch drive by pressing the clutch pedal;

– as soon as clean brake fluid appears in the containers, close the bleed valves;

– bleed the brake system;

ATTENTION
It is not recommended to use the fluid drained from the system to fill the tank, as it is saturated with air, has a lot of moisture and may be contaminated. The brake fluid used must comply with the requirements of the Vehicle Operation Manual.

- bleed the clutch drive (see “Clutch” subsection).

Replacing front and rear disc brake shoes and caliper assemblies

Replacement of the brake shoes and brake calipers of the front axle and rear axle is described in the supplier’s documentation.

It is necessary to replace the brake shoes simultaneously in the right and left brakes of one axle when the thickness of the friction material decreases to 2 mm.

After replacing the brake pads, the first 80-100 km of run, until the new pads are worn in, care should be taken, since the vehicle braking distance may be slightly increased. During this period, prolonged braking should be avoided so as not to overheat the brake pads.

Brake light switch position adjustment

The position of the brake light switch 11 (see Fig. 6.2) is adjusted by its movement with the nuts 20 loosened.

During adjustment, the switch rod should rest against the pedal stop pressure pad.

The installation dimension C, between the rod foot and the sensor body, must be 0.2-1.2 mm

Upon the end of the adjustment, tighten nuts 20 to a torque of 2-4 N·m (0.2-0.4 kgf·m).

When the pedal is moving hard, lubricate the push rod pin with graphite grease Barbatia 4 (from Shell), Energrease C3-Y (from British Petroleum Co.), Mobilgrease Graphited 3 (from Mobil Oil Corp.).

Parking brake drive adjustment

During maintenance, it is necessary to periodically inspect the condition of the cables, as well as adjust the parking brake drive in cases of a significant increase in the lever stroke and a decrease in the parking brake efficiency. If the housing or protective boots are damaged, the cable assembly must be replaced.

If the lever 18 (see Fig. 6.9) of the parking brake moves to the maximum possible stroke (up to the stop) and at the same time it is impossible to achieve a force of 392 N (40 kgf) applied to the middle of the lever handle, or low braking efficiency is observed, the parking brake should be adjusted as follows:

- place the vehicle on a flat horizontal platform, place wheel chocks under the front wheels;
- lower the lever 18 to the lowest position, and set the gear lever to the neutral position;
- loosen the rear wheel nuts, raise the vehicle rear so that the wheels do not touch the stand plane, place the axle on a stand, then remove the wheels;
- completely loosen the tension of the cables by releasing the adjusting nut 11 in the area of fastening of the front cable 23; loosen the brake caliper 22;
- turn the brake disc, aligning the adjusting hole in the disc with the teeth of the parking brake adjustment link sleeve (Fig. 6.11);
- use a slotted screwdriver to rotate the sleeve until the disc brakes, then in the opposite direction by 7-8 teeth. The disc shall freely rotate manually;
- in the same sequence, adjust the second parking brake (the sleeve shall be rotated in the opposite direction);
- rotate the nut 11 (see Fig. 6.9) of the front cable adjusting end until one of the drive levers 1 shifts. Further movement of the drive levers can lead to partial braking of the brakes and premature wear of the brake pads in operation;
- lock the adjusting nut 11 with the lock nut 10 to a torque of 23.5-35.3 N·m (2.4-3.6 kgf·m), tighten the brake caliper retaining nut 22 to a torque of 6.7-9.0 N·m (0.68-0.91 kgf);
- reinstall the rear wheels, lower the vehicle, tighten the wheel nuts to the required torque.

With a properly adjusted drive, the parking brake lever should move a stroke of 6-8 clicks when a force of 392 N (40 kgf) is applied to the lever handle.

When replacing cables, the following requirements must be met:

- lubricate the threads of nuts 6 and 11 and the tips of the cable housings with a thin layer of SRI Grease EP2, Ulti-Plex Synthetic Grease EP1.5 (from CHEVRON) or Albida EVS (from Shell)
- install brackets 4 and 25 and pin 14 as shown in Fig.6.9.

Dimension A of the protruding threaded part of the housing end must correspond to no more than two threads.

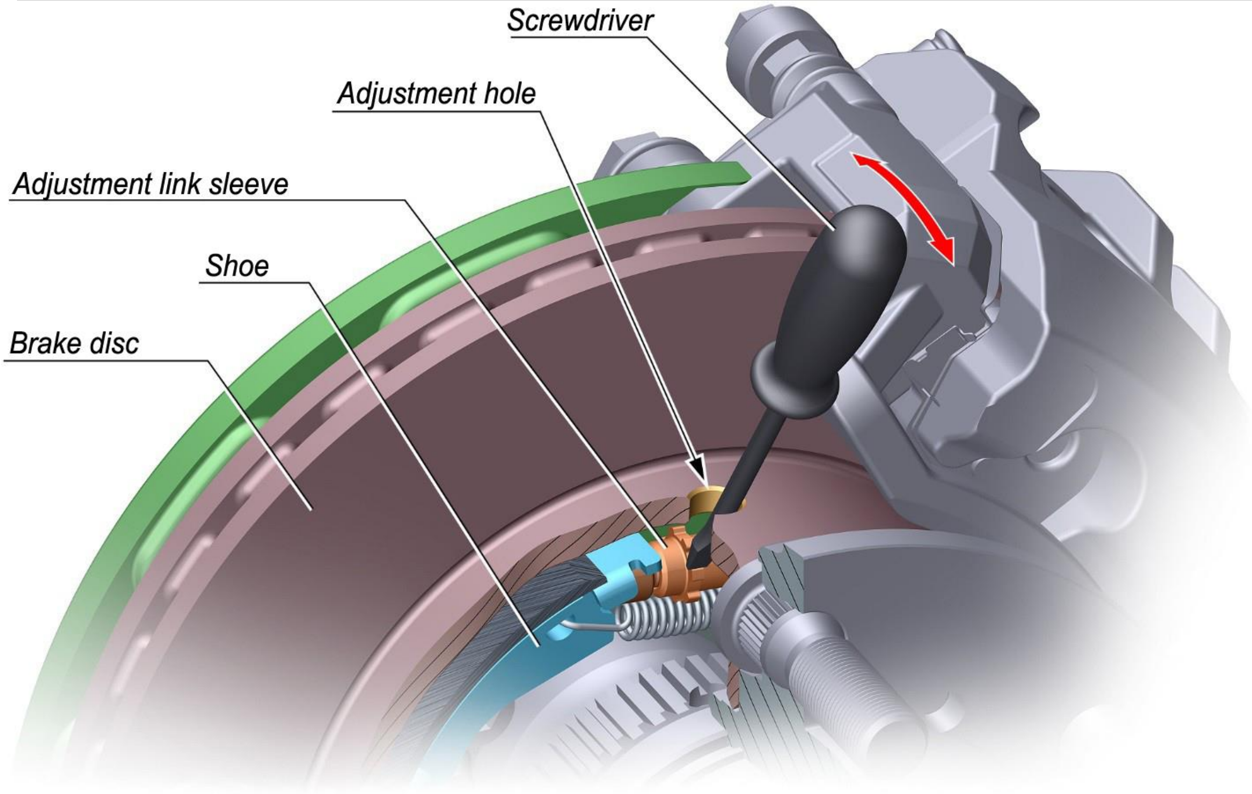


Fig. 6.11. Parking brake adjustment (without removal of hub with brake disc)

Replacing parking brake shoes

Replacement of parking brake shoes is carried out in case of wear of one of the pads to a thickness of less than 2 mm.

It is allowed to operate the brake drum with wear up to a diameter of Ø170 mm, no more. For information: the diameter of the new brake drum is $168^{+0.2}$ mm.

Determining the thickness of parking brake pads is allowed without removing the hub with the brake disc (see Fig. 6.12) by measuring the difference in distances from the outer surface of the brake disc to the rim of the shoe and pad. The measurement shall be carried out with a caliper through a special adjustment hole (Ø 12 mm) in the brake disc.

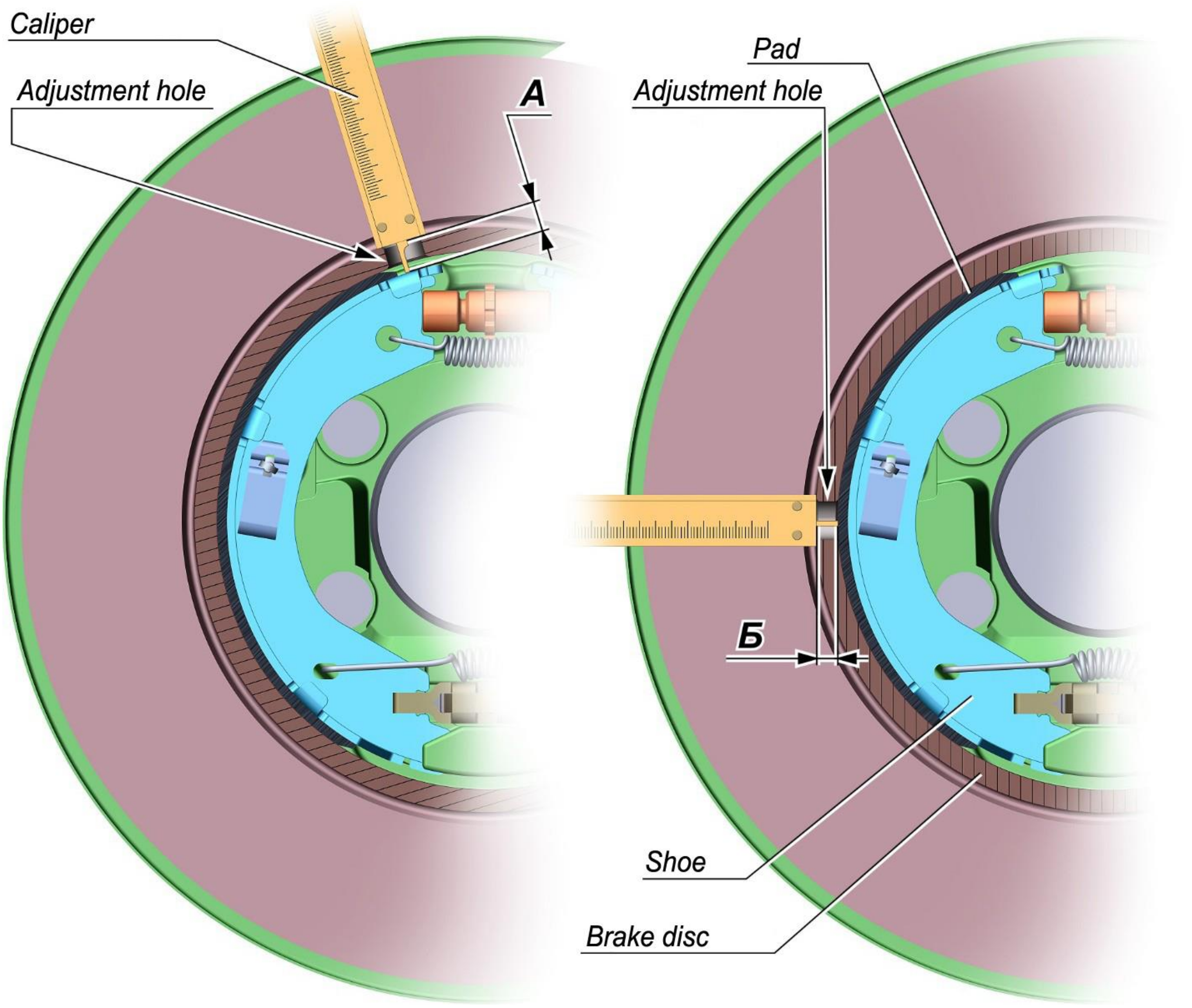


Fig. 6.12. Parking brake pad thickness measurement

The brake shoes must be replaced simultaneously on the right and left parking brakes (Fig. 6.10).

The brake pad removal must be carried out as follows:

- place the vehicle on a flat and horizontal platform and install wheel chocks under the front wheels;
- lower the parking brake lever;
- loosen the rear wheel nuts, raise the vehicle rear so that the wheels do not touch the stand plane, place the axle on a stand, then remove the wheels;
- disconnect and remove the brake caliper without disconnecting the hose, hang the caliper on the frame, avoiding tension on the hose;
- unscrew the mounting bolts and remove the half shaft using a puller (see "Transmission" section);
- unscrew the hub bearing retaining nut and remove the hub with the brake disc and bearing, remove the O-ring (see "Transmission" section);
- completely loosen the tension of the cables by releasing the adjusting nut 11 in

the area of fastening of the front cable 23; loosen the brake caliper 22 (Fig. 6.9);
- remove the coupling 28 and clamping 6 springs (Fig. 6.11);

- remove the brake shoes 1 and the adjustment link (part 3 and 4) from the support backplate 12;

- clean the parking brake parts from dirt.

Installation of new brake shoes must be carried out in the reverse order of removal, taking into account the following:

- installed shoe pads must be dry, without traces of oil and fuel;

- lubricate with CASMOLY MS243 grease or equivalent:

1) brake backplate in the places of its contact with the brake shoes (6 sites);

2) brake shoe supports and coupling spring 8 in the area of contact with the expansion link.

- lubricate the threaded surfaces of the adjustment link parts (sleeve 3 and adjusting screw 4) with CASTROL K764 grease or its equivalent. Rinse the parts before lubricating;

- assemble the adjustment link by screwing the parts up to the stop, avoiding wedging;

- springs must be installed as shown in Fig. 6.10.

After installing the hub with the brake disc, check the oil level in the rear axle housing and top up if necessary.

Adjust the parking brake actuator as described above.

New parking brake pads must be run in so that the brakes can provide the necessary efficiency when braking.

Run-in should be carried out after adjusting the parking brake drive on the brake bench, observing safety precautions, as follows:

- install the rear wheels on the bench rollers;

- set the gear lever to neutral position;

- turn on the bench, ensuring the roller rotation frequency, corresponding to the vehicle speed of 5-10 km/h;

- set the parking brake lever to 1 click and run in the pads for 5 minutes.

Check after the brakes have cooled down. When a force of 147-196 N (15-20 kgf) is applied to the lever handle, the total braking force on the rear wheels must be at least 3435 N (350 kgf). Check when rotating the bench rollers in the direction corresponding to the reverse vehicle movement.

Brake module removal and installation

The **brake module removal** (Fig. 6.2) must be carried out in the following sequence:

- drain the brake fluid from the hydraulic brake actuator (see "Replacing brake fluid in hydraulic actuator of brakes and clutch" subsection);
- clean the booster, the brake master cylinder and the pipeline connection points from dust and dirt;
- disconnect the hose from the check valve of the vacuum booster by loosening the clamp[33)] fastening;
- loosening the fastening clamp, disconnect the brake fluid supply hose to the clutch master cylinder and the wire connector to the brake fluid level emergency drop indicator sensor;
- disconnect the pipelines from the brake master cylinder;
- disconnect the vacuum booster push rod eye from the pedal;
- unscrew the four nuts securing the vacuum booster to the front panel;
- remove the module from the engine compartment and remove the gasket;
- remove the check valve.

In case of replacing polyamide bushings, remove the bracket with the brake pedal by disconnecting the wire connector from the brake light switch and unscrewing the two remaining nuts of the bolts that secure the bracket to the front panel. To disassemble the bracket with the brake pedal, proceed as follows:

- unscrew the nut of the pedal bolt, remove the bolt, remove the pedal from the bracket and remove the distance bushing from the pedal hub;
- remove two polyamide bushings from the pedal hub.

Assemble and install the pedal bracket in the reverse order of disassembly and removal, taking into account the following:

- before assembly, lubricate the outer and inner surfaces of the polyamide bushings, as well as the parts mating with them, with Barbatia 4 grease (from Shell), Energrease C3-Y (from British Petroleum Co.), Mobilgrease Graphited 3 (from Mobil Oil Corp.).
- tightening torque of the brake pedal mounting bolt nut - 40-56 N·m (4.0-5.6 kgf·m), nuts of the bolts securing the brake pedal bracket to the front panel - 12-18 N·m (1.2-1.8 kgf·m).

In case of replacement of one of the brake module assemblies (master cylinder with a tank or vacuum booster), disconnect the master cylinder from the vacuum booster, replace the faulty unit, install a new O-ring 3 (see Fig. 6.6), install the master cylinder on the vacuum booster studs, install new nuts and tighten them to a torque of 17-23 N·m (1.7-2.3 kgf·m). The replacement procedure and technical requirements are set out in the supplier's documentation.

The **brake module installation on the vehicle** must be carried out in the following sequence:

- install a check valve on the vacuum booster, keeping the angle D=15º±15º (see

---

[33)] - For diesel vehicles

Fig. 6.2);

- install the booster assembly with the brake master cylinder on the vehicle after installing gasket 15 (see Fig. 6.2), and tighten retaining nuts to a torque of 12-18 N·m (1.2-1.8 kgf·m);
- connect the push rod eye to the brake pedal by installing the pin and pin stopper. Before assembling, apply grease Barbatia 4 (from Shell), Energrease C3-Y (from British Petroleum Co.), Mobilgrease Graphited 3 (from Mobil Oil Corp.);
- check and, if necessary, adjust the brake light switch position (see “Brake light switch position adjustment” subsection;
- connect the pipelines to the brake master cylinder, removing transport plugs from it, the tightening torque of the nuts is 15-20 N·m (1.5-2.0 kgf·m);
- connect and clamp the brake fluid supply hose to the clutch master cylinder. Cut off the soldered end of the tank fitting in area G, preventing the ingress of foreign particles into the tank (for a new master cylinder with a tank or a new brake module);
- install the vacuum booster hose on the check valve fitting, maintaining a distance E=5 mm, not more, from the fitting collar end and secure the hose with a clamp. Install the clamp at a distance F=3-7 mm from the hose end;
- connect the wire connector to the brake fluid level emergency drop indicator sensor;
- fill the tank with brake fluid and bleed the brake and clutch drive.

ABS hydraulic control valve removal and installation

To remove the hydraulic control valve, it is necessary to:

- disconnect the ABS harness terminal block 2 (Fig. 6.13) from the hydraulic control valve plug connector (see “Anti-lock braking system” subsection);
- disconnect six pipelines from hydraulic control valve 1;
- loosen three nuts 3 securing the hydraulic control valve to the bracket 4 and remove the hydraulic control valve.

To install a hydraulic control valve, it is necessary to:

- install the hydraulic control valve in the bracket;
- carefully connect and tighten six connecting nuts 5 securing the pipelines to the hydraulic control valve with a torque that ensures the joint tightness, but max. 15.7 N·m (1.6 kgf·m);

WARNING
Pipe nuts have different threads. Change of connection points is not allowed.

- tighten three nuts 3 securing the hydraulic control valve to the bracket to a torque of 6-10 N·m (0.6-1.0 kgf·m);

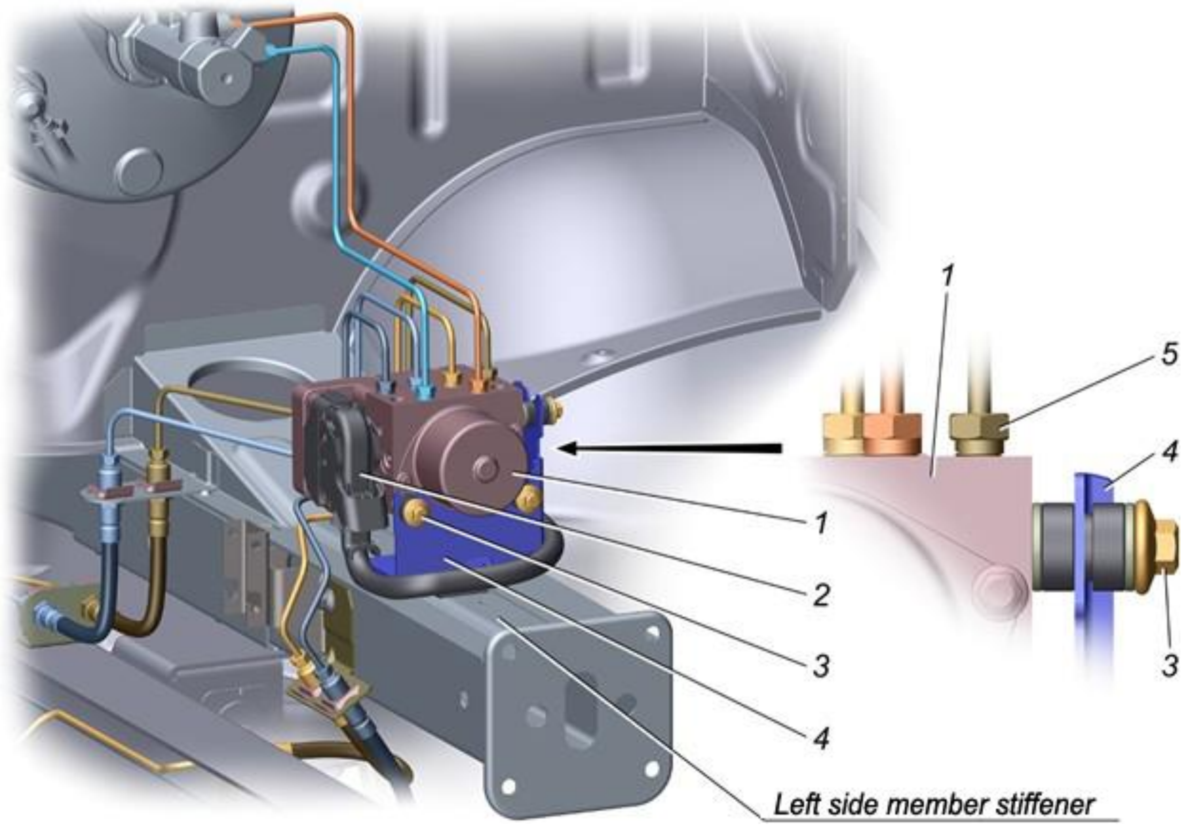


Fig. 6.13. ABS hydraulic control valve installation: 1 - hydraulic control valve; 2 - ABS harness connector terminal block; 3 - nuts securing hydraulic control valve to bracket; 4 - hydraulic control valve bracket; 5 - pipeline nuts;

- using a special diagnostic program, check the identification number of the ABS control unit software, install the ABS harness wire terminal block into the hydraulic control valve electronic control unit plug connector, add brake fluid to the tank and bleed the brake system and hydraulic control valve (see “Anti-lock braking system…” subsection).

Front brake disc replacement

If cracks or especially deep scratches are found on the working surfaces of the disc, or if the disc is worn to a thickness of 30 mm or less, replace the disc with a new one.

The brake disc removal must be carried out as follows:

- brake the vehicle with a parking brake and install wheel chocks under the rear wheels;
- remove the cap and loosen the front wheel fasteners;
- raise the vehicle front, place a stand under the lower arm and remove the wheel;
- disconnect and remove the brake caliper from the strut without disconnecting the hose, hang the caliper on the frame, avoiding tension on the hose;

disconnect and remove the hub with the brake disc from the strut;

- disconnect and remove the disc from the hub.

The assembly and installation of the hub with the brake disc must be carried out in the reverse order of removal and disassembly.

Required tightening torques for:

- bolts securing the disc to the hub – 54-69 N·m (5.5-7.0 kgf·m);
- screws securing the wheel hub bearings to the strut – 52-59 N·m (5.3-6.0 kgf·m);
- bolts securing the brake caliper to the suspension strut - 230-310 N·m (23.5-31.5 kgf·m).

When assembling the threaded part of the bolts securing the brake caliper and disc, as well as the screws securing the wheel hub bearings to the strut (at a length of 3-5 threads from the end), it is necessary to apply a layer of anaerobic sealant Loctite 243 (from Henkel) or Weicon AN 302-43 (from Weiecon).

Before applying the sealant, clean the part surfaces from the old sealant and degrease them.

Rear brake disc replacement

If cracks or especially deep scratches are found on the working surfaces of the disc, or if the disc is worn to a thickness of 19 mm or less, replace the disc with a new one.

The brake disc removal must be carried out as follows:

- put chocks under the vehicle front wheels;

- lower the parking brake lever;

- loosen the rear wheel nuts, raise the vehicle rear with a jack so that the wheels do not touch the stand plane, place the axle on a stand, then remove the wheels;

- disconnect and remove the brake caliper without disconnecting the hose, hang the caliper on the frame, avoiding tension on the hose;

- unscrew the mounting bolts and remove the half shaft using a puller (see “Transmission” section);

- unscrew the hub bearing retaining nut and remove the hub with the brake disc and bearing, remove the O-ring (see “Transmission” section);

- unscrew the six fixing screws and remove the disc from the hub.

The assembly and installation of the hub with the new brake disc must be carried out in the reverse order of removal and disassembly.

Required tightening torques for:

- screws securing the disc to the hub – 88-108 N·m (9-11 kgf·m);
- rear axle hub retaining nuts - 353-392 N·m (36-40 kgf·m);
- bolts securing rear axle half shafts – 90-125 N·m (9.0-12.5 kgf·m);
- bolts securing rear axle disc brakes - 157-196 N·m (16-20 kgf·m).

When assembling the threaded part of the bolts securing the brake caliper and screws securing the disc to the hub at a length of 3-5 threads from the end, it is necessary to apply sealant Loctite 243 (from Henkel) or Weicon AN 302-43 (from Weiecon).

Before applying the sealant, clean the part surfaces from the old sealant and degrease them.

After installing the hub, check the oil level in the rear axle housing and top up if necessary.

Adjust the parking brake actuator.

7. Electrical equipment

The electrical equipment of vehicles is made using a single-wire circuit. The second wire is the metal parts of the engine and vehicle (body). All negative leads of electrical equipment are connected to the vehicle body.

Rated voltage – 12 V DC.

Maintenance and repair of electrical equipment components as part of the F2.8L engine (generator, starter, etc.) are set out in the maintenance and repair documentation for the F2.8L engine.

7.1. Battery

A maintenance-free, electrolyte-filled and charged battery with a capacity of 75Ah or 85Ah is installed on the vehicle (Fig. 7.1). The battery is located under the hood on the right (in the direction of travel) in a special slot and secured with a bar and a bolt.

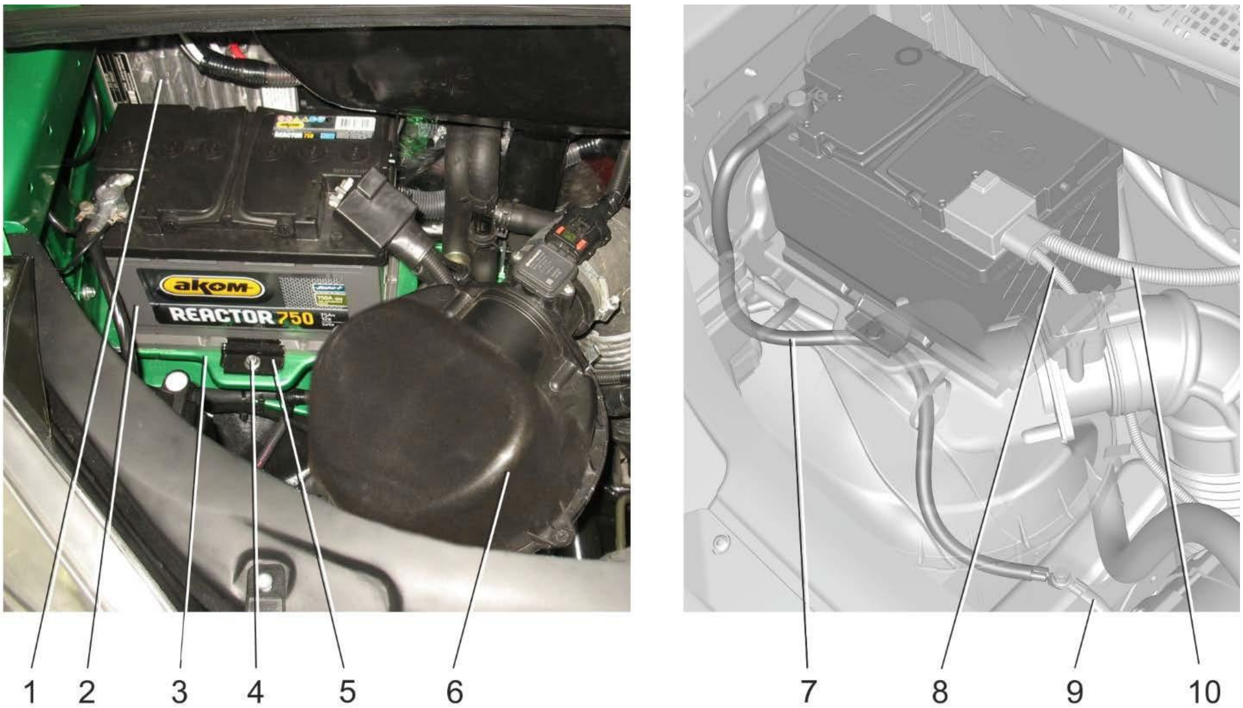


Fig. 7.1. Battery installation: 1 – engine control unit; 2 – battery; 3 – battery base; 4 – bolt; 5 – bar; 6 – air filter; 7 – wire; 8 – wire to generator; 9 – wire to engine; 10 – wire to starter

The battery removal must be carried out in the following sequence:

- first disconnect the negative and then the positive wire from the battery terminals (the positive terminal is larger than the negative one).
- disconnect the mass air flow sensor wire connector;
- remove the hose from the air filter insert by loosening the fastening clamp;
- unfasten the latches and remove the upper part of the body (cover) of the filter assembly with the insert;
- unscrew the bolt 4 (Fig. 7.1) and remove the bar 5 securing the battery;
- remove the battery from the base and from the vehicle engine compartment, as shown in Fig. 7.2;

The battery must be installed in the reverse order of removal.

The tightening torque of the bar fastening bolt should be 12-18 N·m (1.2-1.8 kgf·m), the nuts of the wire ends – 5-6 N·m (0.5-0.6 kgf·m).

Connect the wires to the battery terminals - first the positive wire, then the negative one.

ATTENTION
Cables must be connected to the battery terminals correctly. Wrong polarity is not allowed.

After installation, lubricate the cable and battery terminals with gun grease Retinax C, Unedo 2.3, (Phodine Rl. 2) (from Shell).

a)

b)

c)

d)

Fig. 7.2. Procedure for removing battery from vehicle

7.2. Lighting and light alarm

7.2.1. Headlights

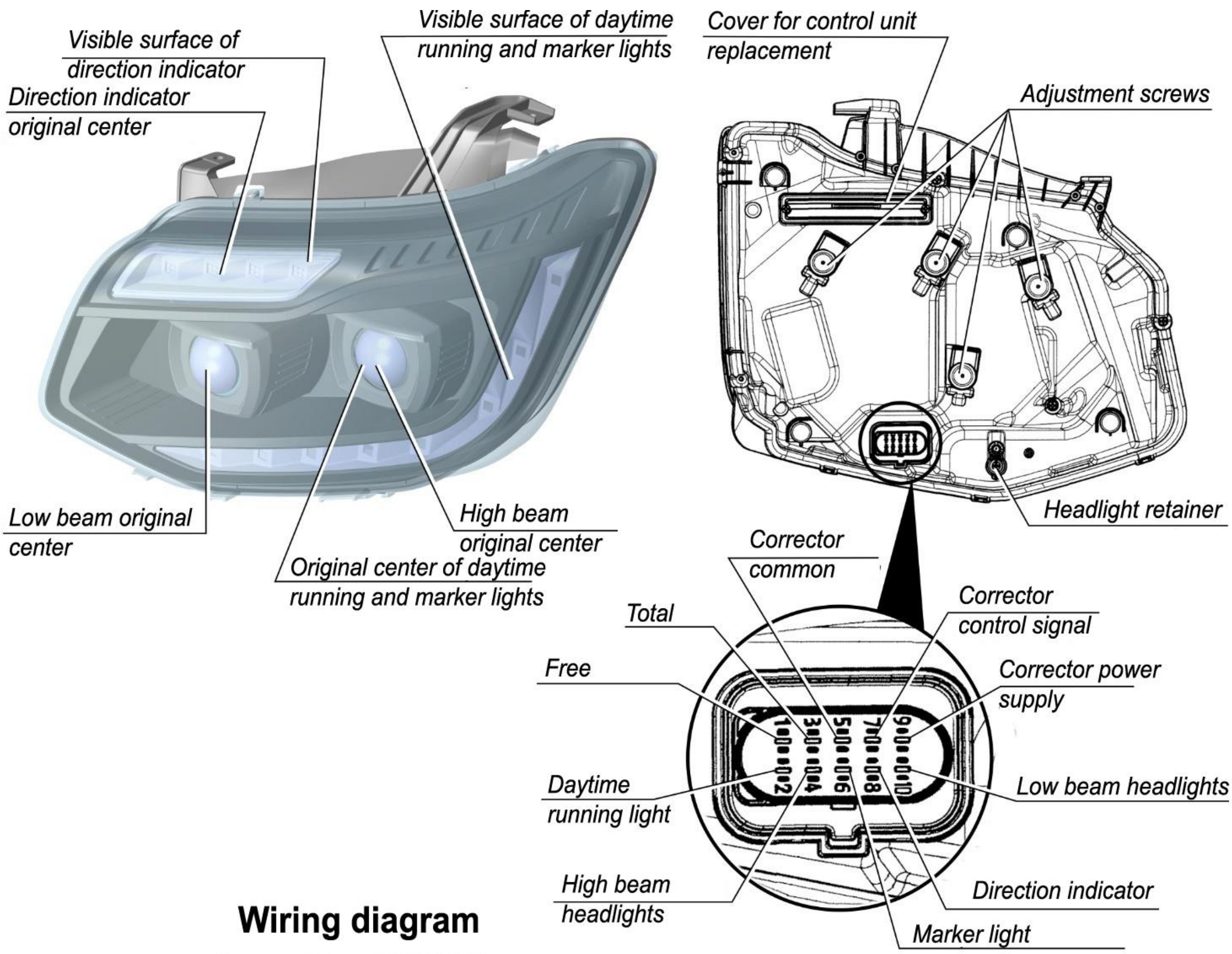
The vehicle has LED headlamp clusters. In the headlight (Fig. 7.3), the following illumination areas are distinguished:
- daytime running light and marker light;
- direction indicators;
- low beam headlight;
- high beam headlight.

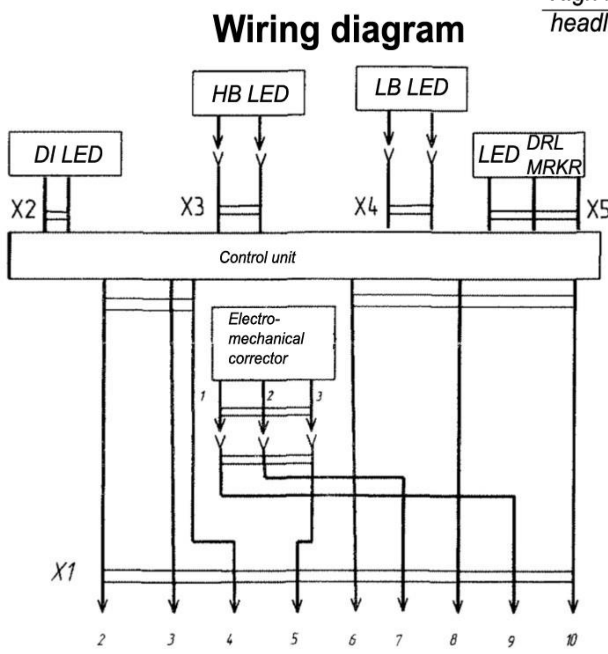
The headlights are equipped with:
- adjustment devices (for initial headlight installation);
- electromechanical corrector (for adjusting the low and high beam inclination angle depending on the vehicle load).

The marker light and headlights are switched on by the exterior lighting switch of the lighting control module. Switching the headlights (high beam-low beam) and turning on the direction indicators is carried out by the understeering switch. The daytime running lights turn on automatically when the ignition is turned on, and are turned off by moving the exterior lighting switch of the lighting control module to positions I and II.

The initial adjustment of the light beam is carried out by four manual adjustment assemblies (screws) located at the rear of the headlight, by $\pm$ 3° in the vertical plane and $\pm$ 2° in the horizontal plane. The initial inclination of the light-dark boundary is set at the vehicle manufacturer and is indicated on a plate next to the headlight (2.0%).

To adjust the headlights depending on the vehicle load, electromechanical correctors are installed in the headlights, allowing the driver to change the inclination angle of the low and high beams. Changing the light beam inclination is carried out by the lighting control module headlight corrector switch.





Pin	Circuit	Light source
1	Free	-
2	Daytime running light	Non-replaceable light source (max. 15 W)
3	Total	-
h	High beam headlights	Non-replaceable light source (max. 15 W)
5	Corrector common (3)	-
6	Marker light	Non-replaceable light source (max. 75 W)
7	Corrector control signal (2)	-
8	Direction indicator	Non-replaceable light source (max. 5 W)
9	Corrector power (1)	-
10	Low beam headlights	Non-replaceable light source (max. 15 W)

Fig. 7.3. Headlight

LED headlamp clusters are non-repairable products and, in case of failure, should be replaced with new ones.

Manual adjustment of the headlights must be carried out using the screen (Fig. 7.4) as follows:

- check tire pressure and, if necessary, bring it to normal;
- place the unladen vehicle on a flat, horizontal platform, ensuring a distance of

(10+0.04) m between the headlight lenses and a vertically installed screen;

- turn the headlight beam corrector switch of the module to position “0”;
- turn on the low beam;
- adjust the light beams by turning the adjusting screws (see Fig. 7.3) of the manual adjustment assemblies in turn for each headlight.

For adjusted headlights, the horizontal section of the light-dark boundary (separating line) must coincide with the line X—X (Fig. 7.4) on the left side of the screen (for the left headlight – to the point of intersection of the lines X-X and G-G, for the right headlight – to the point of intersection of the lines X=X and D-D). The inflection points of the separating lines of the low beam light spots must coincide with the intersection points of the lines X-X with the lines G-G and D-D for the left and right headlights, respectively (Fig. 7.4).

The angular deviation in the horizontal and vertical direction of the point of intersection between the left horizontal and right inclined section of the headlight beam light-dark boundary from the vertical plane passing through the reference axis must not exceed $\pm$0.5%.

When the headlights are turned on in high beam mode, the center of the light spot for adjusted headlights must coincide with the intersection of the horizontal line H-H and the vertical lines G-G and D-D for the left and right headlights, respectively.

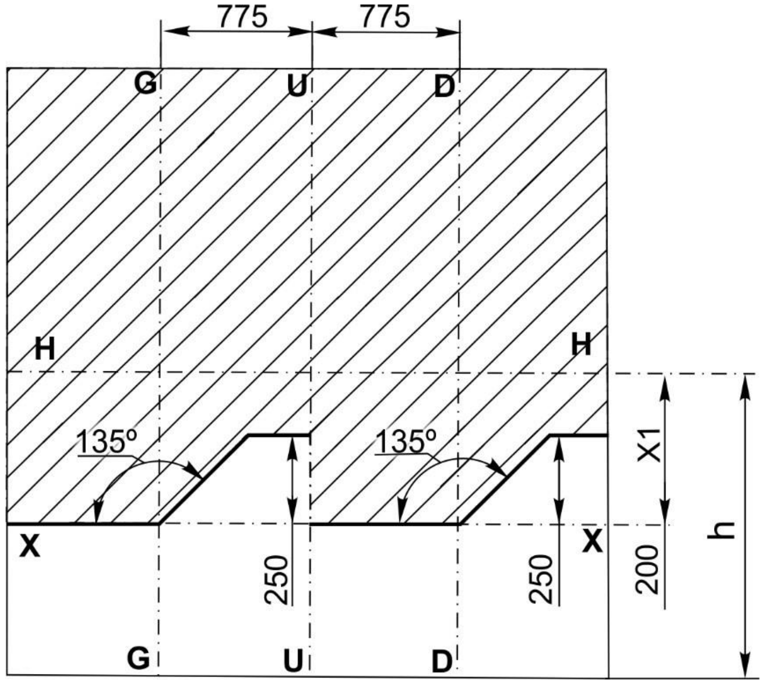


Fig. 7.4. Screen layout for headlight adjustment: h=968 mm - height of the center of the low beam headlights on the vehicle; V—V - vehicle axle

WARNING
The headlight lenses are made of plastic. Therefore, it is unacceptable to clean them from dust and dirt using various fuels, other active substances and liquids, as well as dry wiping with brushes and rags. Contamination must be removed only with abundant watering of these products with a water jet.

Table 7.1

Bulbs used in the vehicle

Purpose and place of installation	Type	Power, W
Headlights	LEDs	
Fog lamps	H11	55
Side turn indicators	LEDs	
Tail lamps:		
marker light	P10W	10
brake light	P21W	21
direction indicator	P21W	21
reversing light	P21W	21
fog light	P21W	21
Rear number plate lights	LEDs	
Front, side and rear marker lights	LEDs	
Interior dome lights	LEDs	
Cigarette lighter lighting	A12-1.2	1.2
Emergency brake light switch indicator light	A12-1.2	1.2

7.2.2. Cab lighting

The cab dome light (Fig. 7.5) is located on the roof liner or in the overhead console[1)] at the front and is fixed with a latch.

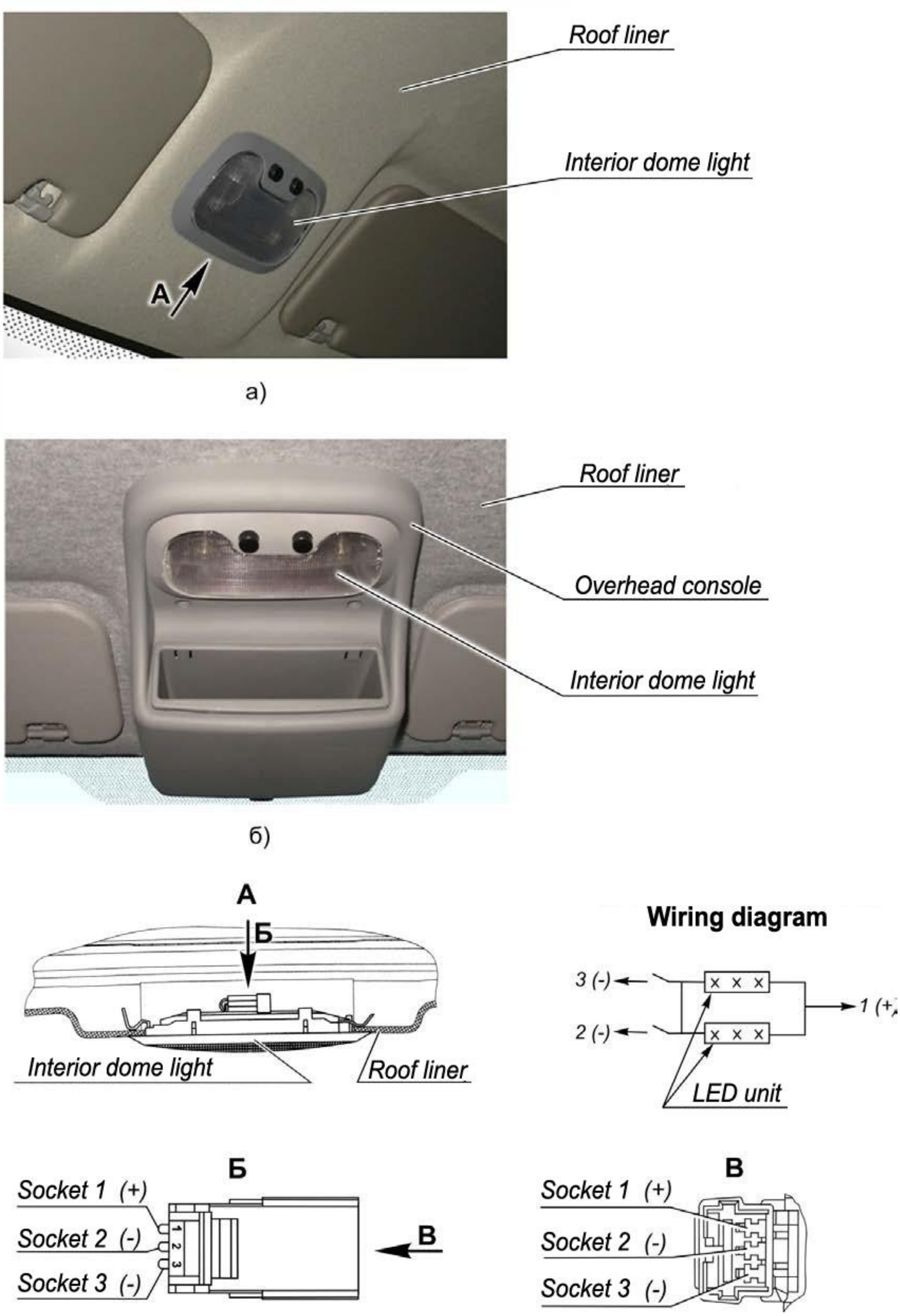


Fig. 7.5. Cab dome light installation: a - for vehicles without a console; b - for vehicles equipped with a console

---

1) – Installed on some of the vehicles

The dome light has two buttons and a common interior lighting section.

To turn on the dome light, press the dome light switch on the driver's side. To turn off the dome light, press the same button again.

When the passenger-side dome light switch is pressed, the interior lighting, as well as the footboard lamp on vehicles with a two-row cab, are switched on/off "from the open door" as follows:

- when the driver's and/or passenger door is opened, the cab lighting and the footboard lamp will turn on and remain on for 10 minutes, after which the dome lights will turn off forcibly to avoid battery discharge;
- when closing the doors of the driver and passengers, the cab lighting and the footboard lamp will smoothly turn off after 10 seconds;
- when the instrument and starter (ignition) switch is turned on to position I with the dome light on, the cab lighting and the footboard lamp will smoothly turn off after 2 seconds without a 10 second delay.

When the doors are closed, the interior dome light is not controlled by the button on the passenger side.

ATTENTION
Do not leave the cab dome light on for a long time when the engine is not running to avoid battery discharge.

If the LEDs in the cab dome light burn out, it is necessary to replace the dome light in the following sequence:

- insert a screwdriver into the groove in the center of the left end of diffuser 1 (Fig. 7.6), pry off the lens, turn the screwdriver and remove the lens;
- slide the dome light into the seat and remove the dome light;
- install a new dome light by sliding it into the seat;
- install the lens in the dome light housing, snap the fixing member onto the lens.

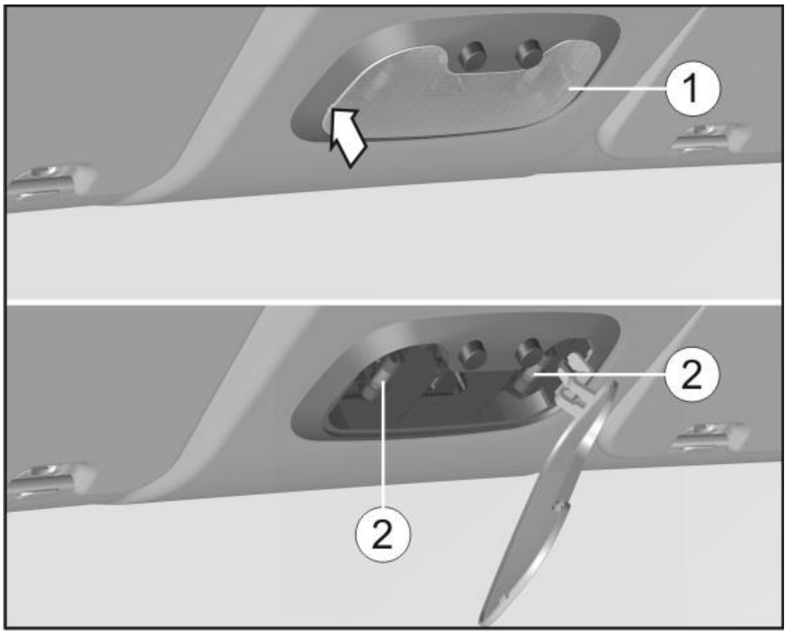


Fig. 7.6. Cab dome light replacement: 1 – lens; 2 - LEDs

7.2.3. Fog lamps[1)]

Fog lamps (Fig. 7.7) are installed in the front bumper panel and illuminate the roadbed under adverse driving conditions (rain, fog or snow).

To remove the fog lamps, it is necessary to disconnect the fog lamp wire connector, remove the front bumper (see “Body” section) and unscrew the fog lamp fixing screws.

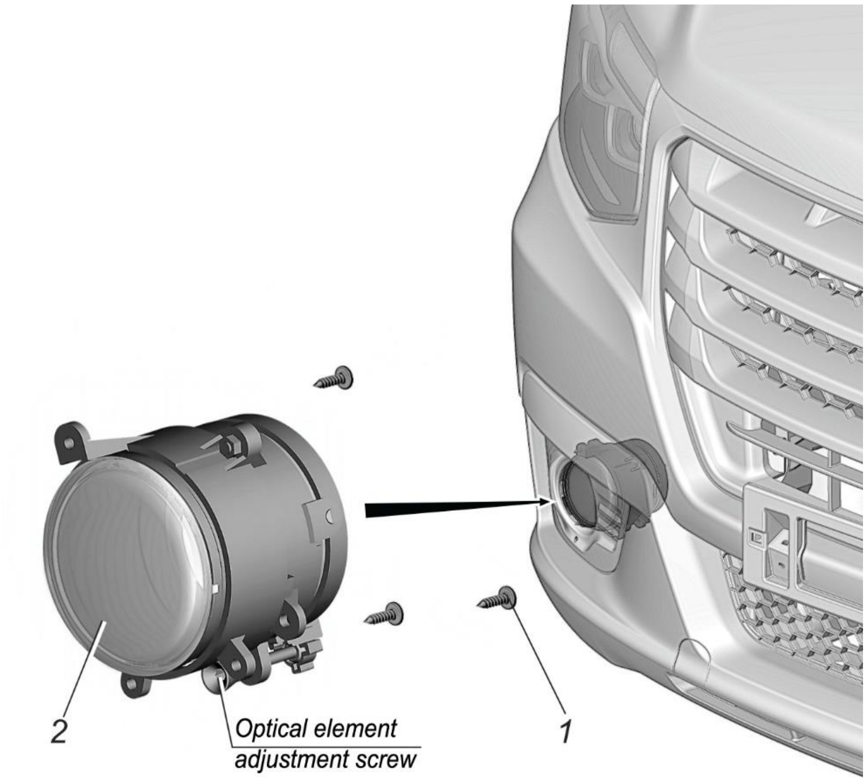


Fig. 7.7. Fog lamp installation: 1 – screw; 2 - fog lamp;

The **bulb replacement** must be carried out in the following sequence:

ATTENTION
Access to the fog lamp bulb is provided from under the front bumper.

- remove the connecting block 1 (Fig. 7.8) from the fog lamp;
- turn and remove holder 2 with a faulty bulb. The holder with the bulb assembly must be replaced;
- install the holder with the bulb into the headlight;
- connect the wire connector block.

1) – Installed on some of the vehicles

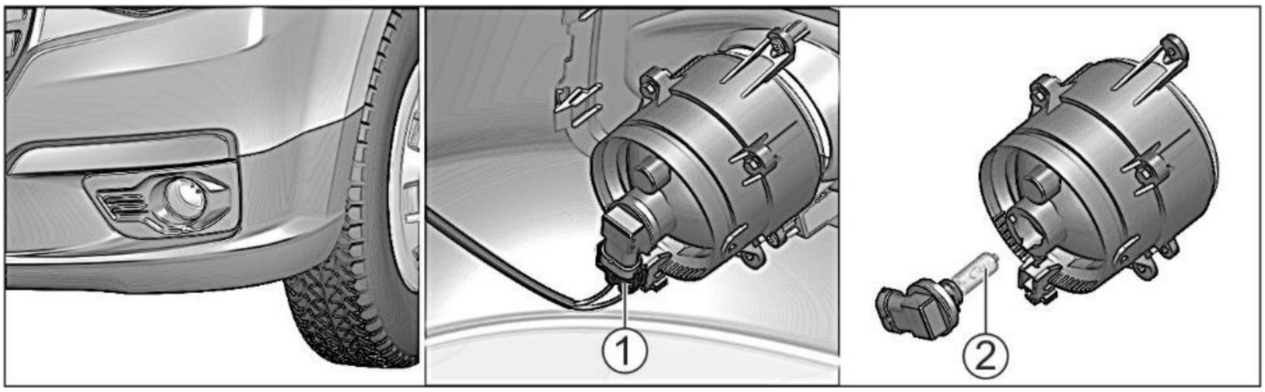


Fig. 7.8. Fog lamp bulb replacement; 1 - connecting block; 2 - holder with bulb

The **fog lamps are adjusted** using the screen (Fig. 7.9).

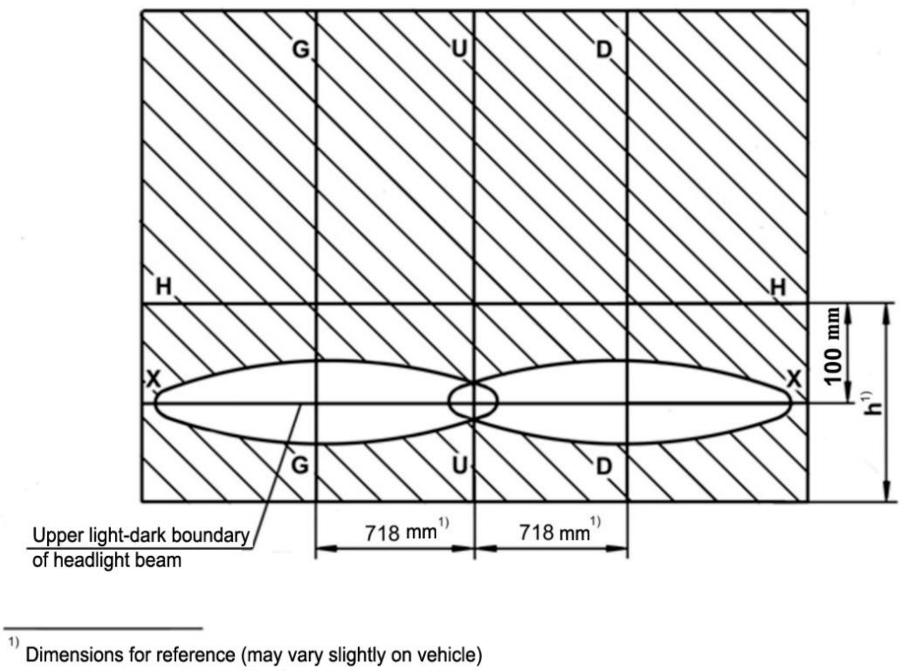


Fig. 7.9. Screen layout for vehicle fog lamp adjustment: h=525 mm - height of the lamp center from the floor

The adjustment must be carried out as follows:

- check the tire pressure. If necessary, bring it to normal;
- place the unladen vehicle on a flat, horizontal platform, ensuring a distance of (10+0.04) m between the headlight lenses and a vertically installed screen;
- turn on the fog lamps;
- accurately determine the value of dimension h;
- adjust the position of each fog lamp in turn so that the maximum light beam of

the lamp is on the line X-X, the lamp that is not adjusted must be temporarily covered with an opaque material.

The upper light-dark boundary of the fog lamp beam directed at the screen should be parallel to the plane of the roadbed (work platform), and the horizontal separating light-dark boundary should be visible on the screen at a distance of at least 2.25 m on both sides of the line U-U and being below the line H-H.

The fog lamp light beam should be inclined downwards towards the road, while the angle between the plane containing the upper light-dark boundary and the plane of the roadbed should be 34´ (1.0%).

The headlight adjustment screw rotation torque should be 0.2-0.6 N·m (0.02-0.06 kgf·m), adjust with the wrench Hex S4 or Hex S5, or TORX T20.

The tightening torque of the screws securing the fog lamp to the frontend is 1.5-2.5 N·m (0.15-0.25 kgf·m).

7.2.4. Side direction indicator

The direction in which the vehicle is turning is indicated by a flashing light in the front and rear direction indicators. Side direction indicators (Fig. 7.10) are located on the front panels of the bus sidewalls. LEDs are used as a light source.

The side direction indicator is a non-repairable product, and in case of failure it should be replaced with a new one. The tightening torque of the nuts securing the direction indicator to the fender arch is 3.53-4.90 N·m (0.36-0.5 kgf·m).

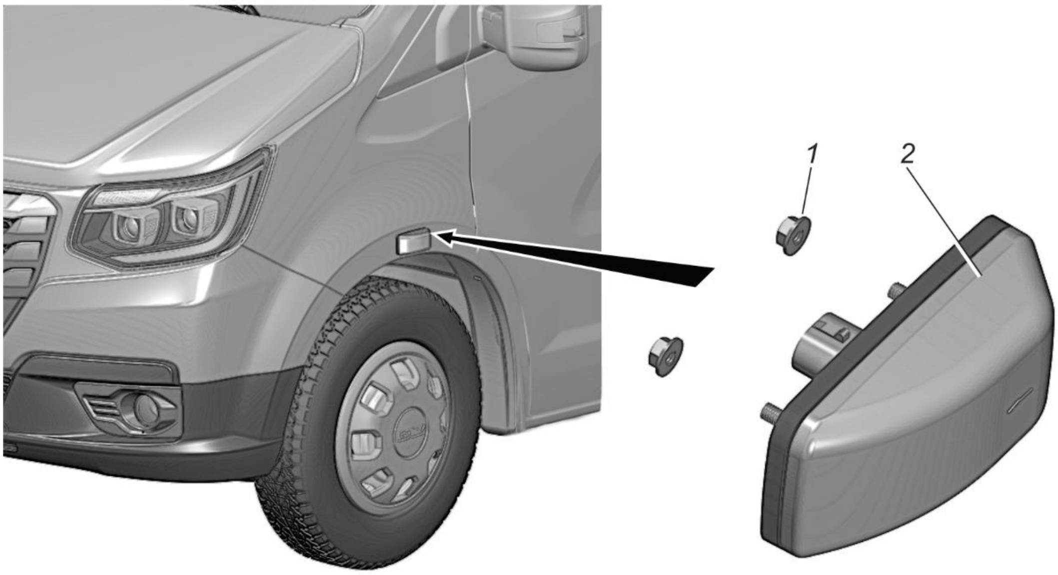


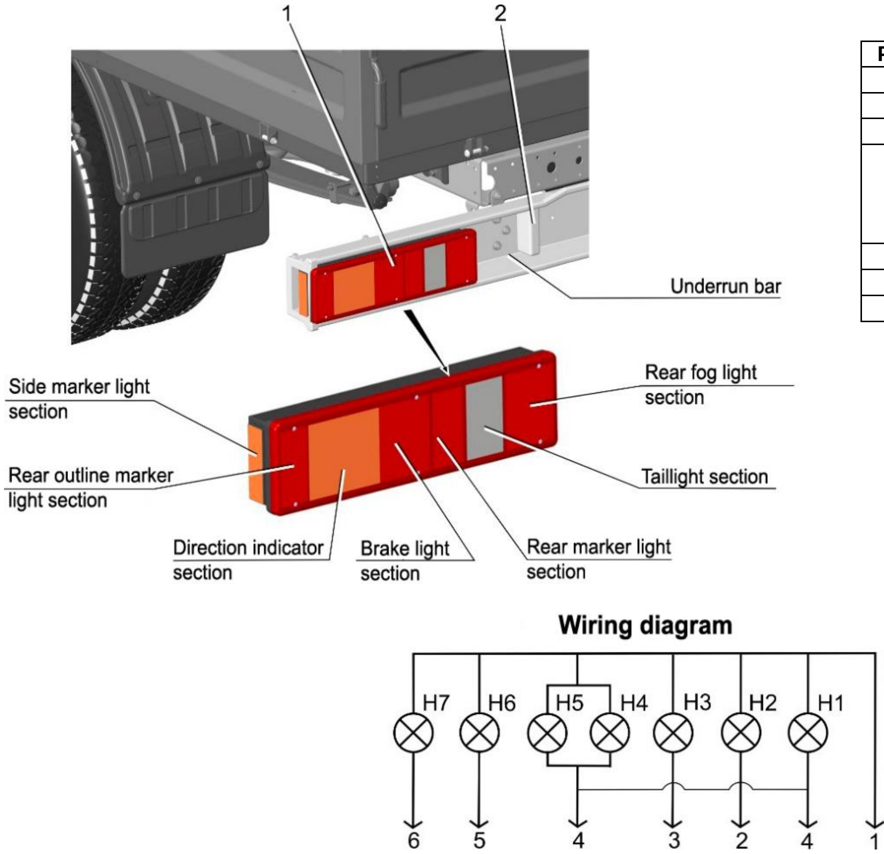
Fig. 7.10. Side direction indicator installation: 1 – nut; 2 – side direction indicator

7.2.5. Tail lamps, number plate light

Tail lamps. The vehicle is equipped with tail lamps on the underrun bar, including sections of marker light, brake light, direction indicator, reversing light, fog light, and separately installed number plate lights with LEDs.

The design and location of the lamp sections are shown in Fig. 7.11.

To replace the taillight bulbs, remove the lens by unscrewing the four fixing screws.



Pin No.	Purpose
1	Total
2	Direction indicator
3	Brake light
4	Rear outline marker light and side marker light. Rear marker light
5	Taillight
6	Rear fog lamp
7	—

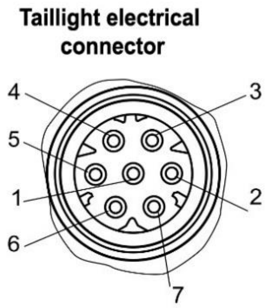


Fig. 7.11. Tail lamp: 1 **-** tail lamp;2 – number plate light

To replace the rear lamp bulbs, it is necessary to unscrew the two screws 1 (Fig. 7.12) securing the lens and remove the lens 2 by pulling it by the outer edge in the arrow direction.

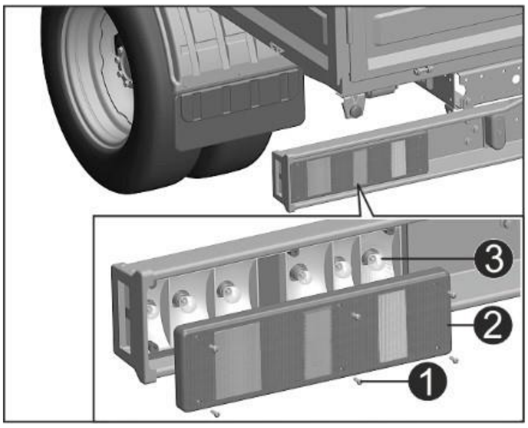


Fig. 7.12. Tail lamp bulb replacement: 1 – screws; 2 – lens; 3 – bulbs

7.2.6. Lighting control module

The vehicle has a lighting control module 144.3769 (Fig. 7.13) or 145.3769[1)].

The lighting control module is designed to switch electrical circuits for controlling exterior lighting, including daytime running lights, front or rear fog lights, adjusting the level of illumination of controls and instruments, and controlling the headlight beam angle.

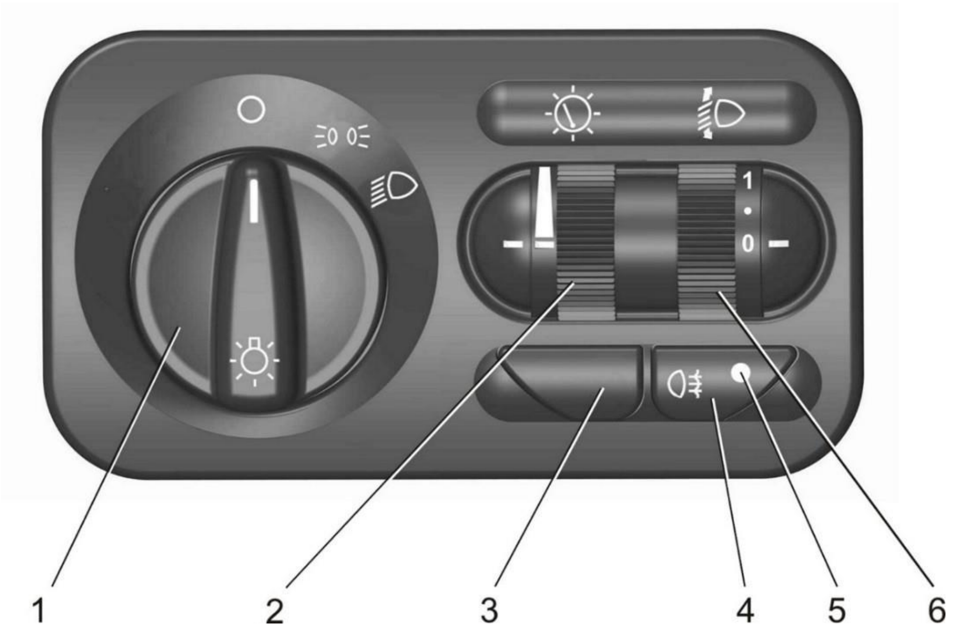


Fig. 7.13. Lighting control module: 1 - exterior lighting switch; 2 - instrument lighting controller; 3 - plug; 4 - rear fog light switch; 5 - indicator light; 6 - headlight range corrector switch

The lighting control module 145.3769 is distinguished by a front fog lamp switch with an indicator light instead of plug 3.

Backlight of symbols, scales, pointers of the controller and corrector switch, indicator light is carried out by LEDs, the illumination color is light green, for indicator lights: front fog lights)[1)] – green, rear fog lights – yellow.

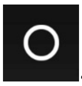
The **exterior lighting switch** is designed to switch electrical circuits for controlling marker lights, number plate lights, headlights and daytime running lights. The exterior lighting switch has three fixed positions:

[1)] - For vehicles equipped with fog lamps

 – all exterior lighting off;

 – marker lights on;

 – additionally switched on low or high beam headlights, depending on the steering column switch lever position for direction indicators and headlights.

The daytime running lights turn on automatically when the instruments and starter are turned on, if the exterior lighting switch is in position . Turning the switch to position  or  turns off the daytime running lights.

The torque of resistance to turning the knob of the exterior lighting switch from fixed positions should be 8-15 N cm (0.8-1.5 kgf·cm), the torque of resistance to turning the knob beyond the extreme positions should be at least 20 N·cm (2 kgf·cm).

The **front[1] and rear fog light switches** control the front fog lamp and rear fog lamp electronics. The switches have no mechanical key lock.

The front fog lamps are turned on when the switch is pressed while the marker lights are on.

The lights go off when:

- pressing the switch key again;
- turning the instrument and starter switch key to position 0;
- turning the marker lights off.

The rear fog lamps are turned on when the switch is pressed, if the low beam, high beam headlights or front fog lamps are on.

The lights go off when:

- pressing the switch key again;
- turning the instrument and starter switch key to position 0;
- switching off the low/high beam headlights, fog lamps.

The rotary **instrument lighting controller** is designed to adjust the level of illumination of the vehicle controls and instruments. Controller wheel rotation angles - 160°. The controller must provide smooth adjustment of mixed loads (LEDs and lamps) with a power of up to 35 W. The adjustment range does not depend on the load value.

The regulator wheel rotation resistance torque is 1.3-2.3 N·cm (0.13-0.23 kgf·cm), the torque of resistance against wheel rotation from a fixed position is 2.8-6.0 N·cm (0.28-0.60 kgf·cm). The torque of resistance to turning the wheel beyond the extreme positions is min. 20 N·cm (2.0 kgf·cm).

The rotary **headlight beam corrector switch** is designed to control headlight corrector gear motors and has seven fixed positions.

[1] – For lighting control module 145.3769

The electromechanical headlight corrector is designed to adjust the beam angle of the low (high) beam of headlights depending on the vehicle load from the driver's seat. The corrector consists of a headlight corrector switch of the lighting control module (on the dashboard), two electromechanical drives (inside each headlight) and connecting wires from the corrector switch to the drives (headlights) (under the vehicle hood).

When the vehicle is not loaded, it is necessary to align the number "0" on the corrector switch wheel with the "–" pointer (mark) on the lighting control module housing. (In this position, the headlights are set to their original position and can be adjusted with special screws installed in the headlight sockets, using the screen).

With a fully loaded vehicle, it is necessary to align the number "1" on the unit handwheel with the "-" mark on the control unit housing.

The control voltage from the corrector switch, as well as the supply voltage, is fed through the connecting wires to two electromechanical drives simultaneously.

The torque of resistance to turning the switch wheel from a fixed position is 2.8-6.0 N·cm (0.28-0.60 kgf·cm). The torque of resistance to turning the wheel beyond the extreme positions is min. 20 N·cm (2.0 kgf·cm).

The numbering of the control module connector plugs is shown in Fig. 7.14. The electrical circuits of the lighting control modules are shown in Fig. 7.15.

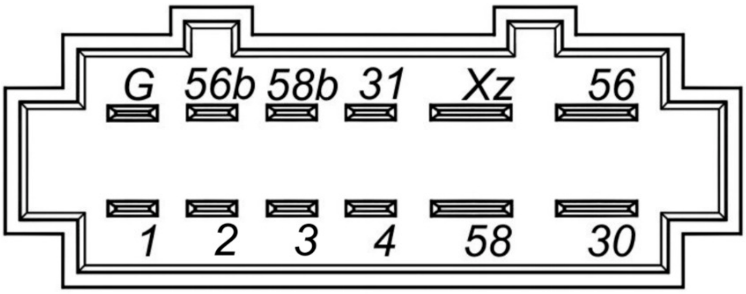


Fig. 7.14. Numbering of lighting control module connector plugs

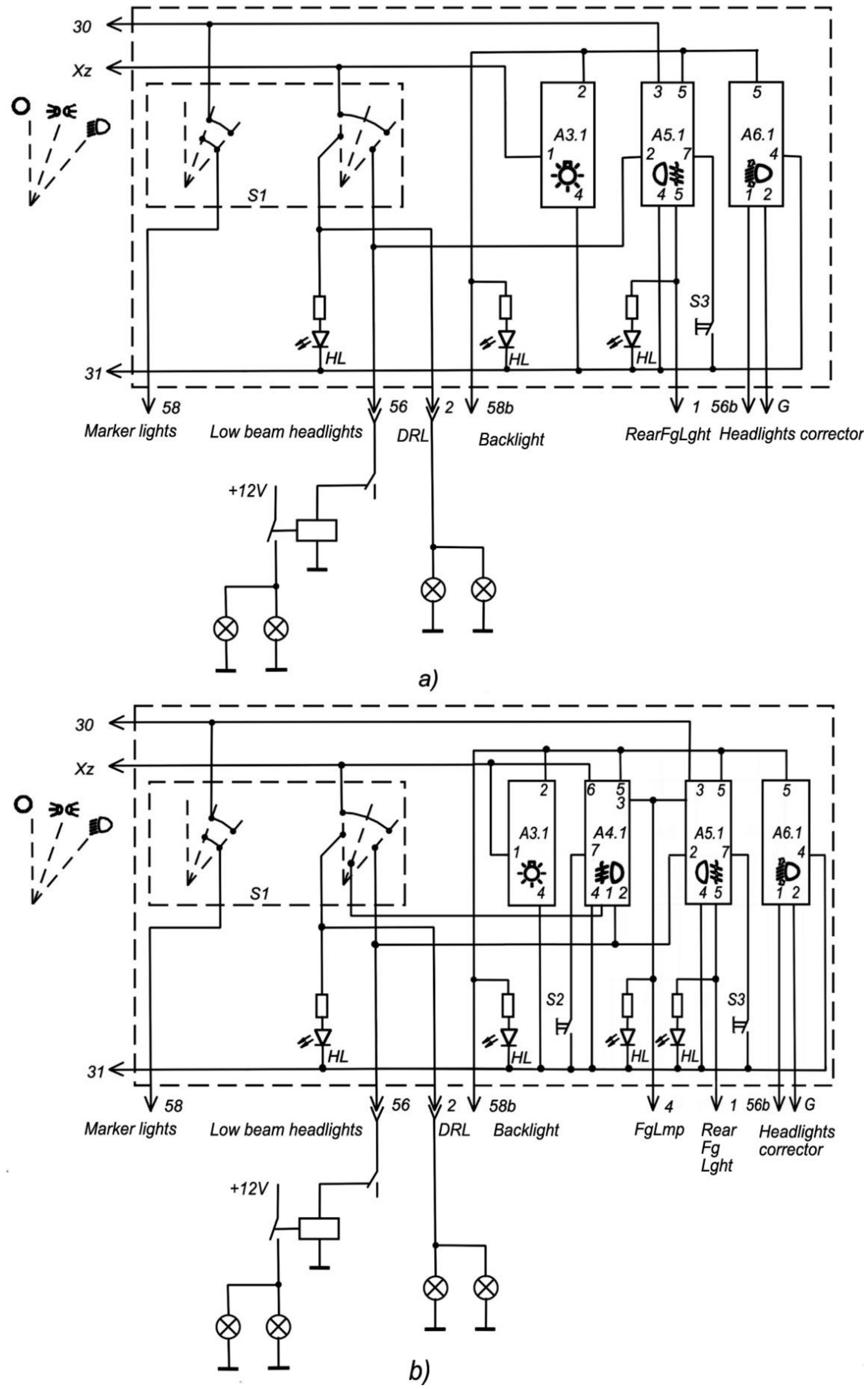


Fig. 7.15. Lighting control module electrical circuit: a – for lighting control module 144.3769; b – for lighting control module 145.3769; S1 – exterior lighting switch; S2 – front fog lamps switch; S3 – rear fog light switch; A3.1 – symbol backlight voltage regulator; A4.1 – electrical assembly of front fog light power switch [1]; A5.1 – electrical assembly of rear fog light power switch; A6.1 – electronic switch for headlight range corrector

[1] – For lighting control module 145.3769

To ensure the necessary vehicle lighting control module operation algorithm, loads are connected in accordance with Table 7.2 and supply voltage is applied to pin **30**, and additionally to the following pins:

Xz - when the "ignition" position of the instrument and starter switch is on;

56b - when the exterior lighting switch is turned to the "headlights on" position;

1 - when turning on the rear fog lights;

4 – when turning on the front fog lights.

Pin **58b** is supplied with an adjustable backlight voltage for function symbols and instruments from an external device that provides this function.

Table 7.2

Load name	Output pin	Rated load	Load type
Headlights	56	1 A	inductive
Marker lights	58	10 A	lamp
Daytime running lights	2	4 A	lamp
Rear fog light relay	1	4A (2 x 21 W)	lamp
Front fog light relay	4	1A	inductive
Backlight LEDs for symbols and scales	58b	0.4 A	LED
Headlights corrector gear motors	G 56b	10 mA[1)] in standby mode 1 A in rod movement mode	active

At any movement speed of the switch keys, exterior lighting switch handle, regulator wheels and corrector switch to adjacent positions, a clear switching without jamming, closing-opening of contacts should be ensured.

The control module is a maintenance-free and non-repairable product; in case of failure, replace it with a new one.

[1)] - Currents provided by external load

When removing the control module from the dashboard, the applied force must be min. 80 N (8 kgf), when installing the control module - max. 50 N (5 kgf).

7.2.7. Light alarm switch

The light alarm switch (Fig. 7.16) is located on the left, under the steering wheel.

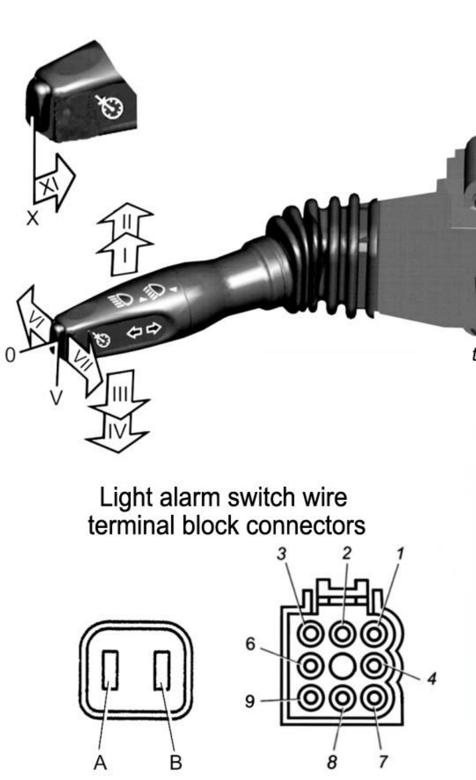
The switch shall perform the following functions:

- direction indicator control;
- “high” beam control when the exterior lighting switch of the lighting control module is on;
- light alarm control;
- emergency brake light control;
- cruise control.

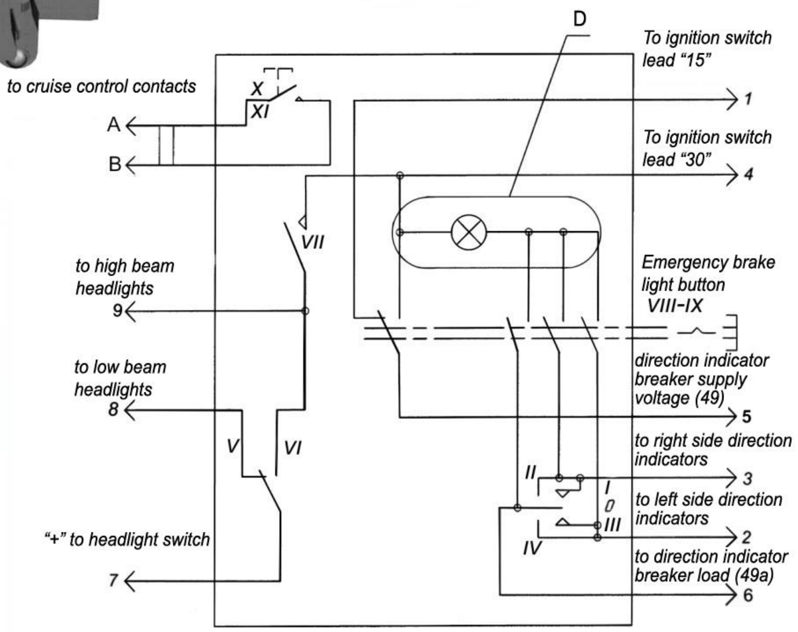
The switch consists of a mechanical drive that provides manual switching on and automatic switching off, and a switch designed to connect the electrical circuits of warning lamps with a current source. Cruise control is controlled by a button located at the lever end.

Switches must have a clear switching from one position to another, ensuring reliable fixation in the intended positions and switching of electrical circuits. The switch must ensure that there is no break in the electrical circuit of the emergency brake light button in the on position when a side force is applied to the button.

Violation of the clarity of switching on or the absence of light in the direction indicators can occur due to burning of the switch contacts, failure of the switch relay, malfunctions of the lamps and their holders. Bulbs should only be changed when the switch is off. The force for switching the direction indicator switch lever from one working position to another should be 3.9-7.9 N (0.4-0.8 kgf). The force of switching the lever from the “low beam” position to the “high beam” position and vice versa and turning on the high beam signaling should be 3-6 N (0.3-0.6 kgf). The emergency brake light button pressing force is 10-20 N (1-2 kgf). The cruise control button pressing force is 4.5-9.5 N (0.45-0.95 kgf) at full stroke. The voltage drop across the leads should be max. 0.04 V at a current of 0.95-1.05 A. If the switch is faulty, replace it with a new one.

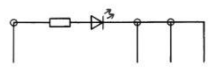


Wire number	Wire color
1	white
2	yellow
3	red
4	green
5	pink
6	brown
7	orange
0	sky blue
9	violet
A	brown
B	black



Note. Arabic numerals indicate wire numbers, Roman numerals indicate switch position numbers

D (option)



7.16. The electrical circuit of the switch and the position of the switch handle and the button for turning on the "Cruise control" function: 0 - direction indicators off; I - right direction indicators on (self-return to position 0); II - right direction indicators on; III - left direction indicators on (self-return to position 0); IV - left direction indicators on; V - low beam headlights on; VI - high beam headlights on; VII - light alarm on (self-return to position V); VIII - emergency brake lights off; IX - emergency brake lights on; X - cruise control circuit open; XI - cruise control circuit closed (self-return to position X)

The light alarm switch and the wiper switch with pause control are installed on the bus as a set.

- kit includes:
- – light alarm switch;
- – wiper switch with pause control.

If the light alarm switch is faulty, replace it with a new one from the installed set, or install a different switch set.

The flashing of the direction indicators is achieved by turning on the contact transistor relay of the breaker in the electrical circuit. If one of the warning lamps in any of the direction indicators burns out, the indicator light in the instrument cluster turns off (respectively, on the side on which the lamp burned out).

“Cruise control” function

If the vehicle speed is over 48 km/h, the vehicle can move in the “Cruise control” mode.

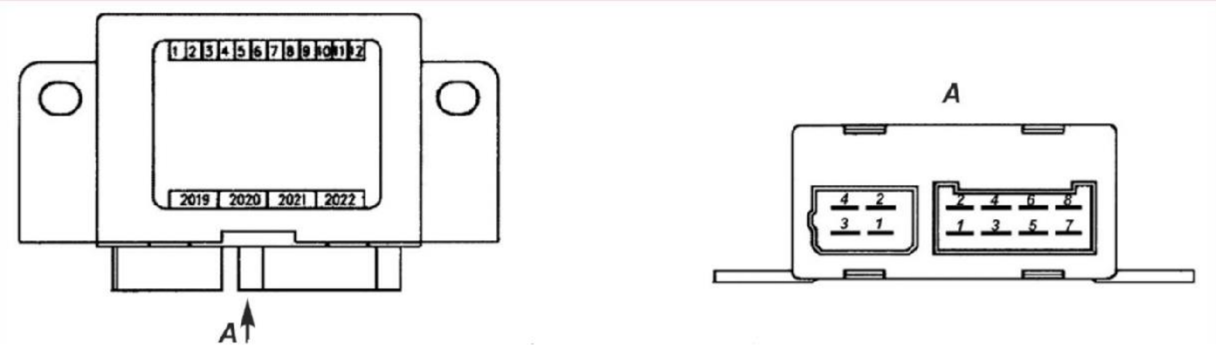
For a function operation description, see the “Specifications and controls” section.

7.2.8. Direction indicator breaker

The direction indicator breaker (Fig. 7.17) is installed on the dashboard stiffener near the steering column.

Breaker specifications

Input supply voltage, V… 9-18
Output voltage of warning lamps, V… ....(U pow.-0.2)
Maximum output current of warning lamps, A.....................................10
Maximum output current of indicator lights, mA 30



Connector	Pin	Circuit
X1	1	rear left side warning lamp
X1	2	right side on input
X1	3	front LED direction indicator and left side repeater light
X1	4	left side on input
X1	5	left side indicator light
X1	6	power plus
X1	7	weight
X1	8	output to understeering switch
X2	1	right side indicator light
X2	2	front LED direction indicator and right side repeater light
X2	3	rear right warning lamp
X2	4	none

Fig. 7.17. Direction indicator breaker electrical connectors and pin assignment

If the direction indicator bulbs fail, the frequency of interruptions does not change

The breaker is a non-repairable product.

If the warning lamps do not turn on, constantly on or do not turn on at the specified frequency, the breaker must be replaced.

7.2.9. Reversing light switch

The reverse light switch (Fig. 7.18) is used to automatically turn on the light when reversing. The switch is installed in the gearbox and is mechanically connected to the gear lever. When the lever is in the appropriate position, the switch connects the reversing light circuit to the power source.

During operation, periodically check the reliability of the switch fastening. Checking the operability of the switch removed from the vehicle can be done using an indicator light and a 12 V power source according to the diagram in Fig. 7.18. The light should light up when the ball moves to L=0.76-2.24 mm. Replace faulty switch. The voltage drop at the switch leads should be max. 0.12 V at a current of 5 A.

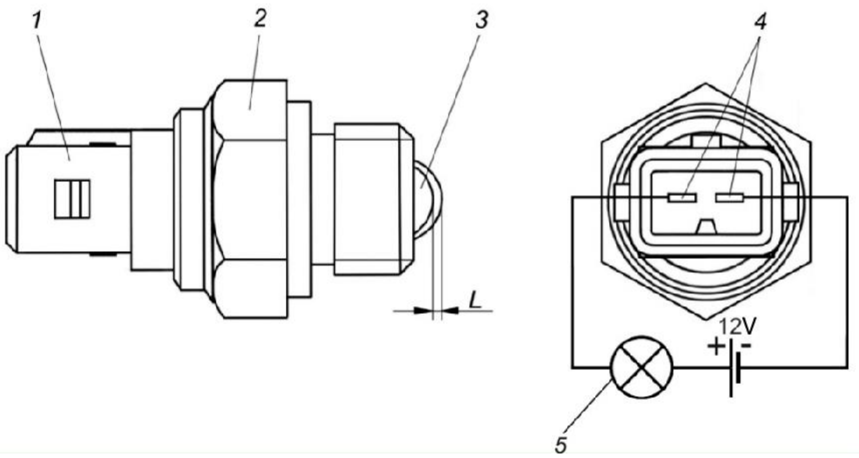


Fig. 7.18. Reversing light switch: 1 - sealed block; 2 - body; 3 - ball; 4 – leads; 5 – lamp

Possible malfunctions of lighting, light alarm and remedies

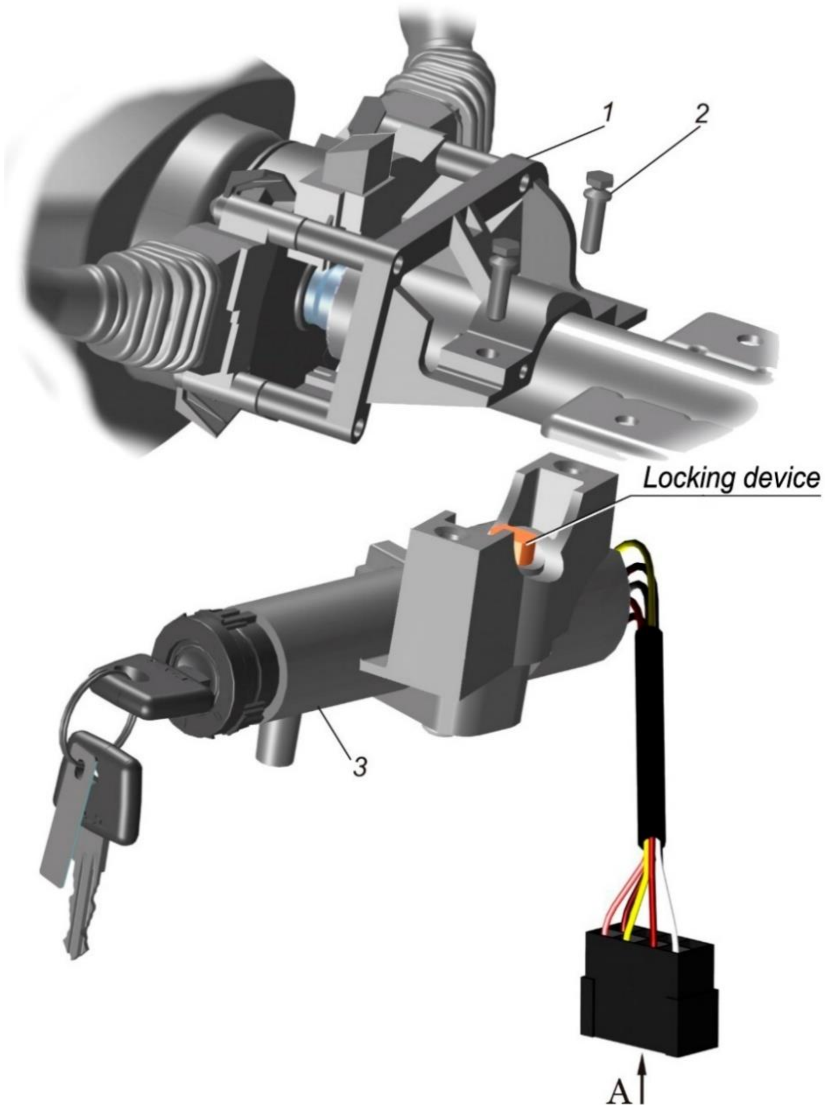
Malfunction cause	Remedy
Individual bulbs do not light up	
Filament burnout	Replace burnt out bulbs
Broken fuse	Eliminate the cause of the burnout and replace the fuse
Contact failure in lamp holder	Clean the oxidized contact, bend the holder spring contact
Contact failure in connecting blocks	Check the reliability of the connection in the blocks
Faulty power switch or switch	Using an indicator light, check the operability of the switch and, if necessary, replace it

Malfunction cause	Remedy
Brake light does not turn on	
Wires disconnected from the brake light switch	Connect the wires
Brake light switch does not work	Replace the switch
Incorrectly adjusted brake light switch position	Adjust switch position
Frequent burnout of bulb filaments	
Too high voltage regulation	Check voltage regulator for regulated voltage limits, replace voltage regulator if necessary (see engine maintenance and repair documentation)
Direction indicators not working *(in emergency brake light mode, all four lights work)*	
Blown fuse in direction indicator circuit	Inspect wiring, repair damage and replace the fuse
Direction indicators not working *(in emergency brake light mode, lamps also do not work)*	
Fuses blown	Inspect wiring, repair damage and replace the fuses
Contact failure in the plug block on the emergency brake light switch or breaker	Check the connection reliability of the plug blocks and wires. Connect the wires if necessary
Direction indicators are on without flashing	
Sintering of direction indicator breaker contacts	Replace the breaker

7.3. Switches

7.3.1. Instrument and starter switch (ignition switch)

The instrument and starter switch (Fig. 7.19) is installed on the steering column under the steering wheel. The instrument and starter switch has a locking device with a key and an anti-theft device (locking the steering column shaft). The instrument and starter switch key positions are shown in Fig. 7.20.



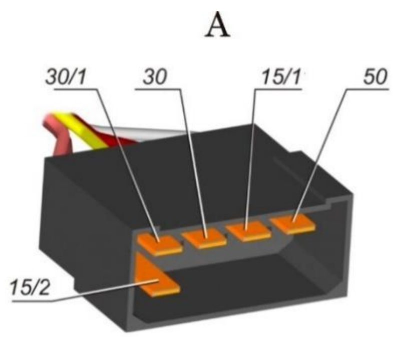


Table No. 1

Position	Contact wiring diagram				
III	30	15/2	50	30/1	15/1
O	30	15/2	50	30/1	15/1
I	30	15/2	50	30/1	15/1
II	30	15/2	50	30/1	15/1

Table No. 2

Contact details	Wire color
30	Yellow
15/2	Brown
15/1	Red
30/1	Pink
50	White

Fig. 7.19. Instrument and starter switch installation: 1 – steering column; 2 – bolt; 3 – instrument and starter switch

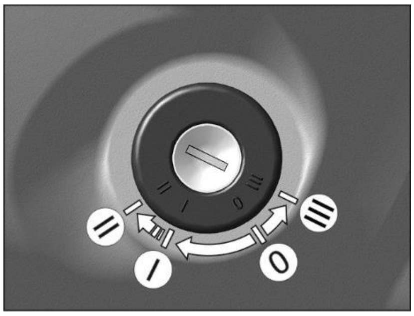


Fig. 7.20. Instrument and starter switch key positions: 0 – everything off, key cannot be removed, anti-theft device off; I – instruments on, key cannot be removed; II – instruments and starter on, key cannot be removed; III – instruments off, key removed, anti-theft device on

The key automatically returns from position II (Fig. 7.20) to position I. Repeat turning of the key to position II from position I is blocked. Reactivation of the starter circuit (position II) is only possible after the key has been returned to position 0.

To turn off the anti-theft device, insert the key into the instrument and starter switch and, while slightly shaking the steering wheel to the right and left, turn the key to position 0.

IT IS PROHIBITED TO
remove the key from the lock while the vehicle is moving, including when towing it, in order to avoid locking the steering shaft.

To check the instrument and starter switch serviceability, it is necessary to assemble the electrical circuit shown in Fig. 7.21.

When the key is turned to position I (instruments are on), lights A and B should be on, in position II (instruments and starter are on), lights A and B should be on. In positions 0 and III, the lights should be off. The voltage drop in the instrument and starter switch circuits must not exceed the values specified in Table 7.3.

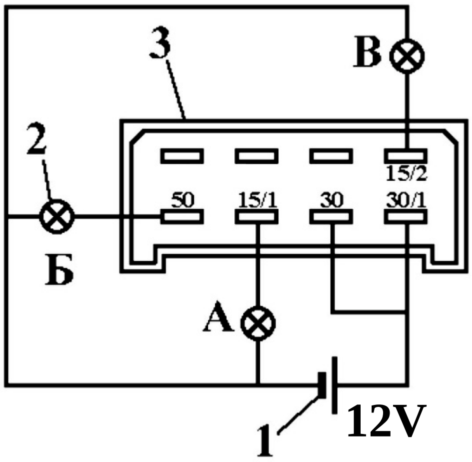


Fig. 7.21. Electrical circuit for checking instrument and starter switch: 1 - battery, 2 - indicator light, 3 - instrument and starter switch plug block

Table 7.3

Electrical circuit	Current, A	Voltage drop, mV, max.	
		for new vehicles	maximum permissible value
30-50	5.0	150	220
30-15/2	22.0	300	380
30/1-15/1	7.5	180	260

In the event of a malfunction, replace the instrument and starter switch with a new one.

When installing the instrument switch and starter on the steering column, tighten bolts 2 (see Fig. 7.19) until the heads break off.

7.3.2. Push-button switch

The push button switch is installed in the center of the dashboard. The switch serviceability can be checked using an indicator light and a power source according to the diagram in Fig. 7.22. Checking the health of the symbol backlight indicator light can be carried out using a power source by applying a voltage of 12 V to leads A (“-”), leads B and D (“+”) according to the diagram in Fig. 7.22. The voltage drop at the switch leads should be max. 0.3 V at a current of 8 A.

The switch is non-repairable product, and in case of failure, it should be replaced with a new one.

The switch mounting force is 30-70 N (3-7 kgf), the switch dismantling force is min. 60 N (6 kgf).

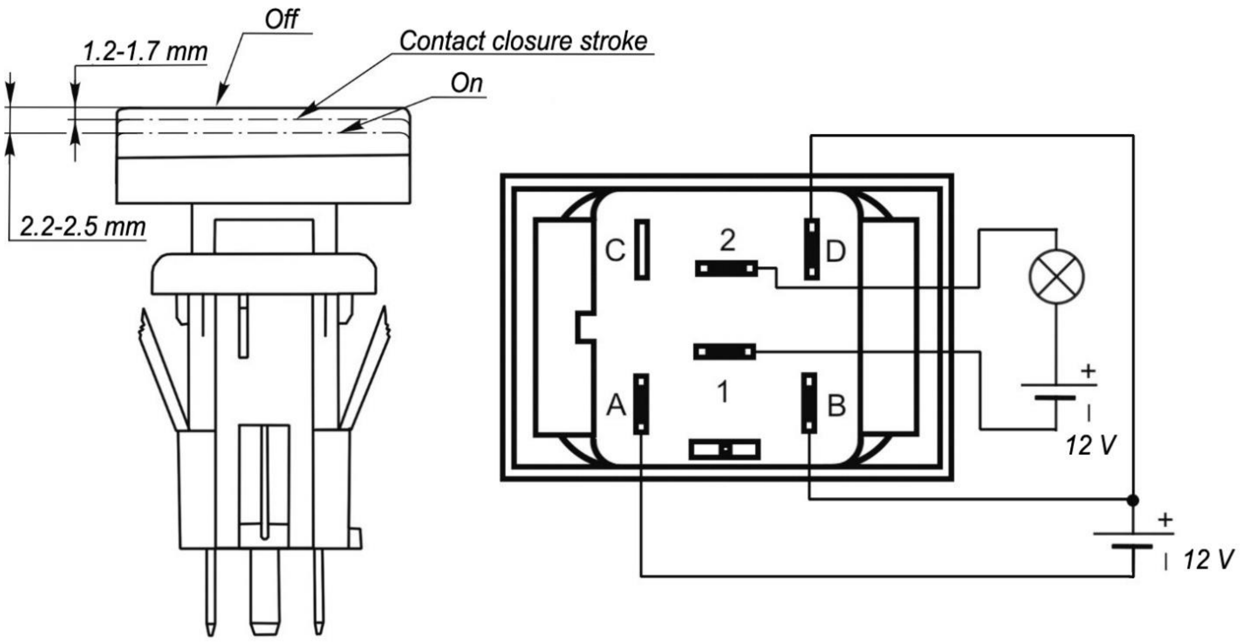


Fig. 7.22. Push-button switch

7.3.3. Clutch pedal position signal switch

The clutch pedal position signal switch is installed on the bracket to the right of the clutch pedal.

The clutch switch switches the on-board electric system voltage +12 V, as a sign of clutch engagement, to the control unit. The switch is designed for identification of the gear engagement/disengagement moment by the control unit in order to determine the mode of engine operation (idle, transmission engaged).

The switch serviceability can be checked using an indicator light according to the diagram in Fig. 7.23. When the switch rod protrudes to a distance of less than 14 mm, the indicator light should be on, and at a distance of more than 16.3 mm, the light should go out. The voltage drop at the switch leads should be max. 0.1 V at a current of 6 A. Replace faulty switch. When installing a new switch, adjust its setting (see “Clutch” subsection).

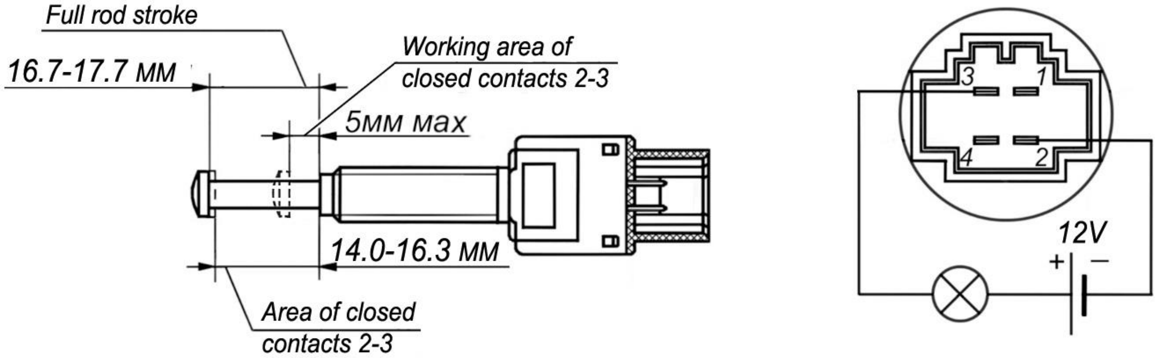


Fig. 7.23. Checking clutch pedal position signal switch

7.3.4. Brake light switch

The brake light switch is installed on a bracket to the right of the brake pedal.

The signal from the switch goes to the engine control unit, the body electronics unit and the parking brake unit.

The switch serviceability can be checked using an indicator light according to the diagram in Fig. 7.24. When the switch rod protrudes to a distance of 13.5-15 mm, the indicator light L1 should be on, the indicator light L2 should go out, and when the rod is pressed (protrusion 2.05-3.05 mm), the light L1 should go out, and the light L2 should be on. The voltage drop at the switch leads should be max. 0.1 V at a current of 6 A.

Replace faulty switch. When installing a new switch, adjust its installation on the bracket (see “Brakes” section). The brake lights should only turn on when the pedal free travel is selected.

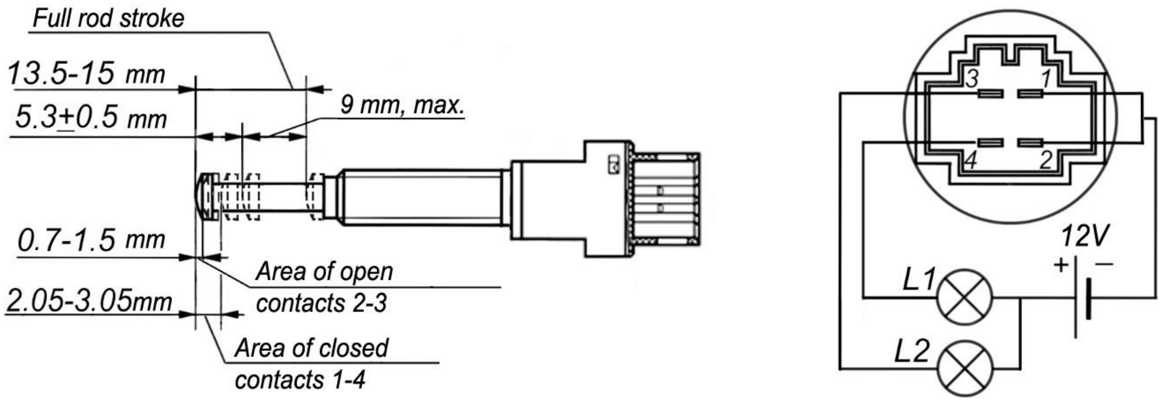


Fig. 7.24. Checking brake light switch

7.4. Power window regulator and rear-view mirror switches

On the left door of the vehicle cab, there is a unit (Fig. 7.25) of switches for controlling power window regulators and exterior rear-view mirrors[1)] or a unit of switches for controlling power window regulators, on the right door - a power window regulator control switch.

The power window regulator and exterior rear-view mirror control switch unit consists of two power window regulator control switches, a rear mirror electric drive control switch (joystick knob) and a front panel for mounting the switches and joystick. The fastening of switches and joystick in the front panel and the front panel in the door is provided with latches.

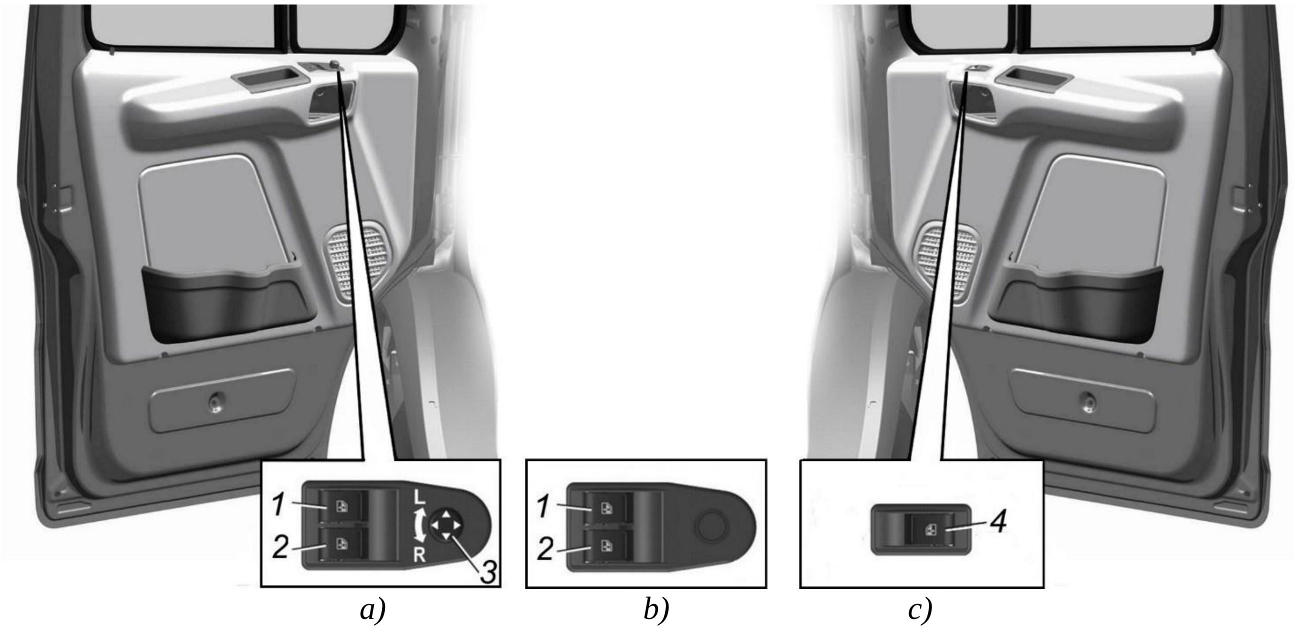


Fig. 7.25. Control switch unit for power window regulators and rear-view mirrors and control switch for right door power window regulator: a – control switch unit for power window regulators and rear-view mirrors; b – power window regulator control switch unit; c – right door power window regulator control switch; 1 – left door power window regulator control key; 2, 4 – right door power window regulator control keys; 3 – rear-view mirror control joystick [1)]

Pressing the power window regulator control key down lowers the window, pressing it up raises the window.

To adjust the electrically driven exterior mirrors with the instruments and starter (ignition) turned on, it is necessary to select the right R mirror or left L mirror by turning handle 3 of the control joystick.

[1)] - For vehicles equipped with electric rear-view mirrors

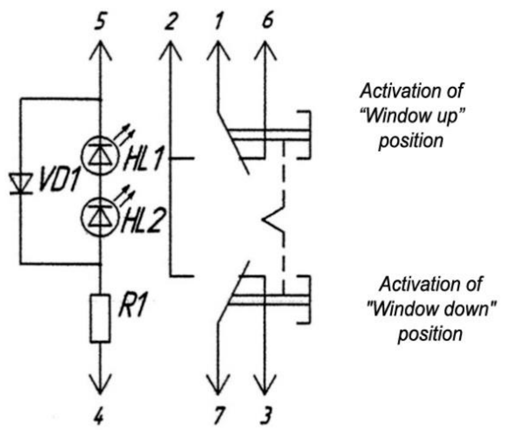
Mirrors are adjusted by pressing the joystick right, left, forward, backward. Move the handle to the right or left to adjust it horizontally and forward or backward to adjust it vertically.

The power window regulator and exterior rear-view mirror control switches must ensure clear switching and fixation of the keys (joystick handle) in the middle position. Jamming of switch keys and joystick knob is not allowed.

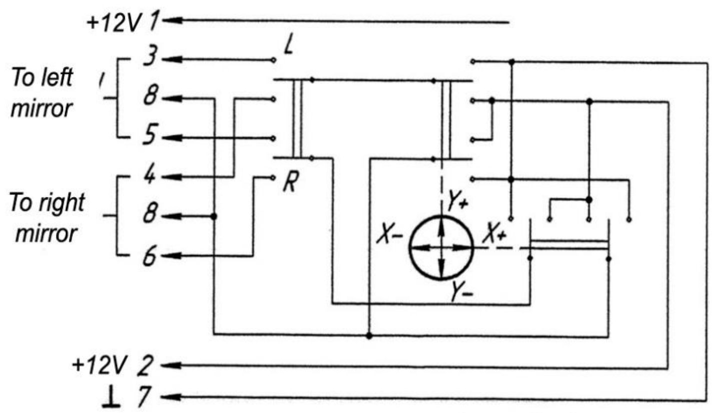
Wiring diagrams of control switches for power window regulators and rear-view mirrors are shown in Fig. 7.26.

The power window regulator and rear-view mirror control switch units and the right door power window regulator control switch are maintenance-free and non-repairable products; in case of failure, they should be replaced with new ones.

Power window regulator switch unit wiring diagram



Rear-view mirror control switch wiring diagram



Right door power window regulator switch wiring diagram

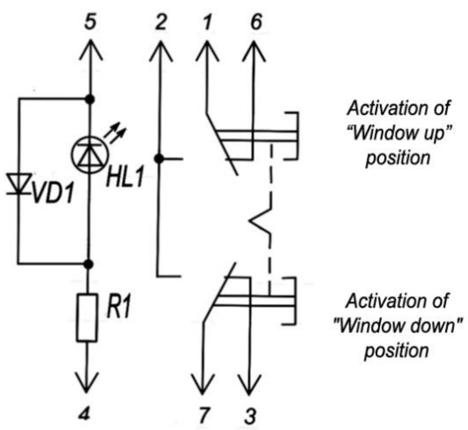
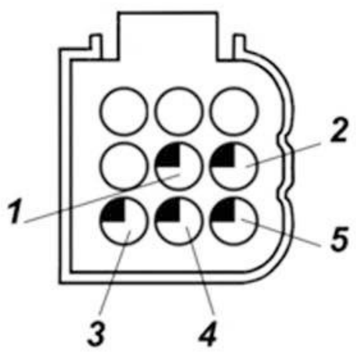


Fig. 7.26. Wiring diagrams of control switch unit for power window regulators and rear-view mirrors and power window regulator control switch

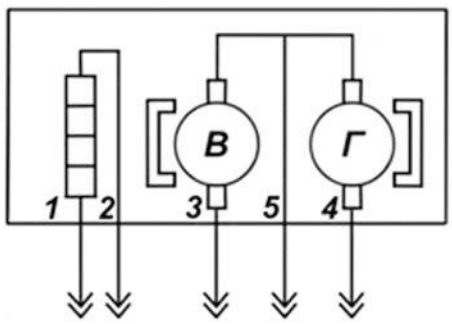
7.5. Exterior rear-view mirror with electromechanical drive

The design of exterior rear-view mirror with electromechanical drive is described in the “Cab” section.

To check the movement of the rear-view mirror optical elements, apply a voltage of 12 V to the pin block leads in accordance with the diagram of movement of the mirror optical elements (Fig. 7.27).



Schematic electrical diagram



Mirror element rotation diagram

	Drive pin numbers			
	1 red	*2* sky blue	*3* green	*4* red
↑			–	+
↓			+	–
←	+	–		
→	–	+		

Pins	Wire color
1	Black
2	Brown
3	Green
4	Sky blue
5	Red

Fig. 7.27. Wiring diagram and wire connector of exterior rear-view mirror: V - vertical movement of optical element, H - horizontal movement of optical element

To check the rear-view mirror heating elements, apply a voltage of 12 V to pin block leads 1 and 2 in accordance with the wiring diagram (Fig. 7.27).

7.6. Horns

The vehicle is equipped with a set of two horns: low and high tone.

The horns are installed on the radiator frame base (frontend), the tightening torque of the bolt securing the horn bracket to the frontend is 5.5-8.0 N·m (0.55-0.80 kgf·m).

The horns are activated by the horn switch located in the center of the steering wheel.

The horns are designed for short-term operation, therefore it is necessary to avoid turning on the horns for a long time. If the horns sound weak, adjust the tone and intensity of the sound with a screw (Fig. 7.28).

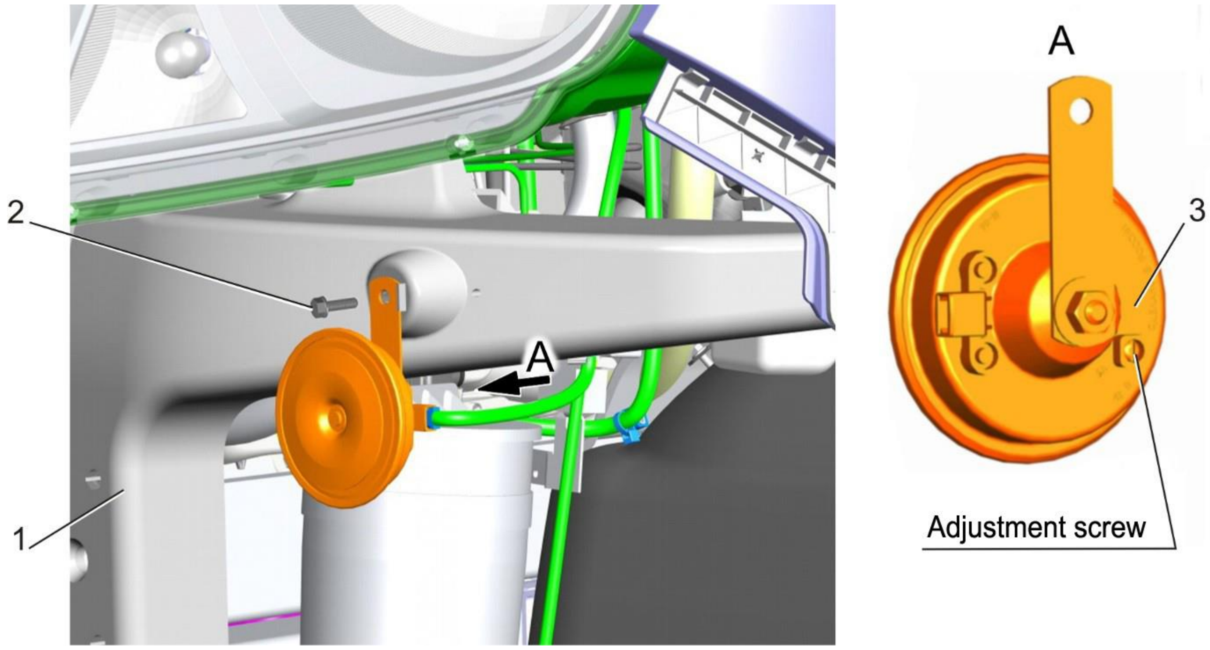


Fig. 7.28. Horn installation: 1 – frontend; 2 – bolt; 3 – horn

Checking the operability of the horn in the vehicle shall be carried out by ear when the horn is turned on.

The horn failures are considered to be a decrease in the purity of sound and sound level, destruction from shaking during vehicle operation, and loss of tightness.

The horn is a maintenance-free and non-repairable product; in case of failure, the signal should be replaced with a new one.

Horn technical specifications

Rated voltage, V…..12
Acoustic pressure level at voltage of 11.9-12.1 V, dB 105-118
Current consumption, A, max. 5

7.7. Windshield wiper and washer

7.7.1. Wiper

To clean the windshield and provide the driver with good visibility, the vehicle is equipped with an electric wiper with two arms with blades. The wiper drive 12 (Fig. 7.29) is located under the hood.

When the wiper is turned off, the wiper blades automatically fold along the border of the windshield ceramic strip.

The windshield wiper is a maintenance-free product.

To obtain a good cleaning of the windshield, it is necessary to constantly monitor the glass surface condition, avoiding oil stains on it that interfere with the moisture removal. The rubber band of the blades must be protected from oil and gasoline.

ATTENTION
To avoid damage to the paintwork of the hood, do not operate the wiper with the hood open.

If there is dry dust and dirt on the glass, do not turn on the wiper, as this will cause scratches and rubbing on the glass, as well as damage the rubber band of the blades.

If it is necessary to remove the wiper blades, it is recommended to put pieces of a rubber tube on the arm ends.

The rubber band of the blade must be elastic, straight, without flaws along the entire length of the edge adjacent to the glass. Under these conditions, the blade should wipe off the heavily dampened glass in no more than three double strokes at low speed. The blades should be cleaned with warm water and a few drops of dishwashing liquid. If after cleaning the blades leave marks on the glass, replace the blades with new ones.

The blade replacement must be carried out as follows:

- move the wiper arm away from the windshield and hold the blade at a right angle to the arm;
- press the plastic clamp ends, according to the arrows shown in Fig. 7.30, a;

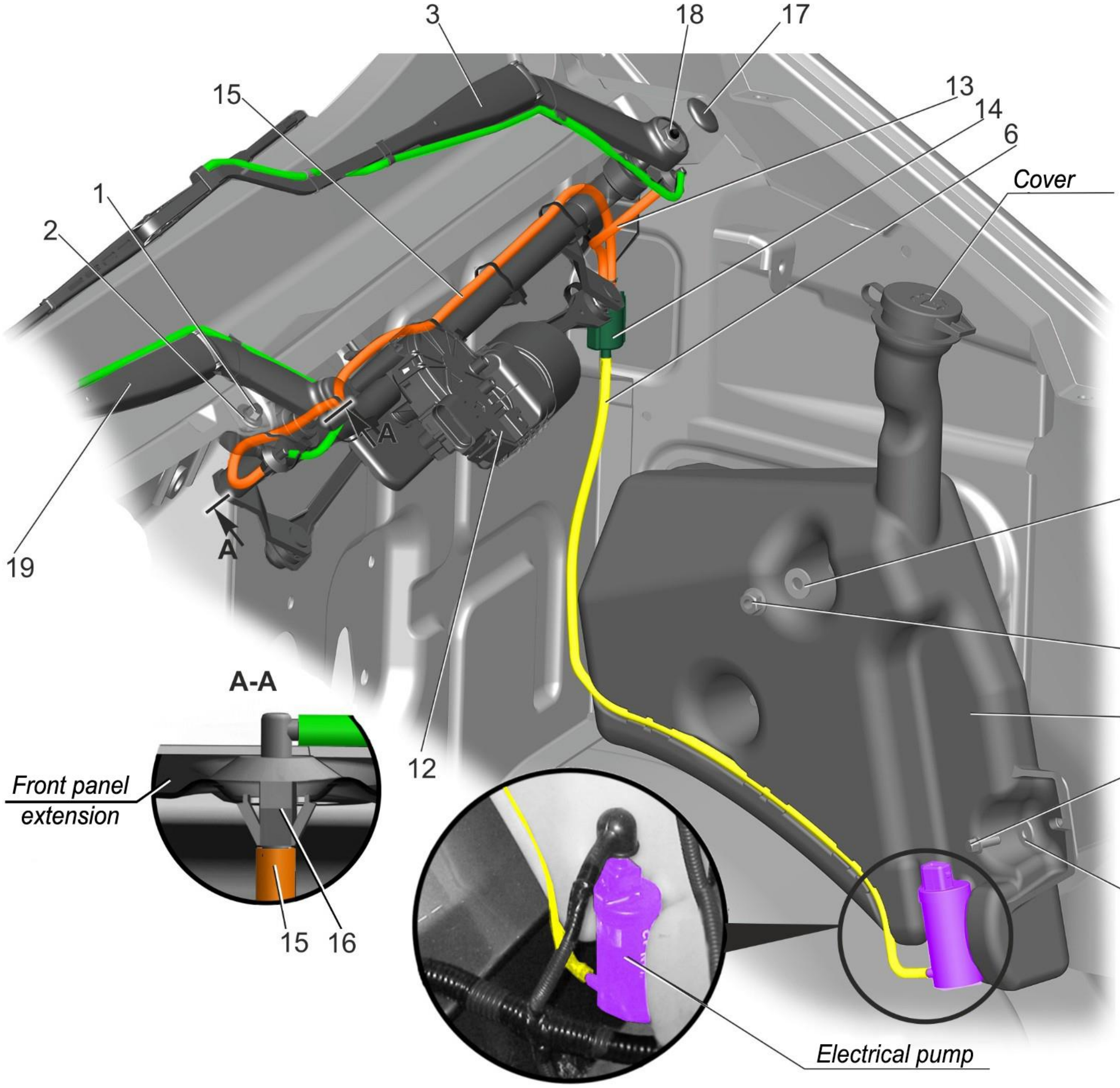


Fig. 7.29. Windscreen wiper and washer installation: 1, 10 – bolts; 2, 8, 11 – washers; 3, 19 – arms with blades; 6, 13, 15 – tubes; 7, 18 – nuts; 9 – washer; 12 – wiper drive; 14 – tee with valve; 16 – adapter; 17 – cap

.

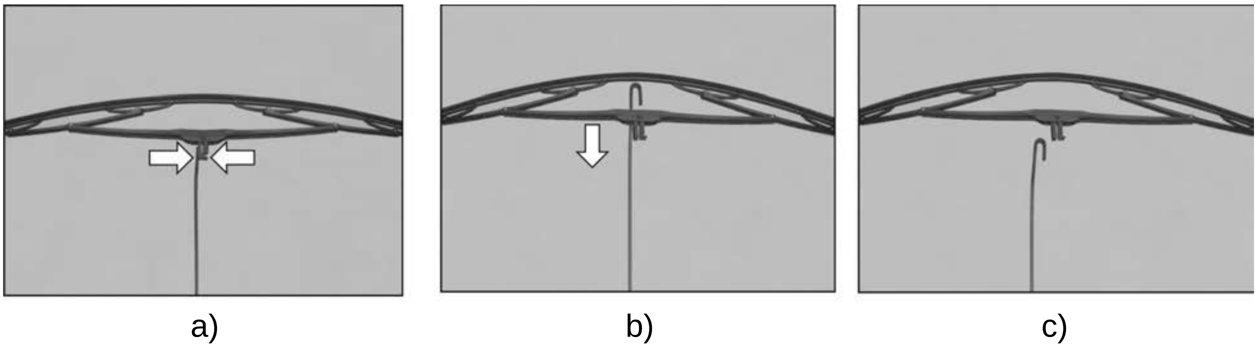


Fig. 7.30. Wiper blade replacement

- slide the blade along the arm in the arrow direction (Fig. 7.30, b) and remove the blade (Fig. 7.30, c);

- install the new blade in the reverse order of its removal, making sure it is correctly attached to the wiper arm.

The blade arm replacement must be carried out as follows:

- remove the caps from the blade arms;
- unscrew the nuts securing the arms to the drive shafts and remove the blade arms from the shafts;
- turn on the wiper and turn it off after 1-2 minutes of operation;
- install arms with blades on the drive shaft. The blades should be located along the upper border of the ceramic strip applied on the inside of the windshield. Tighten the nuts securing the blade arms to the axles to a torque of 10.78-15.69 N·m (1.1-1.6 kgf·m). Insert adapters 16 (see Fig. 7.29) and caps 17 into the holes and fix by pressing;
- turn on the wiper. During operation, the blades should not touch the lining. If the blades hit the lining or stop too high after switching off, the setting of the arms on the axle must be slightly adjusted.

The wiper wiring diagram is shown in Fig. 7.31.

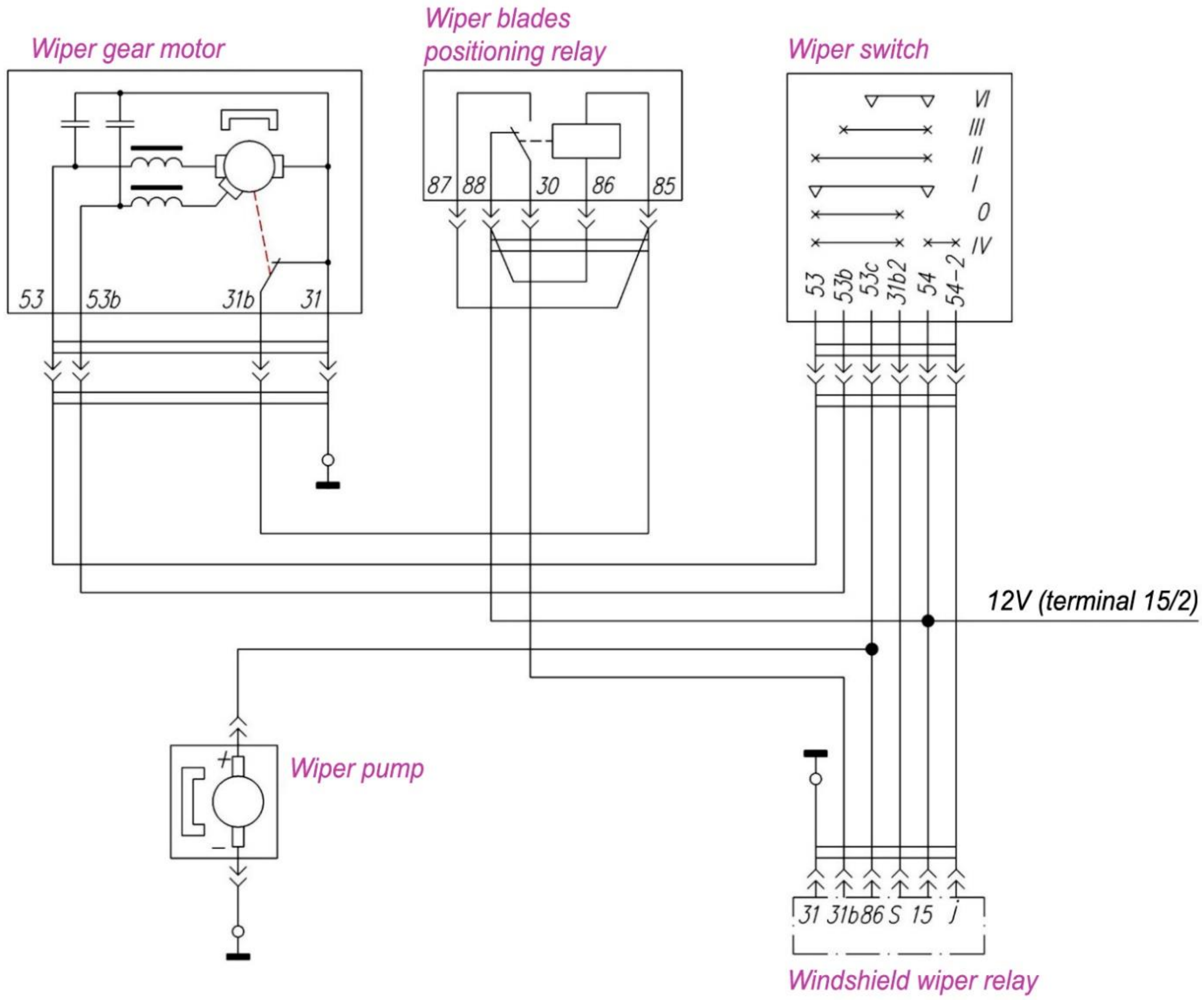


Fig. 7.31. Wiper wiring diagram

If the wiper fails, it is necessary to determine what is faulty - the wiper or the switch. To do this, disconnect the plug block from the switch (it is located under the dashboard) and connect the block plug ends (which remained on the wiring harness going to the wiper), as shown in Fig. 7.32, A - for low speed and in Fig. 7.32, B - for high speed.

If the wiper starts to work, then the switch is faulty, and if not, the wiper is faulty.

To check the serviceability of the wiper removed from the vehicle, it is necessary to connect the wiper plug block according to the diagram shown in Fig. 7.33 (light 1 will flash).

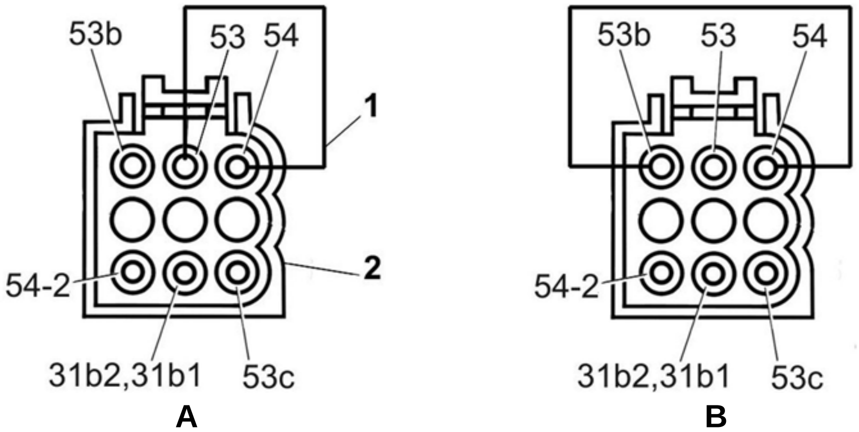


Fig. 7.32. Electrical circuit for checking vehicle wiper: A - low speed; B - high speed; 1 - additional jumper; 2 - wiring harness plug connector to wiper switch

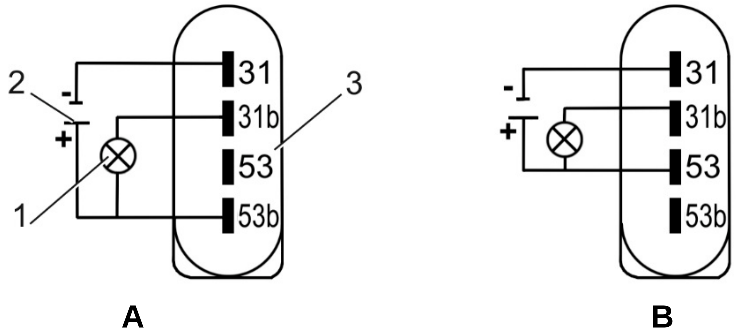


Fig. 7.33. Electrical circuit for checking vehicle wiper removed from vehicle: A – high speed operation; B – low speed operation; 1 – indicator light; 2 – battery; 3 – wiper connecting block

If the wiper operates at low and high speeds, but does not operate in intermittent mode, check serviceability of the switch, the intermittent wiper relay and the wiper blades positioning relay. In case of failure, they should be replaced with new ones: switch, wiper drive, arms and blades, intermittent relay and blades positioning relay.

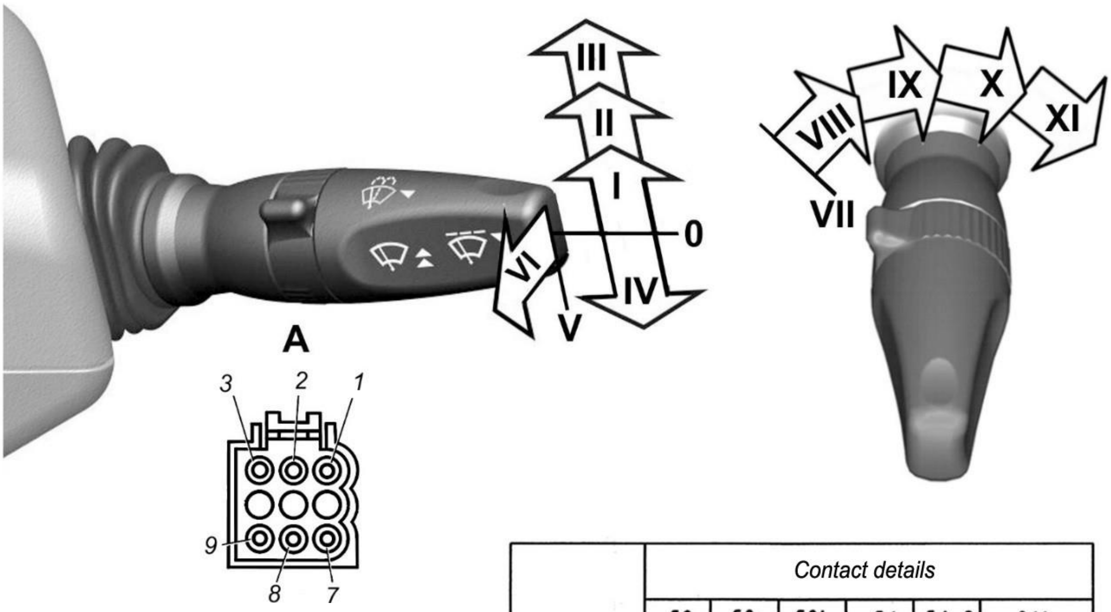
When installing the wiper drive, tighten the mounting bolts to a torque of 5.39-7.85 N·m (0.55-0.80 kgf·m).

7.7.2. Wiper switch with pause control

The wiper and washer control is combined, and is carried out by a switch (Fig. 7.34), located on the right under the steering wheel.

The switch, in addition to two constant wiper speeds, includes an intermittent operation mode with an increase in the pause between double strokes.

Moving the switching lever, switching the regulator from one position to another must be clear without jamming, with reliable fixation in the provided positions and switching of electrical circuits in accordance with Fig. 7.34.



Number on body	Wire number	
54	1	yellow
53	2	sky blue
53b	3	violet
53c	7	orange
31b	8	white
54-2	9	brown

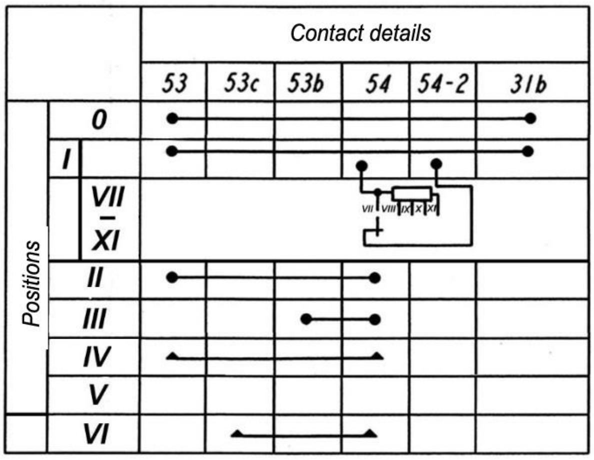


Fig. 7.34. Connection diagram of wiper switch pins at various handle positions: A – location of plugs in connecting block;
0 - off; I and VII-XI - intermittent wiper operation on with increase in pause between double strokes to maximum; II - first wiper speed on; III - second wiper speed on; IV - first wiper speed on (self-return to pos. 0, non-fixed position); V - washer off; VI - joint operation of wiper and washer off (self-return to pos. V, non-fixed position)

The voltage drop at the output contacts of a new switch (with wires) at a current of 0.9-1.1 A should not exceed 0.04 V, for a used switch – max. 0.06 mm. The voltage drop between pins 54 and 54-2 (see Fig. 7.35) in position IV-VII of the new switch at a current of 0.9-1.1 A should not exceed 0.04 V, for a used one – max. 0.06 mm

The force for switching lever from one fixed position to another should be 3-7 N (0.3-0.7 kgf). The washer activation force (non-fixed) should be 1.5-3.0 N (0.15-0.3 kgf).

If the wiper switch is faulty, replace it with a new one from the installed set, or install a different switch set. (see “Light alarm switch” subsection).

Possible malfunctions of wiper and remedies

Malfunction cause	Remedy
Wiper does not work when turned on	
No contact in connecting blocks Switch does not work Faulty gear motor Blown fuse due to jamming of the drive levers, faulty gear motor	Check connections and troubleshoot Check the switch and replace if necessary Replace the wiper drive Find the cause of the malfunction, eliminate it and replace the fuse or wiper motor
Blades hit the cab parts during operation	
Blade arms set incorrectly	Change the setting of the blade arms
Incorrect position of the blades after turning off the wiper	
Arms set incorrectly	Set the blade arms
Wiper only runs at one speed	
Faulty gear motor or switch	Check and, if necessary, replace the wiper drive or switch
Wiper does not work in intermittent mode	
Faulty switch (if wiper does not turn on) Faulty gear motor, intermittent relay or blades positioning relay (if wiper works without pause)	Check and, if necessary, replace the switch Check and, if necessary, replace the faulty product
No wiper blades positioning	
Faulty gear motor, intermittent relay or blades positioning relay	Check and, if necessary, replace the faulty product
Wiper does not work in washer mode	
Faulty intermittent relay	Check and, if necessary, replace the relay

7.7.3. Windshield washer

The washer consists of a tank with electric pump installed in it, jets and hoses (see Fig. 7.29).

Washer specifications

Rated voltage, V 12

Pressure developed by washer pump at supply voltage of 13.4-13.6 V and closed outlet fitting, MPa (kg/cm^2), min., 0.14-0.16 (1.4-1.6)
current consumption, A, max. 3.5

At a positive ambient temperature, clean drinking water is used as a fluid, at a negative ambient temperature, special fluids for vehicle washers are used.

Possible malfunctions of windshield washer and remedies

Malfunction cause	Remedy
Fluid does not flow to windshield	
Clogged jet	Rinse the jets, blow them out with compressed air or replace the jets. Rinse the washer tank and fill it with clean fluid
Hose sealing failure	Replace hoses or cut and remove damaged ends
Damage to the sealing bushing connecting the electric pump and the tank	Replace the sealing bushing
Tank sealing failure	Replace the washer assembly
Incorrect wiring connection	Troubleshoot wiring connection. The “–” lead must be connected to the vehicle body
Faulty electric pump	Replace the electric pump
Faulty switch	Check and, if necessary, replace the switch

Windshield washer jets

If the pressure of the water jet (windshield washer fluid) is insufficient, first check for the presence of washer fluid in the washer fluid tank. Clogged washer jet holes (nozzles) can also cause insufficient water jet pressure, if necessary, clean the jet holes or replace the jets.

The coolant jet direction is shown in Fig. 7.35.

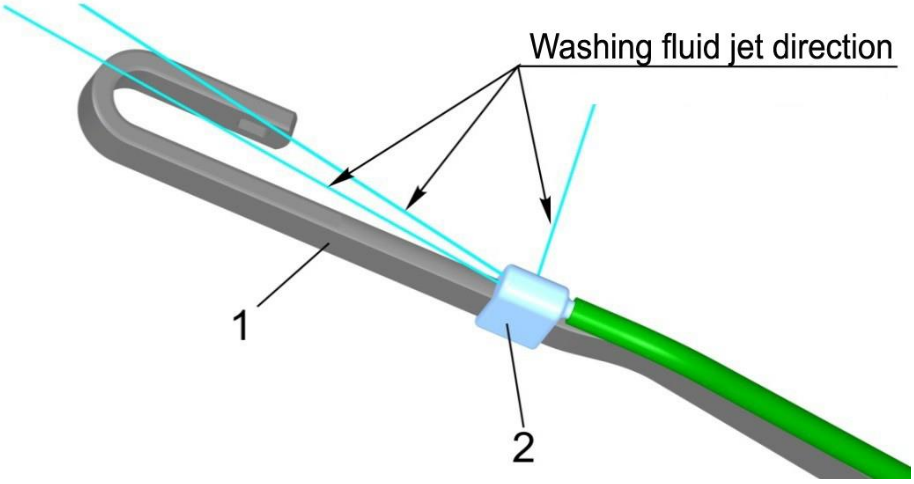


Fig. 7.35. Coolant jet direction: 1 – wiper arm; 2 – jet (nozzle)

Intermittent wiper relay and wiper blades positioning relay

An electronic relay is used to create intermittent operation of the wiper, positioning the blades when the wiper is turned off, turning on the wiper in the washer mode.

The relay serviceability can only be checked when working with a wiper.

Together with the intermittent relay, a wiper blades positioning relay with interference suppression diodes is used. In case of malfunction, replace this relay with a new one.

7.8. Auxiliary heater switch

The heater switch is installed on the dashboard and is designed to switch the electric circuits for controlling the heater fan (Fig. 7.36).

Fig. 7.36. Auxiliary heater switch installation

The switch (Fig. 7.37) has five fixed positions (the vehicle has four positions, in the fifth position the heater continues to operate at the third (maximum) speed). Switching from one position to another and fixing the handle in all positions must be clear – without play, jamming and intermediate (false) positions. The switch design must ensure reliable electrical contact with the electrical circuit.

The force applied when installing the switch in the dashboard mounting hole must be max. 50 N. The switch fixation in the mounting hole must be clear – the switch must be immovable in the mounting hole, both in the axial and transverse directions.

The switching torque is 7-13 N·cm (0.7-1.3 kgf·cm), the torque of switch knob turning beyond the extreme positions is min. 100 N·cm (10 kgf·m).

The voltage drop across the contacts of a new switch must be max. 10 mV/A; for a used one, max. 20 mV/A.

The switch is non-repairable and maintenance-free product, in case of failure, replace it with a new one.

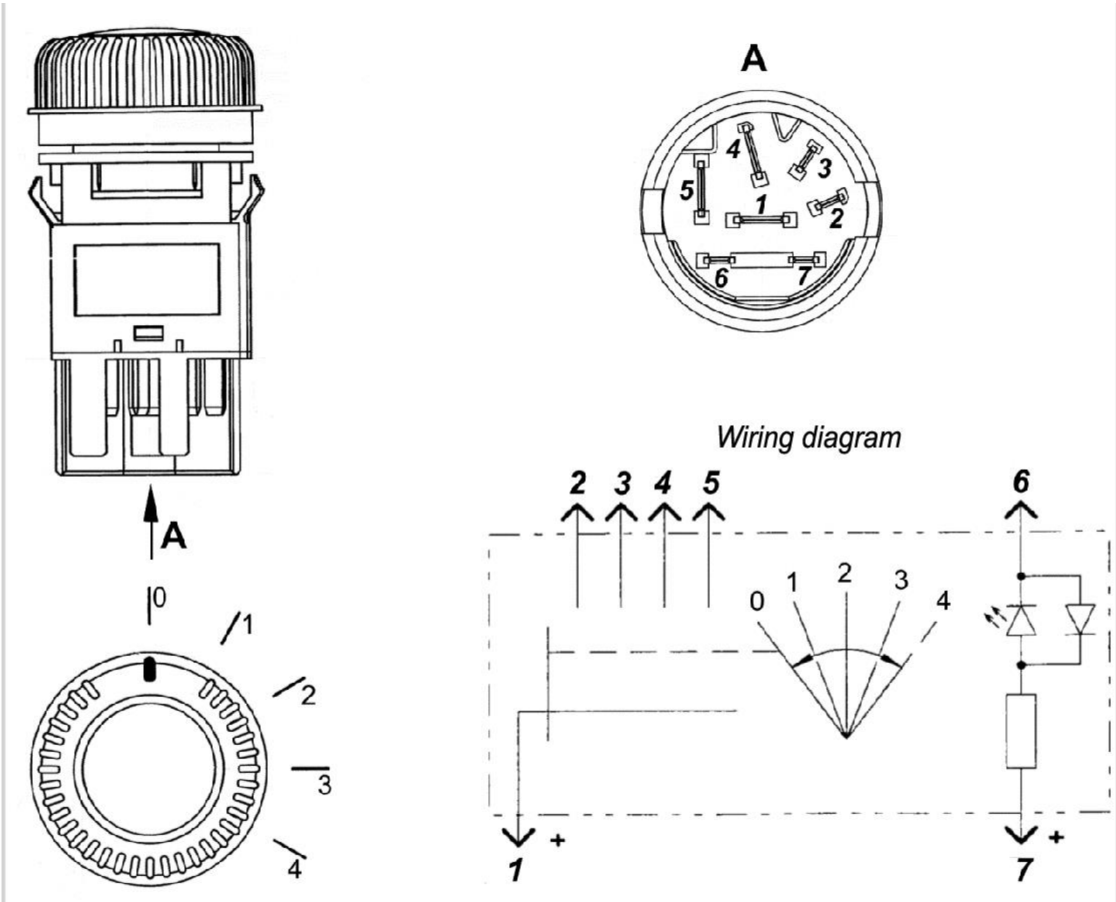


Fig. 7.37. Auxiliary heater switch

7.9. Door lock system control unit

The door lock system control unit (Fig. 7.38) is installed on the dashboard stiffener near the steering column, is designed for simultaneous (central) locking or unlocking of the vehicle doors and delays and smoothly extinguishes the cab dome light. The control unit has a function to protect the lock motors from overheating caused by excessively frequent locking/unlocking of the doors. In this case, the central lock stops working for a few minutes, after which its function is fully restored. The electrical circuits for connecting the units are shown in Fig. 7.39 and 7.40.

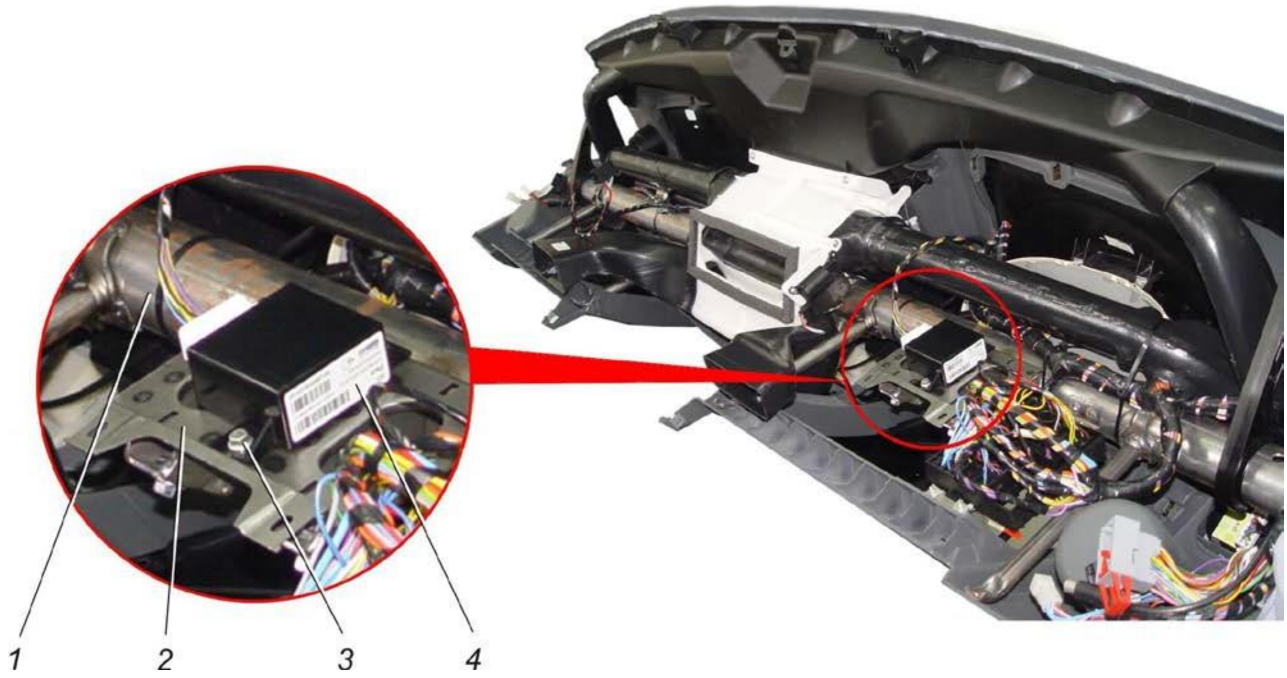


Fig. 7.38. Door lock system control unit installation: 1 – dashboard base; 2 – rear steering bracket stiffener; 3 – screw, 4 – door lock system control unit

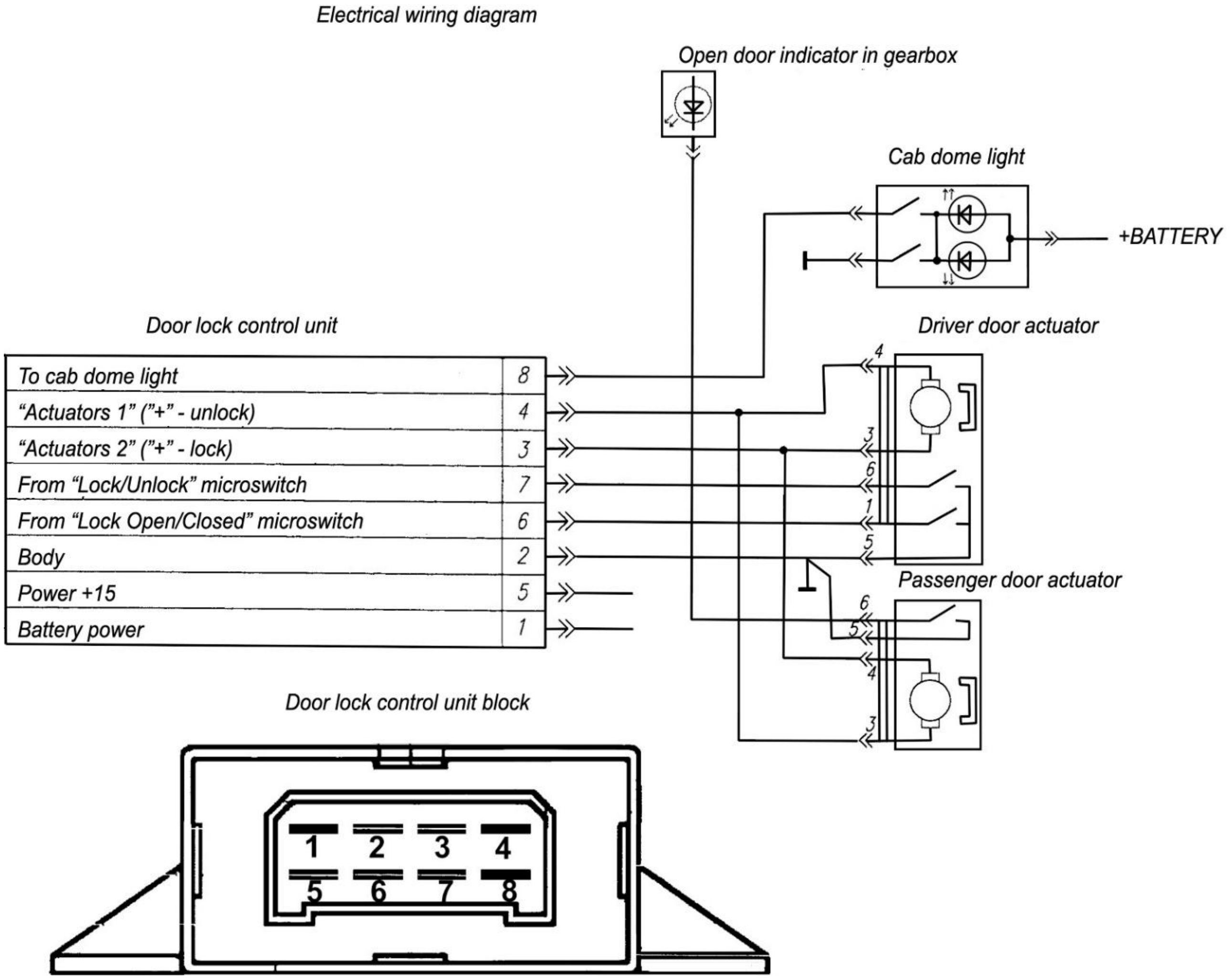
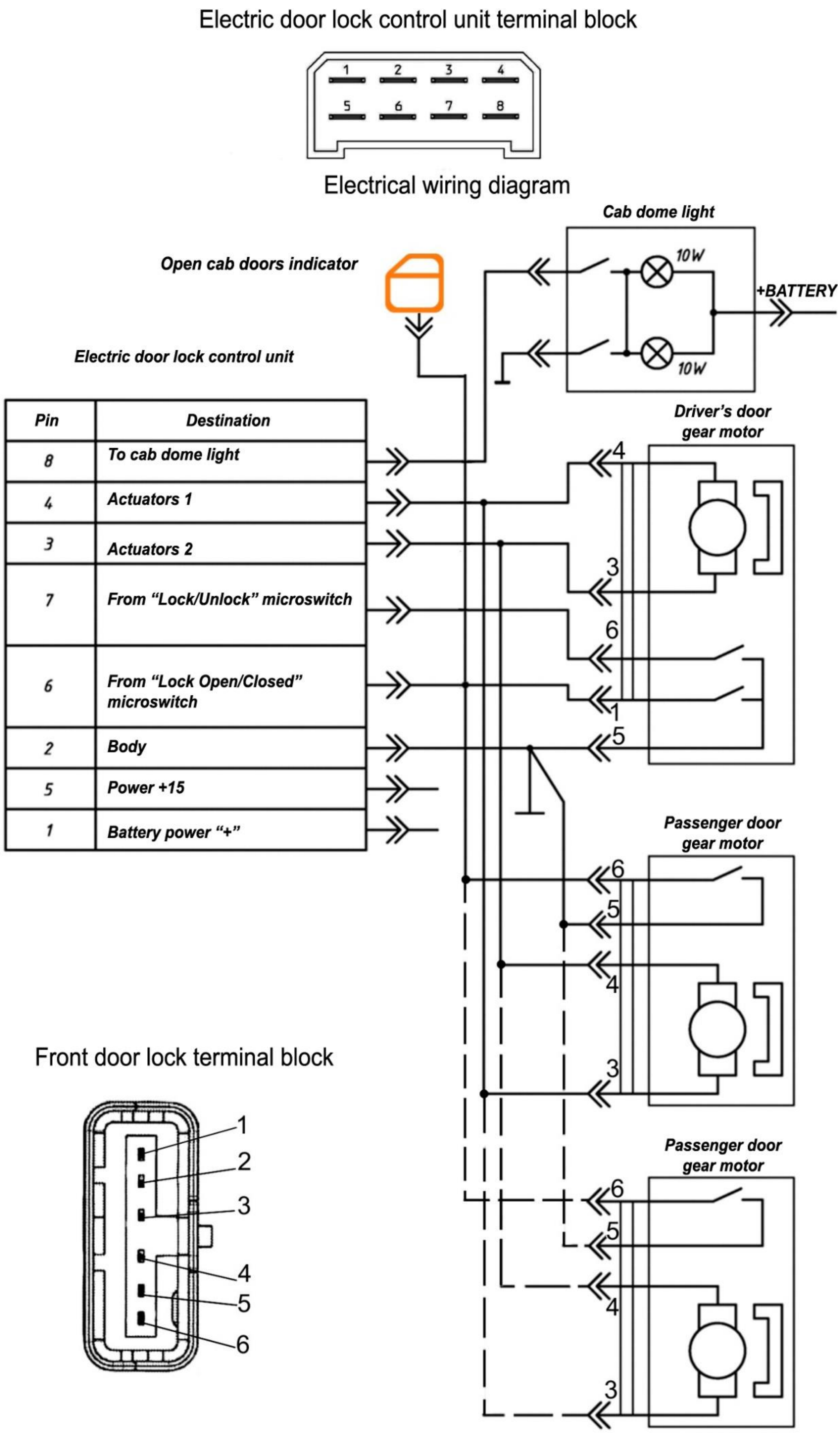


Fig. 7.39. Electrical wiring diagram for door lock system control unit



Pin	Destination
8	To cab dome light
4	Actuators 1
3	Actuators 2
7	From "Lock/Unlock" microswitch
6	From "Lock Open/Closed" microswitch
2	Body
5	Power +15
1	Battery power "+"

Fig. 7.40. Electrical wiring diagram for door lock system control unit

Specifications of door lock system control unit A21R23.3867100

Rated voltage, V 12

Operating voltage, V 9.0-15.5

Current consumption at rest, mA, max. 6

Actuator voltage supply time, ms...350-450

The door lock system control unit is a maintenance-free and non-repairable product, and if it fails, replace it with a new one. Tighten the screws 3 (Fig. 7.38) securing the control unit to the rear steering bracket stiffener until it stops.

7.10. Multifunctional current transfer device

The multifunctional current transfer device (MCTD) is used to transmit electrical circuit signals from the horn switch and car stereo control buttons mounted on the movable steering wheel to the fixed steering column and vehicle wiring harness.

The MCTD (Fig. 7.41) is installed on the steering column and is attached to the base of the switches with screws.

Specifications

The electrical resistance to direct current for any device circuit is 0.2-0.8 Ohm.

The rotation of the moving part from the middle (central) position must be at least 2.5 turns to the left and right.

The tightening torque of the mounting screws is 1.0-1.1 N·m (0.10-0.11 kgf·m).

The MCTD is a maintenance-free and non-repairable product, and in case of failure it must be replaced with a new one.

When removing and installing a multifunctional current transfer device, it is not allowed to turn the contact device cover against the body (marks B and C must be aligned, the cover must be fixed against the body). Angular deviation of max. +5° between marks C and D is allowed.

If necessary, install the cover in the middle position against the MCTD body, aligning the marks B and C, and fix it (the cover rotation from the middle position must be at least 2.5 turns to the left and right).

When installing a new MCTD, remove the latch or adhesive tape immediately before installing the steering wheel.

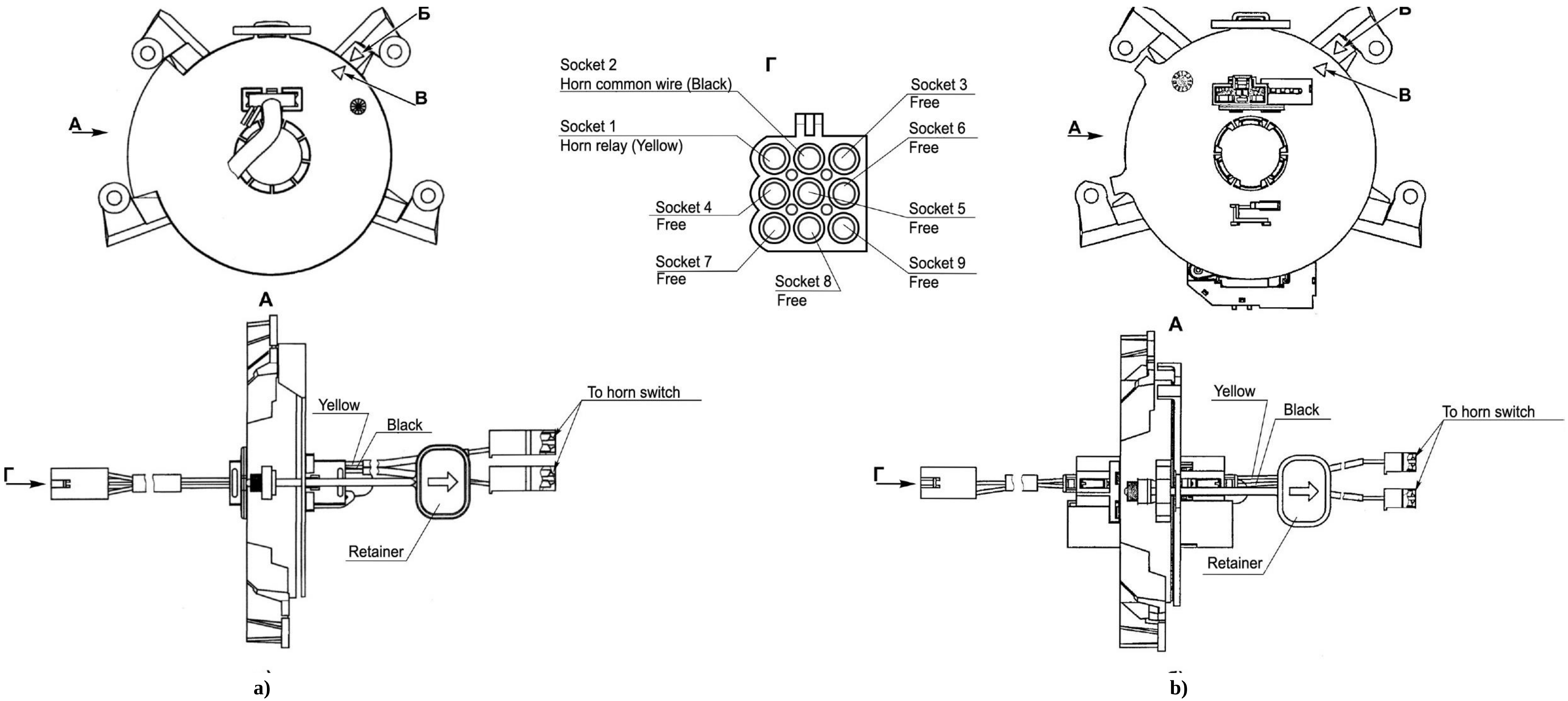


Fig. 7.41. Multifunctional current transfer device

a, b - design options

7.11. Instruments and their sensors

7.11.1. Instrument cluster

To monitor the systems, the vehicle is equipped with an electronic instrument cluster (Fig. 7.42), in which control devices are installed: a tachometer, a speedometer, an engine temperature gauge, a fuel gauge, indicators and a trip computer multifunction display.

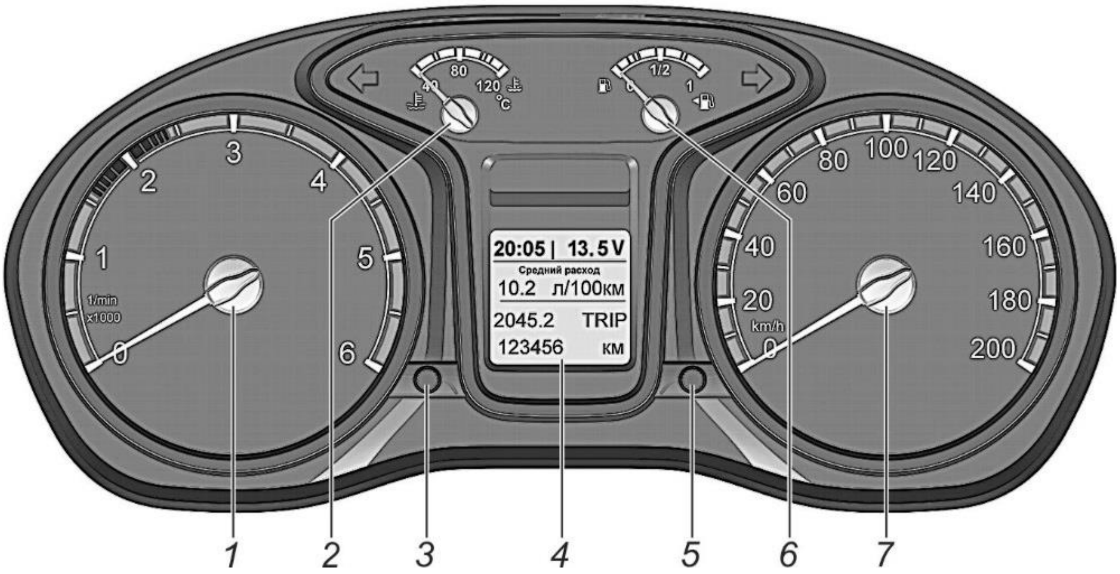


Fig. 7.42. Instrument cluster: 1 – tachometer; 2 – engine coolant temperature gauge; 3 – “Mode”/trip computer control button; 4 – trip computer multifunction display; 5 – button for zeroing daily mileage readings/setting hours and minutes; 6 – fuel gauge; 7 – speedometer

To test the operation of pointer instruments and alarm indicators, use the “self-test” mode of the instrument cluster and refer to the supplier’s documentation. The instrument cluster is a maintenance-free and non-repairable product. In case of failure, replace the instrument cluster with a new one.

The **instrument cluster removal** must be carried out as follows:

- remove the fuse box cover and lower the steering column to the lower position;
- remove the plug on the mini-timer [1)] of the preheater-heater, unscrew the fixing screw, disconnect the electrical connector and remove the mini-timer with the gasket;
- remove the instrument cluster trim;
- unscrew the four screws securing the instrument cluster; disconnect the electrical connector and remove the instrument cluster.

[1)] - For vehicles equipped with preheater-heater

Install the instrument cluster in the reverse order to removal, taking into account the following:

- tighten the screws securing the instrument cluster must be carried out starting from the upper attachment points;

- tightening torque of the screw securing the mini-timer [1)]of the preheater-heater is 0.4-0.8 N·m (0.04-0.08 kgf·m).

7.11.2. Sensors

Sensors installed on the engine or supplied with the engine - see the maintenance and repair documentation for the F 2.8L engine.

7.11.2.1. Coolant level gauge

The coolant level sensor (Fig. 7.43) is located in the expansion tank below the MIN mark and is designed to inform the driver (the corresponding indicator lights up in the instrument cluster) about the leakage of coolant from the engine cooling system. The sensor does not relieve the driver of the need to regularly check the coolant level.

[1)] - For vehicles equipped with preheater-heater

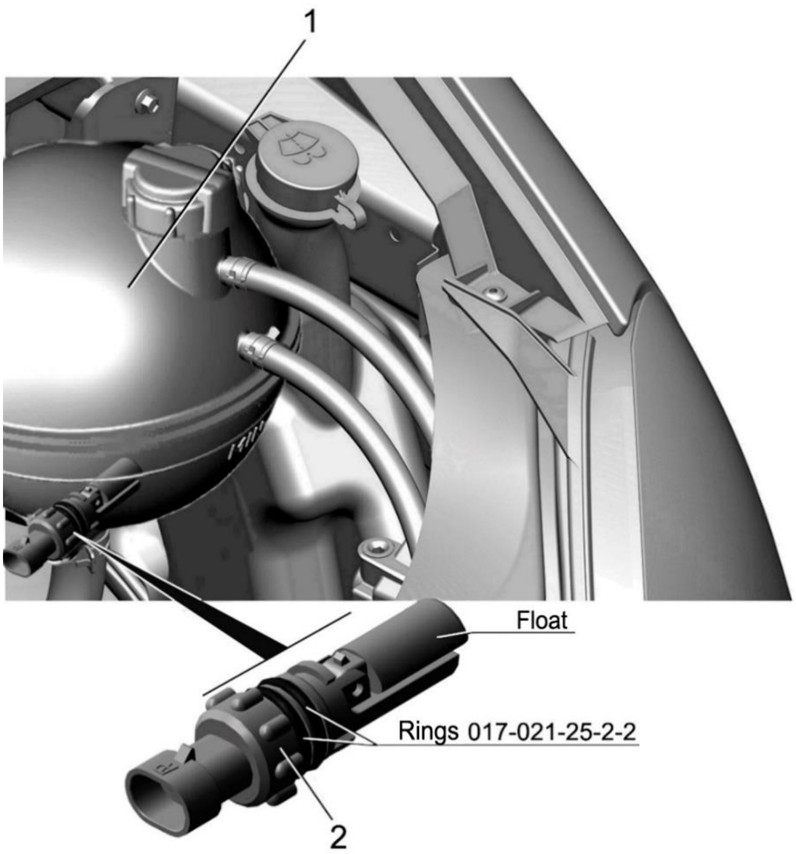


Fig. 7.43. Coolant level sensor installation: 1 – expansion tank; 2 – coolant level gauge

The low coolant level indicator (orange) in the instrument cluster lights up when the sensor float is lowered in the event of a decrease in the expansion tank coolant level.

ATTENTION
When the indicator lights up, it is necessary to eliminate the cause of the coolant leakage and bring the level in the expansion tank of the engine cooling system to normal.

Checking the sensor serviceability shall be carried out as follows:

- while changing the coolant level in the expansion tank (draining the coolant), visually record the moment of contact closure (the indicator will light up). In this case, the coolant level must not be lower than the sensor axis;
- to test the sensor directly, connect the sensor to the electrical circuit, as shown in Fig. 7.44, setting the current to max. 1A.

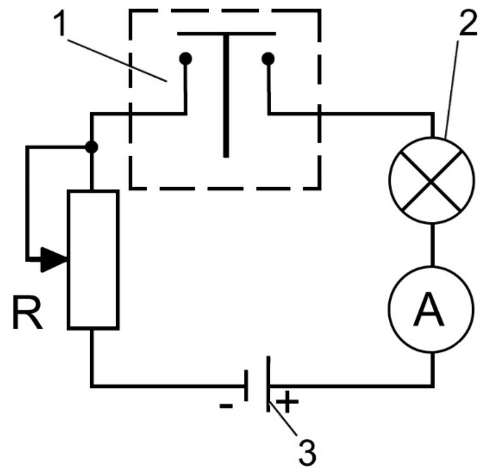


Fig. 7.44. Sensor contact closure check circuit: 1 – coolant level sensor; 2 – light; 3 – power supply; A – ammeter; R – resistor

When the float is lowered onto the sensor body, light 3 should light up, and when the float is raised, it should go out. If this does not happen, the sensor is considered inoperative.

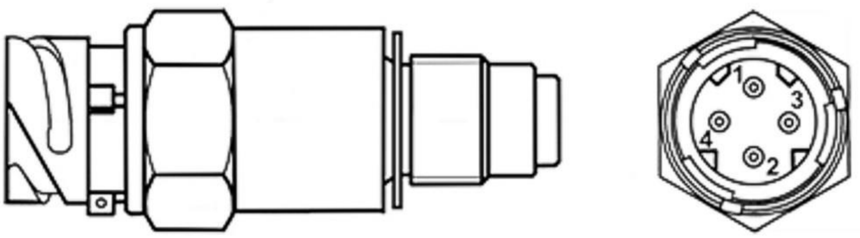
Check the “ease” of the float rotation on the axis. Jamming when turning is not allowed.

The coolant level sensor is maintenance-free and non-repairable product; in case of failure, it should be replaced with a new one.

Install the sensor in the expansion tank by turning the sensor clockwise until it stops, with the float up.

7.11.2.2. Speed sensor

A pulse sensor (speed sensor) is installed in the vehicle speedometer drive (Fig. 7.45). The pulse sensor is designed to convert the angular speed of the speed sensor rotor rotation into the frequency of electrical pulses.



Pin	Name
1	Power “plus”
2	Power “minus”
3	—
4	Output

Fig. 7.45. Pulse sensor

Pulse sensor specifications

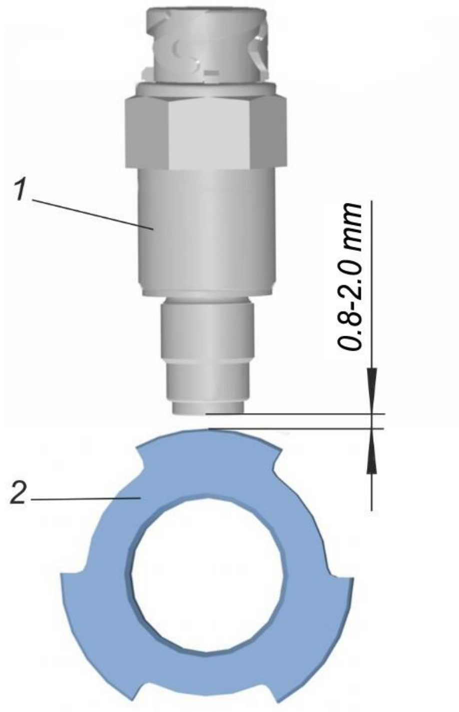
Rated voltage, V 12

Supply voltage, V 6-16

Current consumption at rated supply voltage,
A, max. 0.016

When the teeth of the gearbox rotor move at a distance of (1.4$\pm$0.6) mm from the sensing element, the sensor provides an output pulse signal of a rectangular shape
low signal level, V...0 to 0.9,
high signal level, V.. 4 to 16

To check the pulse sensor, connect the sensor in accordance with Fig. 7.46. The LED should flash as the gear rotor rotates on each tooth.



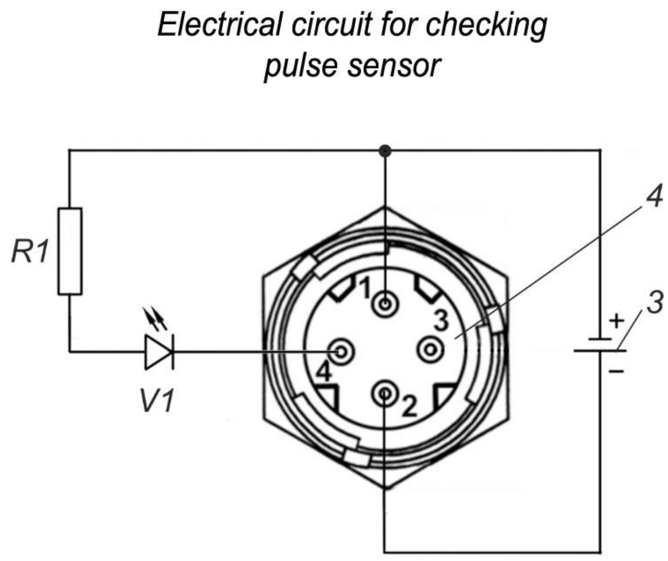


Fig. 7.46. Pulse sensor check circuit: 1 – pulse sensor; 2 – rotor; 3 – battery; 4 – sensor plug connector; R1 – resistance 600 Ohm; V1 – LED

The impulse sensor is a maintenance-free and non-repairable product, and in case of failure, it should be replaced with a new one.

Install the sensor in accordance with the requirements of the “Gearbox” subsection.

7.12. Wiring

If the insulation is damaged, the wires can directly touch the vehicle body, causing short circuits, leading to blown fuses, insulation burning, and even a fire.

For ease of installation and protection against mechanical damage, the wires are braided with a fastening braid into harnesses.

Maintenance

When inspecting the vehicle, carefully check the condition of the insulation on the wires, preventing their damage (rubbing against sharp edges, excessive sagging, etc.). Particular attention should be paid to the cleanliness and reliability of connecting wires to the electrical equipment leads. Wires with even slight damage to the insulation must be wrapped with insulating tape. Loosely tightened or dirty and oxidized leads should be cleaned and tightened. Care must be taken to ensure that oil and gasoline do not get on the surface of the wires, as they destroy the insulation and shorten the service life of the wires.

When repairing electrical wiring, use the wiring diagrams of the engine and the vehicle, which show the colors and cross-sections of the wires. It is not recommended to use wires of other cross-sections, as this may lead to the electrical equipment malfunction.

7.13. Fuses and relays

7.13.1. Fuse block in the engine compartment

Under the hood, on the right side of the front panel, there is a fuse box, where the fusible link 1 (Fig. 7.47) (150A) protects the air heater circuit, the fusible link 2 (90A) protects the general positive circuit of the vehicle, except for the positive generator and starter circuits, the fusible link 3 (90A) is reserve, the fusible link 4 (30A) protects the power supply circuit of the engine control unit. To access the fuses, press the two plastic latches on the cover sides in the direction of the arrows (see Fig. 7.47) and remove the cover. After replacing the fuse strip, tighten the retaining nut to a torque of 5.5-8.0 N·m (0.55-0.8 kgf·m).

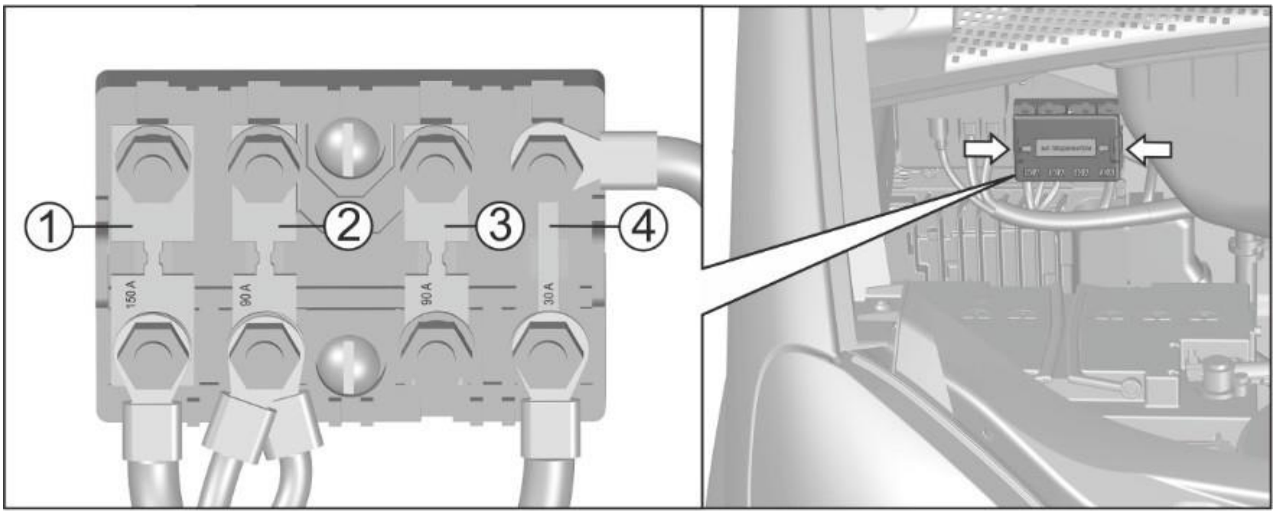


Fig. 7.47. Power fuse box installation: 1, 2, 3, 4 - fuses

7.13.2. Fuse and relay block in the engine compartment

Under the hood on the left on the panel extension there is a relay and fuse box (Fig. 7.48). The limiting current values in amperes and the circuits protected by fuses are indicated in Table 7.4. To access the fuses and relays, proceed as follows:

- press in the plastic snap on the left face of the cover and remove the cover;
- remove the faulty fuse with tweezers;
- troubleshoot the protected circuit;
- install a new fuse;
- close the cover till the snap clicks.

Fig. 7.48. Installation of relay and fuse box located in engine compartment

Table 7.4

Circuits protected by fuses (relay and fuse box located in engine compartment)

Fuse No.	Permissible current, A	Protected circuits
		Fuses
F1	15A	Fog lamps relay
F2	10A	Brake lights
F3	20A	Horns relay
F4	25A	Fuel preheater relay
F5	25A	Coolant post-heater
F6	25A	Instrument and starter switch
F7	25A	Anti-lock braking system
F8	25A	Air conditioner fan
F9	-	Reserve
F10	10A	Low beam headlights
F11	5A	High beam (left headlight)
F12	5A	High beam (right headlight)
F13	7.5A	Marker lights (left side)
F14	5A	Marker lights (right side)
F15	7.5A	Reversing light
F16	10A	Air conditioning compressor
F17	40A	Heater
F18	40A	Anti-lock braking system
F19	40A	Instrument and starter (ignition) switch
		Relay
K1		Air conditioning compressor relay
K2		Starter interlock relay

Fuse No.	Permissible current, A	Protected circuits
K3		Horns relay
K4		Fog lamps relay
K5		High beam headlight relay
K6		Low beam headlight relay
K7		Air conditioner fan relay
K8		Wiper blades positioning relay
K9		Fuel preheater relay
K10		Starter relay

7.13.3. Additional fuses and relays

In the cab, under the dashboard on the left sidewall, there is a block of additional relays and fuses (Fig. 7.49).

The limiting current values in amperes and the circuits protected by fuses are indicated in Table 7.5.

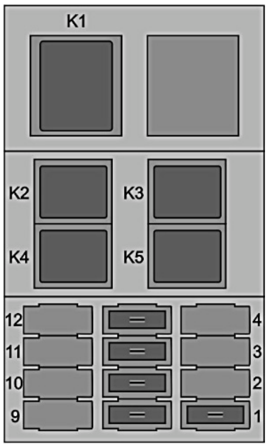


Fig. 7.49. Box of additional relays and fuses

Table 7.5

Circuits protected by additional fuses

Fuse No.	Permissible current, A	Protected circuits
	Fuses	
1	20A	SCR system
2	-	Reserve
3	-	Reserve
4	-	Reserve
5	5A	Carbamide outlet pipe heating

Fuse No.	Permissible current, A	Protected circuits
6	5A	Carbamide dosing pipe heating
7	5A	Carbamide feed pipe heating
8	10A	Carbamide feed module
9	-	Reserve
10	-	Reserve
11	-	Reserve
12	-	Reserve
Relay		
K1		Selective catalysis relay (SCR)
K2		Outlet pipe heating relay
K3		Dosing pipe heating relay
K4		Feed pipe heating relay
K5		Carbamide supply module relay

7.13.4. Relay and fuse box located in dashboard

In the cab, at the bottom of the dashboard, under the steering column, there is a relay and fuse box (Fig. 7.50). The limiting current values in amperes and the circuits protected by fuses are indicated in Table 7.6. To access the fuses, open the cover by pulling it towards you.

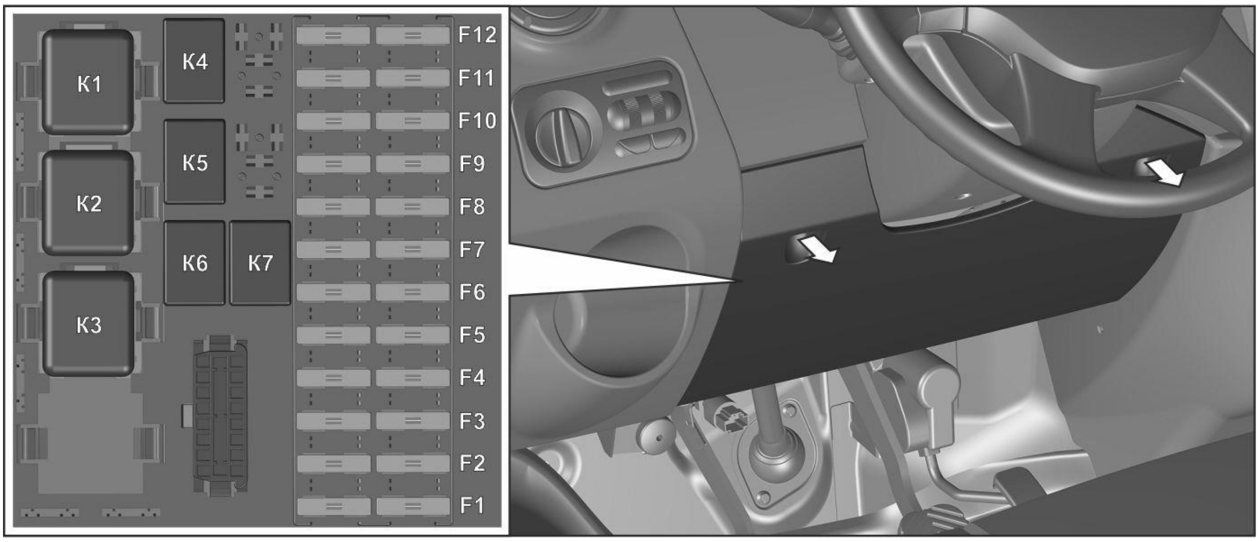


Fig. 7.50. Installation of relay and fuse box located in dashboard

Table 7.6

Circuits protected by fuses (relay and fuse box located in dashboard)

Fuse No.	Permissible current, A	Protected circuits
		Left row fuses protect circuits
F1	7.5A	Daytime running lights
F2	5A	Rear fog lights
F3	7.5A	Direction indicators
F4	7.5A	Instrument cluster, speed sensor, heater control, central lock,
F5	5A	Engine control system
F6	5A	Anti-lock braking system
F7	20A	Cigarette lighter, second row socket
F8	15A	Central lock, car stereo
F9	15A	Lighting control module, backlight
F10	10A	Interior lighting
F11	10A	Emergency brake lights
F12	7.5A	Instrument cluster, diagnostic block, preheater control board
		Right row fuses protect circuits
F1	20A	Wiper, washer
F2	10A	Lighting control module
F3	5A	Mirror motor drive
F4	25A	Window regulators
F5	10A	Mirror heating
F6	10A	Driver’s seat heating
F7	15A	Auxiliary heater
F8	10A	Passive safety system
F9	10A	Locking differential
F10	20A	Horns
F11	–	Reserve
F12	10A	Socket
		Relay
K1		Windshield wiper relay
K2		Heater relay
K3		Lock release relay

Fuse No.	Permissible current, A	Protected circuits
K4	-	Post-heater relay
K5		Differential lock relay
K6		Horns relay
K7	-	Lock release relay

7.14. Electronic engine control system

The integrated microprocessor engine control system is designed to ensure the optimal composition of the air and fuel mixture, supply fuel through the nozzles to the engine cylinders, ignite the air and fuel mixture, taking into account the optimal ignition timing. In its work, the integrated engine control system uses data received from the system sensors and the program stored in the memory of the control unit (CU).

Exhaust gas system sensors: exhaust gas differential pressure sensor (backpressure sensor), gas temperature sensors (temperature sensor unit), nitrogen oxide sensors are shown in Fig. 2.26 (“Engine” section).

7.14.1. Electronic engine control system diagnostics

Engine control unit 1 (see Fig. 7.51) is located under the hood on the right side of the front panel. The number of the engine with which it must work is marked on the control unit. Before starting the diagnostics, it is necessary to check the correspondence of the numbers.

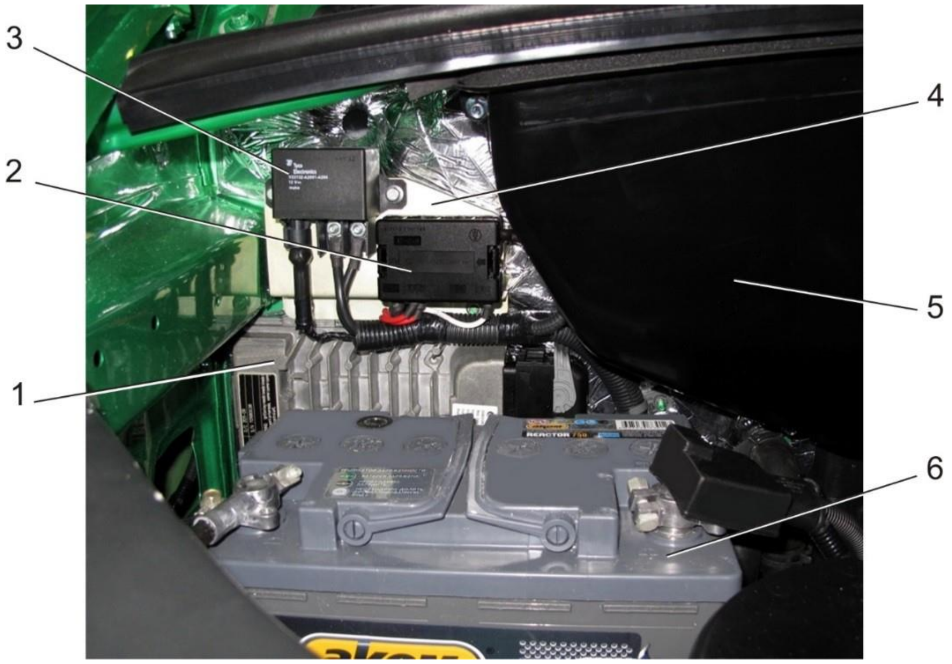


Fig. 7.51. Engine control unit installation: 1 – engine control unit; 2 – fuse box; 3 – air heater relay; 4 – bracket; 5 – front air intake duct; 6 – battery

To diagnose the electronic engine control system, the INLINE 6 (Data Link Adapter) diagnostic adapter with a set of connecting wires and a personal computer with the INSITE program version 8.1 and higher installed are used.

Minimum computer requirements:

- processor – Intel Core-i3;
- RAM - min. 2 GB;
- hard drive – min. 80 GB;
- free hard disk space – min. 6 GB;
- display – SVGA (1024x768 pixels) color;
- installed operating system – Windows 7 and higher;
- installed software – INSITE version 8.0 and higher;
- I/O ports for USB 2.0 port, COM port (RS-232 serial);
- DVD-ROM drive (for software installation);
- keyboard, mouse.

When diagnosing engines, use the INLINE 6 Diagnostic Equipment Operation Manual, the F2.8 Engine Maintenance and Repair Manual, and the INSITE Program User Manual.

The manual for installing the software on a computer is located on the disk attached to the INLINE 6 diagnostic adapter.

The INLINE 6 diagnostic adapter communicates via the CAN bus with the engine control unit using the J1939 protocol.

When the instrument and starter switch is turned on, data exchange is initiated between the INLINE 6 adapter, the INSITE diagnostic program and the engine control unit. At the same time, the CAN/J1939 and USB indicators on the adapter should blink (or RS-232, if the computer is connected to the COM port).

Diagnostic procedure

- connect the diagnostic adapter to the engine control system diagnostic block (Fig. 7.52), while the instrument and starter switch key must be in position “0”;

Fig. 7.52. Engine control system diagnostic connector

- set the instrument and starter switch key to position “I”;

- run the INSITE diagnostic program. Select the type of connection at the bottom of the screen - INLINE USB connection (J1939);

- establish a connection between the program and the engine control unit by activating the “Connect to ECM module” button located in the upper left corner of the program. After establishing an exchange between the diagnostic program and the control unit, the round indicator located in the lower left corner of the computer screen will turn green. If there is no connection, the indicator is red;

- when the “Diagnostic trouble codes” button is activated, the diagnostic program shows all the malfunctions recorded by the control unit. In the event of a malfunction in the control system, it must be eliminated and erased from the unit’s memory. After the malfunction is eliminated, the control system should be re-diagnosed. There should be no recorded malfunctions in the memory of the vehicle control unit after all malfunctions are eliminated;

- upon the end of the diagnostics, set the instrument and starter switch key to position “0”. Disconnect the diagnostic adapter.

7.15. Accelerator pedal module

The accelerator pedal module (Fig. 7.53) is located in the bus body cab and is designed to load the engine by the driver. The accelerator pedal module incorporates a non-contact, dual-channel pedal position sensor, which is designed to determine the accelerator pedal position by the control unit. The accelerator pedal module is a non-repairable product. The accelerator pedal module wiring diagram is shown in Fig. 7.54.

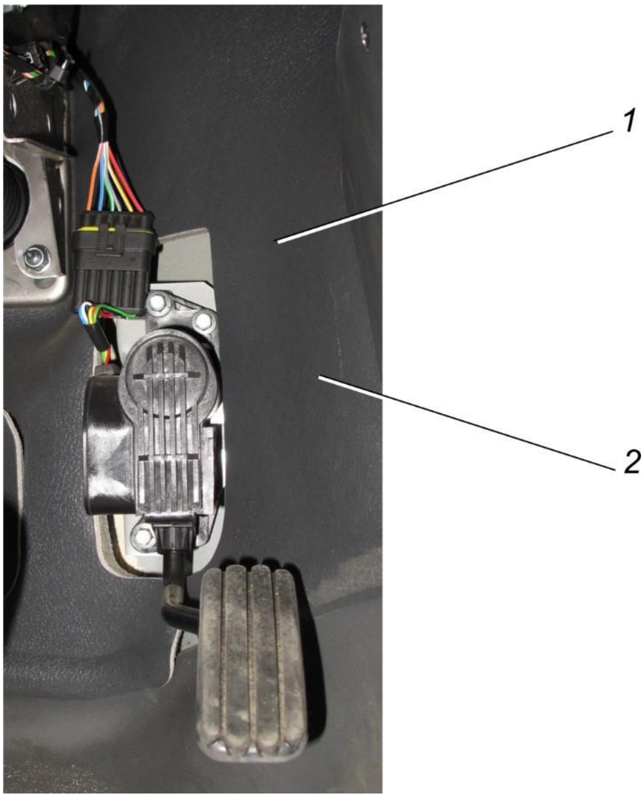


Fig. 7.53. Accelerator pedal module installation: 1 – six-pin connector; 2 – pedal module

Pedal module specifications:

Product supply voltage, V… 4.5-5.5

Sensor type… ....contactless
……………………………………………………dual-channel

Maximum current consumption
in power circuit, max., mA.. 30

Schematic electrical diagram

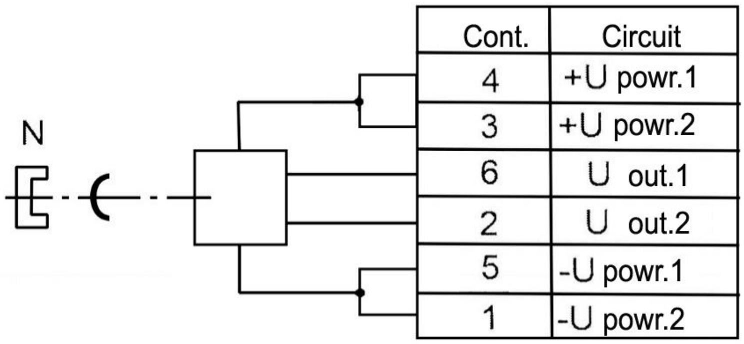


Fig. 7.54. Accelerator pedal module wiring diagram

Accelerator pedal module performance test method

Numbering of contacts in accordance with the pin block on the product.

Checking the electrical characteristics must be carried out at a DC voltage of (5.0±0.5) V and a load resistance of (270±27) kOhm. Power is connected to the leads in accordance with the electrical circuit diagram shown in Fig. 7.54.

The product should be installed on a special tool that ensures the pedal movement to the position of maximum depression.

The leads 4-5 (1st channel sensor) and 1-3 (2nd channel sensor) are supplied with a supply voltage (5.0±0.5) V according to the electrical circuit diagram. The voltage is monitored at leads 5-6 (1st channel sensor) and 1-2 (2nd channel sensor).

The product is considered suitable if the following conditions are met:

- first channel output voltage with pedal not depressed – Uout.1=1.1+0.15 V;
- second channel output voltage with pedal not depressed – Uout.2=0.55±0.15 V;
- first channel output voltage with pedal fully depressed – Uout.1=4.2±0.15 V;
- second channel output voltage with pedal fully depressed – Uout.2=2.1±0.15 V;

7.16. Fuel intake module with fuel level sensor

The fuel intake module (Fig. 7.55) with a fuel level sensor is designed for fuel intake and fuel tank level monitoring.

The fuel intake module is installed inside the fuel tank. The module consists of an intake chamber, a module cover with fittings and a connecting block, a fuel pre-filter and a fuel level sensor consisting of a float connected to a resistor. Depending on the amount of fuel in the fuel tank, the electromagnetic fuel gauge (in the instrument cluster) is supplied with a current, which is determined by the resistance of the module resistor.

The resistance values of the resistor depending on the fuel level and the float position are shown in Table 7.7.

Table 7.7

Resistor resistance depending on fuel level and float position

Tank fuel level, mm	Float position (H), mm		Resistance, Ohm
	fuel intake module from SOATE, CJSC	fuel intake module from Sangsin S&P, Ltd (Korea)	
Empty tank	8	12	330±15
1/8	28.6	33.6	230±10
1/4	55.4	60.4	185±10
1/2	105.8	110.8	118±10
3/4	156	161	65±5
Full tank	206.5	211.5	11±4

Upon reaching the reserve fuel level in the fuel tank (below 10 l, resistor resistance 230±10 Ohm), the reserve fuel level warning lamp in the instrument cluster turns on.

The fuel intake module is a non-repairable product. The fuel intake module must be replaced under the following conditions:

- if the fuel level sensor circuit breaks when the lever is moved smoothly up and down;
- if the resistance when connected to the external electrical connector of the module at the upper (full tank) and lower (empty tank) levels does not meet the requirements (see table).

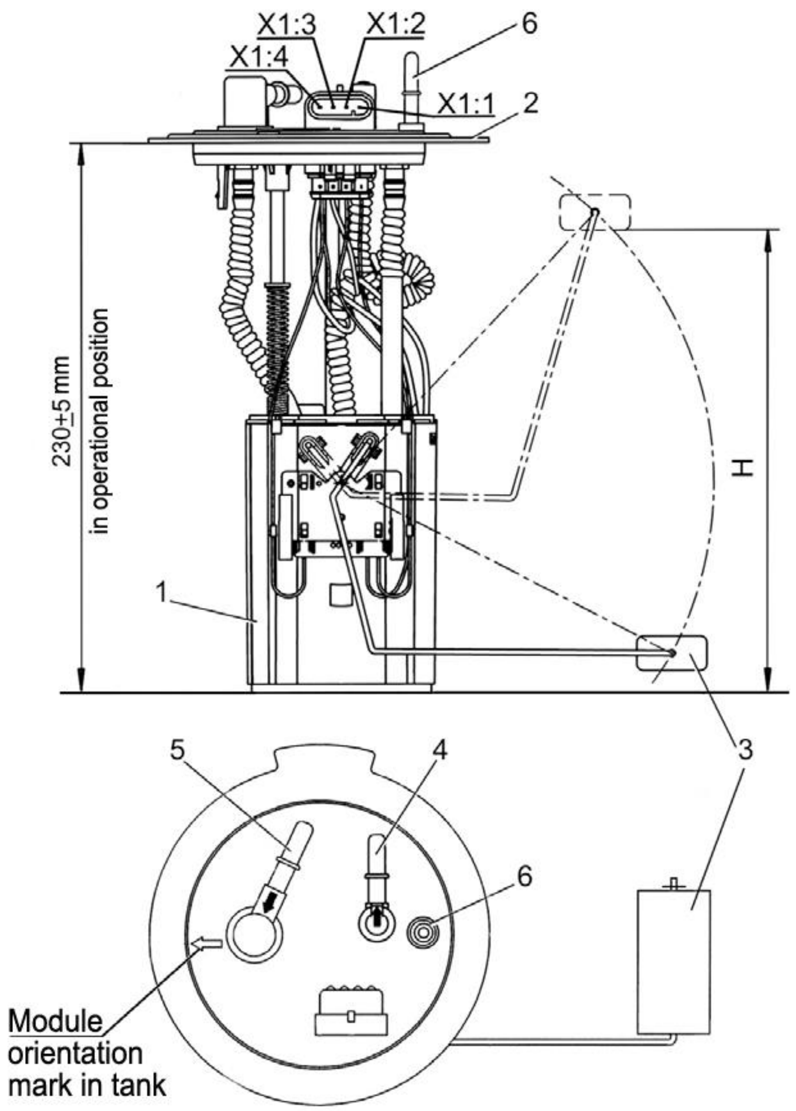


Fig. 7.55. Fuel intake modules: H - float position; 1 - recuperator; 2 - clamping ring; 3 - fuel level sensor float; 4, 5, 6 - fittings

Schematic electrical diagram for connection of fuel level indicator sensor of fuel intake modules is shown in Fig. 7.56.

The arrangement of the connector X1 pins is shown in Fig. 7.57.

Correspondence of pins to electrical circuits is indicated in Table 7.8.

Table 7.8

Correspondence of pins to electrical circuits

Pin designation	Electrical circuit
X 1:1	Fuel gauge
X 1:2	Empty
X 1:3	Empty
X 1:4	Negative fuel gauge

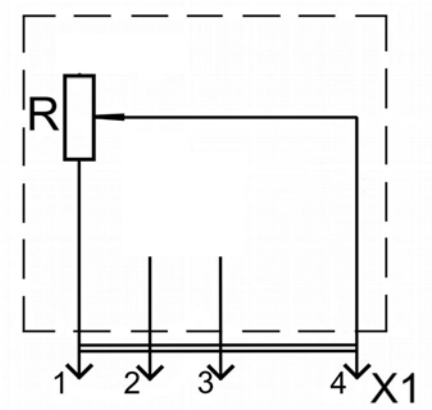


Fig. 7.56. Wiring diagram for fuel level sensor connection:
R - fuel level sensor resistor

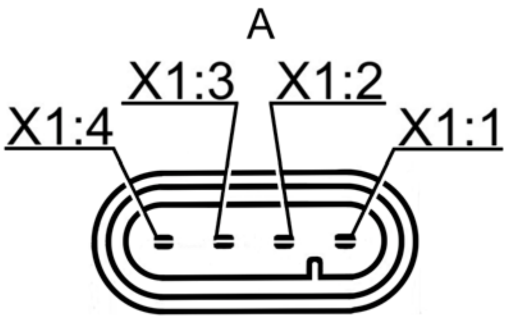


Fig. 7.57. Arrangement of connector X1 pins

Installation and operation instructions

Removal and installation of the fuel intake module must be carried out on the fuel tank removed from the vehicle.

When replacing a faulty fuel intake module, proceed as follows:

- after opening the package, inspect the module for damage on the body, fitting tips, check the integrity and ease of movement of the float fuel level sensor arm.
- install the module in the vehicle fuel tank after installing the O-ring. Turn the clamping ring of the module using the tool with a torque of approx. 200 N·m (20 kgf·m), ensuring the fuel tank tightness (see “Engine” section). Before tightening the clamping ring, the alignment arrows on the fuel intake module and the fuel tank must be aligned (pointing at each other).

Connect the module to the fuel lines of the engine power supply system and the fuel line of the post-heater or preheater, heater[1)], installed on the fuel tank, ensuring

[1)] - For vehicles with heating system post-heater or preheater, heater that the fuel supply and return fuel lines are installed correctly and the connections are tight. Connect the pipes to the module until a characteristic click occurs. Fix the additional fuel intake pipe on the fuel tank with mounting bushings;

Fuel tank connections to the fuel intake module, fuel pipes and filling pipe must be sealed at an air pressure of 30-35 kPa (0.3-0.35 kgf/cm^2) for 30 seconds in a water bath. The appearance of air bubbles is not allowed. Carry out the tightness test with the fuel pipes, filling pipe and filter valve plugged.

- connect the fuel tank wiring harness terminal block to the fuel intake module.

7.17. ABS80(38) series anti-lock braking system

The vehicle is equipped with an anti-lock braking system (ABS) of the ABS80(38) series. The ABS is effective in emergency braking on a road with various surfaces (for example, asphalt and ice) and prevents the wheels from blocking in less favorable grip conditions (on ice), providing the minimum braking distance for the vehicle for this road surface while maintaining its stability and controllability. This ABS has the function of electronic brake force distribution (EBD), which prevents the rear wheels from locking up, causing the rear axle to skid when the vehicle is braked with a partial load.

The electrical part of the ABS consists of:

- hydraulic control valve with built-in electronic control unit in the engine compartment on the left;
- four speed sensors located in the vehicle wheel assemblies (see Table 7.9);

Table 7.9

ABS sensor	Supplier designation	Quantity per 1 vehicle, pcs.
Front left/right	3630 430 055 0	2
Rear left/right	3630 430 057 0	2

- - ABS malfunction indicator  and EBD malfunction indicator  in the instrument cluster panel;
- - ABS wiring harness, which is part of the vehicle wiring harnesses.

Each time the instruments and starter are turned on, the ABS malfunction indicator and the EBD malfunction indicator turn on for about 3 seconds and then turn off. This indicates the serviceability of the ABS electrical components and circuits, as well as the EBD system. It is allowed to briefly turn on the ABS or ABS and EBD malfunction indicator when starting the engine. The ABS and EBD malfunction indicators also turn on when there is an open circuit from the instrument cluster to the electronic control unit.

If the ABS malfunction indicator (orange) continuously on or turns on while driving, this indicates an ABS problem. At the same time, the primary brake system remains operational as without ABS. If the ABS malfunction indicator and EBD malfunction indicator (red) continuously on or turn on while driving, this indicates a malfunction of the ABS and EBD systems.

In the event of a malfunction of the ABS or ABS and EBD, the vehicle must be diagnosed and repaired at a service station.

The schematic electrical diagram of the vehicle ABS80(38) is shown in Fig. 7.58.

ABS diagnostics

To accurately identify and eliminate the malfunctions of ABS electrical components, it is necessary that these works be performed by specialists who know the basics of electrical engineering and can understand electrical circuits.

The ABS80(38) diagnostics can only be carried out using diagnostic equipment.

For ABS82(38) diagnostics, it is recommended to use diagnostic scanner-tester ASKAN-10 with ABS80(38) diagnostics module installed.

NOTE
Diagnostics is not possible if the supply voltage in the vehicle on-board electric system is $\leq$ 6.6 V.

For ABS diagnostics, it is necessary to:

1. Connect the PrM230 Adapter diagnostic cable to the quick-release connector of the ASKAN-10 tester.
2. With the instrument and starter switch key in position “0”, connect the diagnostic connector of the PrM230 Adapter to the vehicle’s OBDII diagnostic block.
3. Turn the instrument and starter switch key to position “I”, the tester display backlight will turn on and the splash screen will appear for a short time, then the tester main menu will appear.

To test the ABS80(38) system, turn on the appropriate diagnostic module.

After starting the module, a short splash screen will appear on the display, followed by the **“MODE”** menu.

After the **“MODE”** menu appears, the green “LINK” LED on the front panel below the display should turn on. If the red “ERROR” LED on the front panel below the display turns on, it is necessary to check the diagnostic cable connection for correctness.

The **“MODE”** menu contains the following subsections: **“ABS description”**; **“Parameters”**; **“Malfunctions”**; **“Vacuum and filling”**; **“Hydraulic unit bleeding”**; **“Tests”**; **“Exit”**, see Fig. 7.59.

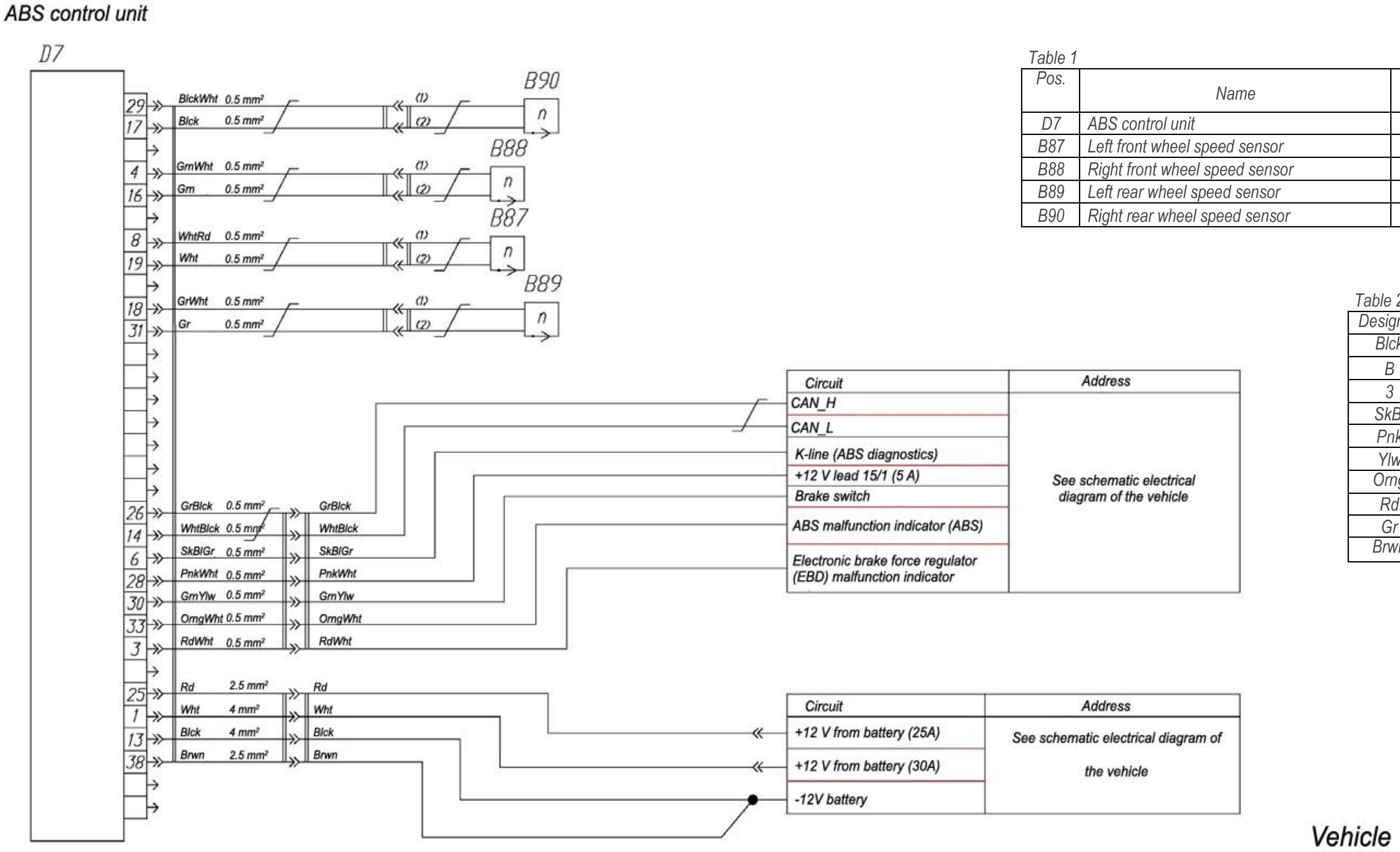


Table 1

Pos.	Name	Qty	Note
D7	ABS control unit	1	
B87	Left front wheel speed sensor	1	
B88	Right front wheel speed sensor	1	
B89	Left rear wheel speed sensor	1	
B90	Right rear wheel speed sensor	1	

Table 2

Designati	Wire color
Blck	Black
B	White
3	Green
SkBl	Sky blue
Pnk	Pink
Ylw	Yellow
Orng	Orange
Rd	Red
Gr	Grey
Brwn	Brown

Fig. 7.58. Schematic electrical diagram of vehicle ABS

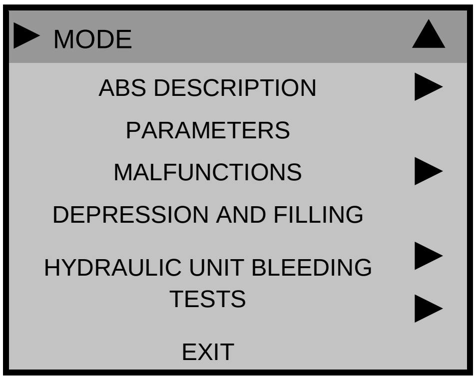


Fig. 7.59

1. The **"ABS description"** subsection menu is shown in Fig. 7.60.

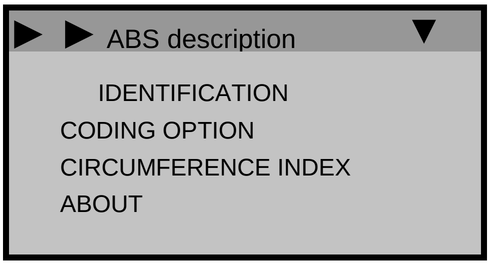


Fig. 7.60.

1.1. In the **"Identification"** item, the identification parameters of the hydraulic control valve are viewed.

1.2. The **"Coding option"** item allows selecting the coding option. On vehicles, changing the coding option is not provided and is not available. The display will show the **"Coding option reading error!"** message, see Fig. 7.61.

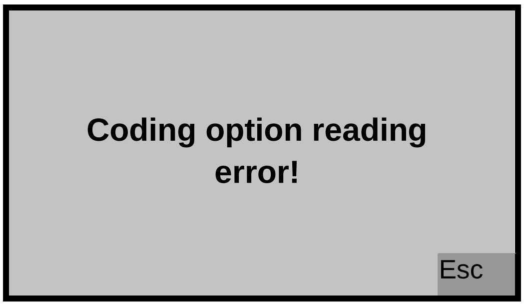


Fig. 7.61.

1.3. In the **"Circumference index"** item, the wheel circumference index is set for the correct display of vehicle speed on the speedometer and odometer in the case of using the vehicle speed signal from the ABS control unit. Changing the wheel circumference index is not provided and is not available on the vehicles. The display will show the **"Negative answer! Current wheel circumference index reading**

error!" message, see Fig. 7.62.

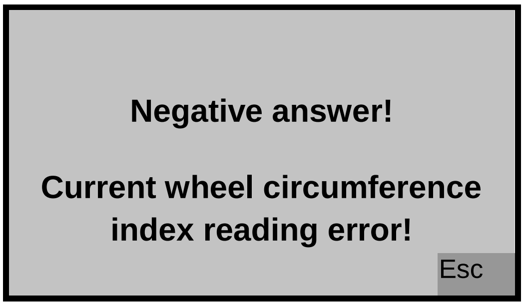


Fig. 7.62

1.4. The **"About"** item allow viewing information about the software module of this scanner tester.

2. The **"Parameters"** subsection allow viewing the values of some of the ABS system parameters. The list of parameters is divided into pages. The top line contains information about the name and number of the current page and the total number of pages. An example of displaying parameters is shown in Fig. 7.63.

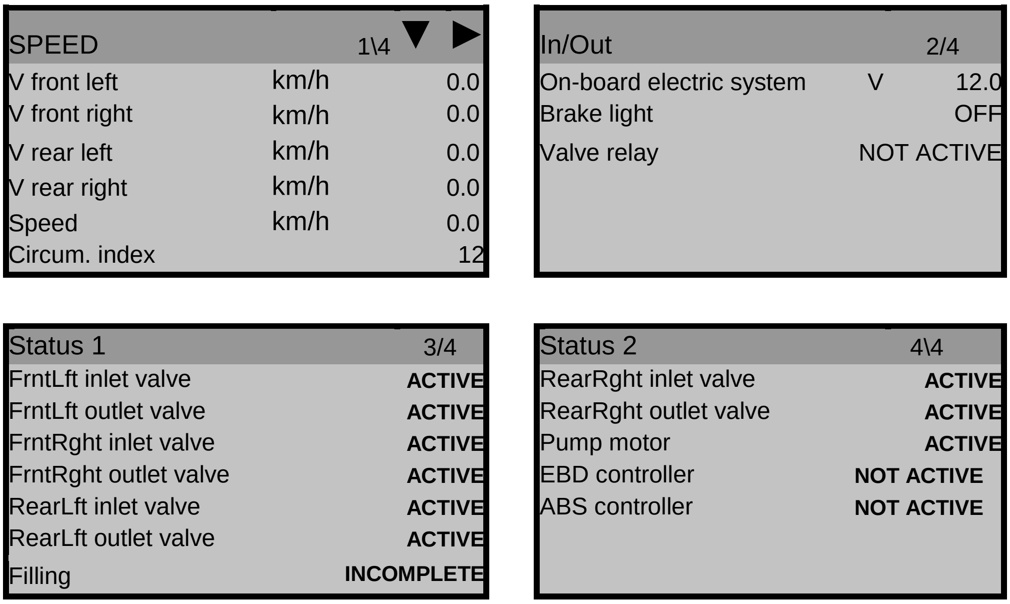


Fig. 7.63.

To switch to another parameter page, press the key with symbol ← or →.

An extended explanation of each parameter can be read on the tester display by pressing the **F3** key.

The extended parameter name available by pressing the F3 key is shown in Table 7.10.

Table 7.10

Parameter page	Displayed parameter name	Extended parameter name available by pressing F3 key	Unit of measurement
Page 1 Speed	V front left	Left front wheel speed	km/h
	V front right	Right front wheel speed	km/h
	V rear left	Left rear wheel speed	km/h
	V rear right	Right rear wheel speed	km/h
	Speed	Vehicle speed	km/h
	Circum. index	Wheel circumference index	
Page 2 In/Out	On-board electric system	Electronic unit mains voltage	V
	Brake light	Brake light switch status	ON/OFF
	Valve relay	Valve relay status	NOT ACTIVE/ ACTIVE
Page 3 Status 1	FrntLft inlet valve	Front left wheel inlet valve status	ACTIVE/ NOT ACTIVE
	FrntLft outlet valve	Front left wheel outlet valve status	ACTIVE/ NOT ACTIVE
	FrntRght inlet valve	Front right wheel inlet valve status	ACTIVE/ NOT ACTIVE
	FrntRght outlet valve	Front right wheel outlet valve status	ACTIVE/NOT ACTIVE
	RearLft inlet valve	Rear left wheel inlet valve status	ACTIVE/ NOT ACTIVE
	RearLft outlet valve	Rear left wheel outlet valve status	ACTIVE/ NOT ACTIVE
	Filling	Hydraulic unit bleeding status. - INCOMPLETE – filling incomplete; - OK – filling completed with a positive result; - NOT OK – filling completed with a negative result;	INCOMPLETE/ OK/NOT OK
Page 4 Status 2	RearRght inlet valve	Rear right wheel inlet valve status	ACTIVE/ NOT ACTIVE
	RearRght outlet valve	Rear right wheel outlet valve status	ACTIVE/ NOT ACTIVE
	Pump motor	Pump motor status	ACTIVE/ NOT ACTIVE
	EBD controller	EBD controller status	NOT ACTIVE/ ACTIVE
	ABS controller	ABS controller status	NOT ACTIVE/ ACTIVE

3. In the **“Malfunctions”** subsection, it is possible to view current and saved malfunctions, erase diagnostic trouble codes, save malfunctions in the tester’s memory for printing.

The “Malfunctions” subsection menu is shown in Fig. 7.64.

MALFUNCTIONS

CURRENT MALFUNCTIONS
STORED MALFUNCTIONS
RESET DTCs
PRINT

Fig. 7.64.

Examples of diagnostic trouble code records are shown in Fig. 7.65.
The top line of the displayed message contains the title of the window – "Diagnostic trouble codes", below it there is a line with three values. The first value - "C0032" indicates a digital diagnostic trouble code; the second - "NO" or "Yes" indicates a malfunction that has been eliminated, but stored in memory/current malfunction; the third - "1/1" indicates the sequence number of the malfunction/total number of malfunctions in the ABS system. The following is a malfunction description.

DIAGNOSTIC TROUBLE CODES

DTC: C0032 NO 1/2
Front left speed sensor: signal line short to ground/open/open power line

stat: "no signal"
ABS light: on

DIAGNOSTIC TROUBLE CODES

DTC: C0011 NO 1/2
Faulty front left outlet valve

stat: "no signal"
ABS light: on

DIAGNOSTIC TROUBLE CODES

DTC: C0037 NO 1/2
Rear left speed sensor:
signal error (out of range/lost/noise/intermittent)

stat: "no signal"
ABS light: on

DIAGNOSTIC TROUBLE CODES

DTC: U0001 NO 1/2
CAN bus off
(Bus-Off)

stat: "no signal"
ABS light: on

Fig. 7.65.

The ABS malfunctions, their descriptions, possible causes and remedies are given in Table 7.11.

Table 7.11

Digital diagnostic trouble code		Malfunction description	Probable cause	Remedy
C0031	0x4031	Front left speed sensor: signal error (out of range, lost, noise, intermittent)	Large clearance (>1.49 mm) between the sensor and the ABS toothed rotor;	Tighten the sensor mounting screw.
			Increased (> 0.21 mm) runout of the ABS toothed rotor against the rotation axis	Replace worn hub bearing or hub assembly with bearing, or rotor (see “Front suspension” subsection).
			Broken ABS rotor toothed surface geometry	
C0032	0x4032	Front left speed sensor: signal line short to ground/open/open power line	The sensor is not connected to the frame harness.	Connect the sensor to the frame harness.
C00A0	0x40A0	Front left speed sensor: power line short to ground	Breakage or short circuit to the negative or positive battery lead of the sensor cable or in the frame harness.	Troubleshoot the frame harness or replace the frame harness.
C00A1	0x40A1	Front left speed sensor: signal line short to UBATT	Short circuit of the wires in the frame harness to each other.	
C00A9	0x40A9	Front left speed sensor: Common error	Sensor malfunction	Replace the sensor.
C0034	0x4034	Front right speed sensor: signal error (out of range, lost, noise, intermittent)	Large clearance (>1.49 mm) between the sensor and the ABS toothed rotor;	Tighten the sensor mounting screw.
			Increased (> 0.21 mm) runout of the ABS toothed rotor against the rotation axis	Replace worn hub bearing or hub assembly with bearing, or rotor (see “Front suspension” subsection).
			Broken ABS rotor toothed surface geometry	

Digital diagnostic trouble code		Malfunction description	Probable cause	Remedy
C0035	0x4035	Front right speed sensor: signal line short to ground/open/open power line	The sensor is not connected to the frame harness.	Connect the sensor to the frame harness.
C00A2	0x40A2	Front right speed sensor: power line short to ground	Breakage or short circuit to the negative or positive battery lead of the sensor cable or in the frame harness.	Troubleshoot the frame harness or replace the frame harness.
C00A3	0x40A3	Front right speed sensor: signal line short to UBATT	Short circuit of the wires in the frame harness to each other.	
C00AA	0x40AA	Front right speed sensor: Common error	Sensor malfunction	Replace the sensor.
C0037	0x4037	Rear left speed sensor: signal error (out of range, lost, noise, intermittent)	Large clearance (>1.49 mm) between the sensor and the ABS toothed rotor;	Tighten the sensor mounting screw.
			Increased (> 0.21 mm) runout of the ABS toothed rotor against the rotation axis	Replace worn hub bearing or hub assembly with bearing, or rotor (see “Front suspension” subsection).
			Broken ABS rotor toothed surface geometry	
C0038	0x4038	Rear left speed sensor: signal line short to ground/open/open power line	The sensor is not connected to the frame harness.	Connect the sensor to the frame harness.
C00A4	0x40A4	Rear left speed sensor: power line short to ground	Breakage or short circuit to the negative or positive battery lead of the sensor cable or in the frame harness.	Troubleshoot the frame harness or replace the frame harness.
C00A5	0x40A5	Rear left speed sensor: signal line short to UBATT	Short circuit of the wires in the frame harness to each other.	

Digital diagnostic trouble code		**Malfunction description**	**Probable cause**	**Remedy**
C00AB	0x40AB	Rear left speed sensor: Common error	Sensor malfunction	Replace the sensor.
C003A	0x403A	Rear right speed sensor: signal error (out of range, lost, noise, intermittent)	Large clearance (>1.49 mm) between the sensor and the ABS toothed rotor;	Tighten the sensor mounting screw.
			Increased (> 0.21 mm) runout of the ABS toothed rotor against the rotation axis	Replace worn hub bearing or hub assembly with bearing, or rotor (see “Front suspension” subsection).
			Broken ABS rotor toothed surface geometry	
C003B	0x403B	Rear right speed sensor: signal line short to ground/open/open power line	The sensor is not connected to the frame harness.	Connect the sensor to the frame harness.
C00A6	0x40A6	Rear right speed sensor: power line short to ground	Breakage or short circuit to the negative or positive battery lead of the sensor cable or in the frame harness.	Troubleshoot the frame harness or replace the frame harness.
C00A7	0x40A7	Rear right speed sensor: signal line short to UBATT	Short circuit of the wires in the frame harness to each other.	
C00AC	0x40AC	Rear right speed sensor: Common error	Sensor malfunction	Replace the sensor.

Digital diagnostic trouble code		Malfunction description	Probable cause	Remedy
C1099	0x5099	Wheel speed sensor common error	Sensors are misplaced, a break in any groups of wires from 3 ABS sensors or from 2 rear ABS sensors, a malfunction of any 3 ABS sensors or 2 rear ABS sensors, a wheel toe-out by more than 6%	Troubleshoot the circuit, replace the ABS sensors, install tires to vehicle specification, check tire pressure for compliance with vehicle specification
U0005	0xC005	CAN bus overvoltage		
U0007	0xC007	CAN bus live		
C1001	0x5001	CAN hardware error		
U0001	0xC001	CAN bus off (Bus_Off)		
U1001	0xD001	Passive CAN error		
C0010	0x4010	Faulty front left inlet valve	ABS hydraulic control valve malfunction	Replace ABS hydraulic control valve
C0011	0x4011	Faulty front left outlet valve		
C0014	0x4014	Faulty front right inlet valve		
C0015	0x4015	Faulty front right outlet valve		
C0018	0x4018	Left rear intake valve failure		
C0019	0x4019	Faulty rear left outlet valve		

Digital diagnostic trouble code		Malfunction description	Probable cause	Remedy
C001C	0x401C	Faulty rear right inlet valve		
C001D	0x401D	Faulty rear right outlet valve		
C1095	0x5095	Valve relay error	Open or short circuit in the power supply circuit of the valve relay, blown fuse 25A in fuse box F44, hydraulic control valve malfunction	Repair the valve relay supply circuit, replace the 25A fuse in the F44 fuse box, replace the hydraulic control valve
C0020	0x4020	Faulty return pump	open or short circuit in the power supply circuit of the pump motor, blown fuse 30A in fuse box F44, hydraulic control valve malfunction	Repair the valve relay supply circuit, replace the 30A fuse in the F44 fuse box, replace the hydraulic control valve
C0072	0x4072	General valve failure	Overtemperature protection tripped, signal invalid, hardware error	Replace ABS hydraulic control valve
C1900	0x5900	ECU supply voltage: high voltage	Supply voltage in the vehicle on-board electric system > 17 V	Eliminate malfunctions associated with increased/decreased supply voltage in the vehicle on-board electric system.
C1901	0x5901	ECU supply voltage: low voltage	Supply voltage in the vehicle on-board electric system < 9.6 V (vehicle speed > 6 km/h)	
C1000	0x5000	ECU fault	Hardware error, microcontroller error	Replace ABS hydraulic control valve
C1010	0x5010		Common software problem	

Digital diagnostic trouble code		Malfunction description	Probable cause	Remedy
C006B	0x406B		Too long control time, etc.	

4. Using the **"Vacuum and filling"** subsection, the procedure for filling the brake system and the hydraulic control valve with brake fluid by creating a vacuum is carried out.

The test is performed on a stationary vehicle with the connection of a special vacuum bleeding unit.

ATTENTION
It is not recommended to use this program without additional equipment to create a vacuum and fill the hydraulic control valve. After replacement and installation of a new unfilled hydraulic control valve, it is recommended to use the "Hydraulic unit bleeding" program.

5. Using the **"Hydraulic unit bleeding"** subsection, air is removed and the internal circuits of the hydraulic control valve are filled with brake fluid.

ATTENTION
Bleeding the hydraulic control valve is only necessary after installing a new hydraulic control valve.

The hydraulic control valve manufacturer notes the need to use a bleeding device that creates an overpressure of at least 2 bar (~2 kgf·cm2) in the brake fluid tank.

Before bleeding the hydraulic control valve, it is necessary to bleed the brake system in the standard way (see "Brakes" section, "Filling (bleeding) brake system with fluid" subsection). Bleeding the hydraulic control valve is carried out in 4 stages with the following *mandatory* sequence: bleeding the left rear wheel; bleeding the left front wheel; bleeding the right front wheel; bleeding the right rear wheel.

The **"ABS bleeding"** subsection menu is shown in Fig. 7.66.

►► ABS BLEEDING ▼
REAR LEFT WHEEL BLEEDING
FRONT LEFT WHEEL BLEEDING
FRONT RIGHT WHEEL BLEEDING
REAR RIGHT WHEEL BLEEDING

Fig. 7.66.

During the bleeding, it is necessary to press and release the vehicle brake pedal with a frequency of one depression/release per about four seconds, while it is necessary to monitor the brake fluid level in the master cylinder tank, avoiding a dry bottom. Bleeding the hydraulic control valve is carried out only on a vehicle with an engine off. During the bleeding, the battery must be fully charged.

While bleeding the hydraulic control valve, it is necessary to put a pipe on the valve of the bled wheel, placing the other end of the pipe in a container with brake fluid, open the valve and press the brake pedal.

After selecting the bleeding stage, press the Enter key. A message will be displayed as shown in Fig. 7.67.

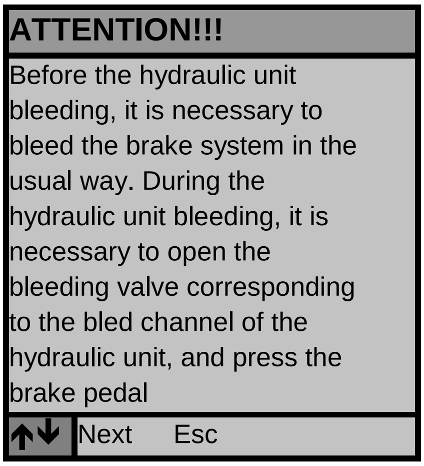


Fig. 7.67.

To start the bleeding procedure, press the F2 key, see Fig. 7.68.

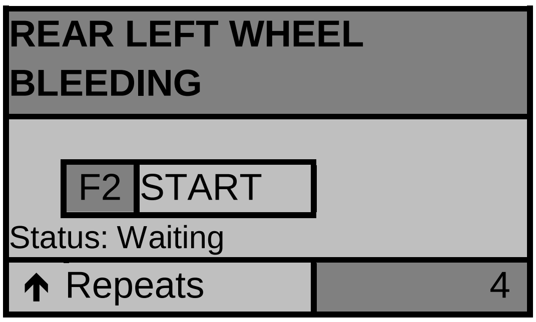


Fig. 7.68.

Upon successful completion of bleeding, a message is displayed in accordance with Fig. 7.69.

ATTENTION!!!
CONTINUE BLEEDING WITH THE PEDAL UNTIL THE AIR IS REMOVED FROM THE HYDRAULIC ACTUATOR!
Next Esc

Fig. 7.69

After bleeding this wheel, press the Esc key.

P.S. In case of unsuccessful test completion, the message in accordance with Fig. 7.70 is not displayed. In this case, repeat the procedure for bleeding the corresponding wheel. Further, if necessary, ABS malfunctions should be checked and eliminated.

The remaining bleeding stages should be performed similarly. If all stages of bleeding are carried out successfully and in the correct sequence (first the left rear wheel, then the left front wheel, then the right front and right rear), the display shows the message **“Filling status successfully recorded”.**

At the same time, in the **“Parameters”** section, the “Filling” parameter status changes from **“INCOMPLETE”** to **“OK”**.

6. In the **“Tests”** subsection, the correctness of the pipeline connection, the operational dynamics of solenoid valves, as well as the quality of signals from speed sensors are checked.

All tests shall be carried out on a brake bench.

ABS sensor replacement

To remove speed sensors:

- disconnect the frame harness block and the sensor block (see Fig. 7.70);
- disconnect the ABS sensor cable supports from their mounting brackets;
- unscrew the sensor fixing screw and remove the sensor from the hole. The sensor is installed in the reverse order of removal. When installing the sensor, sealant Loctite 243 (from Henkel) or Weicon AN 302-43 (from Weicon) should be applied to the screw threads.

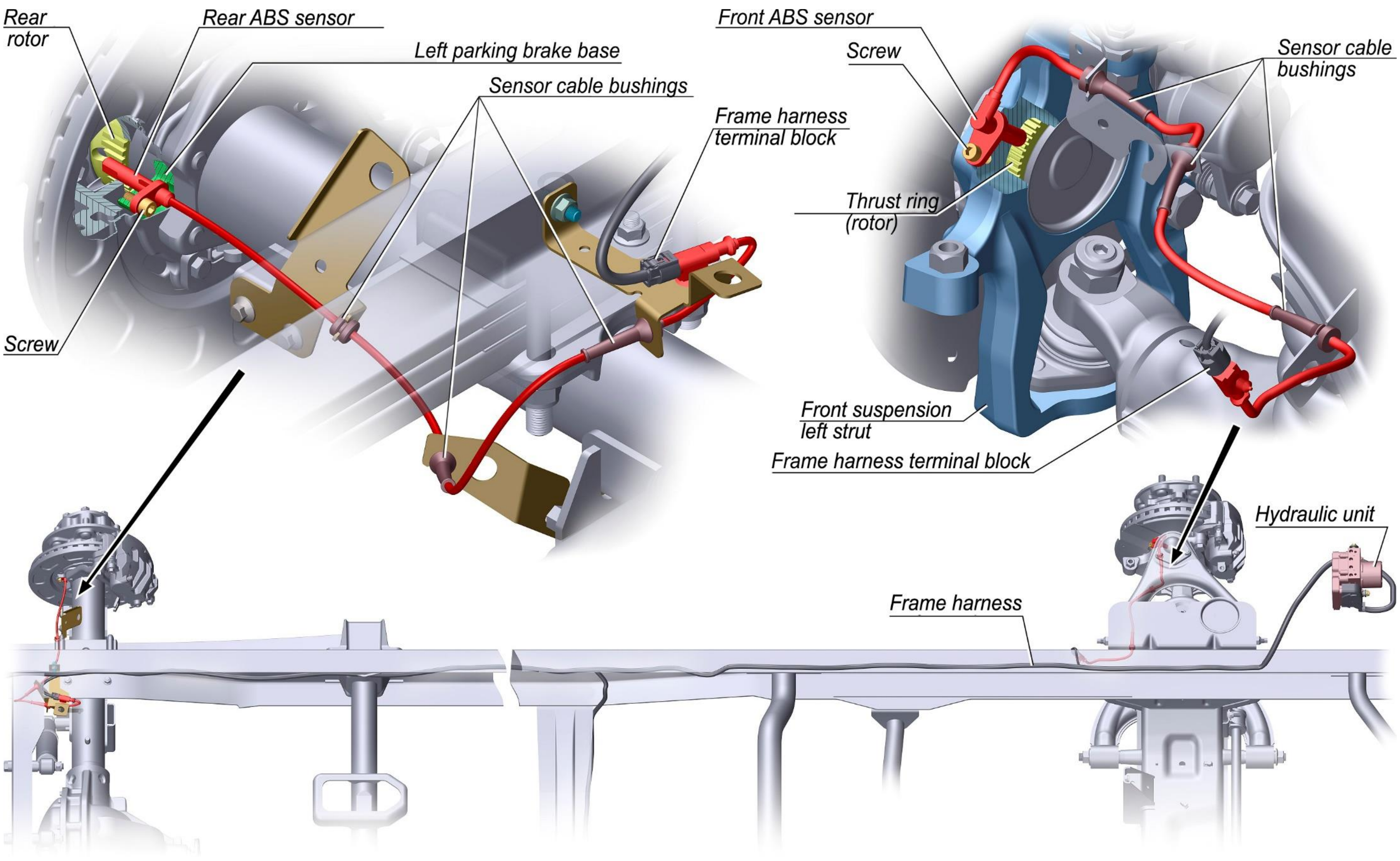


Fig. 7.70. Installation of ABS sensors (Image for vehicle right side is mirror image of this figure)

Disconnection of harness block from hydraulic unit

To disconnect the frame harness terminal block from the hydraulic control valve, it is necessary to:

- press on the block cover surface shown in Fig. 7.72;
- turn the latch up *until it clicks*.

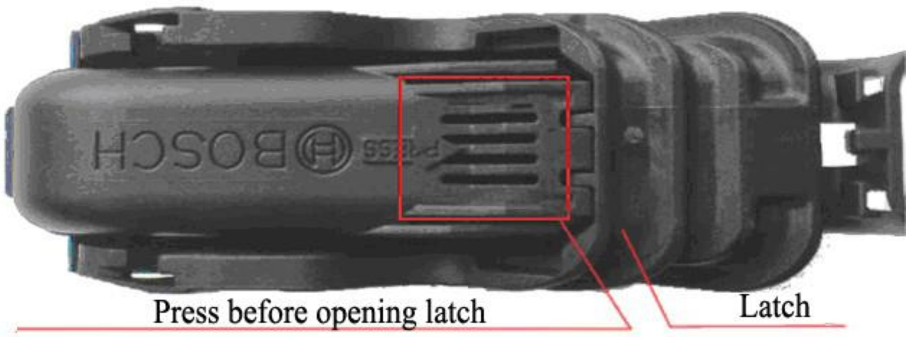


Fig. 7.72.

To connect the frame harness terminal block to the hydraulic control valve, it is necessary to:

- connect the frame harness block (the latch is latched at the top) with the hydraulic unit;
- turn the block latch down *until it clicks*.

8. Cab

ATTENTION
In order to avoid breakage of the fasteners of plastic parts, it is necessary to strictly follow the procedure for disassembling and assembling these parts.

8.1. Cab design

8.1.1. Three-seat cab design

The vehicle cab is all-metal, half-bonnet, three-seat, two-door; equipped with dashboard with built-in air intake, heater located on the front panel under the dashboard, windshield washer and wiper, sun visors, interior dome light, handrail, door pockets[1)] for a first aid kit and documents, seats, seat belts, antenna, and other devices and tools.

To stabilize the engine temperature conditions in cold weather and achieve comfortable conditions in the passenger compartment, a preheater-heater[1)] can be installed on some vehicles, which provides heating of the coolant passing through it using the heat from fuel combustion.

An air conditioning system is provided to create a comfortable microclimate in the vehicle passenger compartment[1)].

To ensure ventilation, check valves are installed on the vehicle to prevent dust, water and other foreign objects from entering the compartment from the outside.

The vehicle is equipped with an overhead console with a pocket and a glasses bin.

Heat and sound insulation of the cab consists of molded multilayer parts for hood and front panel insulation, floor mats and parts made of polymer-bitumen composition, welded onto the doors, roof, floor, rear and front panels.

To protect against corrosion after phosphating, the cab should be covered with cataphoretic and secondary primer. For sealing, additional anti-corrosion protection and damping of structure-borne noise, the cab bottom, internal and external welds, flange connections are coated with plastisol or plastisol mastics. The outer surfaces are covered with enamel. Hidden cavities are treated with protective waxes.

Cab tightness is ensured by rubber seals of doors, door glass, electrical components, levers, engine control drives and chassis units. The windshield glass is adhered to the opening.

[1)] - Installed on some of the vehicles
[1)] - For vehicles equipped with preheater-heater
[3)] - For vehicles equipped with air conditioner

The cab consists of subassemblies - the base, the right and left sidewalls, the front, the roof, the rear, which, when assembled and welded, form a power frame based on box-shaped sections.

Some parts of the trim package are removable. The front bumper, radiator frame base (frontend) and fenders are attached to the cab with screws. The hood is mounted on swivel hinges bolted to the front panel extension. The front bumper is made of shock-resistant elasticated polypropylene, the frontend is made of heat-stabilized glass-filled polypropylene, the vehicle fenders are made of a modified polyamide-based composite.

The cab is attached to the frame on four supports (Fig. 8.1). Two front metal-rubber supports rest on a subframe, rear rubber pads are installed in brackets attached with bolts and nuts to the frame side members. Access to the rear support mounting bolts is provided through holes located in the cab floor and closed with plugs.

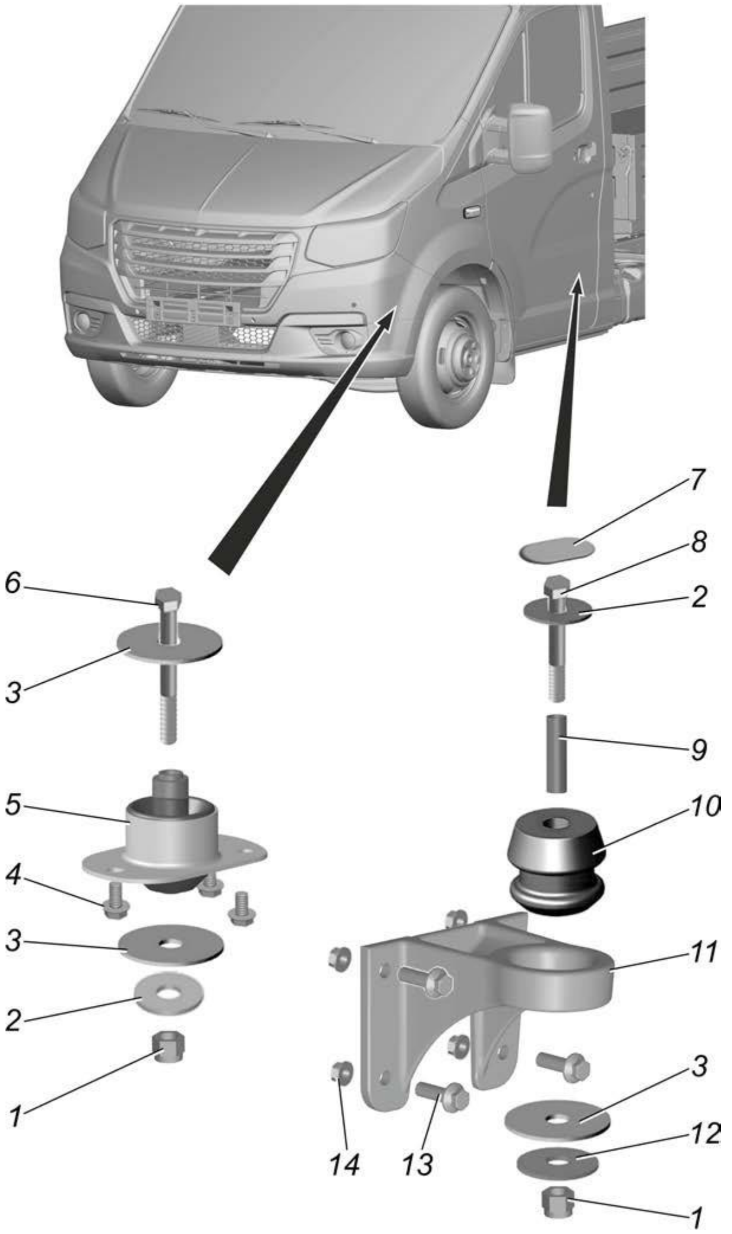


Fig. 8.1. Cab fastening to front suspension subframe and frame: 1, 14 – nuts; 2, 3, 12 – washers; 4, 6, 8, 13 – bolts; 5 – front support; 7 – plug; 9 – distance bushing; 10 – pad; 11 – rear cab mounting bracket

The cab is equipped with two hinged doors. Door openings are made in welded sidewalls.

The cab door consists of panels: outer and inner with stiffeners and door panel connectors. The door inner panel has a power window regulator, a lock and a lock drive are fixed and covered with a molded trim. Fixed and sliding glass are mounted on the door. Door openings are sealed with closed rubber seals.

The doors are connected to the cab using two hinges. Door hinges are a two-link mechanism, one part of which is fixed on the cab sidewall, and the other is welded to the door inner panel.

A limiter is installed to limit the opening of the door and fix it in the open position.

The roof and rear liners are made of a thermoformed carcass material with a thermoplastic binder, lined with a decorative liner material. The rest of the liners, dashboard and inclined strut moldings are made of mineral-filled polypropylene. The liners are fastened with plastic clips or self-tapping screws and special nuts.

The cab has a floor mat made of a multilayer composite material with a wear-resistant decorative top layer based on polyurethane or PVC film, a noise-absorbing layer of flexible polyurethane foam and a waterproofing bottom layer, and a rear floor mat made of needled pile fabric. On the door footboards, the mats are pressed by the footboard flooring made of impact-resistant polypropylene.

The cab has a seat for the driver and a dual seat for passengers. Depending on the vehicle configuration, the driver’s seat can be equipped with an electric seat heating, an adjustable armrest and a seat backrest lumbar support stiffness adjustment mechanism. The passenger seat has no adjustment mechanisms.

All seats are equipped with seat belts, and the extreme seats are equipped with three-point seat belts with inertial coils, the central one is equipped with two-point lap belt. The seat belts for the driver and right passenger are equipped with height adjustment mechanisms for the upper seat belt guides in order to ensure the most comfortable use of the belts. The seat belt buckles are equipped with sensors that activate the seat belt indicator in the instrument cluster.

Heat-absorbing glasses can be installed on some vehicles, which provide a comfortable temperature in the vehicle interior, protect the interior from fading, increase the contrast and clarity of the image, which helps reduce eye fatigue and improves the quality of driving.

Some vehicles can be fitted with electrically heated windshields.

8.2. Cab maintenance features

Paint care

The basis for the durability of the cab paintwork and its anti-corrosion protection is laid during manufacture, however, the preservation of the protective and decorative properties of the coating largely depends on timely and proper care, which is as follows:

- regular cab washing and polishing;
- timely elimination of damage to the paintwork and plastisol coating;
- periodic treatment of the cab with protective compounds.

Regular washing is a necessary means of protecting your vehicle from harmful effects of the environment.

The longer salt, road and industrial dust, adhering insects, bird droppings, etc., remain on the vehicle, the faster the process of paintwork destruction and corrosion formation develops.

It is better to wash the vehicle before the dirt dries, pouring it abundantly with a low-pressure water jet using a soft sponge.

Never remove dust and dirt with a dry cloth. In summer, wash the vehicle outdoors in the shade. Washing in the sun or after driving while the hood is still warm may cause the paintwork to fade.

When washing the vehicle, do not allow a direct jet to hit the electrical equipment and detachable connections in the engine compartment.

In winter, after washing the blade in a warm room, wipe the body dry before leaving, as when the wet surface of the body freezes, cracks can form on the paintwork.

When washing, it is not always possible to remove bitumen stains from the road surface, traces of oil, stuck insects, etc. But since over time these contaminants (especially bird droppings) damage the paintwork, they must be removed as soon as possible using special automotive cosmetics.

The following is **FORBIDDEN** when washing a vehicle:
- use chemically active compounds and substances that have a negative effect on color, for example, soda, kerosene, gasoline, solvents, sea water;
- use water containing mechanical impurities;
- wash in cold weather.

When washing, it is recommended to use car shampoos.

It is especially important to wash vehicles when driving on roads treated with salt-based deicers. It is also necessary to thoroughly wash the underbody and chassis parts, as deposits of dirt and salt contribute to corrosion.

It is recommended to wash the float body at the same time as washing the cab.

Considering that the float body surface is most susceptible to damage during the transportation of goods, special attention must be paid to the timely elimination of damage.

For the purpose of additional protection of the cab paintwork, it is recommended to periodically polish it, especially before the onset of winter, using wax compounds, according to the polishing agent manufacturer instructions. The protective film created by the wax compound prevents the penetration of iron-containing particles from the industrial atmosphere into the paintwork, which form inclusions of a red color on the coating. It is especially necessary to carry out such processing for vehicles stored outdoors.

Polishing is necessary when the color has faded and the use of protective wax compounds is no longer enough to give it the desired gloss. If the polishing agent used does not contain protective elements, the paintwork should then be waxed.

Minor damage to the paintwork, chips, scratches should be repaired without delay before rust has formed. If rust appears, carefully remove it, then apply a layer of anti-corrosion primer and touch up. These works are recommended to be carried out by specialized maintenance companies.

During operation, the cab paintwork, the underbody coating, the chassis assemblies are constantly exposed to stones, crushed stone, gravel, sand, etc. This entails various mechanical damage to the elements of anti-corrosion protection (paint chips, scratches, abrasive wear).

First of all, this applies to wheel arches, the edges of doors and footboards, the surface of the hood and chassis assemblies.

Therefore, the vehicle must be inspected after washing and, if such places are found, as well as other damage to the paintwork, they must be repaired.

Untimely repair of such damage to the coating will lead to the occurrence of underfilm corrosion, followed by peeling of the paintwork and corrosion damage to the metal.

Specialized maintenance companies have the necessary protective coatings, equipment and experience in performing these activities.

The schematic diagram of areas for applying an additional protective coating is shown in Fig. 8.2.

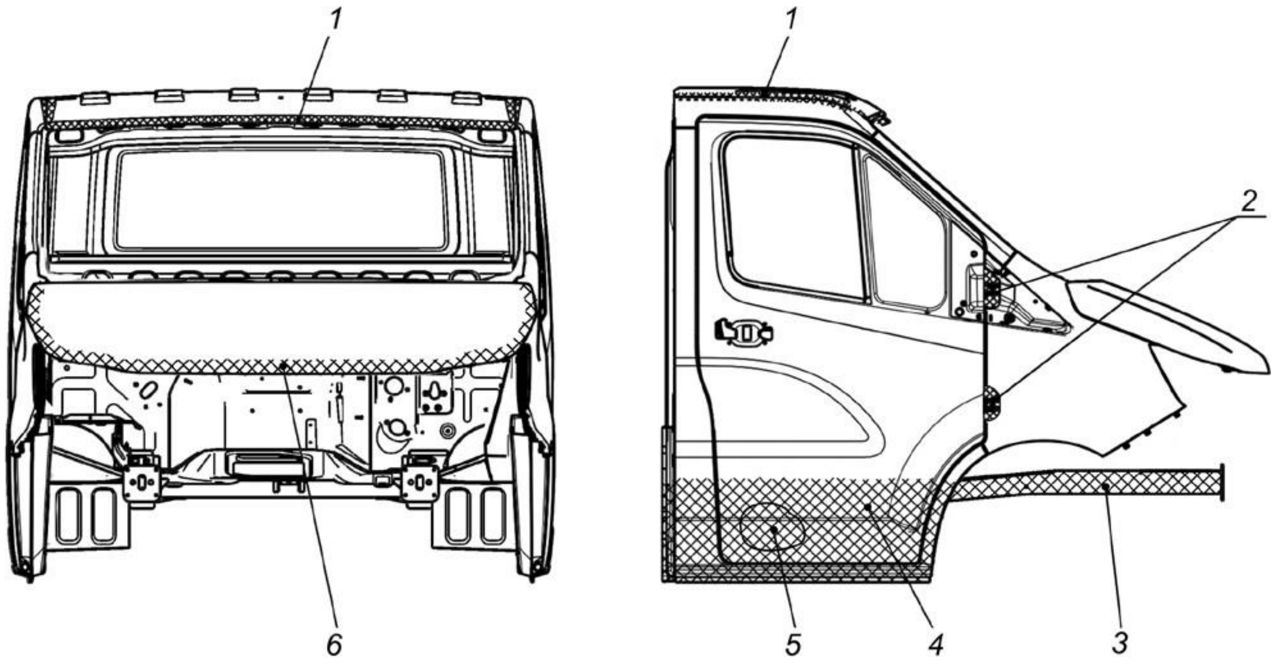


Fig. 8.2. Schematic diagram of additional anti-corrosion treatment areas of three-seat cab hidden cavities: 1 – roof and sidewall connection along perimeter; 2 – door hinge area; 3 – side member cavity; 4 – door cavity; 5 – closed footboard cavities; 6 – hood cavity along perimeter

Maintenance of seat belts

The seat belt maintenance consists in cleaning them from contamination with a mild soap solution.

CAUTION
1. It is forbidden to iron the straps with an iron.
2. Belts must be replaced if they have been critically loaded in an accident.

Maintenance of windows

The window maintenance is necessary at all times of the year to ensure good visibility, which is one of the most important prerequisites for traffic safety. It is necessary to wash not only the outside of the windshield, but also the inside. At a positive ambient temperature, the window cleaning is carried out with clean drinking water, at a negative temperature - using special washing fluids designed to fill the washer tank. The fluid for windows must be of high quality, otherwise the windows will become cloudy.

Cleaning exterior rear-view mirrors

The exterior rear-view mirrors have an anti-reflective coating that reduces glare. To prevent damage to this coating, clean the mirror only with a soft cloth dampened with any glass cleaner.

IT IS PROHIBITED TO
polish the mirror and remove frost with a scraper.

Cleaning exterior lights

Lenses for headlights, direction indicators, tail lamps and decorative rims are made of plastic. Therefore, it is unacceptable to clean them from dust and dirt using various fuels, other active substances and liquids, as well as dry wiping with brushes and rags. It is necessary to remove contamination only with abundant watering of these products with a water jet.

Maintenance of rubber seals

Rubber seals for doors and windows must always be flexible and in good condition. From time to time, it is recommended to lubricate them with a rubber care product so that the seals retain their elasticity in winter.

Maintenance of fabric upholstery

To clean fabric upholstery, use special cleaning products, a dry sponge, a soft brush, a vacuum cleaner.

8.3. Cab repair

The cab components could sustain damage during operation: tears, dents, deformation of parts. When repairing the metal parts of the cab, it should be remembered that after welding the tears on the reverse side of the defective part, a local reinforcement made of sheet steel with a thickness equal to the thickness of the repaired part metal must be welded. Welds must be perpendicular to the tear in the part.

If the paintwork is damaged, the defective surface area shall be cleaned of dirt with sandpaper, degreased with white spirit and tinted with hot-drying synthetic enamel or two-component enamel. Synthetic enamel shall be dried with a reflector, and two-component enamel shall be dried in air for at least 2 hours.

Areas with significant damage (up to metal) before painting with enamel shall be coated with a paint sprayer or a soft brush with primer from PPG, Basf, followed by air drying for 1 hour. Before priming, wipe the damaged areas with a cloth soaked in white spirit. If the paint film is damaged to the primer, the sanded and degreased spot shall be tinted only with enamel. The small paint spots from painting a defective area shall be eliminated by manual polishing using a polishing paste. If the underbody coating is damaged, the damaged surface shall be protected with sprayable MS-polymers such as Simson ISR 70-07 from Bostik or Teroson MS 9320 from Henkel using telescopic or pneumatic guns, followed by air drying (surface film formation after 10-20 minutes, complete curing after 8 hours) or coat with material such as Togocoll D 504/28518 from D Plast, followed by air drying (surface film formation after 40 min, full curing after 24 h).

8.3.1. Cab removal

The workplace must be equipped with a lifting device with a lifting capacity of at least 500 kg.

Before disconnecting the pipelines of the vehicle systems, clean the joints from dirt, after disconnecting, close the openings of the pipelines and assemblies with plugs.

The cab removal must be carried out in the following sequence:

- drain fluid from the cooling system. The expansion tank plug must be removed, and the heater valve must be opened (switch off the ignition when the heater is on);
- drain the oil from the power steering system (see “Steering” section);
- disconnect wires from the battery;
- drain the brake fluid from the hydraulic drive of the brake and clutch (see “Brakes” section);

- remove freon from the pipelines of the air conditioning system using a filling station[1]. (When removing and installing the air conditioning system components, see "Air conditioning system" subsection);
- disconnect the hood from the hinges and remove it;
- disconnect and remove the front bumper panel (see "Front bumper panel removal and installation" subsection);
- disconnect and remove the front bumper base;
- disconnect and remove the radiator frame base (frontend) (see "Engine" section, "Engine removal" subsection);
- disconnect the electrical wires coming out of the cab;
- disconnect the inlet and outlet pipelines from the air conditioning compressor[1];
- disconnect the expansion tank hoses from the branch pipes of the thermostat and the coolant pump, if necessary, remove the fastening straps and move the hoses to the side;
- disconnect the hose from the vacuum brake booster;
- disconnect the wiring block from the temperature and air pressure sensor;
- disconnect the air filter air duct hoses from the engine turbocharger and air filter, remove the air duct;
- disconnect and remove the air filter;
- disconnect and remove the battery;
- disconnect four brake hoses from the brackets and pipes of the ABS hydraulic unit (see "Brakes" section);
- disconnect the pipeline from the clutch master cylinder and the front panel;
- disconnect the heater hoses (preheater-heater[2]) from the coolant outlet pipeline of the exhaust gas recirculation system cooler and from the heater control valve;
- disconnect the grounding wire, which connects the engine and the cab with the battery, from the cab side member stiffener;
- disconnect and remove the driver's seat, the driver's seat base and the passenger seat from the vehicle;
- remove the casing and disconnect the parking brake cable from the lever and cab;
- disconnect the cardan shaft yoke from the steering column intermediate shaft;
- remove the gearshift cable ends from the ball pins of the control linkage cover arms and remove the cables from the cable mounting bracket attached to the gearbox. (see "Transmission" section, "Gearbox" subsection);

[1] - For vehicles equipped with air conditioner
[2] - For vehicles equipped with preheater-heater

ATTENTION
Protect the cable bellow boots and ends from damage.

- unscrew the nuts and remove the bolts and washers securing the front cab supports to the front suspension subframe and the cab to the rear bracket pads. Access to the front attachment points is possible from the engine compartment, to the rear ones – from the cab and from below outside the cab (to provide access to the rear cab mounting bolts, it is necessary to remove the rear mat and floor hole plugs);
- remove the cab using a lifting mechanism, hanging the cab from the door openings, while the doors must be open.

Install the cab on the chassis in the reverse order of removal.

The front metal-rubber supports and rubber pads of the rear brackets must be replaced if the rubber breaks, cracks or hardens, if the rubber is detached from the bushings and supports (front cab attachment points). In case of replacement, before pressing into the rear bracket, dip the pad in soap water.

Before installing the bolts securing the front supports to the cab, apply sealant Loctite 243 (from Henkel) or Weicon AN 302-43 (from Weicon).

Required tightening torques for:

- bolts securing the front supports to the cab – 31-39 N·m (3.1-3.9 kgf·m).
- nuts of bolts securing the front cab supports to the subframe – 80-90 N·m (8-9 kgf·m).
- nuts of bolts securing the rear support brackets to the frame – 56-62 N·m (5.6-6.2 kgf·m);
- nuts of bolts securing the cab to the rear bracket pads – 64-70 N·m (6.4-7.0 kgf·m).

8.3.2. Cab glass replacement

ATTENTION
Glass replacement work must be carried out by two people.

Windshield glass replacement

To adhere the windshield glass to the opening, use the following materials:

- adhesive Teroson PU 8597 HMLC or Teroson PU 8594 HMLC, primer Teroson PU 8519 P (universal); or
- adhesive Sika Tack – Move Transportation or adhesive Sika Tack drive, primer Sika Primer-207 (universal);

or

- adhesive Betaseal 1580, primer Betaprime 5061 (universal);

– isopropyl alcohol for degreasing adhered surfaces. Primers are black liquids based on polyurethane and
containing a solvent.

Adhering should be carried out at a temperature of 18-22 ºC. Before adhering, it is necessary to keep all adhesive components at a temperature of 18-22 ºC for 24 hours.

To replace glass:

– remove the wiper arms with blades, the air intake cover, the hood, the liners of the front struts, the dashboard and the front fenders from the cab;

- remove the interior rear-view mirror, camera holder cover, cab lighting unit, overhead console;

- remove the passenger handrail located above the right cab door, the roof liner, disconnect the windshield electric heating wire connectors and disconnect the windshield wires from the upper stiffener of the windshield opening and the sidewall front strut extension; [1)]

– in an accessible place, pierce a hole in the seal and the adhesive layer between the glass to be replaced and the opening, pass a steel string through the hole. Protect the body paintwork from damage by cutting off the adhesive along the glass perimeter using a stretched string and remove the defective glass. The operation must be carried out by two people;

– remove dirt and remnants of the old seal, smooth out the adhesive remaining on the window opening with a sharp knife, leaving a layer of at least 1 mm thick on it. The adhesive remaining on the opening is an ideal base for adhesion with liquid polyurethane adhesive;

- adhere the camera holder onto the new windshield (see “Camera holder

[1)] - For vehicles with electrically heated windshield

installation" subsection);

- isolate the sharp edge of the windshield opening flange with PVC15x0.2 tape as shown in Fig. 8.4; [1)]

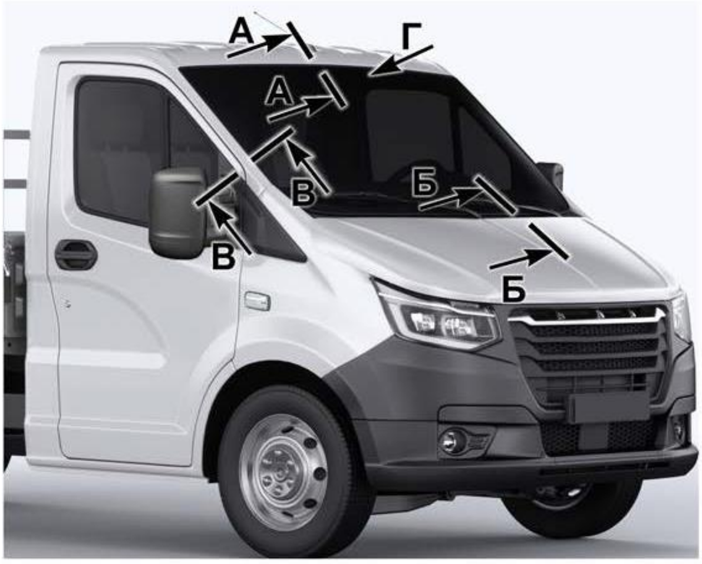
– install a new seal 3 around the glass perimeter (Fig. 8.3, 8.4). The seal must fit snugly against the glass end. Seal wrinkles, waves are not allowed;

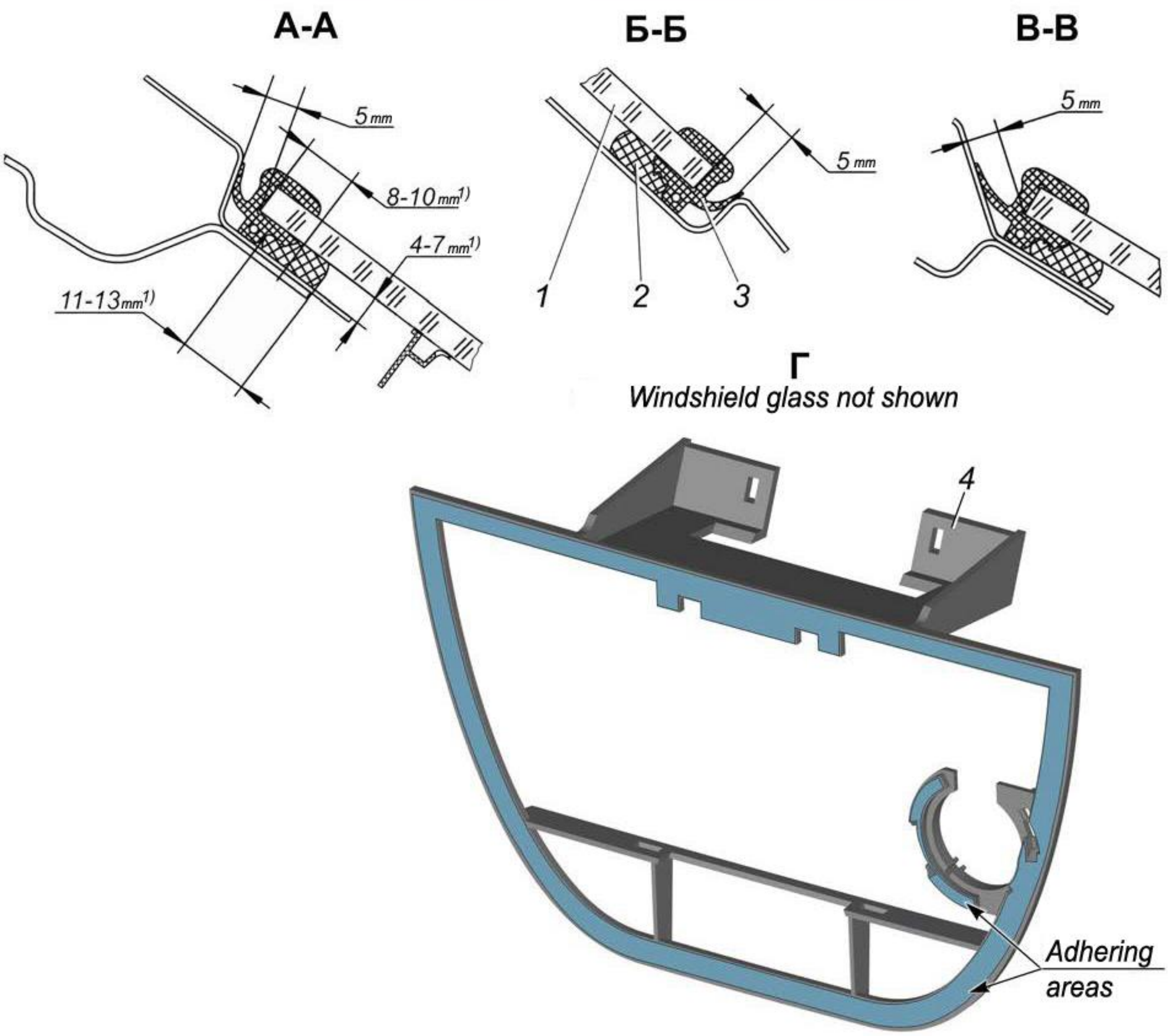
– degrease with a cloth moistened with isopropyl alcohol the adhered surfaces of the cab windshield opening and glass with seal. Drying time 0.5-1 min;

– apply with an applicator or a soft brush evenly, in a thin layer, without gaps, a 23-25 mm wide strip of universal primer or original primer for metal on the windshield opening (on the areas where no cured adhesive left). Wait at least 5 minutes for adhering. Avoid touching the applied primer with hands and cleaning cloth;

– apply with an applicator or a soft brush evenly, in a thin layer, without gaps on the glass surface along the seal edge (Fig. 8.5) a 11-13 mm wide strip of universal primer or primer on the glass. Wait at least 5 minutes for adhering. Avoid touching the applied primer with hands and cleaning cloth;

[1)] - For vehicles with electrically heated windshield





1) *Dimensions are constant along the contour*

Fig. 8.3. Installation of windshield glass without electric heating: 1 – glass; 2 – adhesive layer; 3 – seal; 4 – camera holder

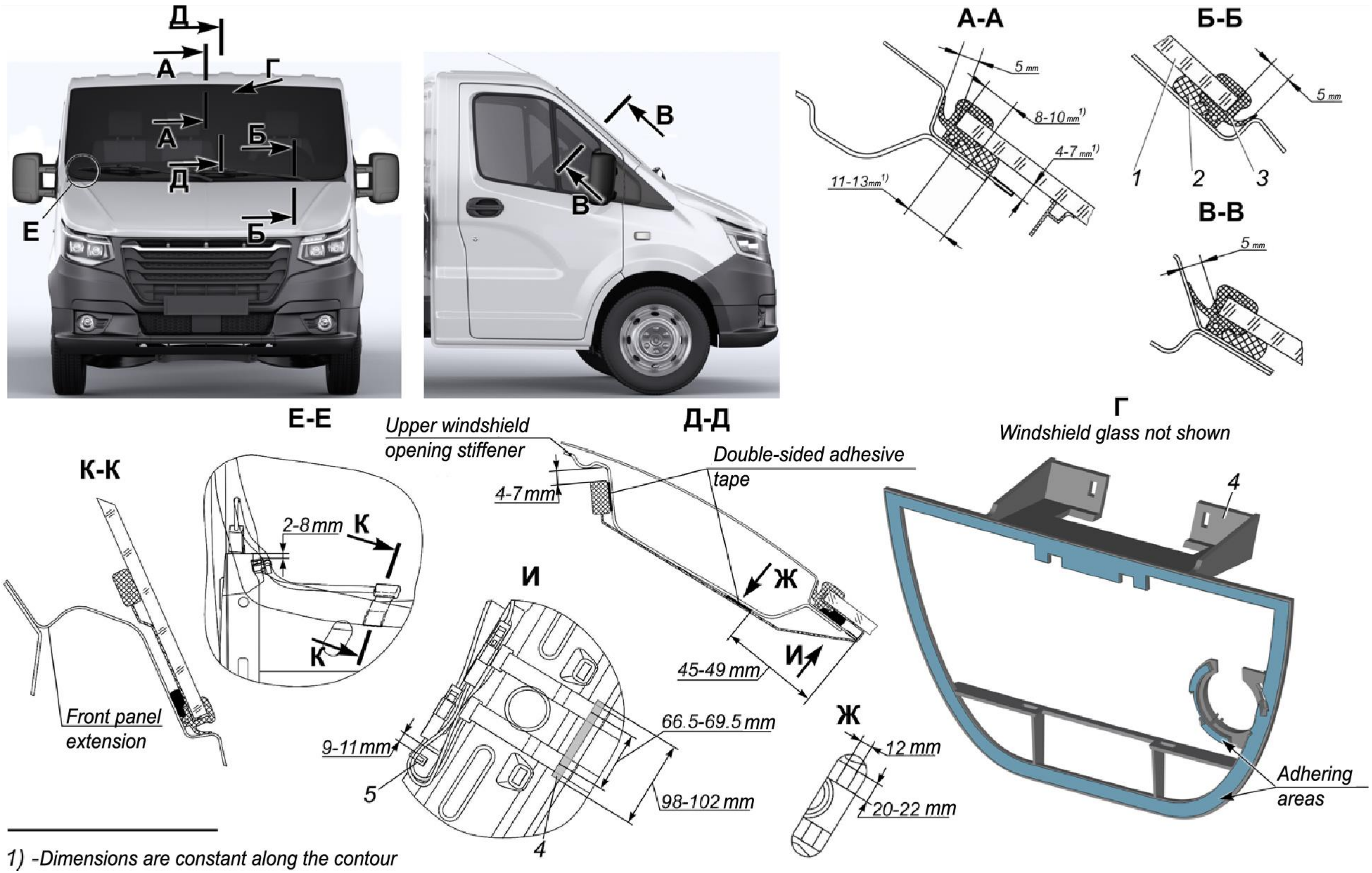


Fig. 8.4. Installation of windshield glass with electric heating: 1 – glass; 2 – adhesive layer; 3 – seal; 4 – camera holder

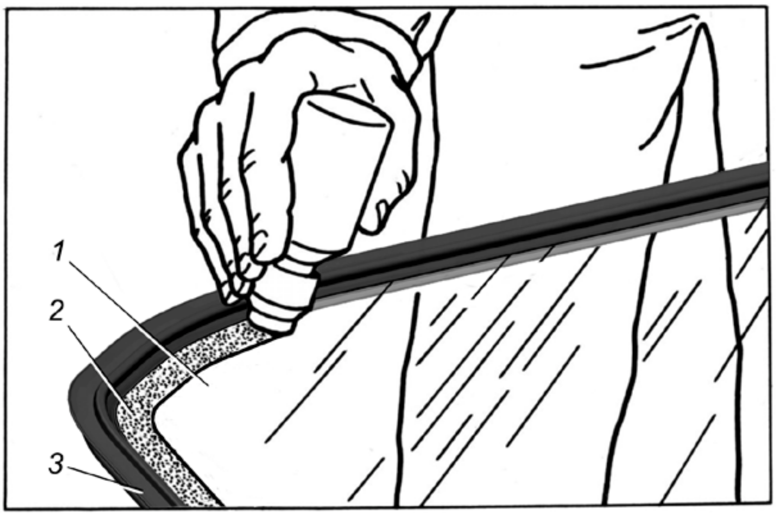


Fig. 8.5. Application of primer to adhered glass surface: 1 –glass; 2 - primer; 3 - seal

– unscrew the nozzle from the cartouche with adhesive and make a cutout in it (Fig. 8.6);

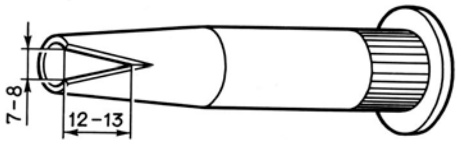


Fig. 8.6. Adhesive application nozzle

– separate the cartouche bottom with adhesive using a knife, pour out the moisture-absorbing powder;

– pierce a hole for the adhesive to come out of the cartouche, screw on the nozzle;

– install the cartouche with adhesive into the tool (Fig. 8.7) and apply adhesive around the glass perimeter (see Fig. 8.8) in the form of a continuous triangular wide strip with a height of at least 10 mm. The wide adhesive strip joint must be located at the bottom of the glass, with the length of the overlap of the wide adhesive strip joint (lock) of at least 15 mm,

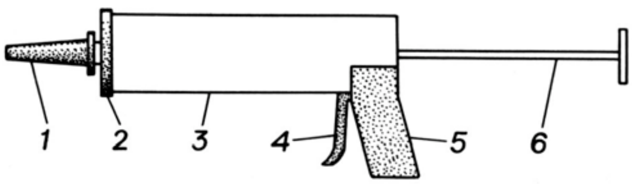


Fig. 8.7. Tool for squeezing adhesive out of the cartouche: 1 – nozzle; 2 - cover; 3 – housing; 4 – lever; 5 – handle; 6 - rod

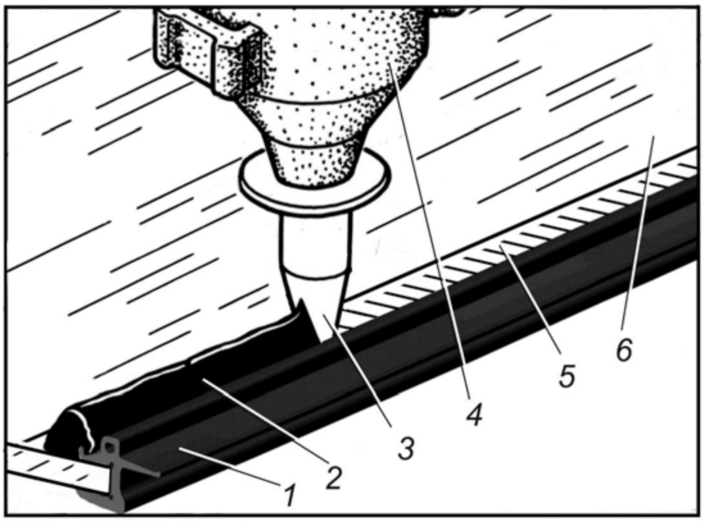


Fig. 8.8. Adhesive application: 1 – seal; 2 – adhesive; 3 – nozzle; 4 – adhesive squeezer; 5 – primer; 6 – glass

– no later than 15 minutes after applying the adhesive, using holders (vacuum cups) attached to the outer side of the glass, install the glass in the window opening (the operation should be carried out by two people), ensuring uniform clearances with the mating cab panels, and press the glass to the opening flanges.

It is not allowed for the adhesive to protrude beyond the glass dimensions outside the cab and onto the opening flange inside the cab.

The seal tab must be in contact with the opening flange;

– fix the glass for 2 hours with rubber bands, threading them around the struts inside the cab (with the doors open);

– after 5-6 hours, check the tightness of the glass-to-metal joints by pouring water from the outside around the glass perimeter using a hose. If necessary, coat the leaks with polyurethane adhesive sealant;

– install the removed parts on the cab.

After fixing the wires for electric heating of the windshield glass, cut off the excess straps to a length of 5-10 mm. [1)]

Camera holder installation

The following is used to adhere the camera holder to the windshield glass: adhesive Teroson PU 8597 HMLC (from Henkel), primer Teroson PU 8519 P (from Henkel).

Adhering the camera holder to the windshield glass must be carried out in the following sequence:

[1)] - For vehicles with electrically heated windshield

- degrease with a cloth moistened with 50% isopropyl alcohol the adhered surfaces of the windshield glass and camera holder. Drying time 2-3 minutes, until complete evaporation;

- matt the camera holder with abrasive Scotch-brite 07447 from 3M or its equivalents;

- re-degrease with a cloth moistened with 50% isopropyl alcohol solution the adhered surface of the camera holder. Drying time 2-3 minutes, until complete evaporation;

- apply evenly, in a thin layer, without gaps, the primer on the holder and on the glass. Wait 4-5 minutes for adhering. Avoid touching the applied primer with hands and cleaning cloth;

- adhere spacers made of double-sided tapes GT 6012 or GT 6212, or PT 1100 (from 3M) or DuploColl 97711.4 AP (from Lohmann), or HN-1080GD (from Hannam Hi-tech Co. Ltd) (on the camera holder ring – 5x5 mm in size in two places, along the camera holder contour – 5-18 mm in size in 3-4 places, evenly distributing them around the perimeter);

- install the cartouche with adhesive in a manual or pneumatic gun and apply adhesive to the camera holder in the form of a continuous wide strip with a height of 3-4 mm;

- install the camera holder on the windshield glass as shown in Fig.8.3, 8.4. Press the adhered surfaces together by hand and hold in a fixed state for 30 s;

ATTENTION
Adhesive must not protrude beyond the camera holder dimensions.

- keep the windshield glass with the camera holder adhered indoors at a temperature of 17-23 °C for 24 hours, then install it on the vehicle.

Sliding and fixed door glass removal

Removal of damaged sliding and fixed door glass must be carried out as follows:

- remove the exterior rear-view mirror (see “Exterior rear-view mirrors” subsection);
- remove the door trim (see “Door trim removal and installation” subsection);
- remove the fixed glass with seal by pushing it out from inside the cab;
- remove the door handle bracket;
- lower the power window regulator slider with the fixed sliding glass down to the access hole, loosen the two screws securing the glass on the slider;
- remove the rear clip of the channel;
- remove the power window regulator (see “Power window regulator replacement” subsection);

- lower the glass down and remove it through the access hole.

Install new glass in the reverse order of removal. The tightening torque of the door handle bracket screws is 7-10 N·m (0.7-1.0 kgf·m).

Rear window glass replacement[1)]

To remove glass:

- dismantle the clips securing the upper rear liner;

- press with a screwdriver and disengage the outer tab of the rear window seal (Fig. 8.9), which closes the window opening in the liner and remove the upper rear liner;

- holding the glass from the outside, squeeze it out from inside the cab together with the seal (at the same time squeezing out the second tab of the seal without damaging it). The work must be carried out by two people, starting from the upper corner of the glass;

- wash the seal in a detergent, clean the flange of the rear window opening and level the opening surface if necessary;

Install the glass in the reverse order of removal. To do this:

- put the seal on the new glass. The seal joint should be at the bottom of the window as shown in Figure 8.9;

- put a cord into the seal groove under the window flange so that its ends converge in the upper part of the glass;

- press the glass assembly with seal from the outside to the window opening so that the seal tab can be tucked behind the window opening flange;

- tucking the seal tab behind the window opening flange, pull out the cord;

- put the cord designed for fastening the liner in the window opening into the seal groove;

- install and fasten the upper rear liner with clips and, putting the outer tab of the seal on the rear liner, pull out the cord. No corrugations on the seal tabs allowed.

After installation, check the tightness of the joints, and, if necessary, coat with mastic.

[1)] – Installed on some vehicles

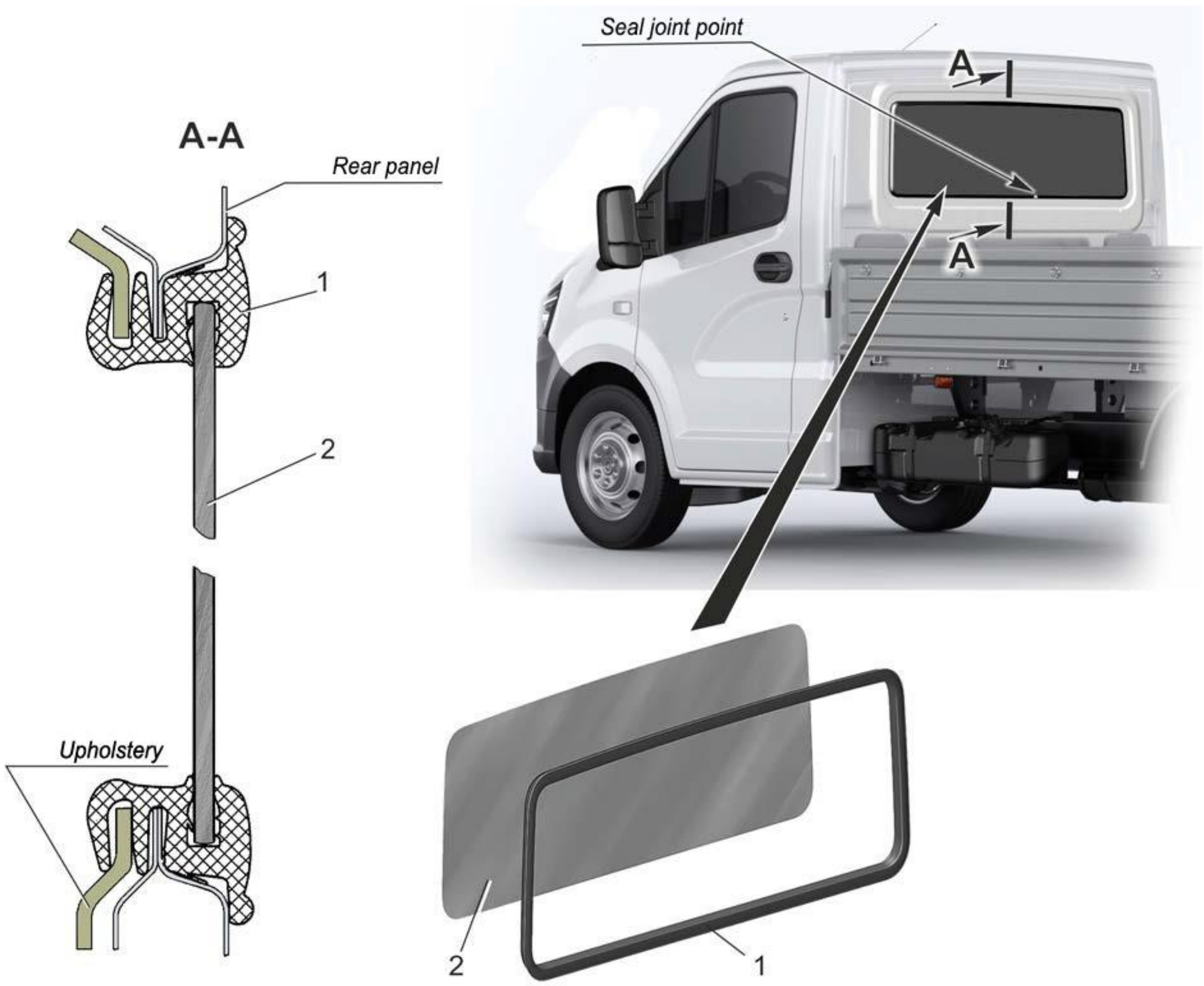


Fig. 8.9. Rear window glass installation: 1 – seal; 2 – glass

8.3.3. Front bumper

Modular front bumper panel (Fig. 8.10), the components of which are made of impact-resistant polypropylene (front bumper panel, lower front bumper panel and hatch covers for towing devices) and a composite material based on polycarbonate and ABS copolymer (radiator grille and radiator grille molding) and fastened together with special latches and screws.

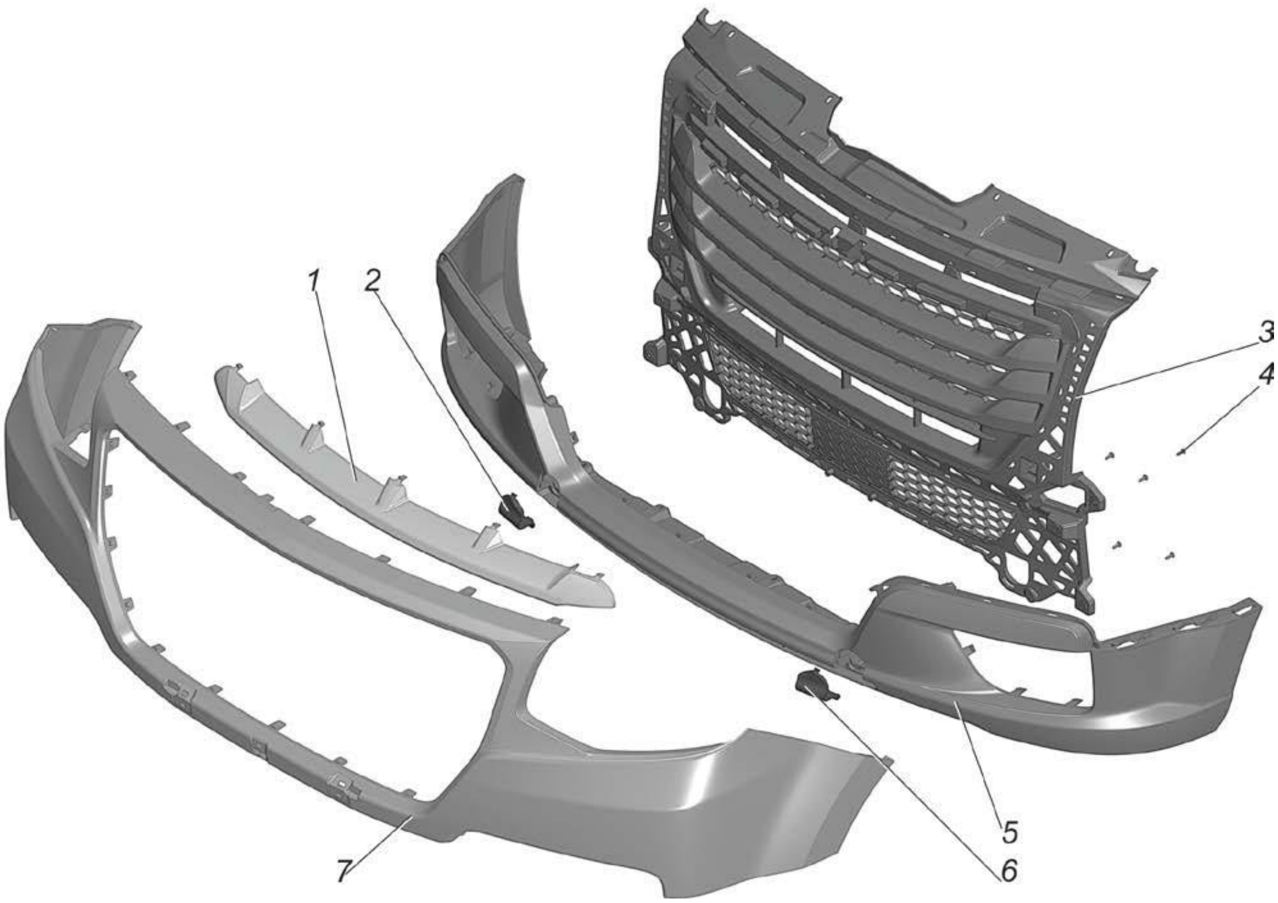


Fig. 8.10. Front bumper panel: 1 – radiator grille molding; 2, 6 – hatch covers; 3 – radiator grille; 4 – screw; 5 – lower front bumper panel; 7 – front bumper panel (upper)

Front bumper panel removal and installation

The front bumper panel removal[1] (Fig. 8.11) must be carried out in the following sequence:

- unscrew the five lower screws securing the front bumper panel to the radiator frame base, four self-tapping screws securing it to the front fender guards;
- disconnect the wire connectors from the fog lamps;[2]
- unscrew two screws securing the number plate and two screws securing the front bumper panel to the front brackets mounted on the radiator frame base;
- unscrew the two screws securing the front bumper panel to the left and right fender holders;
- unscrew the four upper screws securing the front bumper panel to the radiator frame base;
- disengage the front fender guards from the guard holders on the right and left. Disengage the front bumper panel from under the headlight and front fender holders and remove the front bumper panel assembly with plugs from the vehicle;
- remove the holders from the front fenders;
- if necessary, remove the number plate bracket by unscrewing the six fastening screws;
- disengage the front bumper panel latches from the plugs and remove the plugs or plug assemblies with fog lamps[2];
- disconnect the fog lamps[2] from the plugs by unscrewing the three fastening screws.

The front bumper panel installation must be carried out in the reverse order of removal, ensuring the following requirements:

- tightening torque of the screws securing the front bumper panel to the radiator frame base – 4.41-7.8 N·m (0.45-0.80 kgf·m);
- front clearance between the headlight and the front bumper panel P=2-4 mm (Fig. 8.11) must be constant. Clearance unevenness up to 1 mm is allowed;
- front bumper panel and the sidewall panel must form a single surface. Protrusion/recession of max. 0.5 mm is allowed. Clearance of max. 0.5 mm is allowed;
- in the area between points S and T (Fig. 8.11), a smooth decrease in the clearance to 1.5 mm is allowed;
- after installation, adjust the fog lamps (see “Electrical equipment” section).

---

[1] - The front bumper panel removal and installation must be carried out by two people

[2] - For vehicles with fog lamps

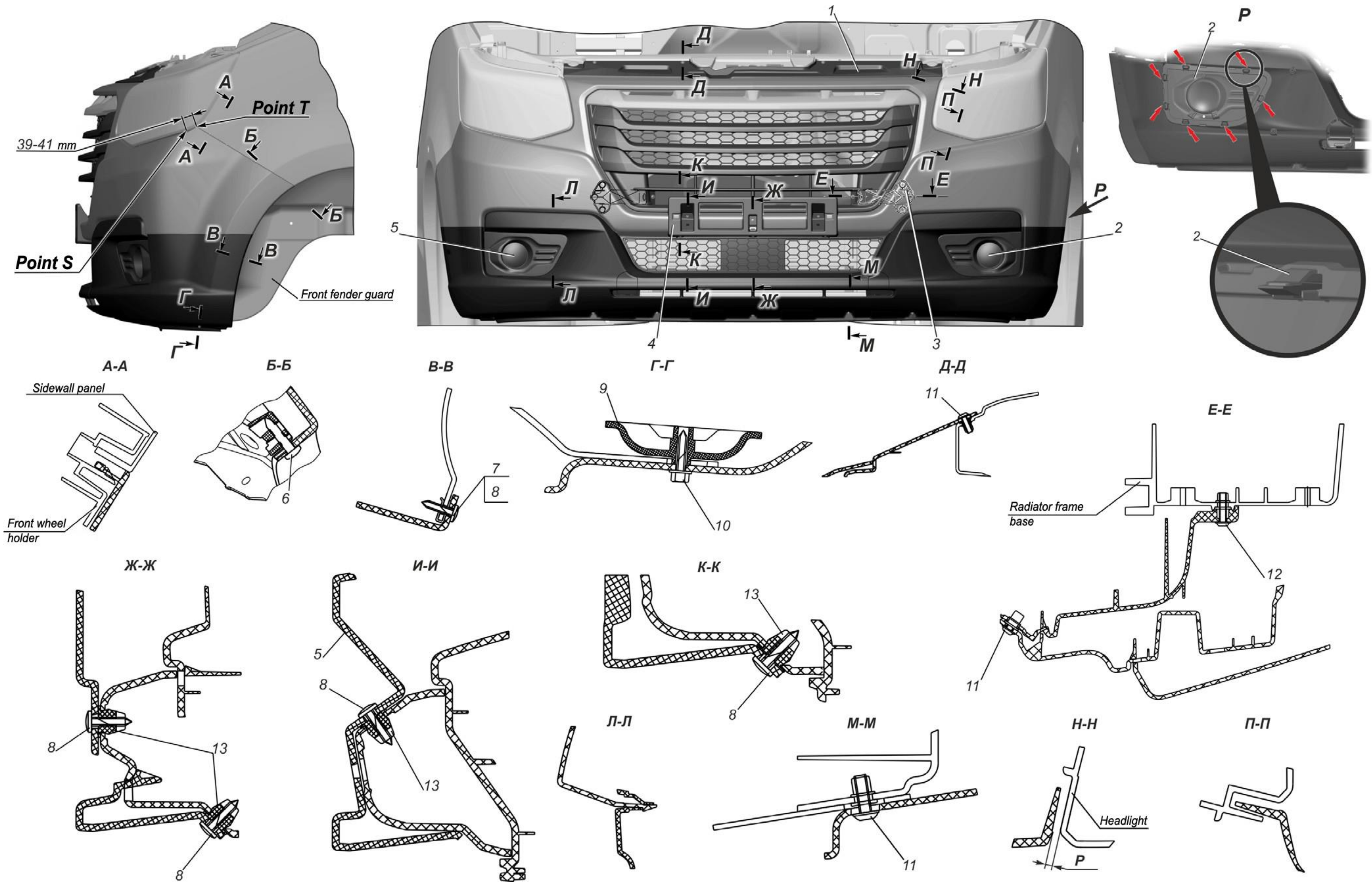


Fig. 8.11. Front bumper panel installation: P=2-4 mm; 1 – front bumper panel; 2, 5 – plugs; 3 – bracket; 4 – front number plate bracket; 6, 8, 10, 11, 12 – screws; 7, 13 – nuts; 9 – front fender guard holder

Disassembly and assembly of front bumper panel removed from vehicle

Disassembly and assembly of the front bumper panel must be carried out when it is fixed in a special tool to ensure the convenience of work and prevent damage to the fasteners and front surfaces of plastic parts during the work.

ATTENTION
In order to avoid breakage of the fasteners of plastic parts, it is necessary to strictly follow the procedure for disassembling and assembling the front bumper panel.

Disassembly of the front bumper panel removed from the vehicle must be carried out in the following sequence:

- unscrew the ten screws securing the radiator grille to the lower and upper panels of the front bumper, the screw locations are shown in Fig. 8.12;

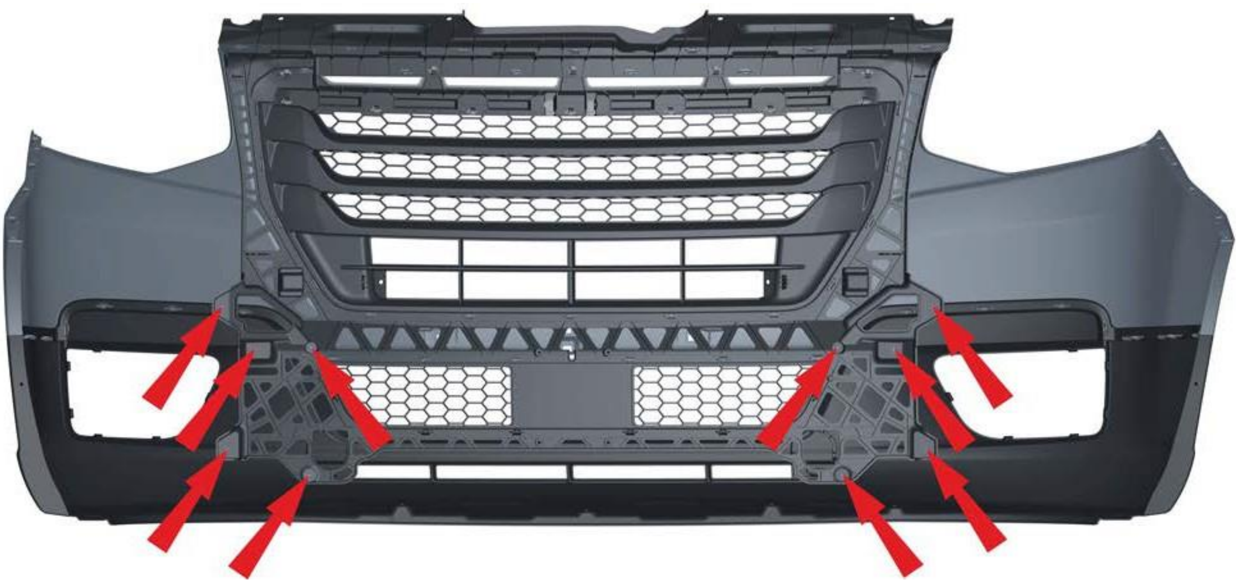


Fig. 8.12. Center panel screw locations

- disengage the latches of the upper and lower panels of the front bumper and the panel tongue from the radiator grille and remove the radiator grille assembly with radiator grille molding. The fasteners of the front bumper panel parts are shown in Fig. 8.13;

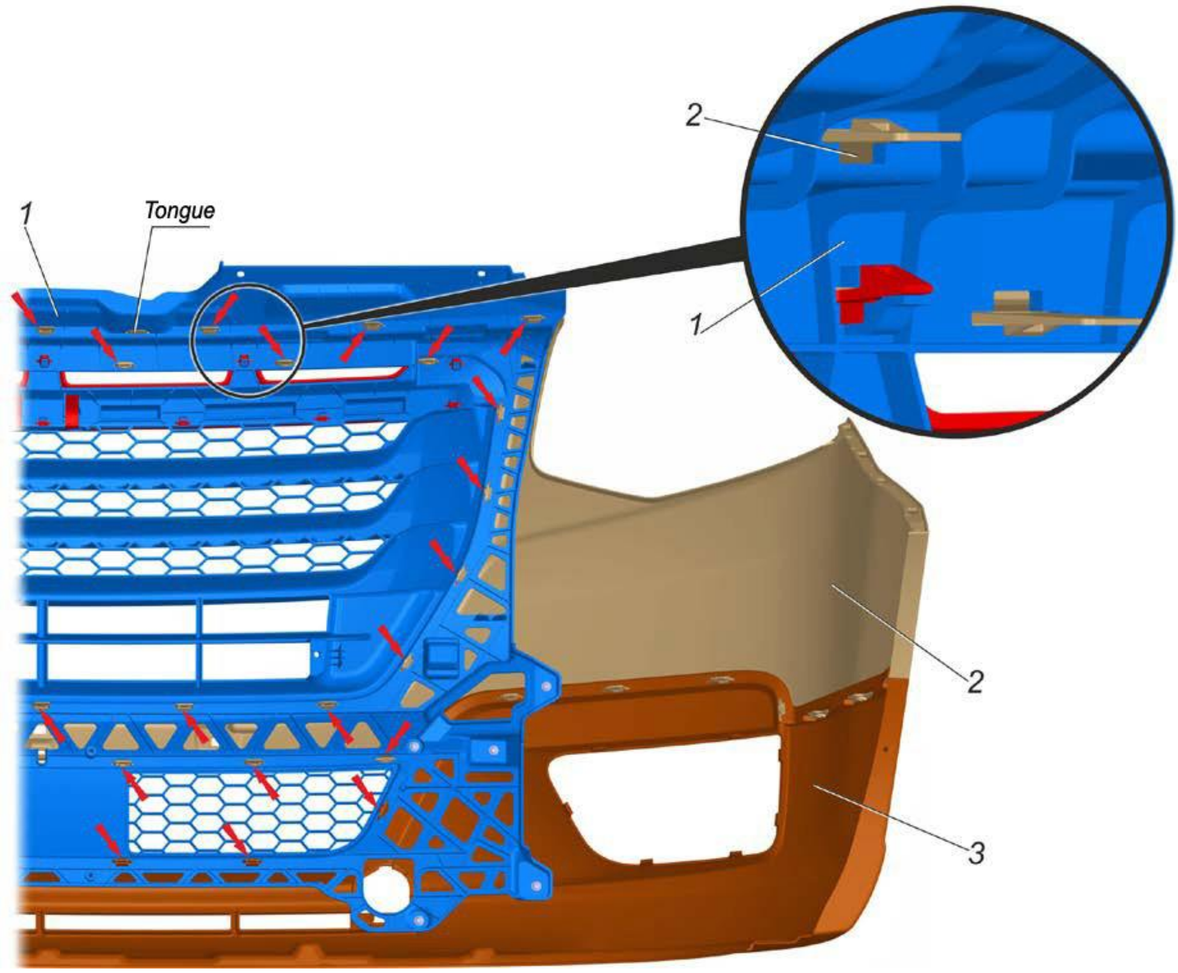


Fig. 8.13. Fasteners of front bumper panel parts: 1 – radiator grille; 2 – front bumper panel (upper); 3 – front bumper panel (lower)

- disengage the radiator grille molding latches from the radiator grille and remove the molding. The fasteners securing the molding to the radiator grille are shown on Fig. 8.14;

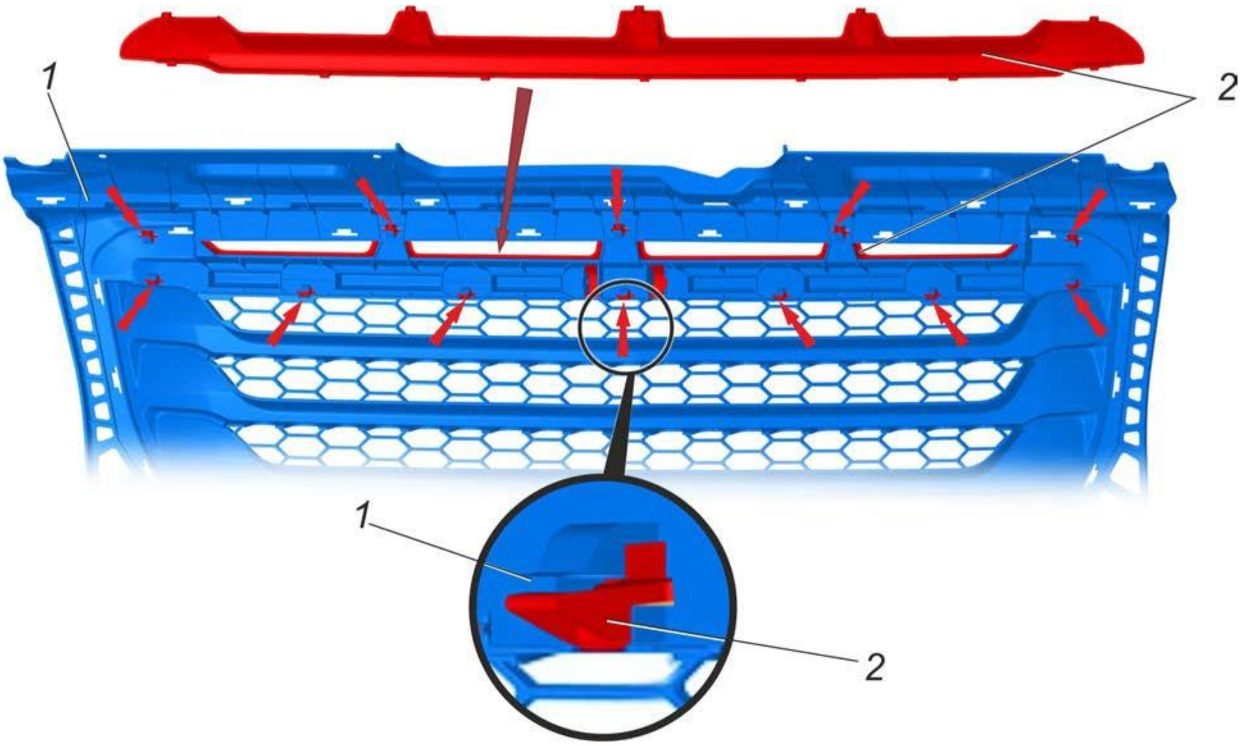


Fig. 8.14. Fasteners securing radiator grille molding to radiator grille: 1 – radiator grille; 2 – radiator grille molding

- disengage the latches of the front bumper upper panel from the lower panel and disconnect the upper panel from the front bumper lower panel. The fasteners securing the front bumper upper panel to the lower panel are shown in Fig. 8.15:

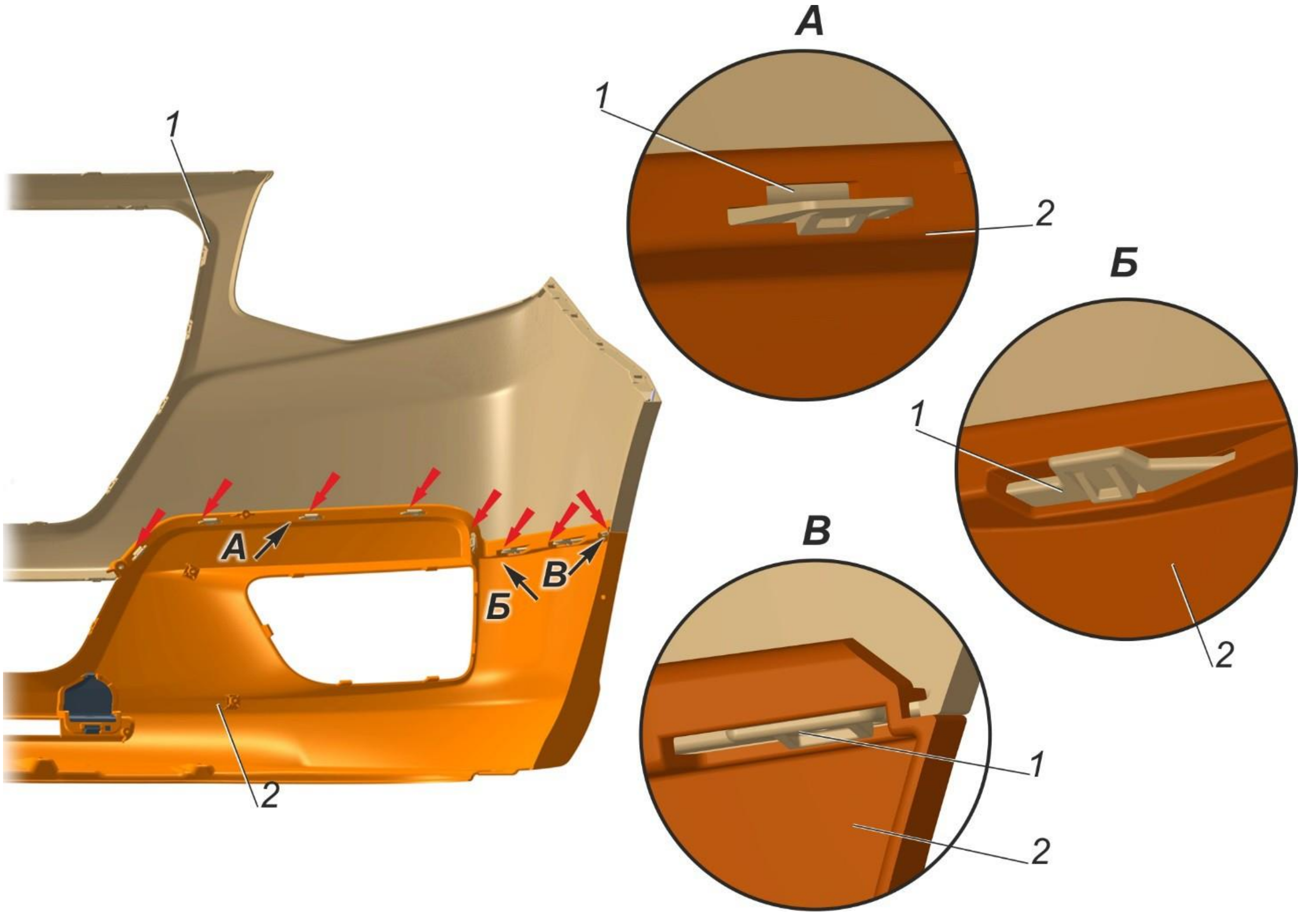


Fig. 8.15. Fasteners securing upper panel to lower panel of front bumper: 1 – front bumper panel (upper); 2 - front bumper panel (lower)

- - disengage the latches of the towing device hatch covers from the front bumper lower panel and remove the hatch covers. The hatch cover fasteners are shown in Fig. 8.16;

Fig. 8.16. Fasteners securing hatch covers to front bumper lower panel: 1 – front bumper lower panel; 2 – hatch cover

The front bumper panel assembly must be carried out in the reverse order of disassembly, ensuring the following requirements:

- mating surfaces of the front bumper towing device hatch covers must not protrude relative to the surface of the front bumper bottom panel. Recession of the front bumper hatch covers relative to the front bumper bottom panel surface up to 1 mm is allowed.

8.3.4. Front fender removal and installation

The front fender removal must be carried out in the following sequence:

- disconnect and remove the front bumper panel (see “Front bumper panel removal and installation” subsection);

- unscrew the screw securing the lower holder to the frontend and remove the bushings, unscrew the three screws securing the front fender to the lower holder and remove the lower holder from the front fender protrusions,

- unscrew screw 9 (Fig. 8.17) securing the mirror molding to the front fender;

- disengage from the fender two latches B (Fig. 8.18) and two centering protrusions A securing the molding 1 and located along the upper edge of the molding;

- remove the molding by disengaging from the front fender two mounting protrusions C, located along the lower edge of the molding;

- unscrew nut 12, screw 15, bolts 10,3, screw 4 and bolt 13 in succession (Fig. 8.17), unscrew nut 7. Disengage the fender hook G from the floor niche and the fender protrusion F (Fig. 8.17) from under the plate of the sidewall front strut extension and remove the fender from the vehicle.

The front fender installation must be carried out in the reverse order of removal.

Tightening torques for:

- nut 7 (Fig. 8.17) and the screw securing the lower holder and the front fender to the frontend – 4.41-7.8 N·m (0.45-0.80 kgf·m);

- bolts 3,10,13 - 2.9-4.9 N·m (0.3-0.5 kgf·m);

- screw 4 - 2.5-3.5 N·m (0.24-0.34 kgf·m);

- tighten screw 15 to the stop.

The clearance between the front surfaces of the fender and the left, right edges of the hood should be 4.5-6.5 mm, the clearance is constant. Clearance unevenness (tapering) up to 1.5 mm is allowed.

Cab lines formed by two or more parts (belt line, maximum width line, fender and hood line forming the headlight opening) must be smooth, mismatch of lines up to 1.5 mm is allowed.

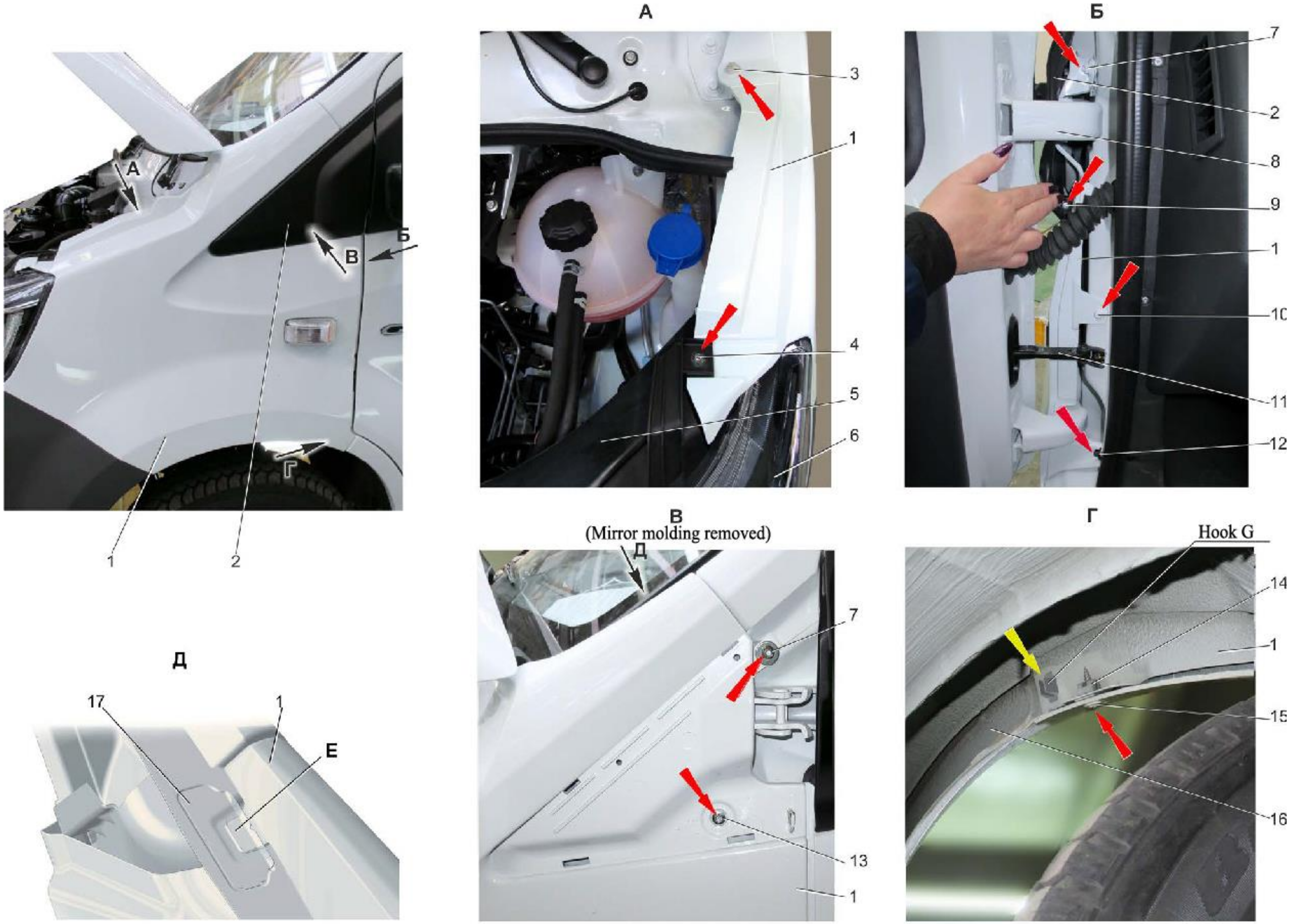


Fig. 8.17. Front fender installation: 1 – front fender; 2 – mirror molding; 3,7,10 – bolts; 4,9,15 – screws; 5 – frontend; 6 – headlight; 8 – hinge; 11 – door stop; 12,13 – nuts; 14 – spring holder; 16 – floor niche; 17 – front strut extension plate

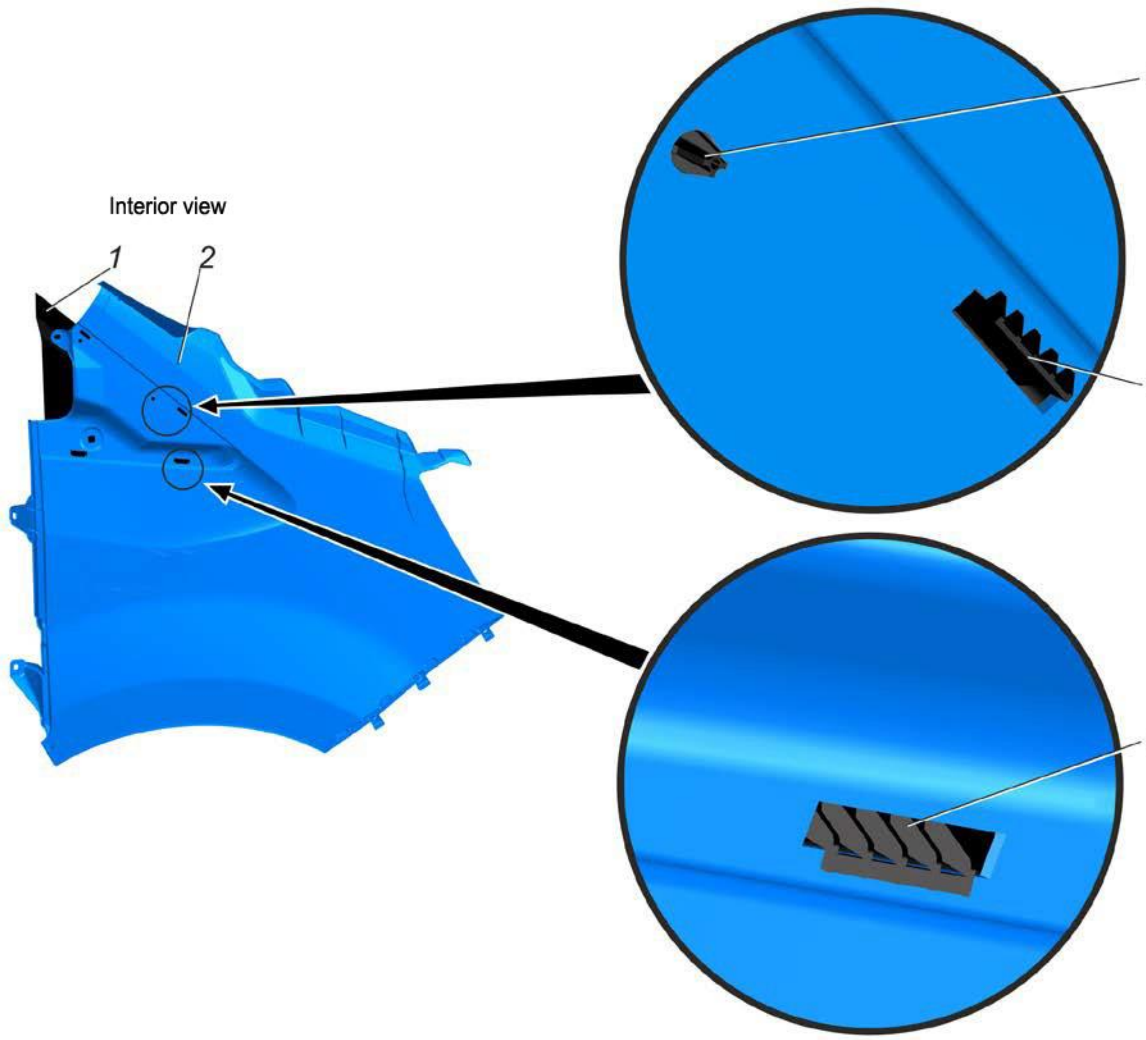


Fig. 8.18. Mirror molding fasteners: 1 - mirror molding; 2 - front fender

8.3.5. Doors

8.3.5.1. Door seal replacement

To remove the door opening jointing edge 3 (Fig. 8.19), it must first be released, dismantling the cab parts if necessary, and then remove the jointing edge from the flange.

A new jointing edge must be attached, starting from the point of installation (see Fig. 8.19). The installation start point is marked on the left door seal with white paint, and on the right door seal with orange paint. The edge jointing should be attached with a rubber mallet or by hand, without applying strong blows. Position the jointing edge joint as shown in Fig. 8.19. Straighten the decorative tab of the new jointing edge by removing the rubber cord located on the inner surface of the tab. After installation, install the previously removed parts on the cab.

If it is necessary to replace the seal 2, clean the old seal and degrease the cab sidewall opening surface, adhere a new seal as shown in Fig. 8.19 after removing the protective coating from the seal adhesive surface.

Installation of buffers and seal of the front door opening are shown in Fig. 8.19.

Clearance C (see Fig. 8.19) between the buffer 4 and the cab sidewall is provided before the installation of the lock, jointing edge and seal of the front door opening, provided that the buffer touches the cab sidewall surface and the door surface recesses relative to the sidewall surface in buffer installation area G (Fig. 8.19) by 3-4 mm.

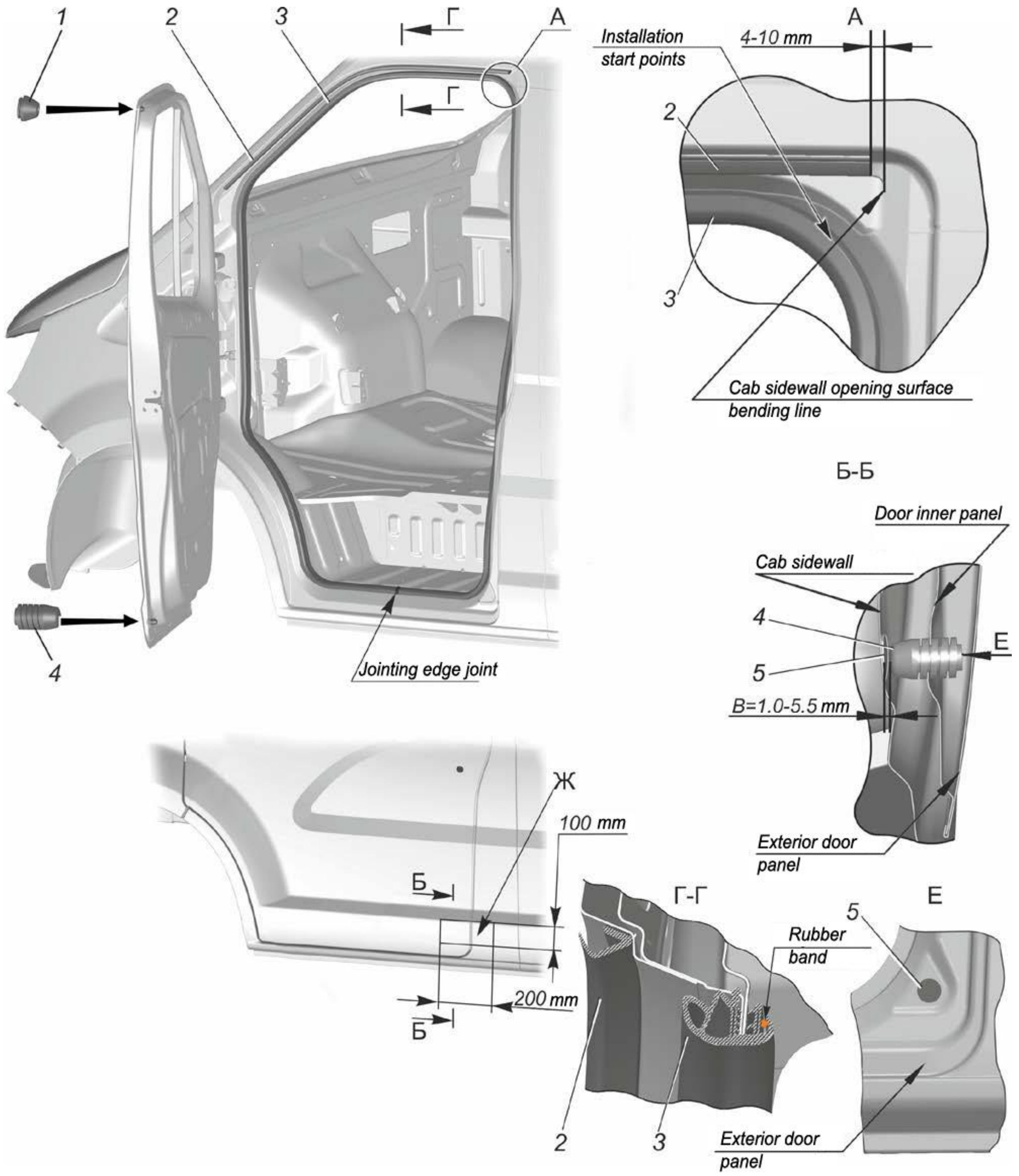


Fig. 8.19. Door seal installation: 1,4 – buffers; 2 – seal; 3 – jointing edge; 5 – protective sticker

8.3.5.2. Door upper hinge

Hinges are used to open and hold the door in a vertical position, and a door stop is used to limit the opening angle and fix (hold) the door in two open positions (Fig. 8.20).

The fixed links of the hinges are equipped with metal-fluoroplastic bushings, so the hinges do not require in-service maintenance.

To remove the front door in case of their damage:

- remove the fender (see “Front fender removal and installation” subsection);
- remove the exterior rear-view mirror (see “Exterior rear-view mirrors” subsection);
- remove the door trim (see “Door trim removal and installation” subsection);
- disconnect the wire connectors of the loudspeaker, the lock actuator and the power window regulator and remove the wiring harness from the door;
- disconnect the limiter from the cab sidewall by unscrewing the screw;
- unscrew the bolts securing the pivots to the sidewall and remove the door.

Install new or repaired doors in the reverse order of removal: first fix the hinges on the cab, and then attach the limiter to the sidewall.

During the installation of doors, it is necessary to maintain clearances, see Fig. 8.21.

The surfaces of the doors must match the surfaces of the mating parts.

It is allowed to recess the edges of the front doors in the area between points M1 and O1 (Fig. 8.21) relative to the surface of the sidewall arches up to 1 mm.

It is allowed to recess the edges of the front doors at point P1 relative to the surfaces of the windshield pillars up to 1 mm.

The protrusion of the door rear edges relative to the sidewall surface up to 1.5 mm is allowed.

In the areas between points E1 and F1, G1 and I1, J1 and K1, L1 and M1, P1 and Q1, a smooth change in the clearances is allowed.

For longitudinal and vertical door clearance adjustment, it is necessary to loosen the bolts securing the door hinges to the cab sidewall and the screw securing the limiter to the cab sidewall.

Upon the end of the adjustment, it is necessary to tighten the mounting bolts. The tightening torque of the screw securing the limiter to the sidewall is 17.65-24.51 N·m (1.8-2.5 kgf·m), the bolts securing the hinge to the sidewall – 78.45-98.06 N·m (8-10 kgf·m).

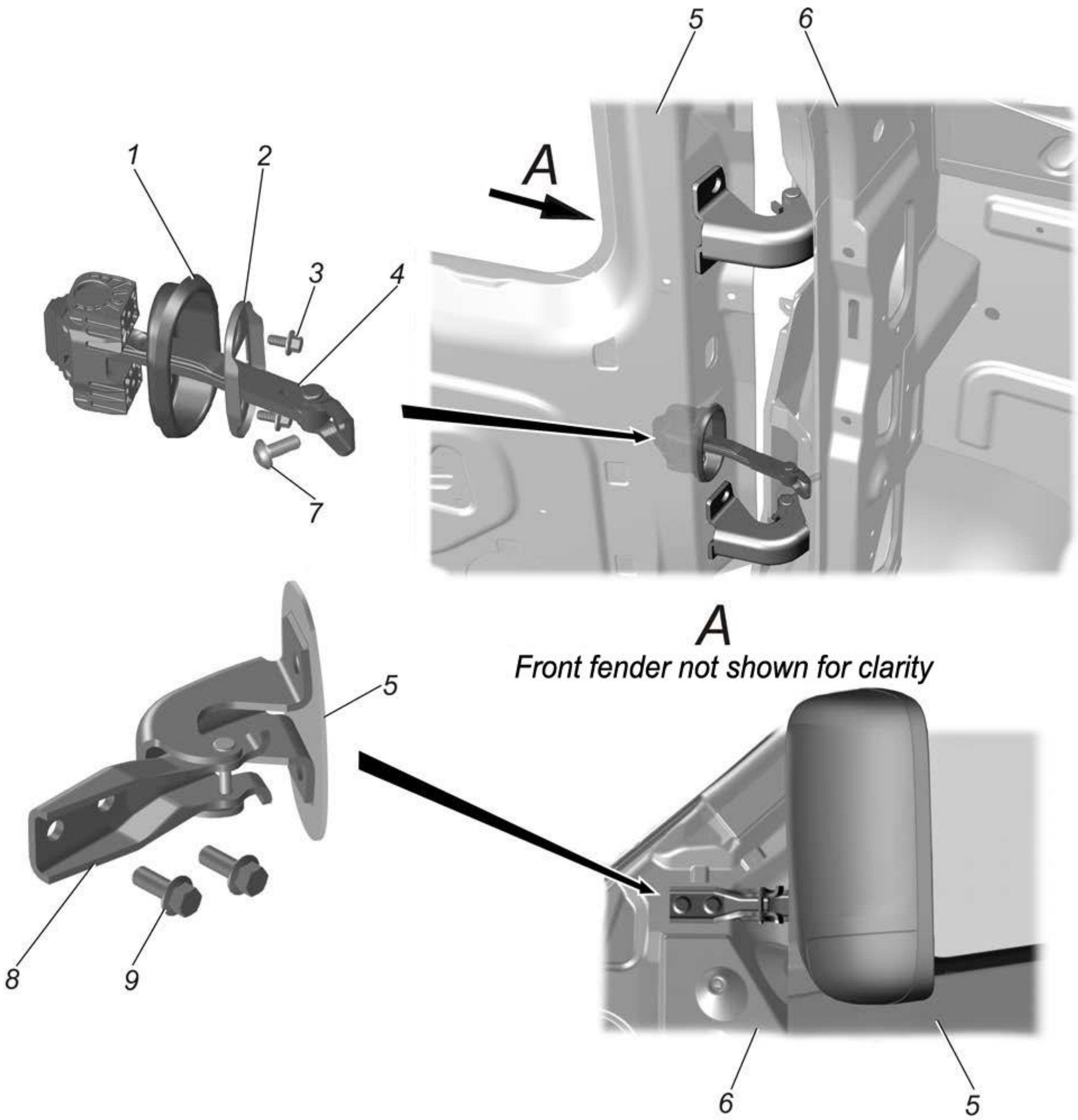
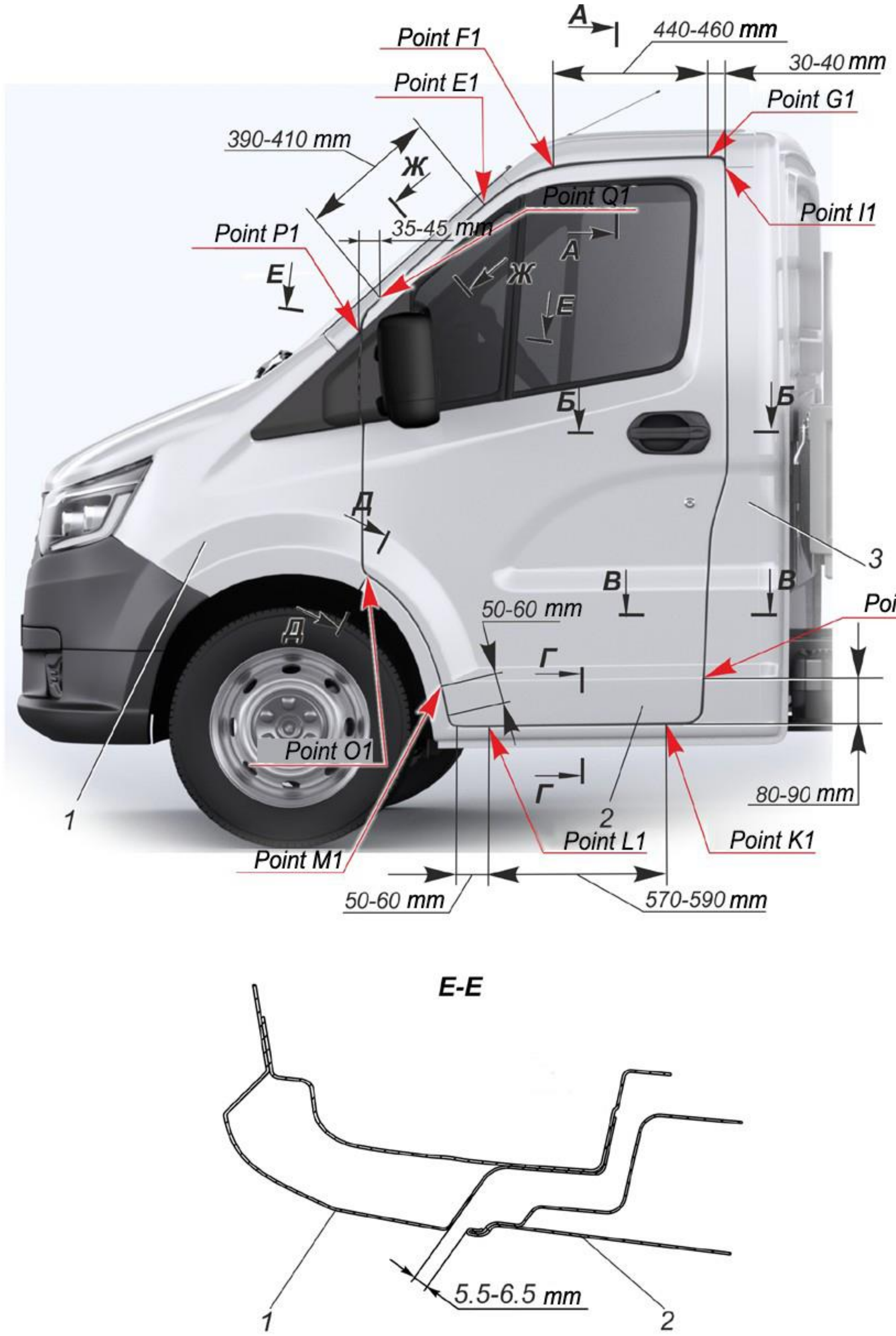
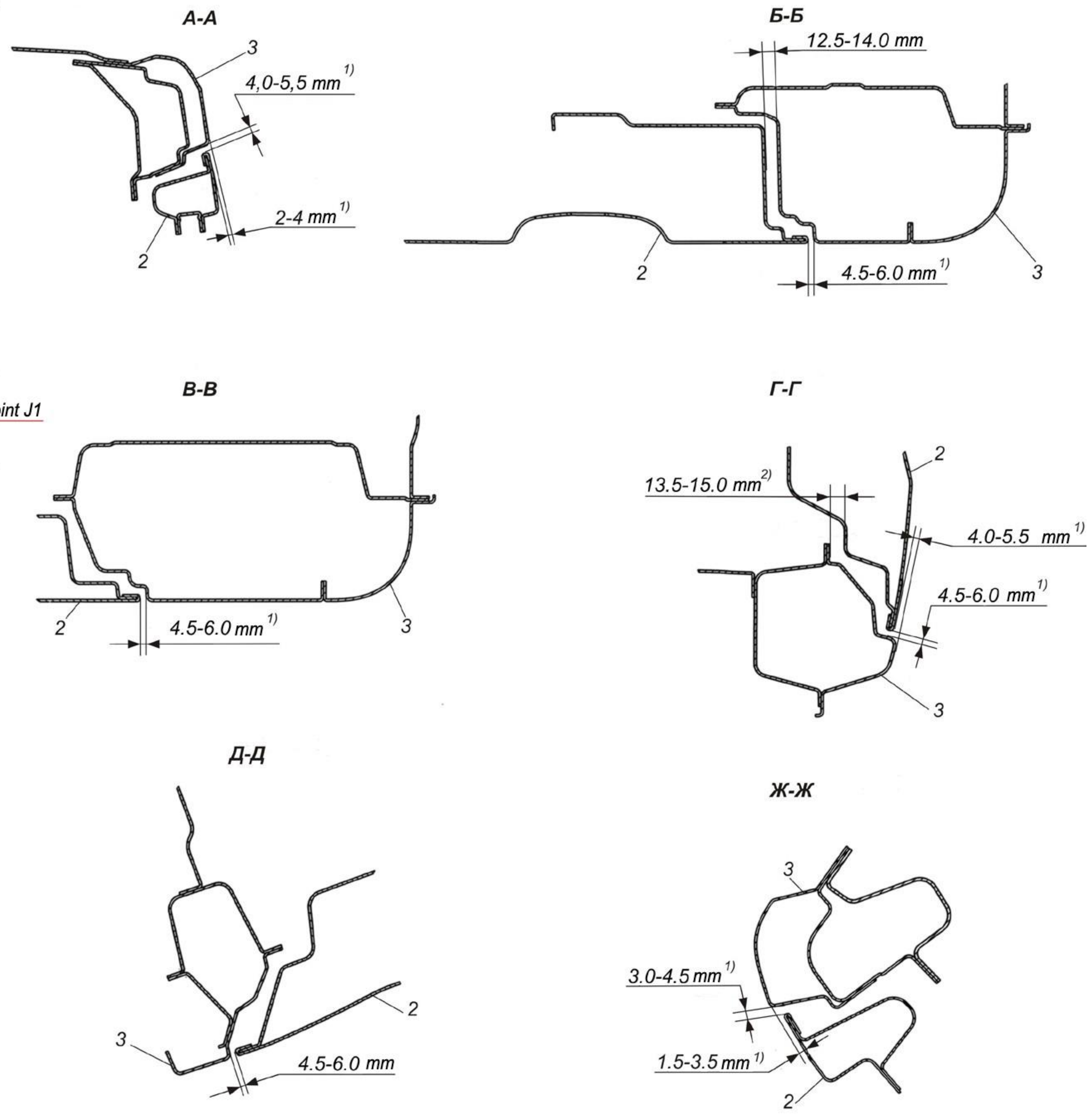


Fig. 8.20. Front door upper hinge: 1 – limiter seal; 2 – plate; 3, 9 – bolts; 4 – limiter; 5 – door; 6 – cab sidewall; 7 – screw; 8 – hinge;





1) - Constant clearances. Clearance unevenness (tapering) up to 1.5 mm is allowed.
2) - Constant clearance along the contour
3) - Constant clearance. Clearance unevenness (tapering) up to 1 mm is allowed.

Fig. 8.21. Front door installation clearances: 1 – fender; 2 – door; 3 – cab sidewall

The limiters must clearly fix the doors in two open positions and not prevent the doors from closing outside the fixed positions. Squeal, crackling and play of moving parts are not allowed.

A faulty limiter must be replaced with a new one.

ATTENTION
Shock and force effects on the limiters during transportation, unpacking and installation are not allowed.

The **limiter replacement** must be carried out in the following sequence:

- remove the door trim (see “Door trim removal and installation” subsection);
- unscrew the screw securing the limiter to the cab sidewall;
- unscrew the bolts securing the limiter stopper to the door, remove the plate and limiter seal, remove the worn limiter through the door mounting hatch;
- install a new limiter in the reverse order of removal. The tightening torque of the screw securing the limiter to the cab sidewall is 17.65-24.51 N·m (1.8-2.5 kgf·m); bolts securing the plate, seal and stopper of the limiter to the door – 6.86-9.8 N·m (0.7-1.0 kgf·m). Tighten the bolts securing the limiter to the door before tightening the screw securing the limiter to the door sidewall.
- check the limiter serviceability.

8.3.5.3. Door trim removal and installation

The door trim removal must be carried out in the following sequence:
- disconnect wires from the battery (for front doors);
- unscrew the two screws securing the door trim handle to the bracket (Fig. 8.22);

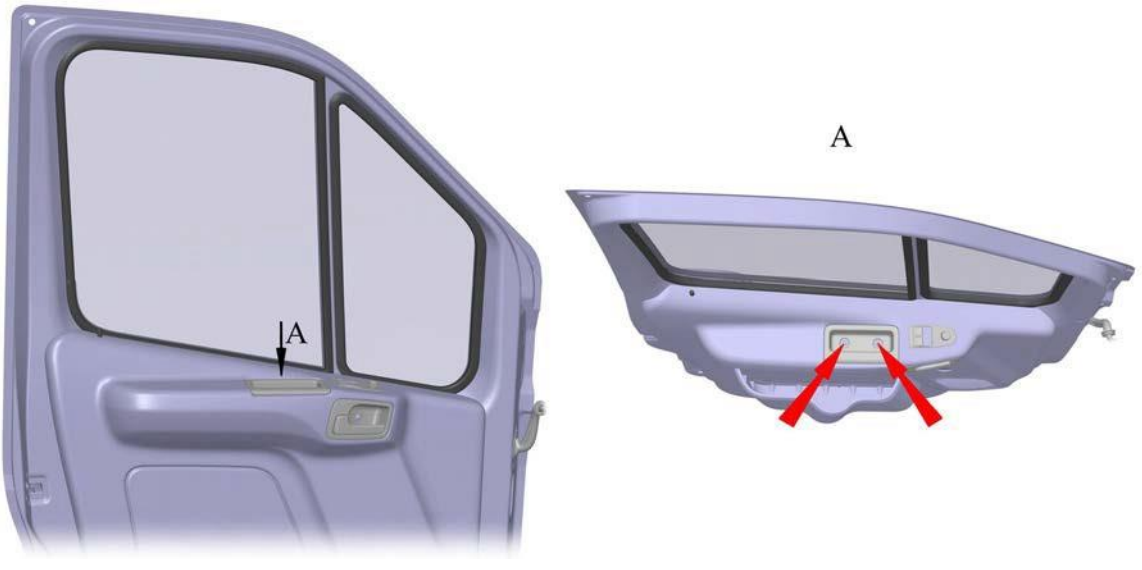


Fig. 8.22. Door trim handle screws

- unscrew the screw securing the lock internal drive socket to the bracket (Fig. 8.23);

Fig. 8.23. Lock internal drive socket screw

- unscrew the two screws securing the trim to the door (Fig. 8.24), located at the trim bottom;

Fig. 8.24. Door trim screws

- remove the power window regulator control switch unit (for the left front door) or the power window regulator control switch (for the right front door) from the trim and disconnect the wire connector;
- sliding the trim up, remove its upper part from the four holders 2 (Fig. 8.25), and disengage from the door seven protrusions C located on the sides of the trim – for the front doors;
- while holding the trim, remove it from the door lock button. Disconnect the cable end from the lock internal drive handle and remove the trim;
- if necessary, in case of replacement, remove the gasket from the door inner panel.

Install the door trim in the order reverse to removal.

The tightening torque of the fastening screws is 7-10 N·m (0.7-1.0 kgf·m).

When assembling, adhere the sealing gasket to the door inner panel after removing the protective coating from the gasket adhesive surface and degreasing the door panel surface.

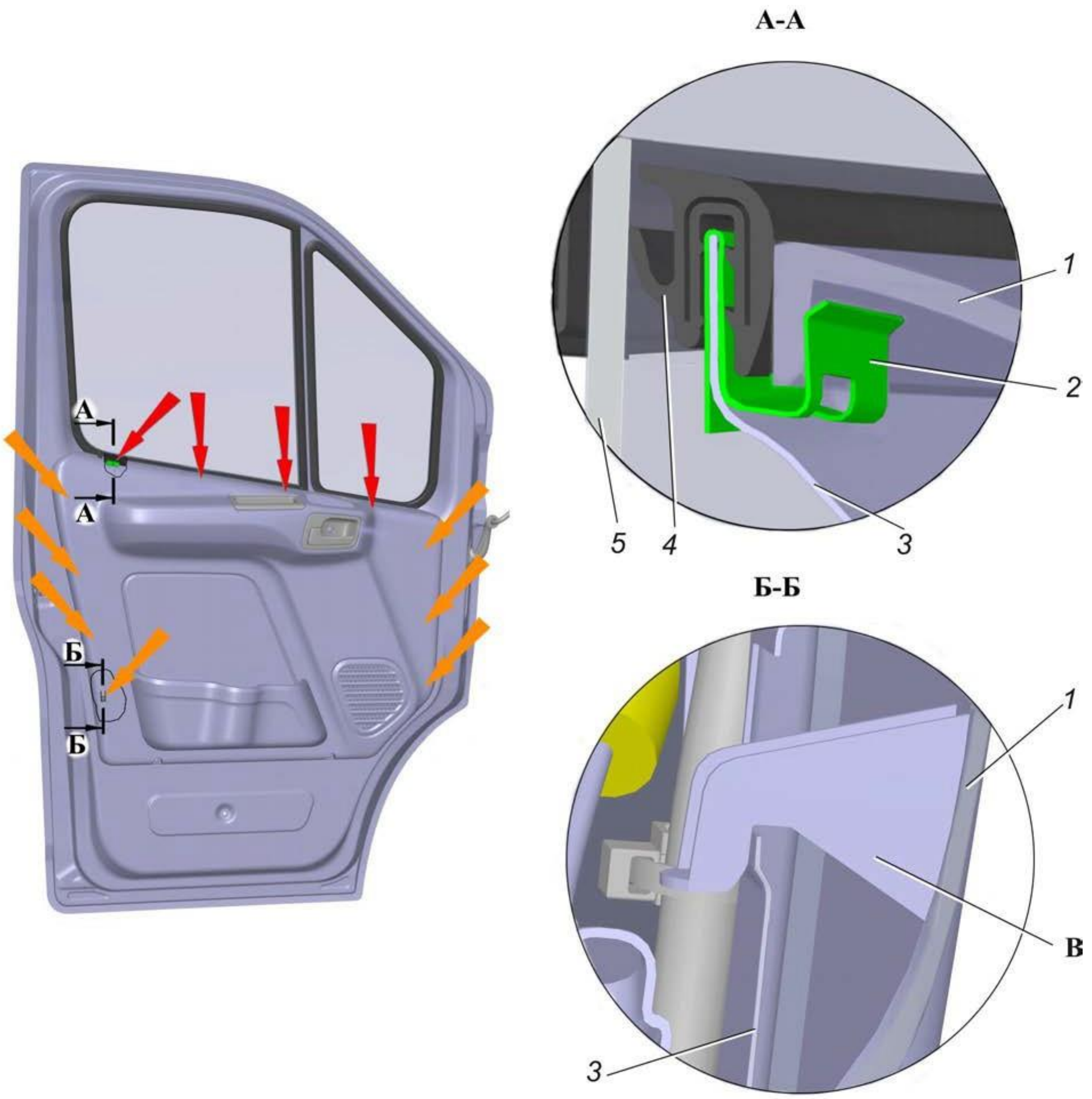


Fig. 8.25. Door trim fasteners: 1 – door trim; 2 – trim holder; 3 – door inner panel, 4 – glass seal; 5 – glass

8.3.5.4. Power window regulators

The power window regulator (Fig. 8.26, 8.27) is used to raise, lower and hold the door window in any position.

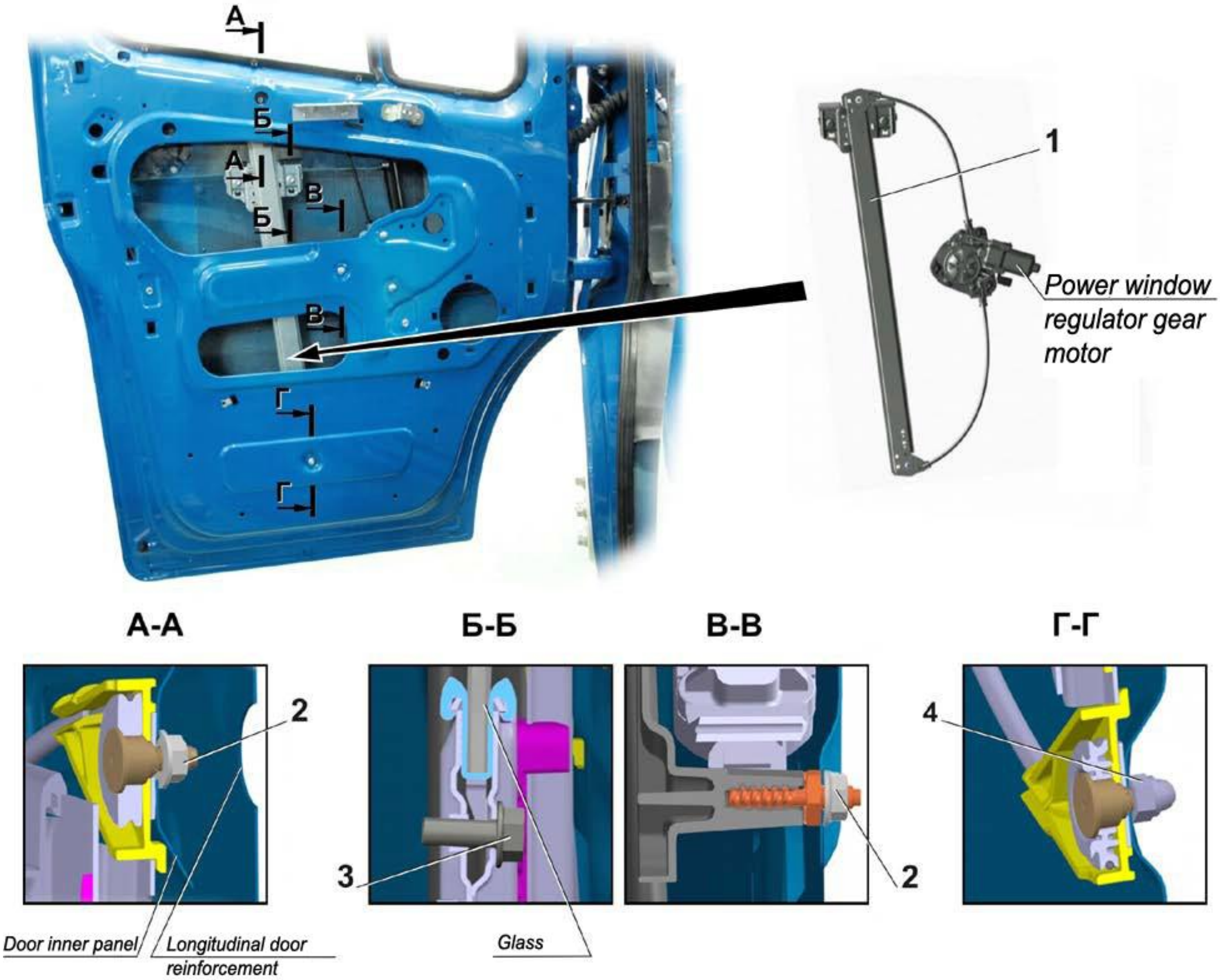


Fig. 8.26. Power window regulator installation (option I):
1 – power window regulator; 2,4 – nuts; 3 – bolt

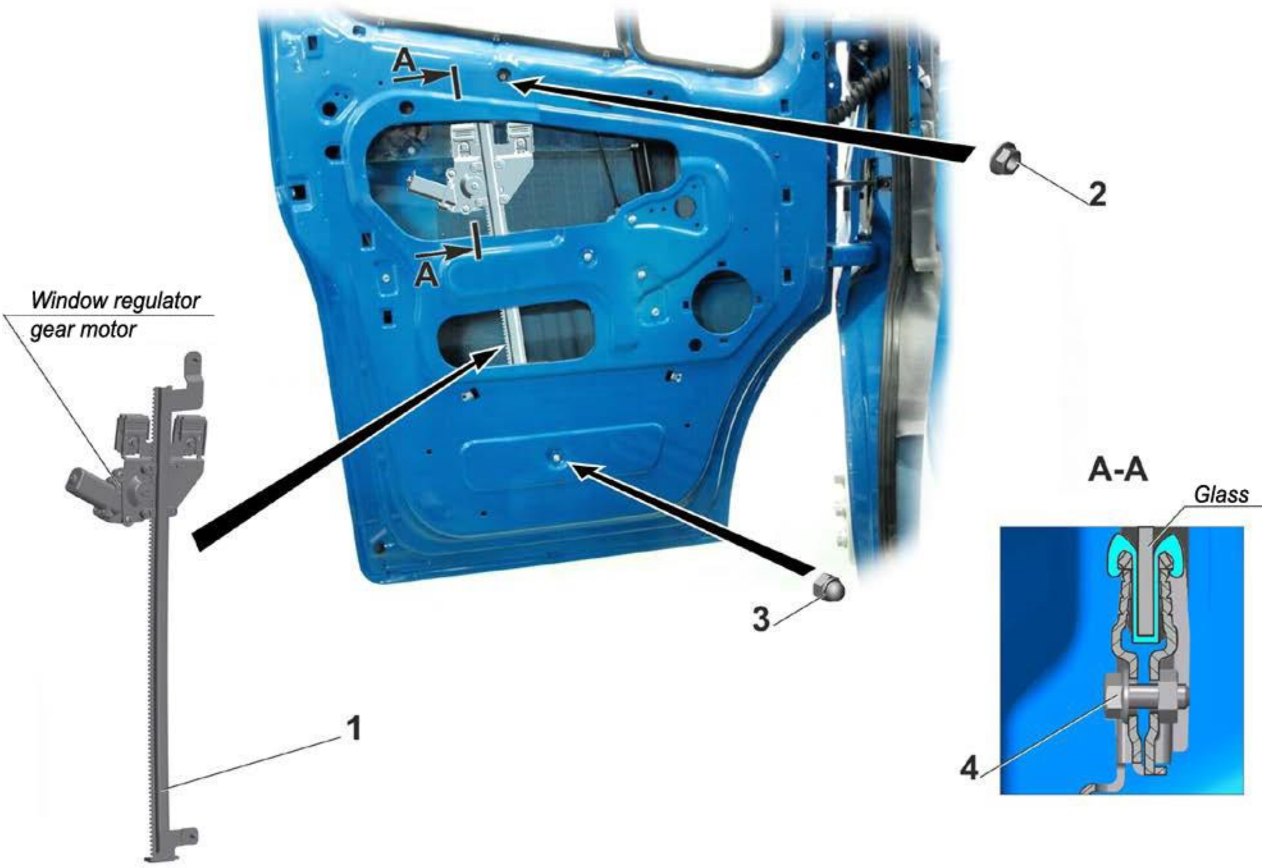


Fig. 8.27. Power window regulator installation (option II):
1 – power window regulator; 2, 3 – nuts; 4 – bolt

The left and right door power window regulators are controlled using the control unit, combined with the electric drive of the exterior mirrors and located on the left door armrest handrail. The right door power window regulator is controlled by the control button on the right door. Power window regulators operate only when the instruments and starter are on. When the instruments, starter and marker lights are on, the symbols for the power window regulator controls are illuminated. Pressing the key down lowers the window, pressing it up raises the window.

Power window regulator test data

Test supply voltage, V 13.3-13.7

Resistance, Ohm 0.09-0.11

Maximum current consumption when moving window
with force of max. 120 N (12 kgf) at test voltage, A, max. .... 16[1] or 8.5[2]

Window raising/lowering time at full
stroke, sec 3.5-5.5

The power window regulator must ensure the movement of the windows in the entire range without their distortion, jerking and jamming, as well as the glass self-braking.

In the event of operability loss, the power window regulator must be replaced.

Power window regulator replacement

ATTENTION
Do not shock the power window regulators during unpacking, transportation and installation.

The power window regulator replacement must be carried out in the following sequence:

- remove the door trim (see “Door trim removal and installation” subsection);
- remove the front clip of the sliding door glass channel;
- lower the glass so that the power window regulator slider is visible in the mounting hatch, loosen the bolts securing the glass clamping plate in the slider to ensure free movement of the glass;
- disconnect the wiring harness terminal block from the power window regulator gear motor.
- raise the window with hands to the upper position and fix it with a wooden wedge inserted between the glass and the seal;
- unscrew the three nuts securing the power window regulator gear motor;
- unscrew the two nuts securing the window regulator gear guide and remove the faulty window regulator from the door;
- install and fix a new window regulator in the reverse order of removal.

The top nut of the gear motor must be tightened first.

The tightening torque of the power window regulator nuts – 6.86-9.8 N·m (0.7-1.0 kgf·m), slider glass clamping plate bolts – 4.8-7.2 N·m (0.49-0.73 kgf·m).

After installing the power window regulator, test its operation. The glass must move smoothly, without jerking or jamming, and be securely held in any position.

[1] – For power window regulators (option I)
[2] – For power window regulators (option II)

8.3.5.5. Door locks

Locks (fig. 8.28) are used to keep the doors in the closed position while driving, in the parking lot and in the event of a traffic accident.

ATTENTION
When driving with the partially closed door, a knock occurs, driving with the door open is **not allowed.**

The central locking system of door locks ("central lock") is designed to simultaneously lock and unlock the driver's and passenger door locks. Locking/unlocking of the locks is carried out using the key from outside the vehicle or by pressing the driver's door lock button.

The driver's door lock is equipped with a control actuator (gear motor) that allows sending a signal through the door lock system control unit to the right passenger door lock to synchronize the unlocking and locking when the levers of the internal and external locks of the driver's door are actuated. The right passenger door lock is equipped with an actuator.

The door locks have two positions: fully closed and intermediate.

The outer handle, the internal drive handle and the lock switch interact with the lock by means of rods.

If you grab the outside handle with the lock unlocked and pull it towards you, the door will open. When the lock is locked, the outer handle has free play.

The internal drive handles unlock the locks on the first stroke, and on the second stroke of the handles, the locks open.

The lock switch is only installed on the left outside handle.

In the open door position, only the passenger door lock is blocked. Blocking the open driver's door with the lock switch and the lock button is not possible. This is provided to reduce the likelihood of locking the doors if the key is left in the instrument and starter switch lock. In the closed door position, the locks of all doors are blocked. The right door has only internal blocking of the lock.

From the inside, the door locks can be blocked by pressing the locking rod buttons; when the locking rod buttons are lowered, the doors cannot be opened from the outside.

The outer handle, the internal drive handle and the lock are non-repairable products and, in case of failure, should be replaced with new ones.

The wiring diagrams for connecting the lock actuators and the outer door handle are shown in Fig. 8.29.

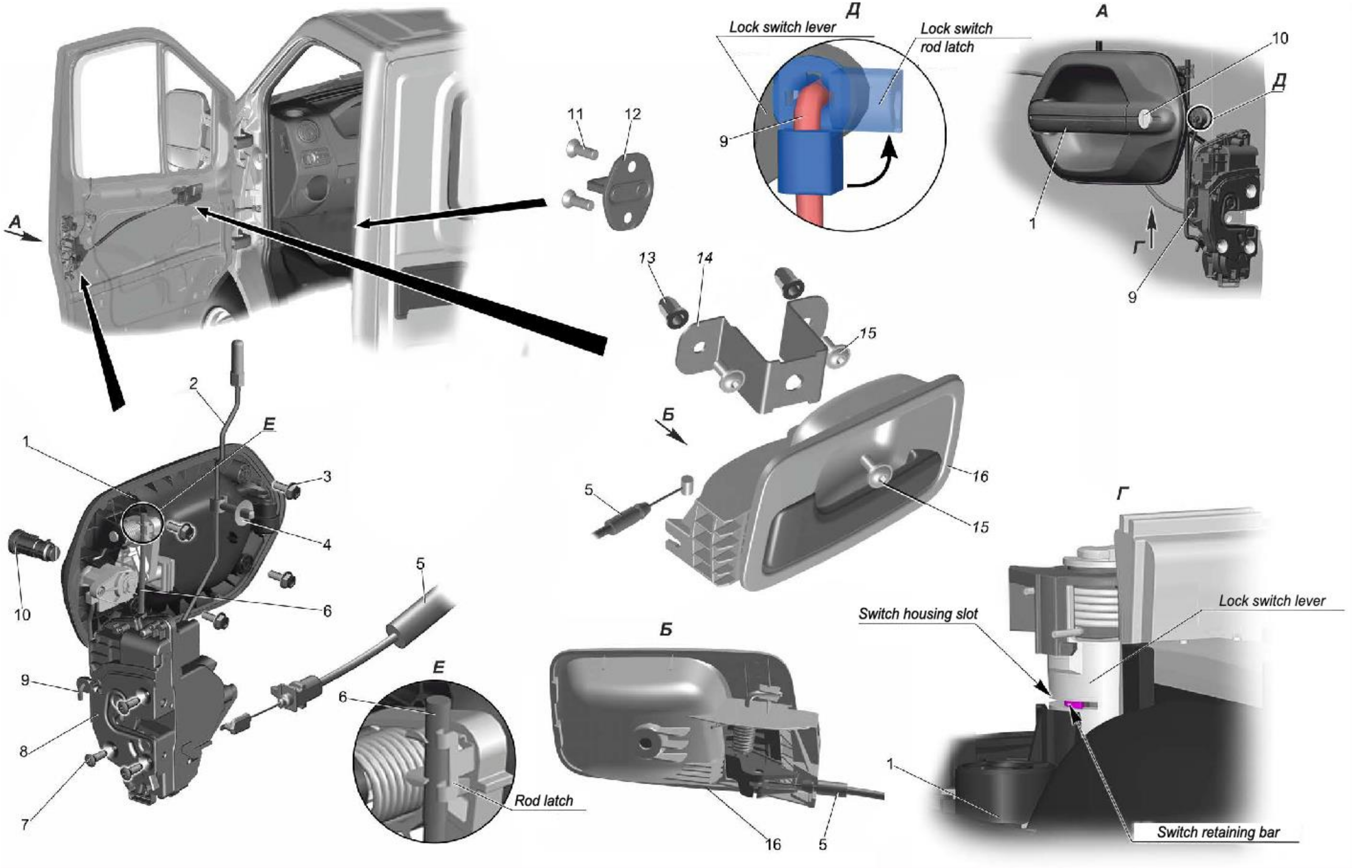
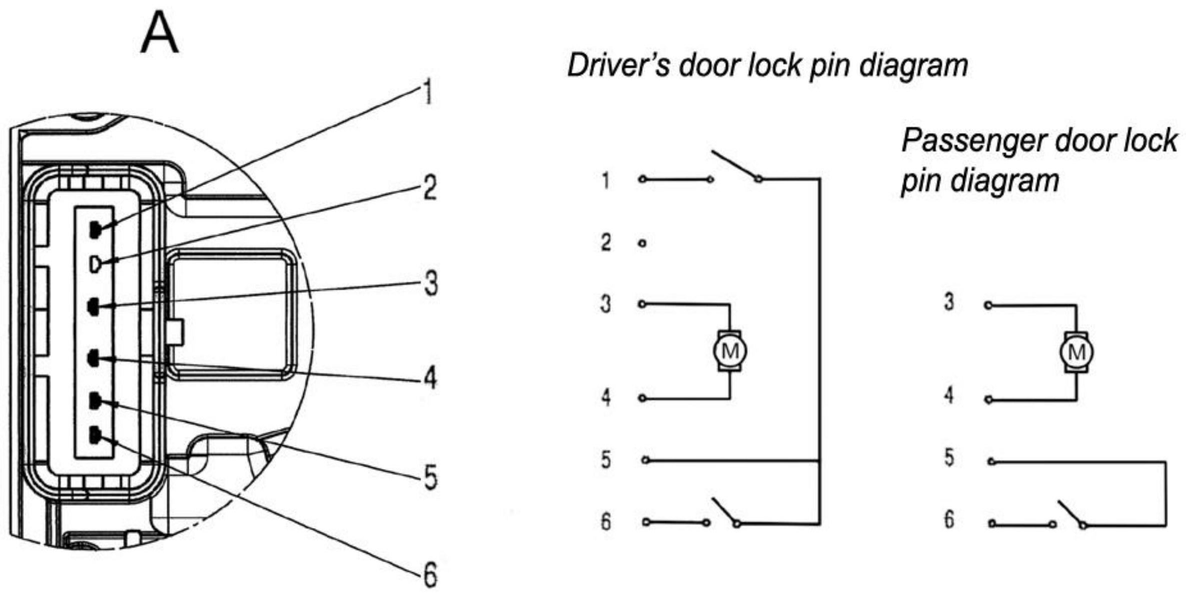


Fig. 8.28. Left door lock and lock drive: 1 – outer handle; 2 – blocking rod with button; 3 – bolt; 4 – clip; 5 – internal drive rod; 6 – outer handle rod; 7,11,15 – screws; 8 – lock; 9 – lock switch rod; 10 – lock switch; 12 – lock latch; 13 – threaded rivet; 14 – bracket; 16 – internal handle;



pins	*destination*
1	*opening microswitch (for driver's door lock)*
2	*—*
3	*electric motor, lead "M1+"*
4	*electric motor, lead "M1-"*
5	*ground*
6	*opening microswitch (for passenger door lock)/central lock (for driver's door lock)*

Fig. 8.29. Wiring diagrams for door lock actuators: A – connecting block plug location; B – outer handle connection block plug location

General requirements

When connecting the outer handle rod with the rod latch, lift the rod up to the stop;

After installing the lock and its drive, test their operation.

When moving the outer handle or turning the inner drive handle, the door lock rotor should rotate until fully open.

Outer handles and handles of internal drives must return to their original position under the force of the springs. Jamming of handles is not allowed.

With the doors closed, the locking rods with buttons must move freely and be clearly fixed in their extreme positions.

The lock switch cylinder must be securely held in the seat of the left outer handle.

With the key inserted, the switch cylinder should rotate clockwise/counterclockwise to lock/unlock the lock, and return to its original position under the action of the lock spring.

At the moment of entry into the lock groove, the door lock latch should not touch the lock body.

Tightening torques for threaded joints of locks and their drives

- screws securing the door lock latch - 17.65-24.51 N·m (1.8-2.5 kgf·m);

- screws securing the lock to the door - 4.9-7.84 N·m (0.5-0.8) kgf·m);
- screws securing the internal drive handle to the bracket - 6.86-9.8 N·m (0.7-1.0 kgf·m).

Outer handle removal and installation

The outer handle removal and installation must be carried out in compliance with the requirements specified in the “General requirements” subsection.

The outer handle removal must be carried out in the following sequence:
- remove the door trim (see “Door trim removal and installation” subsection);
- disconnect the rod from the outer handle, disengaging the rod from the connection with the rod latch;
- turn the lock switch latch in the hole of the lock switch lever in the arrow direction (see Fig. 8.28) so that the latch holder disengages from the switch rod, and remove the switch rod from the latch;
- unscrew the four screws securing the outer handle and remove the handle assembly with lock switch cylinder from the vehicle.

Install the outer handle in the order reverse to removal.

Lock switch cylinder removal and installation

The lock switch cylinder removal and installation must be carried out in compliance with the requirements specified in the “General requirements” subsection.

The lock switch cylinder removal must be carried out in the following sequence:
- remove the door trim (see “Door trim removal and installation” subsection);
- remove the outer handle assembly with lock switch cylinder from the vehicle or move the handle away from the outer door panel without dismantling the outer handle rod and the lock switch rod;
- through the slot in the switch cylinder body, press the retaining bar of the switch cylinder and remove the switch cylinder from the outer handle.

It is allowed to install the lock switch cylinder after installing the outer handle. To secure the lock switch cylinder in the cylinder body, the lock switch cylinder must be turned with the switch retaining bar down to align with the slot in the switch body.

Door lock removal and installation

The door lock removal and installation must be carried out in compliance with the requirements specified in the “General requirements” subsection.

The lock removal must be carried out in the following sequence:

- disconnect wires from the battery;
- remove the door trim (see “Door trim removal and installation” subsection);
- remove the rear clip of the sliding door glass channel;
- disconnect the rods from the outer handle and the lock switch latch (see “Outer handle removal and installation”);
- disconnect the lock actuator wire connector;
- unscrew the screws securing the lock, move the lock with attached parts inside the door towards the mounting hatch, remove the lock with rods.

The lock must be installed in the reverse order of removal.

Lock latch adjustment

To adjust the lock latch, it is necessary to loosen its fastening screws, move the latch vertically until the latch clip is in the center of the groove on the door inner panel, horizontally until the door outer surface in the lock area coincides with the sidewall.

8.3.6. Hood

The hood consists of outer and inner panels, flanged along the contour and adhered. Stiffeners for attaching hinges and a lock are welded to the inner panel. On the rear edge, the hood is hung on the cab using two hinges. The heat and sound insulation is installed on the hood using clips. Two rubber buffers are installed on the front edge of the hood.

To remove the hood from the vehicle, unscrew the four bolts securing the hood to the pivots.

When installing a new or repaired hood on a vehicle, it is necessary to maintain a clearance of 4.5-6.5 mm between the left and right edges of the hood and the fenders, unevenness (tapering) of the clearance up to 1.5 mm is allowed. Symmetrical protrusion or recession of the left and right edges of the hood relative to the fender surfaces up to 2 mm is allowed. For longitudinal and transverse hood clearance adjustment, loosen the bolts securing the hood hinges to the front panel extension, for vertical adjustment – the bolts securing the hinges to the hood. Upon the end of the adjustment, it is necessary to tighten the hood bolts. The tightening torque of the bolts securing the hood to the hinges and the hinges to the front panel extension is 12-18 N·m (1.2-1.8 kgf·m).

Hood lock

The hood is held in the closed position by a pin-type lock (Fig. 8.30).

The hood lock is opened using a remote drive mounted on the left side panel of the cab front under the dashboard, pull its handle towards you, then the lock latch should move to the stop and release the pin - the hood will rise along the front edge by 15-20 mm. After unlocking the lock, the drive handle returns to its original position under the action of the drive spring.

Slightly raise the front of the hood and press the safety hook protrusion up, disengaging it from the socket in the lock body, and open the hood. The safety hook should return to its original position under the action of the safety hook spring.

The hood lock latch (latch body, pin, pin spring, support cup, safety hook, handle latch spring) is located on the hood and moves with it when opened. The other part of the parts (lock body, support plate, latch, spring, spring guide) is located on the frontend.

When the hood is closed, the pin head enters the clearance between the base plate and the latch and, due to the conical protrusion on the pin, presses the latch. The pin protrusion passes under the latch, which, under the action of a spring, returns to its original position and holds the pin and, accordingly, the hood in the closed position.

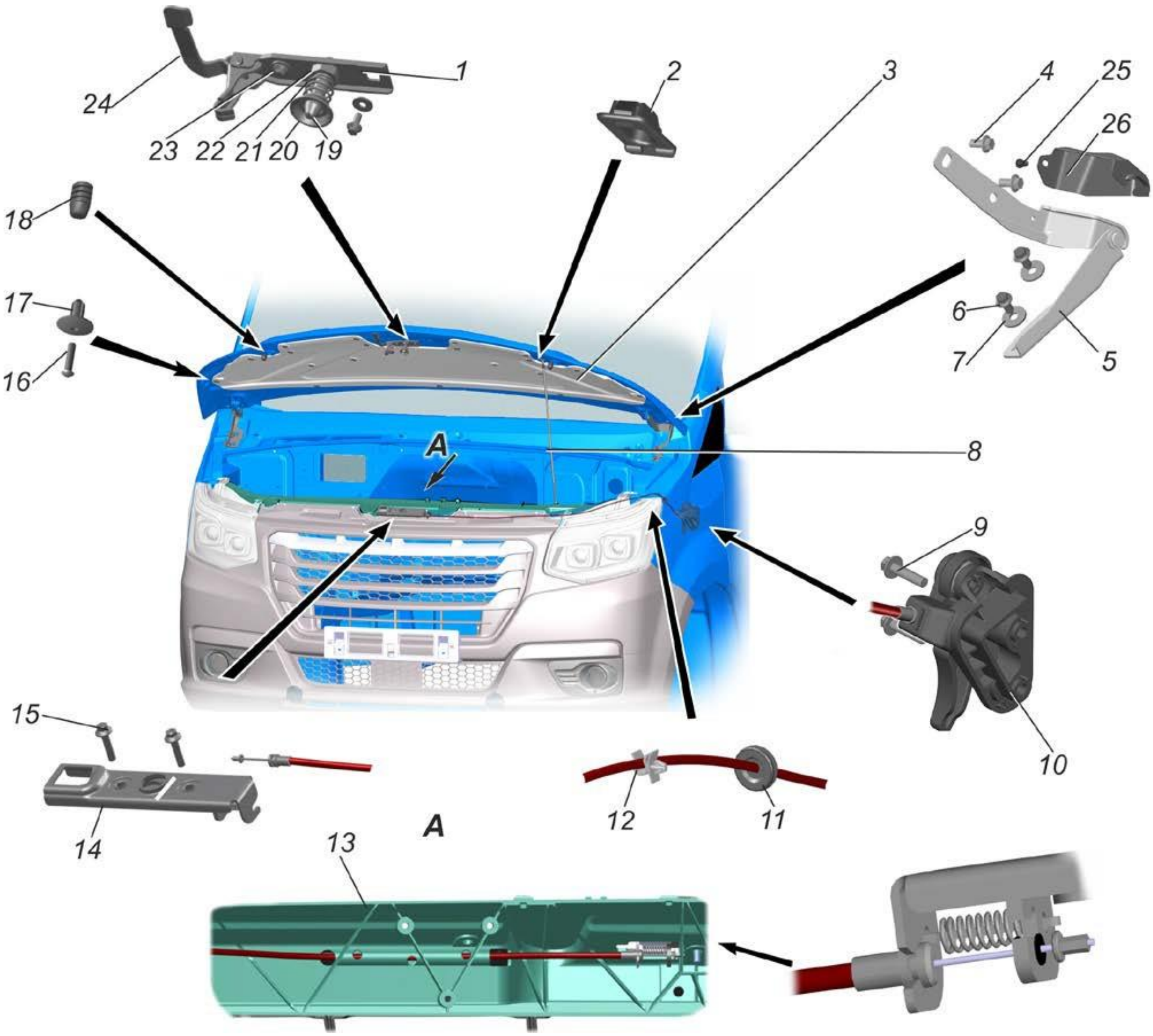


Fig. 8.30. Hood upper hinge and lock: 1 - hood lock latch body; 2 - stop socket; 3 - thermal and sound hood insulation; 4, 6, 9, 15, 23 - bolts; 5 - hood hinge; 7 - washer; 8 - hood stop; 10 – drive of hood lock with rod; 11 - sealing bushing; 12 - clip; 13 - frontend; 14 - hood lock; 16.25 - piston(s); 17 - piston socket; 18 - buffer; 19 - pin; 20 - support cup; 21 - spring; 22 - nut; 24 - safety hook; 26 - hinge plate

The hood latch should be installed after adjusting the hood clearances. When the hood is properly installed, the necessary adjustments are made, the pin should freely enter the lock latch and be clearly fixed in the closed position. In this case, the hood in the closed position under the action of a force of 176-314 N (18-32 kgf) should have a displacement of 0.2-3.0 mm.

Safety hook, fixed on the hood and engaging with the lock, protects the hood from accidental opening when driving. The hook engagement with the lock is adjusted by bending the hook.

Since the hood has a longitudinal and transverse adjustment on the hinges, to compensate for the displacement of the pin (together with the hood), the lock latch body also has a longitudinal and transverse adjustment with the mounting holes. The tightening torque of the bolts securing the lock body and the lock latch body is 7.0-9.8 N·m (0.7-1.0 kgf·m). For vertical adjustment, loosen the pin lock nut and adjust by turning the pin. The tightening torque of the pin lock nut is 11.76-17.65 N·m (1.2-1.8 kgf·m).

The hood lock and lock drive do not require special maintenance and adjustment in service. During maintenance, lubricate the hood lock with grease SRI Grease EP2, Ulti-Plex Synthetic Grease EP1.5 CHEVRON) or Albida EVS (from Shell).

Hood upper hinge

To open the hood to a predetermined angle, two-link hood hinges (see Fig. 8.30) are used, bolted to the front panel extension and the hood. The hinges are unbalanced. In the open position, the hood is held by a hard stop, one end of which is fixed on the frontend, and the other rests against a socket mounted on the hood. In the folded lower position, the stop should be fixed in the frontend latches.

After opening the lock, the hood is lifted up to the stop on the hinge, held with the left hand, and the stop is released from the latches with the right hand, lifted up, inserted into the hole in the stop socket on the hood, then the hood is lowered. Fold the stop in reverse order.

The fixed links of the hinges are equipped with metal-fluoroplastic bushings, so the hinges do not require in-service maintenance.

8.3.7. Overhead console and camera holder cover

On the vehicle, the overhead console (Fig. 8.31) and the camera holder cover are installed on the roof panel.

The overhead console and camera holder cover are made of high impact polypropylene composite material.

The overhead console is equipped with a pocket and a glasses bin.

The overhead console is equipped with a USB device and a cab lighting unit.

An interior rear-view mirror is installed on the camera holder cover.

The **overhead console and camera holder cover removal** must be carried out in the following sequence:

- disconnect wires from the battery;
- remove the cab lighting unit from the overhead console (see “Electrical equipment” section, “Cab lighting unit” subsection);
- open the console glasses bin and unscrew the two screws securing the console to the roof panel brackets;
- unscrew the two screws securing the console to the bracket (see Fig. 8.31);
- disengage the console hooks D from the camera holder cover by gently pulling the overhead console down;
- slide the overhead console back (in the vehicle movement direction), disengaging the mounting hooks F of the console from engagement with the roof brackets and the protrusions E of the console from engagement with the camera holder cover. Hold the overhead console and remove it from the vehicle. Disconnect the wire connectors of USB devices;
- remove USB devices from the console;
- unscrew the set screw 6 of the interior rear-view mirror. Disengage the interior mirror from the plate by sliding it back (in the vehicle movement direction) and remove the mirror;
- unscrew the screw securing the camera holder cover to the bracket and remove the mirror plate;
- disengage the cover latches C and the cover groove from the camera holder and remove the camera holder cover from the vehicle.

The overhead console and camera holder cover installation must be carried out in the reverse order of removal.

The tightening torque of the interior rear-view mirror plate mounting screw is 7.84-9.8 N·m (0.8-1.0 kgf·m);

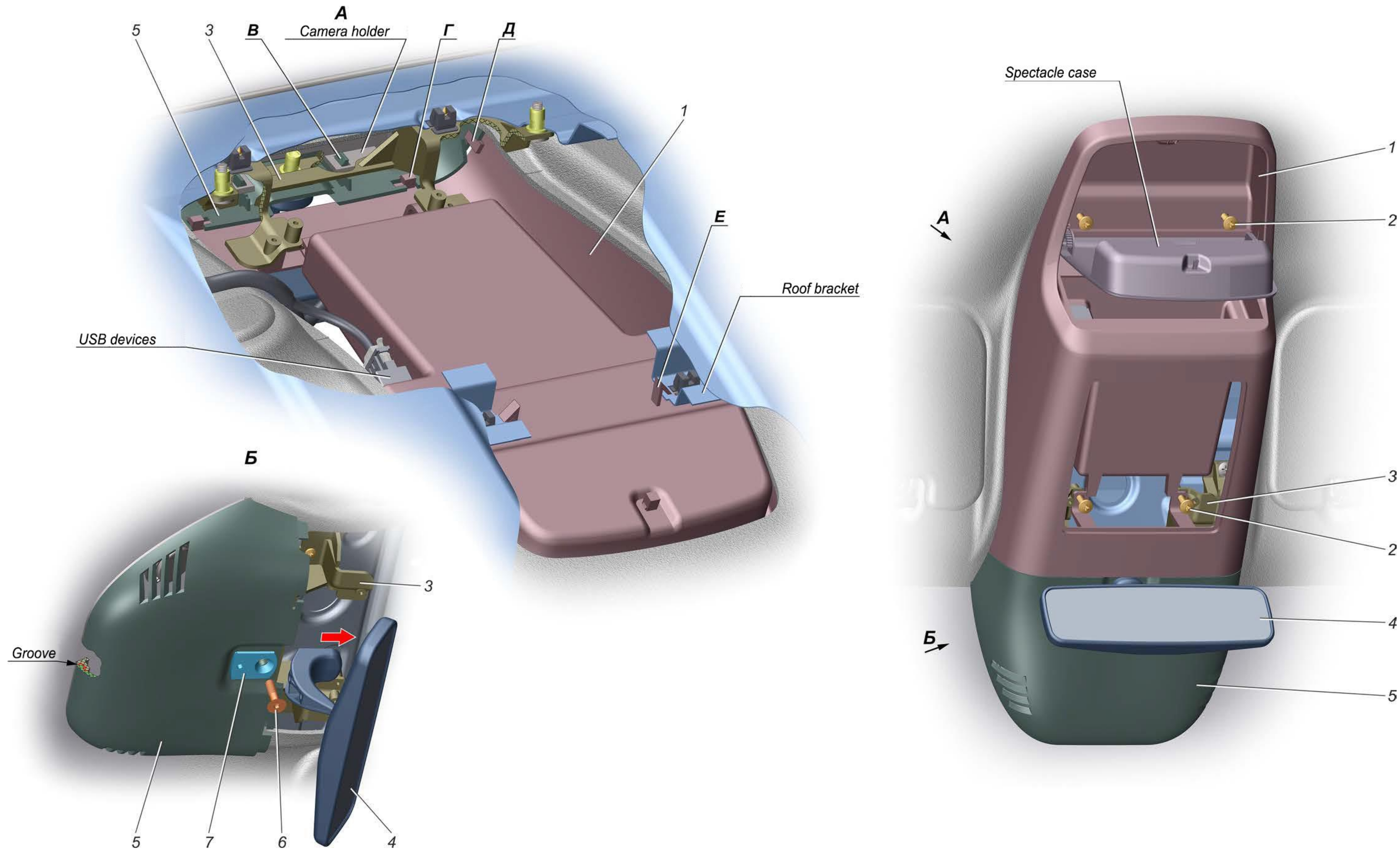


Fig. 8.31. Console and camera holder cover installation: 1 – overhead console; 2 – screws; 3 – bracket; 4 – interior rear-view mirror; 5 – camera holder cover; 6 – screw; 7 – plate

8.3.8. Exterior rear-view mirrors

The vehicle is equipped with exterior rear-view mirrors (Fig. 8.32) with the function of electric heating of the main mirror optical element. The mirrors can be of two types, depending on the main mirror optical element position adjustment mechanism (mechanical and electromechanical).

The mirrors have folding mechanisms, which, in the event of a collision with an obstacle, allow the mirrors to deflect towards the impact, thereby preventing their damage.

The exterior mirrors, both on the left and on the right, include two optical elements: the main spherical (for viewing the rear and side of the vehicle) and the auxiliary spherical (to eliminate the “blind spot” and observe at a wider angle of the situation from the side and rear within the vehicle dimensions).

The electric heating of mirrors is controlled by switch 1 (Fig. 8.33) located on the dashboard.

The main mirror optical element position is controlled by a mechanical or electromechanical drive, which ensures the optimal position for observation. At the same time, the mechanisms play the role of braking devices that keep the optical element in a predetermined position during operation.

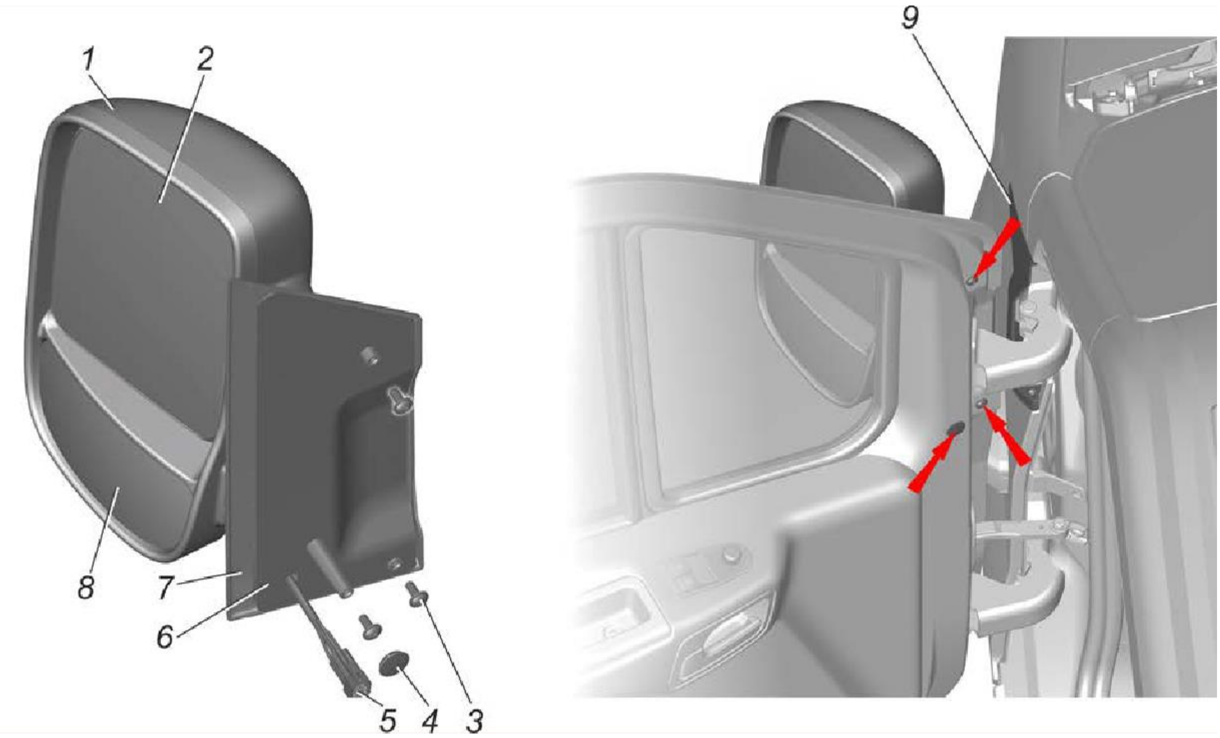


Fig. 8.32. Exterior rear-view mirror with electromechanical drive: 1 – mirror housing; 2 – main mirror optical element; 3 – mirror mounting screw; 4 – plug; 5 – electrical connector (pin block); 6 – gasket; 7 – strut; 8 – auxiliary optical element; 9 – mirror molding

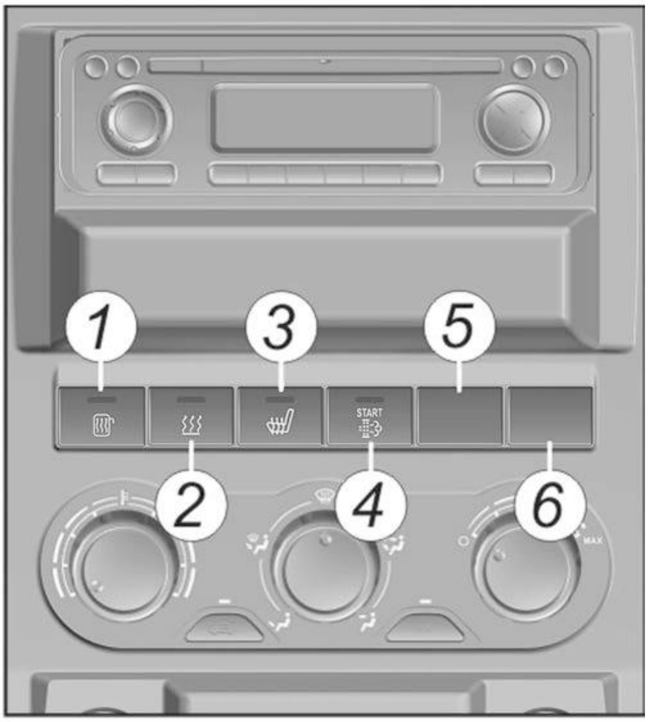


Fig. 8.33. Dashboard switches: 1 - exterior rear-view mirror heating switch; 2 - coolant post-heater switch; 3 - driver's seat heating switch; 4 - particulate filter regeneration switch (non-locking button); 5,6 - plug

The auxiliary mirror optical element is nonadjustable, fixed in the mirror housing.

The mirrors are assembled into a single assembly, which is attached directly to the door through a gasket.

Checking the operability of the electric heating and the electromechanical drive of the exterior mirror optical element is described in the "Electrical equipment" section.

The mirror is a non-repairable assembly and, in case of failure, should be replaced with a new one.

The **exterior rear-view mirror removal** must be carried out in the following sequence:

- remove plug 4 (Fig. 8.32) from the door;
- unscrew the three screws securing the mirror to the door;
- disconnect the mirror wire connector and remove the mirror assembly with gasket from the vehicle.

Install the exterior rear-view mirror in the order reverse to removal.

For the mirror molding removal, see the "Forward fender removal and installation" subsection.

8.3.9. Seats

8.3.9.1. Driver's seat

There are two types of driver's seat installed on the vehicle. The driver's seat (Fig. 8.34) is adjustable, anatomical, depending on the vehicle configuration, it can be equipped with an armrest, electric seat heating and a seat backrest lumbar support stiffness adjustment mechanism.

The seat has the following adjustments:

- longitudinal;
- longitudinal cushion movement;
- seat back height;
- seat front height;
- backrest tilt angle;
- lumbar support stiffness;
- headrest height;
- armrest angle.

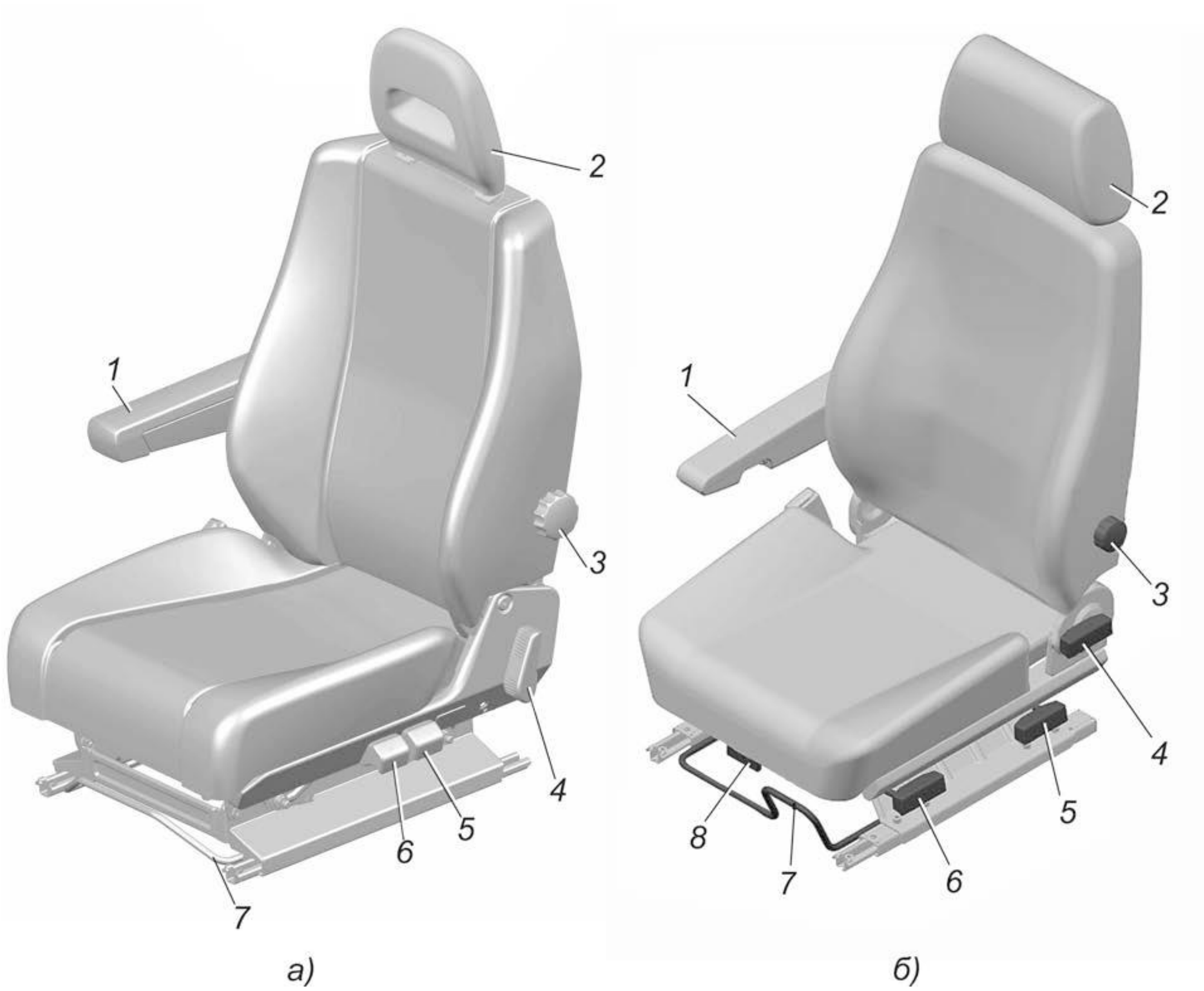


Fig. 8.34. Driver's seat: a, b - driver's seat; 1 - armrest; 2 - headrest; 3 - seat backrest lumbar support stiffness adjustment handle; 4 - seat backrest angle adjustment lever; 5, 6 - height adjustment handles for seat front or rear; 7 - seat longitudinal adjustment handle; 8 - cushion longitudinal movement adjustment handle

To move the seat longitudinally, pull longitudinal adjustment handle 7 up and select the desired seat position. After adjustment, make sure the seat is locked into place.

To adjust the height of the front or rear of the seat, lift up handle 6 or 5, respectively, and sequentially set the desired height of the front or rear of the seat.

To adjust the seat backrest angle, turn lever 4 and select the desired backrest position.

To adjust the seat backrest lumbar support stiffness, turn handle 3 and select the desired stiffness of the lumbar support.

To adjust the longitudinal movement of the cushion, lift handle 8 up, and without releasing, make the adjustment, then release the handle.

The **driver's seat headrest** height is adjustable.

To adjust the driver's seat headrest (Fig. 8.35), press the latch 1 and, holding it, move the headrest to the desired position (up or down). Then release the latch and try moving the headrest to make sure it is secure.

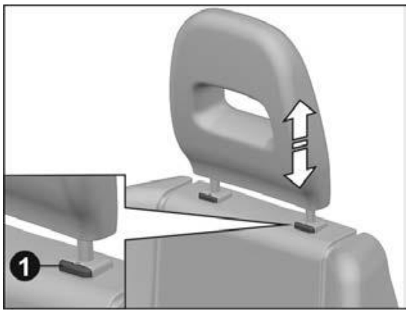


Fig. 8.35. Driver's seat headrest adjustment: 1 – latch

To adjust the driver's seat headrest (Fig. 8.36), grasp the headrest with your hands and move (up or down) the headrest so that the back of your head is against the center of the headrest.

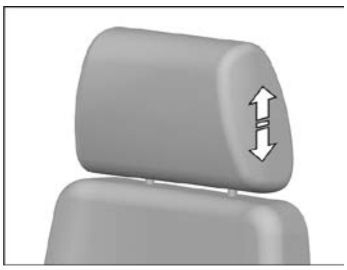


Fig. 8.36. Driver's seat headrest adjustment

Removing the seat 1 (Fig. 8.37) from the base 2 must be carried out as follows:

- disconnect the seat wire connector[1)];
- move the seat all the way back and unscrew the two front screws securing the seat to the base, remove the washers;
- move the seat all the way forward and unscrew the four rear screws securing the seat to the base, remove the washers;
- remove the seat assembly.

Install the seat in the reverse order of removal. The tightening torque of the screws securing the seat to the base is 19.61-24.51 N·m (2.0-2.5 kgf·m).

[1)] – For vehicles equipped with an electrically heated driver’s seat

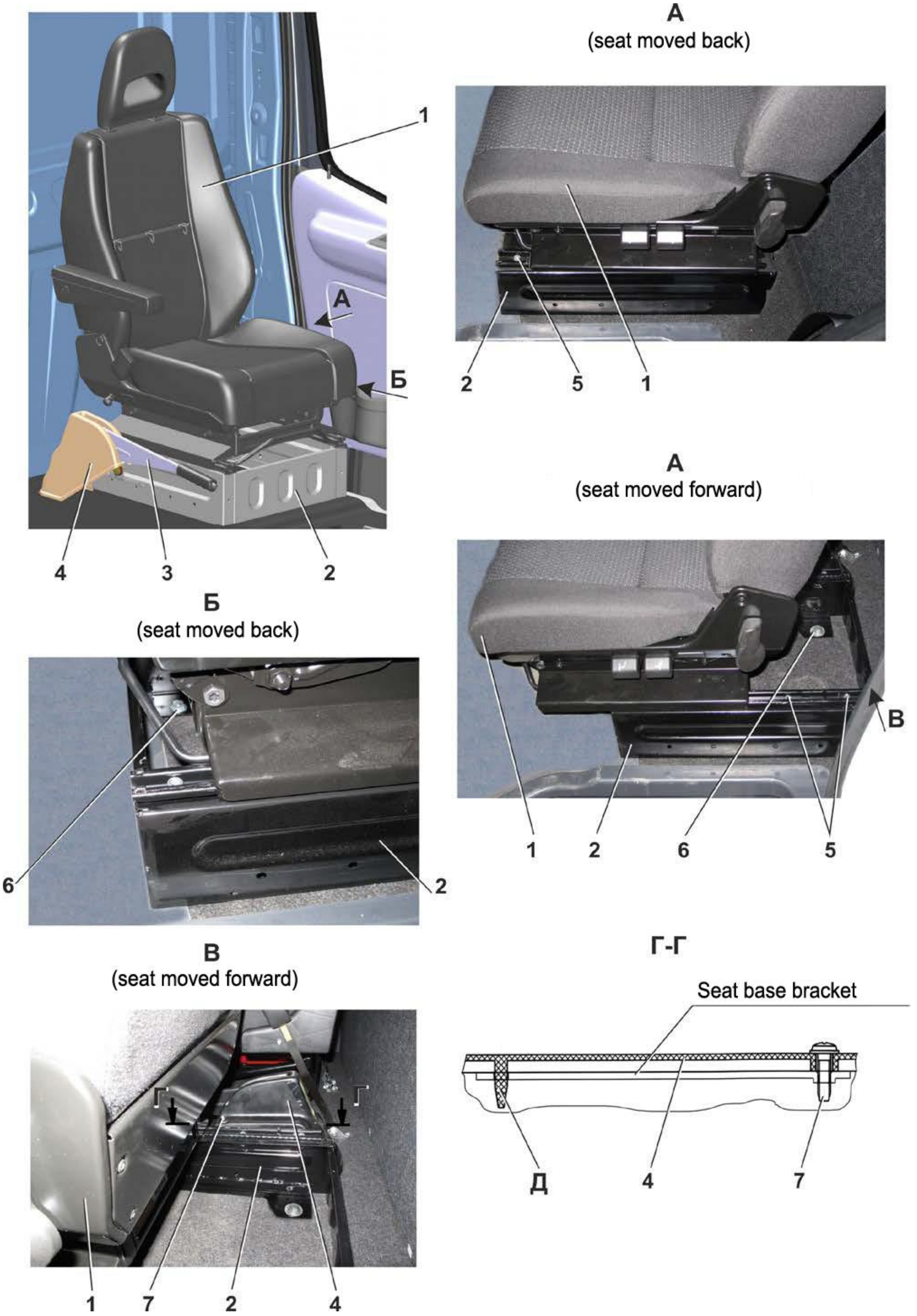


Fig. 8.37. Driver's seat installation: 1 – seat; 2 – seat base; 3 – parking brake lever; 4 – lever casing; 5, 7 – screws; 6 – bolts

8.3.9.2. Passenger seat

The passenger seat (Fig. 8.38) is double and unregulated. The seat is fastened to the flooring with four bolts.

Two passenger presence sensors are adhered with double-sided adhesive tape on the passenger seat cushion, under the upholstery.

On some vehicles, the fire extinguisher brackets are welded to the seat base.

Tightening torques for: bolts securing the seat base to the flooring – 43.15-60.8 N·m (4.4-6.2 kgf·m), bolts securing the fire extinguisher bracket to the seat – 4.41-7.84 N·m (0.4-0.8 kgf·m).

Fig. 8.38. Passenger seat of vehicle with three-seat cab

8.3.10. Dashboard

The dashboard (Fig. 8.39, 8.41) has a modular design, the base part of it is riveted to the metal base. The plastic parts of the dashboard are made of polypropylene.

The dashboard installation is shown in Fig. 8.40.

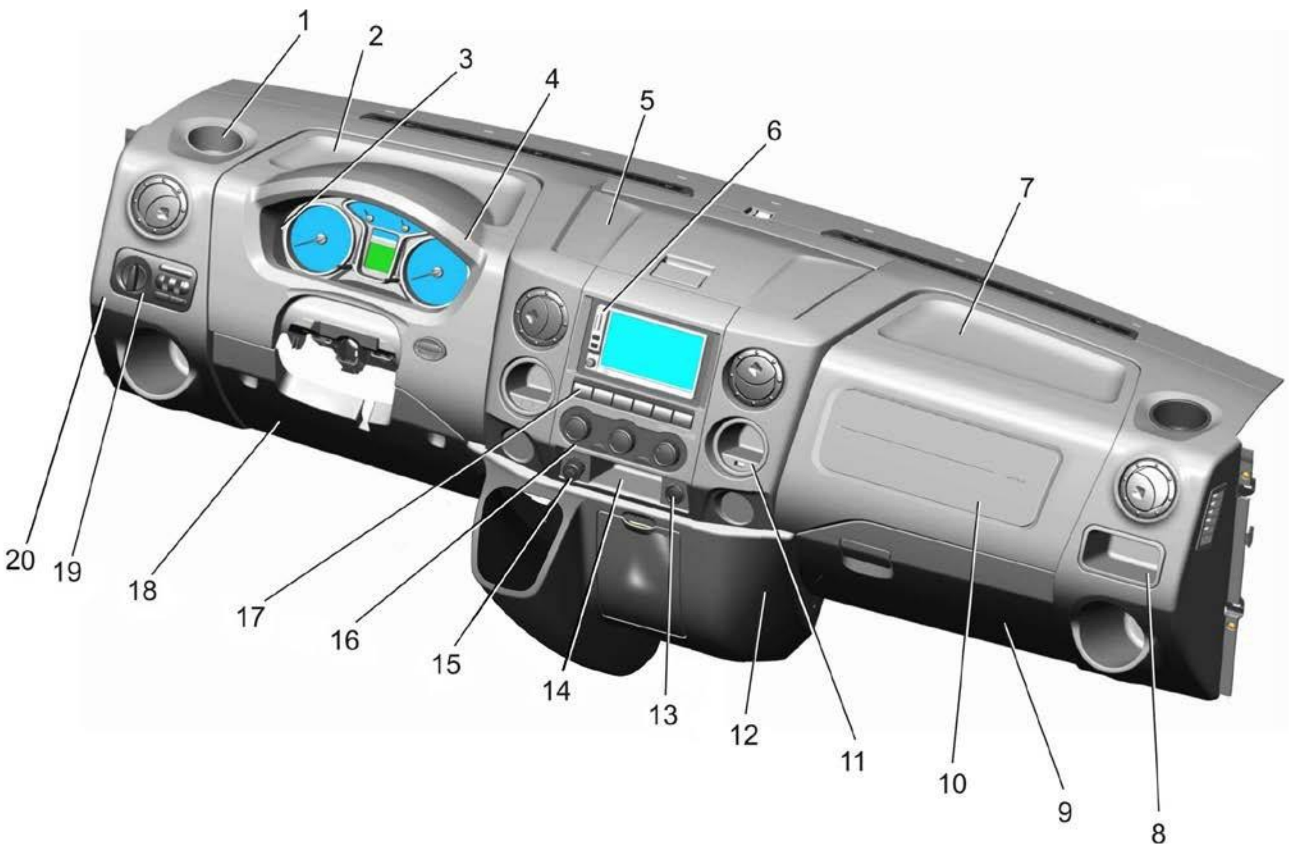


Fig. 8.39. Dashboard: 1 – insert; 2 – left insert; 3 – instrument cluster; 4 – instrument cluster trim; 5 – document pocket; 6 – car stereo; 7 – right insert; 8 – niche for small things; 9 – glove compartment; 10 – passenger airbag module; 11 – central insert; 12 – console; 13 – socket; 14 – central trim; 15 – cigarette lighter; 16 – heating, ventilation and air conditioning control board; 17 – dashboard switches; 18 – fuse cover; 19 – lighting control module; 20 – dashboard

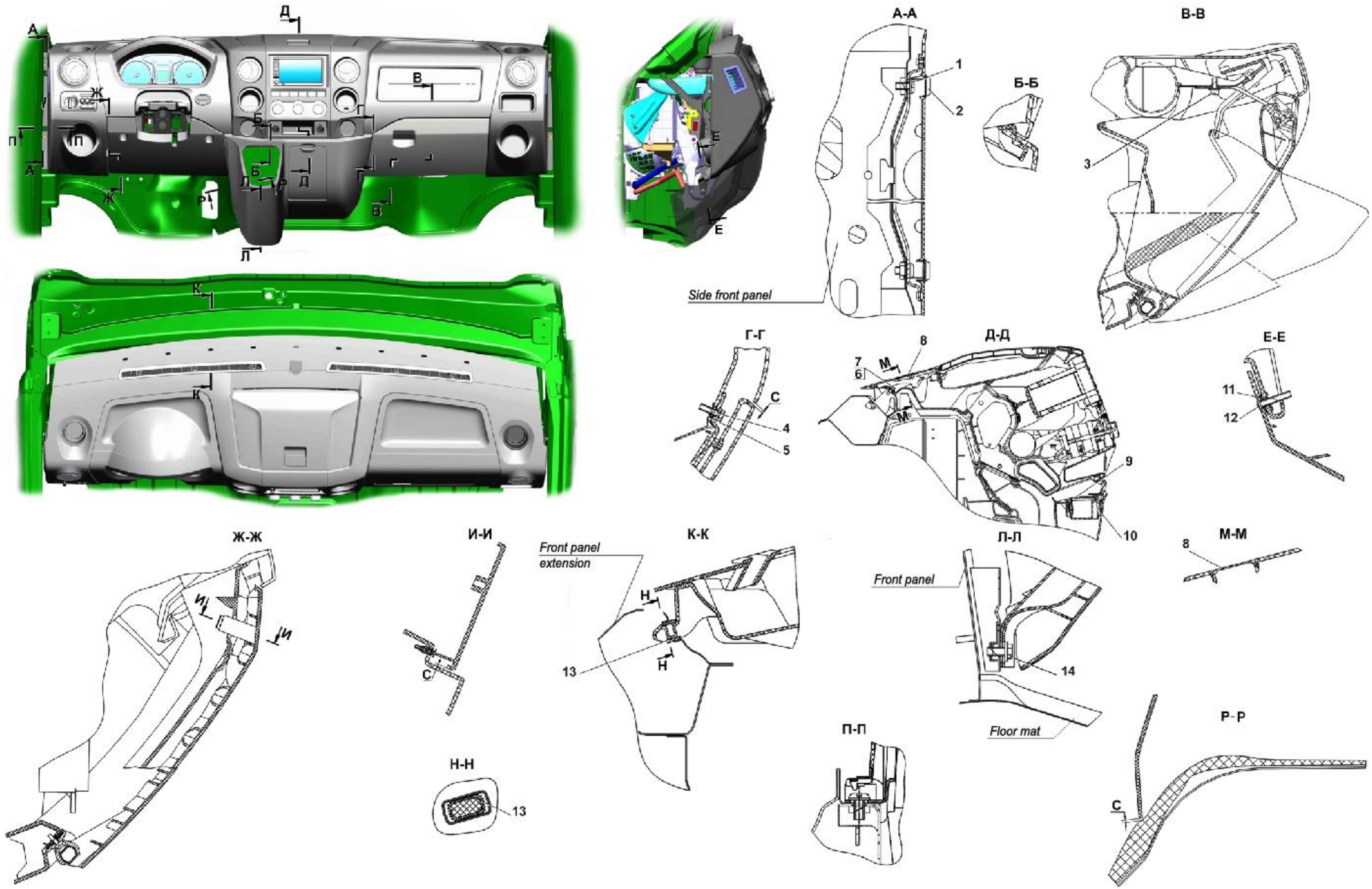


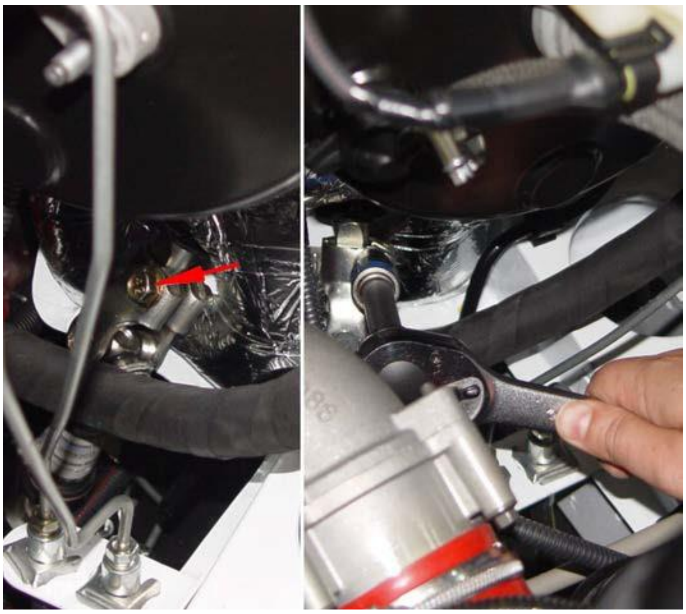
Fig. 8.40. Dashboard installation: C=2 mm; 1, 3, 4, 12 – screws; 2, 8 – plugs; 5, 11 – nuts; 6, 14 – bolts; 7 – washer; 9 - ashtray; 10 – glove compartment insert; 13 – seal

Dashboard removal

To remove the dashboard, perform the following operations:

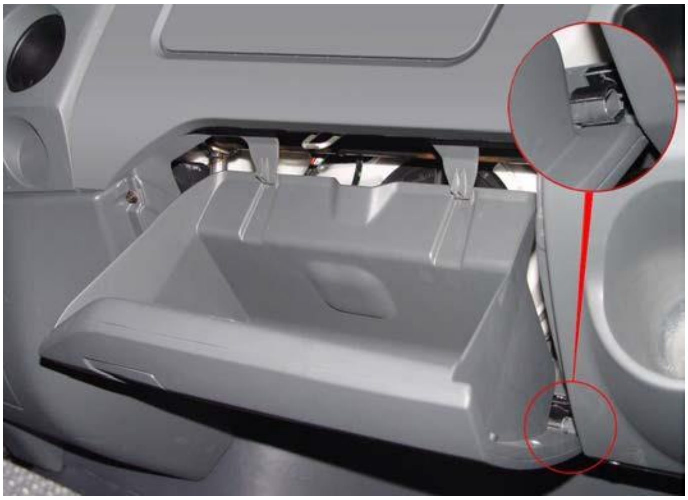
- set the steered wheels to a position corresponding to the straight-line vehicle movement;

- disconnect the battery by first disconnecting the negative wire, then the positive one (the positive terminal is larger than the negative one);

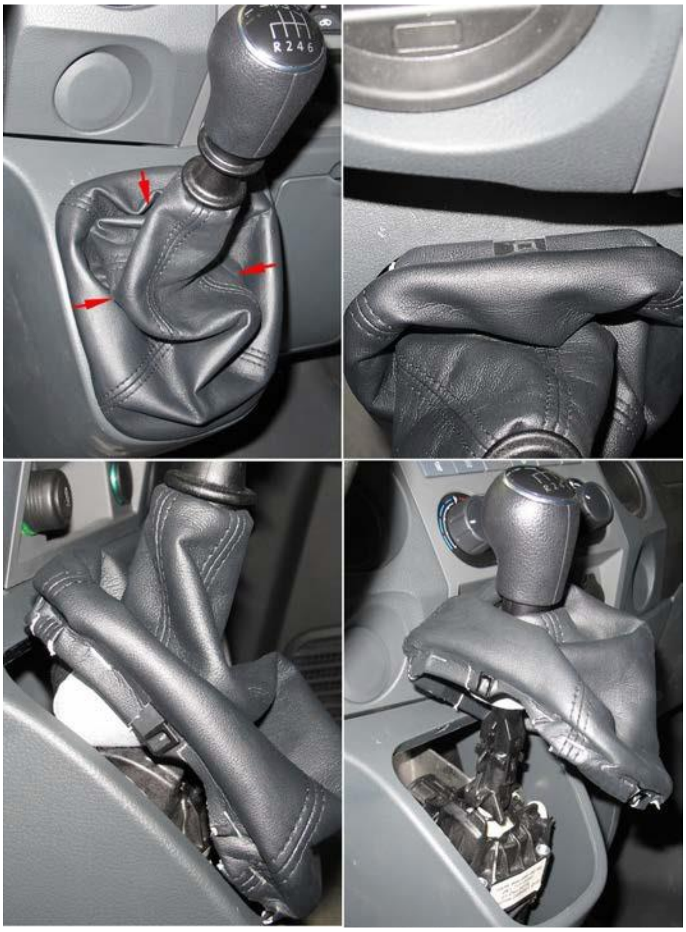


- unscrew the tie bolt and disconnect the cardan shaft yoke from the steering system intermediate shaft and lower it down;

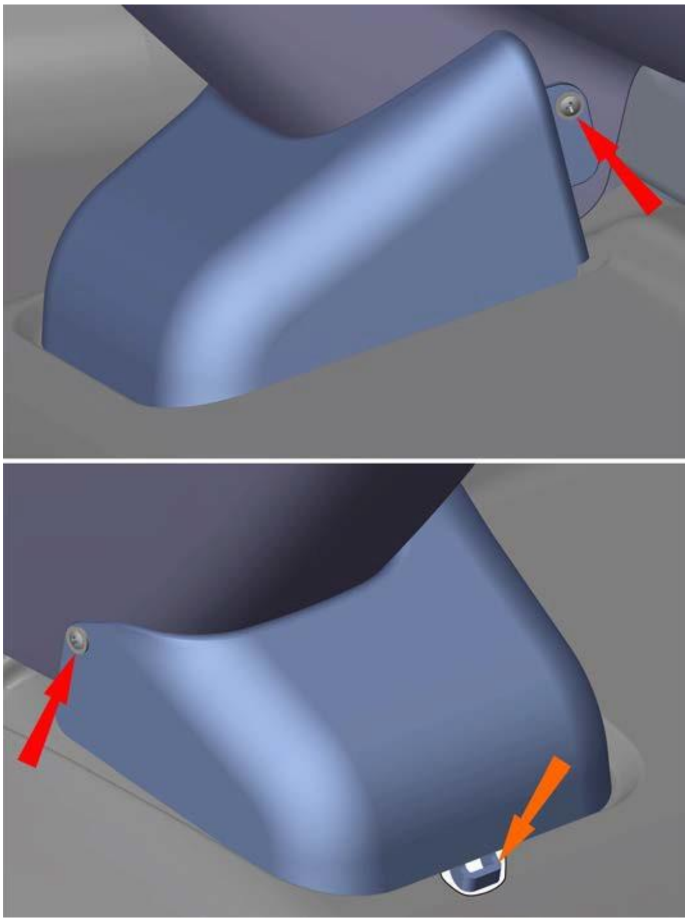
- open the fuse box cover by disengaging the two spring holders located on the cover sides from the panel, and remove the cover by disengaging the cover axes from the pivot axes;



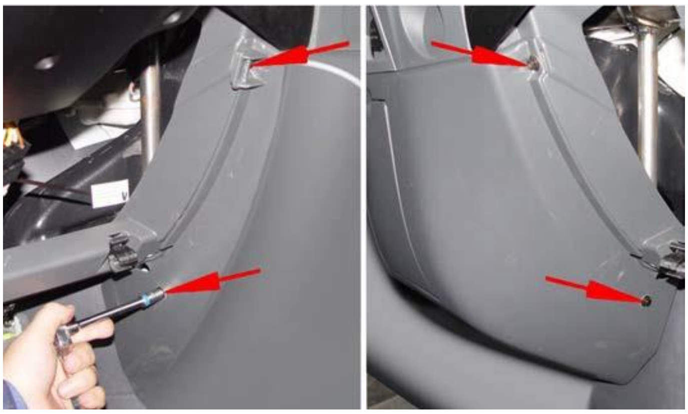
- open the glove compartment, disengage the compartment pins from the hinge pins and remove the compartment;



- disconnect the boot frame (sleeve) of the master support from the dashboard console by pressing one by one and disengaging the boot frame latches: the top latch - down (in the direction of the arrow) and towards you, the left and right side latch - to the lever of the master support (in the direction of the arrows) and towards you, and disengaging the lower latch from the console;



- unscrew the two screws securing the floor mat trim to the dashboard console and disengage the trim tongue from the bracket. Remove the floor mat trim from the vehicle;



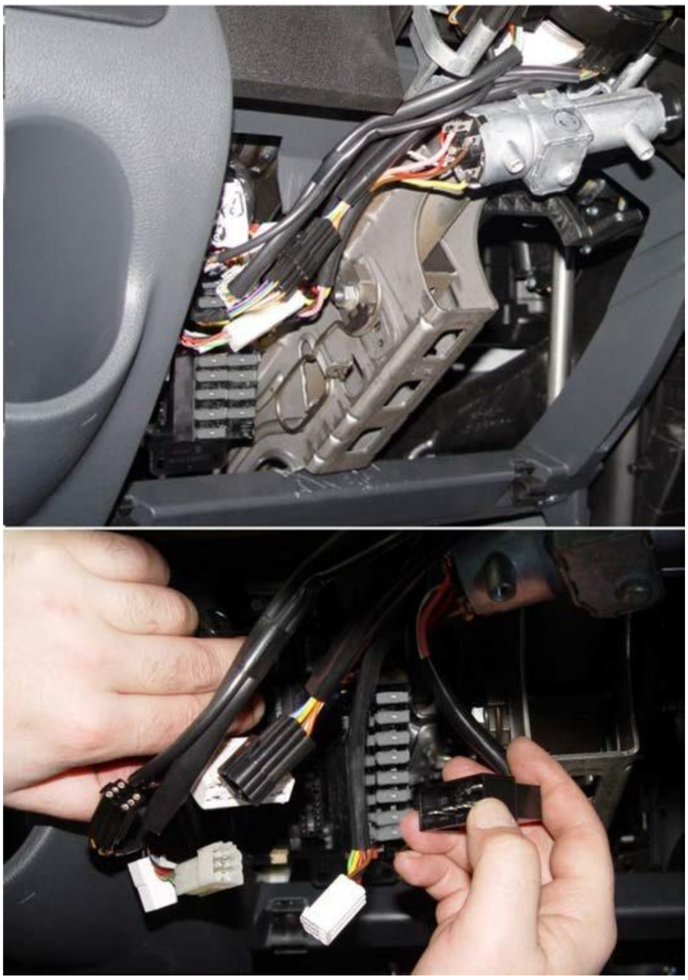
- unscrew the four screws securing the console to the panel;

- disengage from the panel: first two spring holders located on the sides of the console, then the latches located on top of the console, and remove the console;

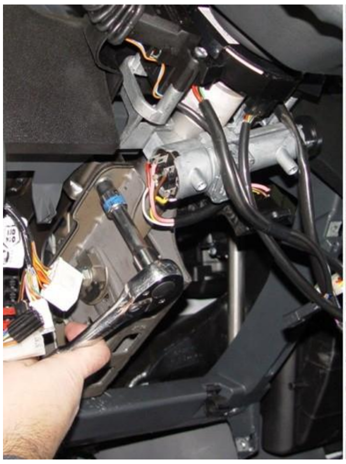
- unscrew the four bolts securing the master support to the dashboard base bracket, remove the master support and put it on the cab floor without disconnecting the cables (see “Gearbox” subsection);

- raise the floor mat and disconnect the steering intermediate cardan shaft support housing from the front panel by unscrewing the two mounting bolts;

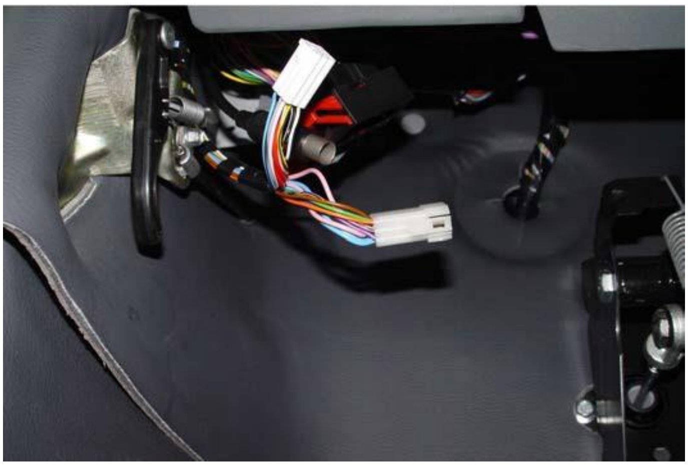
- remove the lower casing of the steering column by unscrewing the four fixing screws;



- disconnect the wire connectors of the ignition lock, current transfer device, light alarm and wiper switches;




- disconnect the steering column from the dashboard base by unscrewing the four mounting bolts. Remove the upper steering column casing. Remove the steering column assembly with the steering wheel from the vehicle (the driver's airbag module is located inside the steering wheel);

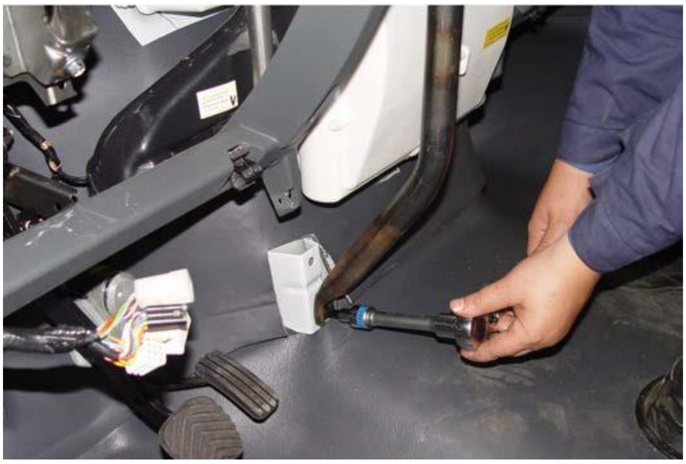


- disconnect the wire connectors located on the left (in the vehicle movement direction) under the dashboard: two connectors for connecting the dashboard harness to the engine compartment harnesses, the mirror drive connector[1)], the power window regulator drive connector and the antenna cable connector;

- disconnect the wire connectors located on the right (in the vehicle movement direction) under the dashboard: the mirror drive connector [1)] and the power window regulator drive connector;

[1)] – Installed on some vehicles

- disconnect the heater wire connectors;



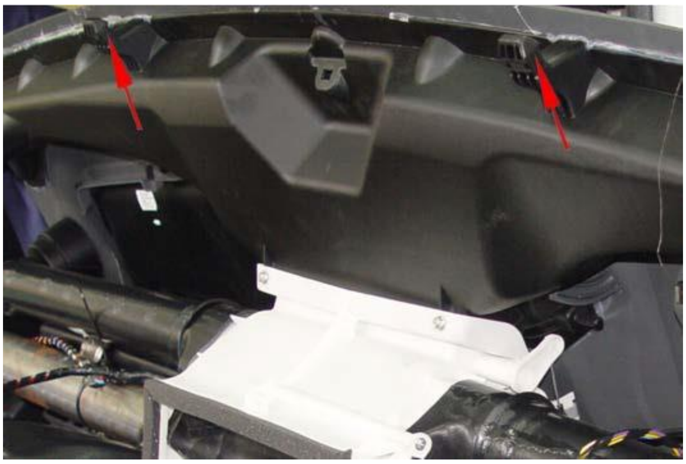
- disconnect the dashboard base frame support from the front panel by unscrewing the dashboard mounting bolt;

- remove the plug in the central part of the dashboard, unscrew the bolt securing the panel to the front panel bracket using the magnetic tool insert. Bolt tightening torque - 5.5-8.0 N·m (0.55-0.80 kgf·m);

- remove the door seal from the flange in the place where the dashboard fits, remove the dashboard plugs (two on each side);

- unscrew the four bolts securing the dashboard to the front end side panels. Bolt tightening torque - 18-22 N·m (1.8-2.2 kgf·m);

- raise the dashboard up by 6-8 mm, disengaging the dashboard side hooks from rectangular holes in the front struts of the cab;



- move the dashboard back (in the vehicle movement direction), disengaging the dashboard positional protrusions from the front panel, and remove the dashboard.

Install the dashboard in the reverse order to removal, taking into account the following:

- steered wheels must be set in a position corresponding to the straight-line vehicle movement;
- install the upper yoke of the cardan shaft on the steering column intermediate shaft until it stops against the intermediate shaft protrusion, insert the bolt into the yoke hole and tighten (see “Steering” section);
- tightening torques for joints:

- bolt securing the cardan shaft upper fork to the steering column intermediate shaft – 28-32 N·m (2.8-3.2 kgf·m);
- bolts securing the steering column to the dashboard base – 18-25 N·m (1.8-2.5 kgf·m);
- bolts securing the steering intermediate cardan shaft support housing to the front panel – 5.5-8.0 N·m (0.55-0.80 kgf·m).

- when installing, ensure clearances between the panel and mating parts C=2 mm (see Fig. 8.40);

- glove compartment in the closed position must fit snugly against the dashboard. Adjustment should be carried out by moving the lock tongue stop with the screw 3 loosened (see Fig. 8.40).

Disassembly and assembly of dashboard removed from vehicle

Disassembly and assembly of the dashboard must be carried out in a tool to protect the assemblies and front surfaces of the dashboard from destruction, scratches and other damage. The tool must provide: reliable fastening of the dashboard in its original position, corresponding to its position on the vehicle.

The **dashboard disassembly** must be carried out in the following sequence:

- install the dashboard with base 6 (Fig. 8.41) into the tool and fix it;
- disconnect the glove compartment hinge pins 30 and the fuse covers;
- remove the mini-timer[1)] (Fig. 8.42) of the preheater, first removing the plug, unscrewing the screw and disconnecting the wire connector;
- remove the instrument cluster trim 45 (Fig. 8.41) by disengaging five spring holders from the dashboard and three holders from the left insert;
- remove the instrument cluster 1 by first unscrewing the four screws securing the instrument cluster to the brackets and the left insert 12 and disconnecting the wire connector;
- remove the left insert 12 be disengaging five spring holders from the dashboard;
- remove the upper glove compartment 34 after unscrewing the fastening screw from the inside of the compartment and disengaging five spring holders from the dashboard and three holders from the right insert. Remove the brake 7 (Fig. 8.43) of the door[2)] 3, unscrew the fastening screws 6, remove the springs 4 and the door 3;
- remove the right insert 19 (Fig. 8.41) be disengaging five spring holders from the dashboard;
- at the right toothed sector of the document pocket cover, remove the stopper 16 from the retarder housing 17, then the retarder housing with brake 18 from the dashboard pin. Open the document pocket door 15 and pull it out to the stop of the pocket hinge latches into the dashboard, disengage the hinge latches and the toothed sector of the pocket door from the panel and remove the document door panel;
- disconnect the wire connectors of the switch 4 for controlling the auxiliary heater[3)], the socket 39, the cigarette lighter 40 [4)] or the user interface unit 41 of the ERA-GLONASS system[5)];
- remove the auxiliary heater control switch from the dashboard[3)];
- remove the center trim 43 by disengaging the two lower latches from the panel, eight latches on the sides, two in the jumper above the heater control board and two spring holders located in the upper part of the center trim;

[1)] – For vehicles equipped with preheater-heater
[2)] - Some vehicles are equipped with upper glove compartment with door
[3)] – For vehicles equipped with auxiliary heater
[4)] – For vehicles equipped with cigarette lighter
[5)] – For vehicles equipped with ERA-GLONASS system

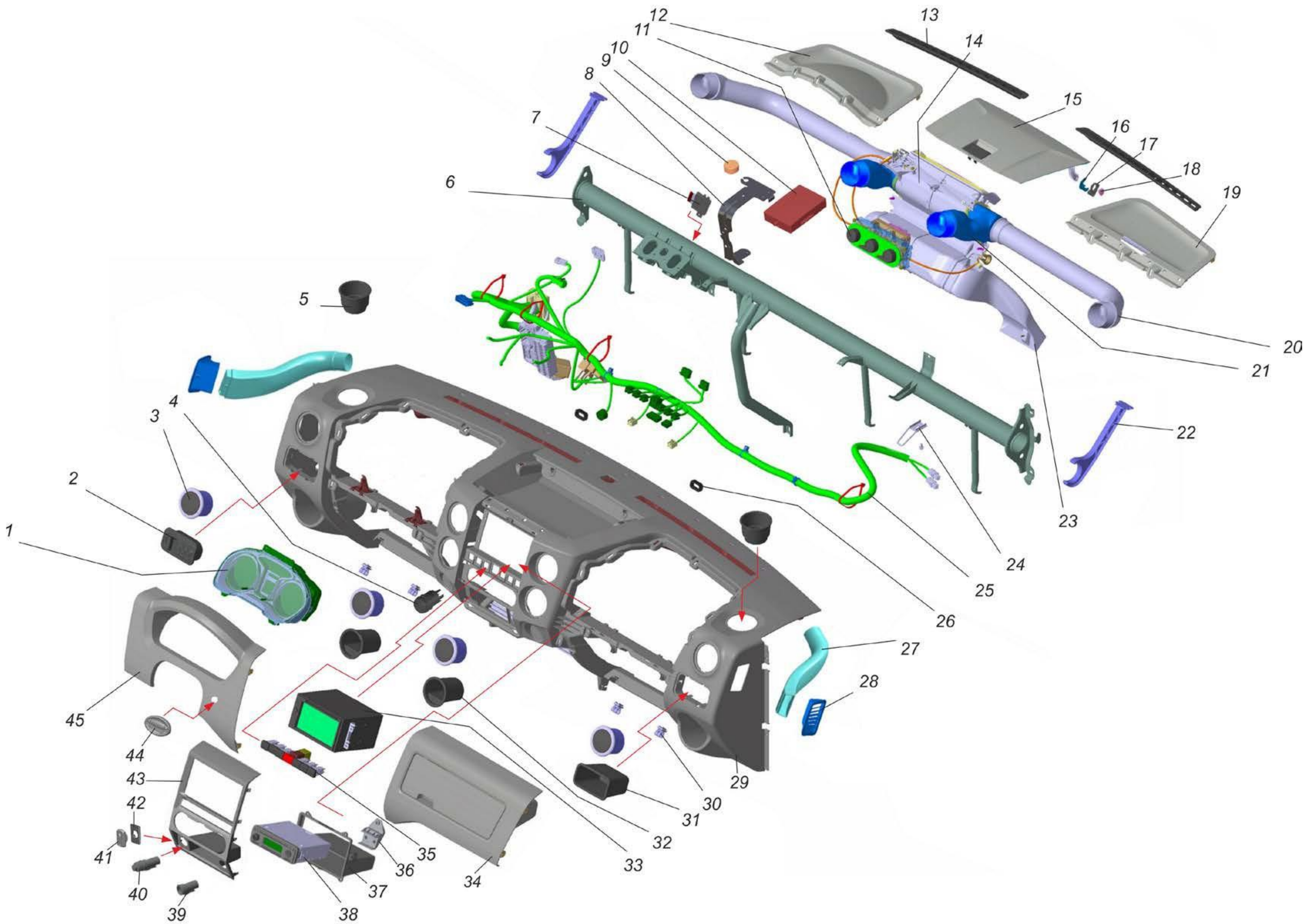


Fig. 8.41. Composition of dashboard removed from vehicle: 1 – instrument cluster; 2 – lighting control module; 3 – cab ventilation deflector; 4 – auxiliary heater switch[1)]; 5 – insert; 6 – dashboard base; 7 – door lock system control unit; 8 – bracket[2)]; 9 – GLONASS/GPS antenna[2)]; 10 – ERA-GLONASS system control unit[2)];11 – heating, ventilation and air conditioning control unit; 12 – left insert; 13 – windshield defroster; 14 – distributor; 15 – document pocket door; 16 – stopper; 17 – retarder housing; 18 – brake; 19 – right insert; 20,27 – branch pipes; 21, 23 – air ducts; 22 – base brace; 24 – lock tongue stop; 25 – wiring harness; 26 – seal; 28 – defroster; 29 – dashboard; 30 – hinge pin; 31 – niche for small things; 32 – central insert; 33 – car stereo 2DIN[3)]; 34 – upper glove compartment; 35 – switches; 36 – center trim insert bracket[3)]; 37 – center trim insert[3)]; 38 – car stereo 1DIN[3)]; 39 – socket; 40 – cigarette lighter;[4)] 41 – user interface unit[2)]; 42 – button base[2)]; 43 – center trim; 44 – mini-timer[5)]; 45 – instrument cluster trim

---

1) – Installed on some of vehicles with a seven-seat cab

2) – For vehicles with ERA-GLONASS system

3) – The vehicle is equipped with a 1DIN car stereo with a center insert and bracket or a 2DIN car stereo, or a center insert with a plug and bracket (the plug is not shown in the figure)

4) - For vehicles equipped with cigarette lighter

5) - For vehicles equipped with preheater-heater

Fig. 8.42. Preheater mini-timer removal

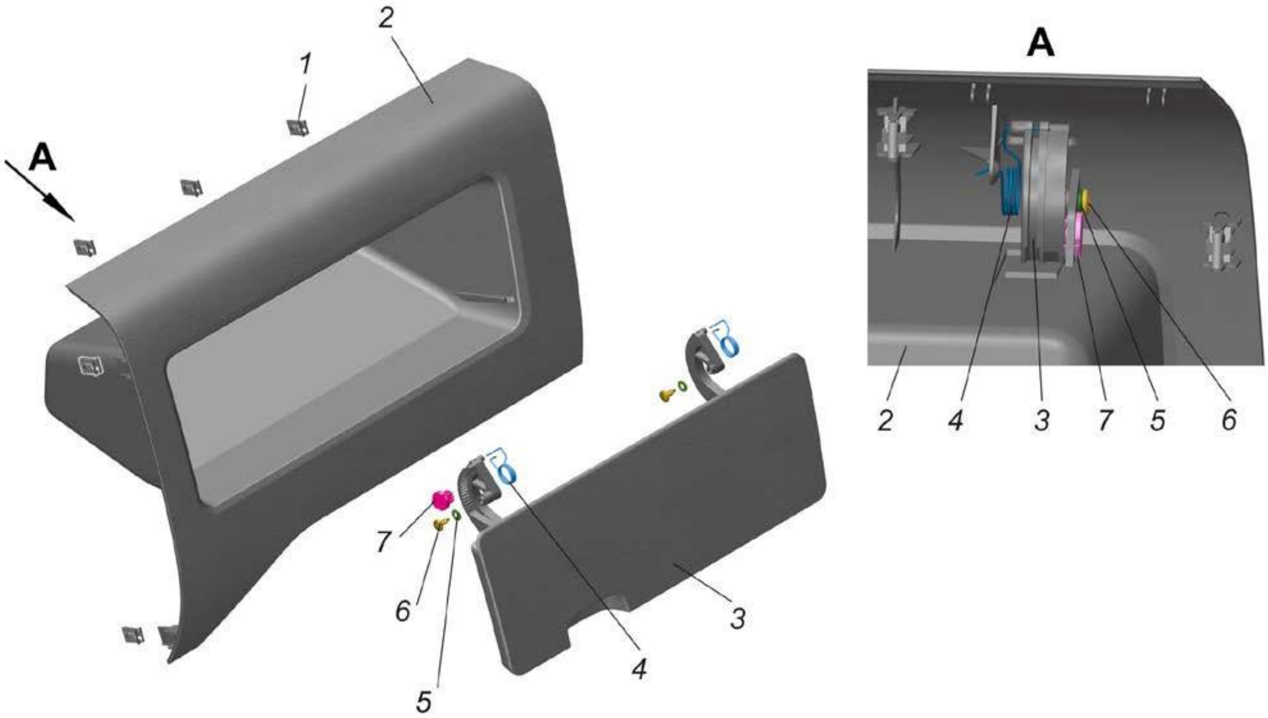


Fig. 8.43. Upper glove compartment with door: 1 – spring holder; 2 – upper glove compartment; 3 – door[1)]; 4 – spring; 5 – nut; 6 – screw; 7 – brake

- remove the car stereo 2DIN[2)] by unscrewing the screws securing it to the dashboard and disconnecting the wire connectors and the GPS antenna;
- remove the GPS antenna[2)] from the dashboard;
- remove the insert 37 of the center trim by unscrewing the screws securing it to the dashboard and disconnecting the car stereo 1DIN wire connector[3)];
- remove the car stereo 1DIN[3)]from the central trim insert by unscrewing the

[1)] – Installed on some vehicles
[2)] – For vehicles with 2DIN car stereo
[3)] - For vehicles with 1DIN car stereo

nut securing the car stereo to the bracket 36 of the insert. Remove bracket 36 by unscrewing two screws securing it to the center trim insert;

- remove socket 39, cigarette lighter 40 [1] or user interface unit 41 of the ERA-GLONASS system[2] and button base 42 [2], having previously unscrewed the nut of the user interface unit, from the central trim;
- remove the light control module 2 from the dashboard by disconnecting the wire connector and pressing the module latches from inside the dashboard;
- remove inserts 5 and 32, niche 31 for small things from the dashboard by pressing them from inside the dashboard;
- remove the windshield defroster 13 from the dashboard by releasing the latches;
- remove the door lock system control unit 7 by unscrewing the screws securing the unit to the dashboard base;
- disconnect the connectors of the wires and the GLONASS/GPS antenna 9 from the ERA-GLONASS system control unit 10. Remove the control unit 10 and the GLONASS/GPS antenna by unscrewing the antenna retaining nut from the bracket 8 [2];
- remove the bracket 8 from the dashboard base 6 by unscrewing the fixing screws [2];
- remove the defrosters 28 of the side windows from the side branch pipes 27 and the dashboard by pressing the latches from the inside of the dashboard;
- remove the side branch pipes 27 from the dashboard;
- unscrew the four screws securing the heater control board, two bolts securing the distributor to the dashboard base, two screws securing the distributor to the dashboard, two screws securing the air ducts to the dashboard, remove the air ducts and ventilation pipes from the interior ventilation deflectors and remove the distributor assembly with heater control board, air ducts and ventilation pipes;
- remove the air ducts 23 and the ventilation pipes 20 from the distributor 14;
- remove the deflectors 3 for interior ventilation from the dashboard by depressing the latches of the deflectors from the inside of the dashboard;
- disconnect the relay and fuse box from the dashboard by unscrewing the four screws securing it to the dashboard and to the lower bracket of the unit;
- remove the lower bracket for fastening the relay and fuse box by unscrewing the two screws securing it to the dashboard;
- remove the wiring harness 25 by removing the straps attaching the wiring harness to the dashboard base 6;
- remove the base braces 22 by unscrewing the screws securing the braces to the dashboard;

---

[1] – For vehicles equipped with cigarette lighter

[2] – For vehicles equipped with ERA-GLONASS system

remove the glove compartment lock tongue stop 24 from the dashboard base by unscrewing the fastening screw.

The dashboard 29 riveted to the metal base 6 is a non-separable connection (if necessary, it is allowed to rivet new parts: dashboard 2 (Fig. 8.44) and base 3 using the pop rivet tool 704.30.010 (thirteen rivets);

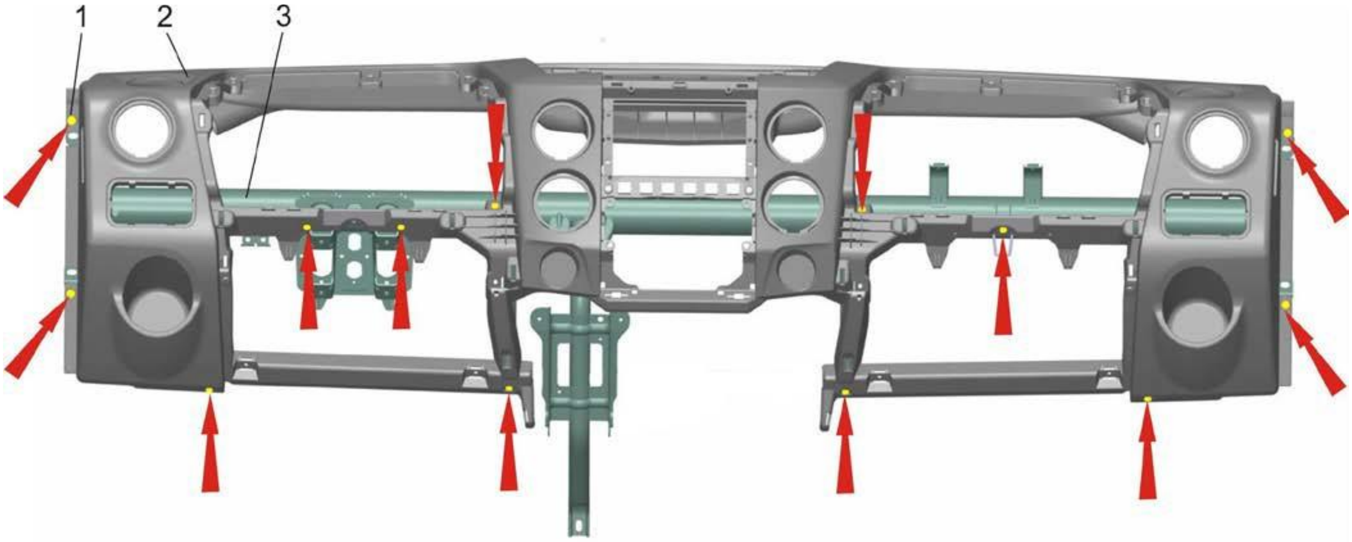


Fig. 8.44. Fastening dashboard to base: 1 – rivet; 2 – dashboard; 3 – dashboard base

The **dashboard assembly** must be carried out in the reverse order of disassembly, taking into account the following:

- tighten the screw securing the door locking system control unit to the base until it stops and tighten the nuts securing the car stereo 1DIN[1] to the central trim bracket insert until they stop;

- tighten the screws securing the instrument cluster must be carried out starting from the upper points of attachment (to the left insert);

- tightening torque of the screw securing the mini-timer[2] of the preheater-heater is 0.4-0.8 N·m (0.04-0.08 kgf·m);

- tighten the lower screw securing the bracket and the nut of the ERA-GLONASS user interface unit manually until it stops[3];

- install the ERA-GLONASS system control unit on the bracket until it stops[3];

- tightening torque of the upper screw securing the bracket and the nut of the ERA-GLONASS antenna - 5.5-7.8 N·m (0.55-0.8 kgf·m)[3];

- tightening force of the strap fastening the antenna cable to the ERA-GLONASS system bracket is 98-117.7 N (10-12 kgf)[3].

[1] - For vehicles with 1DIN car stereo
[2] - For vehicles equipped with preheater-heater
[3] – For vehicles equipped with ERA-GLONASS system

8.3.11. Cab (interior) heating and ventilation

The interior heating system is liquid, dependent, with heat intake from the coolant of the engine cooling system.

The heating system consists of a main heater (heater module), an air distributor, an air intake, a main heater control system, and a piping system, including an electric heater valve. The main heater is located under the dashboard on the cab front panel.

On some vehicles, a preheater-heater with an electric pump is installed in the heating system, which provides heating of the coolant passing through it using the heat from fuel combustion. The preheater-heater is located in the engine compartment in front of the battery on the right side member of the cab near the front fender guard.

For heating system diagrams, see “Engine” section (Engine Cooling System Diagrams).

The heating system is designed for continuous operation for a long time and provides multiple air exchange in the cab, the required air speed and temperature, and the temperature of the cab surfaces.

Supply and exhaust ventilation systems are provided in the vehicle cab. Supply ventilation is carried out through the heating system when the fan of the main heater is turned on, and when the windows of the cab doors are lowered. Exhaust ventilation is carried out through valves in the rear panel of the cab, connected to the atmosphere.

8.3.11.1. Main heater (heater module)

The vehicle cab heating intensity depends on the temperature and volume of air that has passed through the heater.

The air temperature is determined by the amount of air that has passed through the heater core and is controlled by the mixing damper.

The air volume is determined by the fan operation mode with four rotation speeds, controlled by a knob on the control unit.

Outside air passes through the air intake cover into the air intake located in the engine compartment on the front panel, changes its direction, is separated from rainwater and filtered. Then the air from the air intake enters the heater module and then to the air distributor installed on the dashboard base.

The air distributor air ducts are designed to redistribute the air flow in three directions: to the feet of the driver and passengers, to the windshield and side windows of the doors, to the chest area through the ventilation deflectors.

The piping system is located in the engine compartment of the vehicle and in the cab in the heater module itself and ensures the circulation of the heated fluid through the heater core.

The piping system includes hoses connecting the engine to the heater core pipes and the electric heater valve. The valve can be in two positions: fully open or fully closed.

The **control system** is designed to maintain a comfortable temperature in the vehicle cab. The heater is controlled using the control board located in the central part of the dashboard (Fig. 8.45).

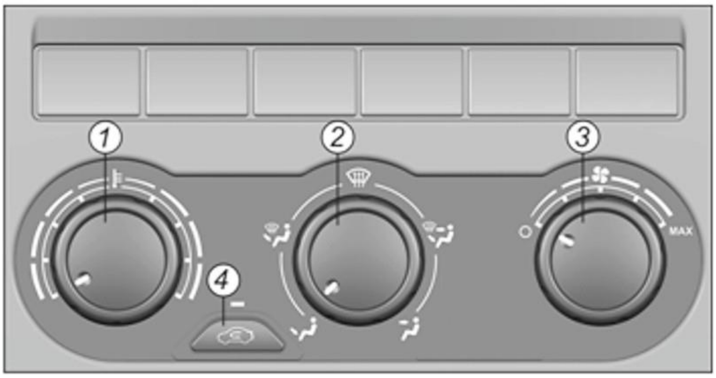


Fig. 8.45. Heating and ventilation control board: 1 – air temperature regulator knob; 2 – air flow distribution regulator knob; 3 – heater fan speed control knob; 4 – air recirculation mode on/off button

Glass defogging

To quickly defog the windshield and door windows, it is necessary to set the control board knobs to the positions shown in Fig. 8.46.

Fig. 8.46. Position of regulator knobs for window defogging

Cab heating

For quick heating of the cab, it is necessary to set the control board knobs to the positions shown in Fig. 8.47.

Fig. 8.47. Position of regulator knobs for cab heating

To achieve maximum heating efficiency, as well as to isolate the cab from unpleasant odors and smoke, it is necessary to turn on the recirculation mode by pressing button 4 (Fig. 8.45). The recirculation mode will automatically turn off after 10 minutes. Forced deactivation of the recirculation mode is carried out by pressing button 4 again. After stopping and then starting the engine, the recirculation damper automatically switches to the outside air intake mode.

ATTENTION
Do not use the recirculation mode for a long time, as in this case, the flow of fresh air into the vehicle cab stops, which can lead to deterioration of health, as well as fogging of the windows.

When the cab is warm enough, we recommend setting the fan speed knob 3 to the middle position, the air distribution control to the position corresponding to comfortable air distribution and adjust the temperature by moving the temperature control knob 1 within the red zone.

Ventilation

To maximize the intake of fresh air into the cab, it is necessary to set the control board knobs to the positions shown in Fig. 8.48, open the ventilation deflectors and adjust the direction of air flow with the ventilation deflectors.

ATTENTION
To prevent the penetration of unpleasant odors and exhaust gases of vehicles in front into the interior, when driving in a tunnel, etc., it is recommended that you turn on the recirculation mode using button 4 (Fig. 8.45).

Fig. 8.48. Position of regulator knobs for cab ventilation

Heating system maintenance and repair

The heater module maintenance consists of periodic inspection and operation checks. If coolant leaks at the hose connections, the spring clamps must be replaced.

The heater module operation description, possible malfunctions and remedies, heater module repair, air distributor and heater control system are set out in the supplier's documentation.

ATTENTION
Before carrying out the work, stop the vehicle engine, turn off the heaters, preheater-heater.

Before disconnecting the pipelines, clean the joints from dirt, after disconnecting the pipelines, close the openings with plugs to prevent ingress of contaminants into the assemblies and systems.

Heater module removal

Removal of the heater module 2 (Fig. 8.49) must be carried out in the following sequence:

- disconnect wires from the battery;
- drain fluid from the engine cooling system (3-4 liters). The expansion tank plug must be removed, and the heater valve must be opened (switch off the ignition when the heater is on);
- disconnect the hoses from the heater module tubes by loosening the fastening

clamps;

- remove the dashboard (see “Dashboard” subsection);
- disconnect two wire connectors from the heater module gear motors;
- unscrew the bolts securing the heater module and the heater module tube bracket to the front panel;
- unscrew the nuts securing the heater module to the heater bracket and the fan bracket;
- remove the heater module from the vehicle;

Install the heater module in the order reverse to removal. After installing the heater module and filling the system, check the tightness of the connections and test the heating system operation.

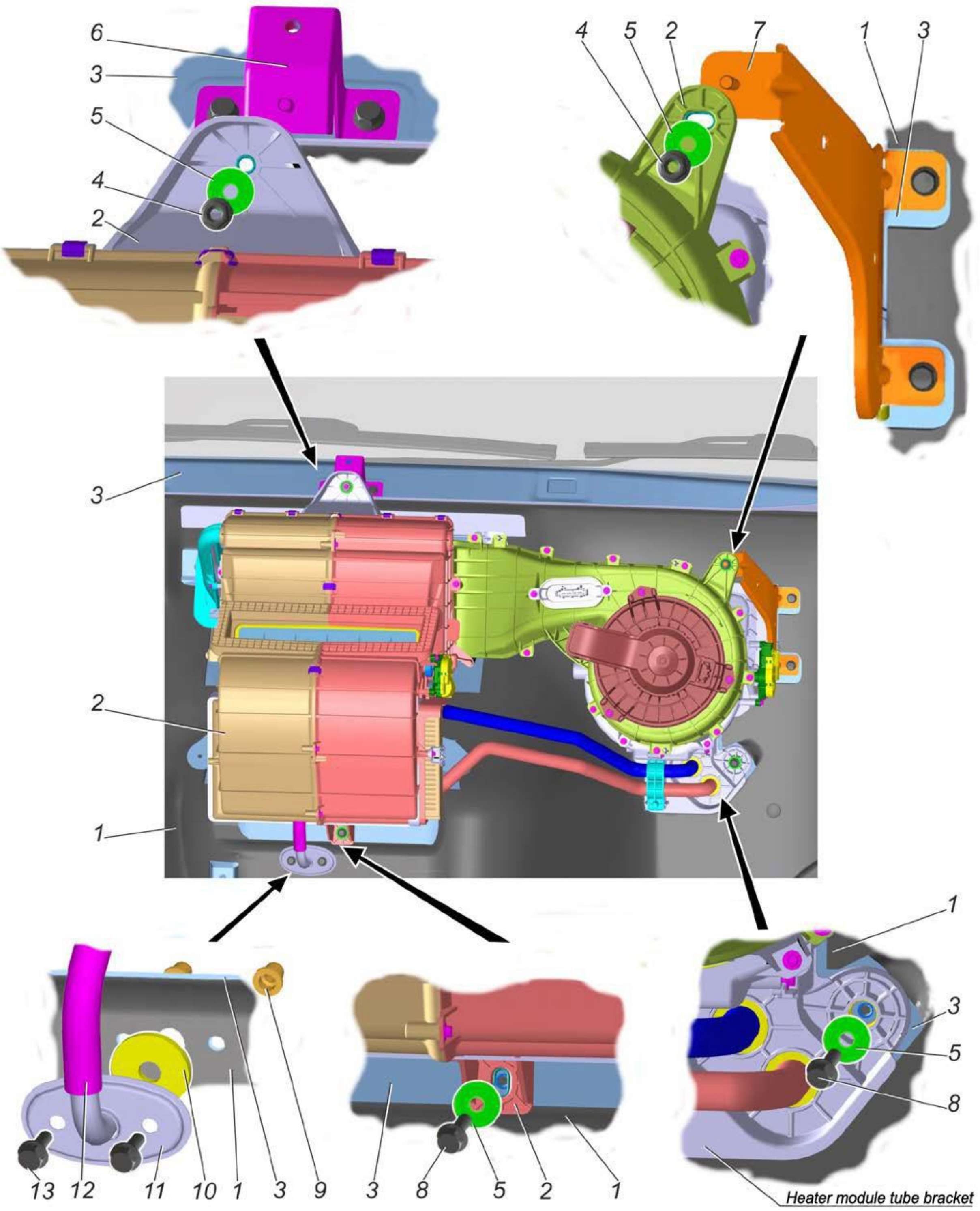


Fig. 8.49. Heater module installation: 1 – front panel insulation; 2 – heater module; 3 – front panel; 4 – nuts; 5 – washers; 6 – heater bracket; 7 – fan bracket; 8 – bolts

8.3.11.2. Heater air intake filter replacement

The heater air intake filter must be replaced in the following sequence:

- remove the front duct 12 (Fig. 8.50) from the drain pipe bushing 6 and two pins D of the rear duct 4 after unscrewing the five bolts securing the front air intake duct to the rear one;

- remove the housing assembly 10 with the filter 9 by unscrewing the four bolts securing the filter housing to the rear duct;

- remove the filter from the housing;

- clean the internal surfaces of the front and rear ducts and the filter housing from dirt;

- check the integrity of the seals and replace if necessary;

- install a new filter in the housing after applying adhesive sealant Loctite 5900 (from Henkel) or Loctite 5699 (from Henkel) to the rear air intake duct along the contour of the filter housing installation position without breaks in a wide strip of 4-5 mm (Fig. 8.51);

- install the housing with the filter on the rear duct, tightening the mounting bolts;

- install the front duct on the rear duct, aligning the groove of the front duct with the drain bushing and the holes on the front duct with the pins of the rear duct, tighten the bolts of the front duct.

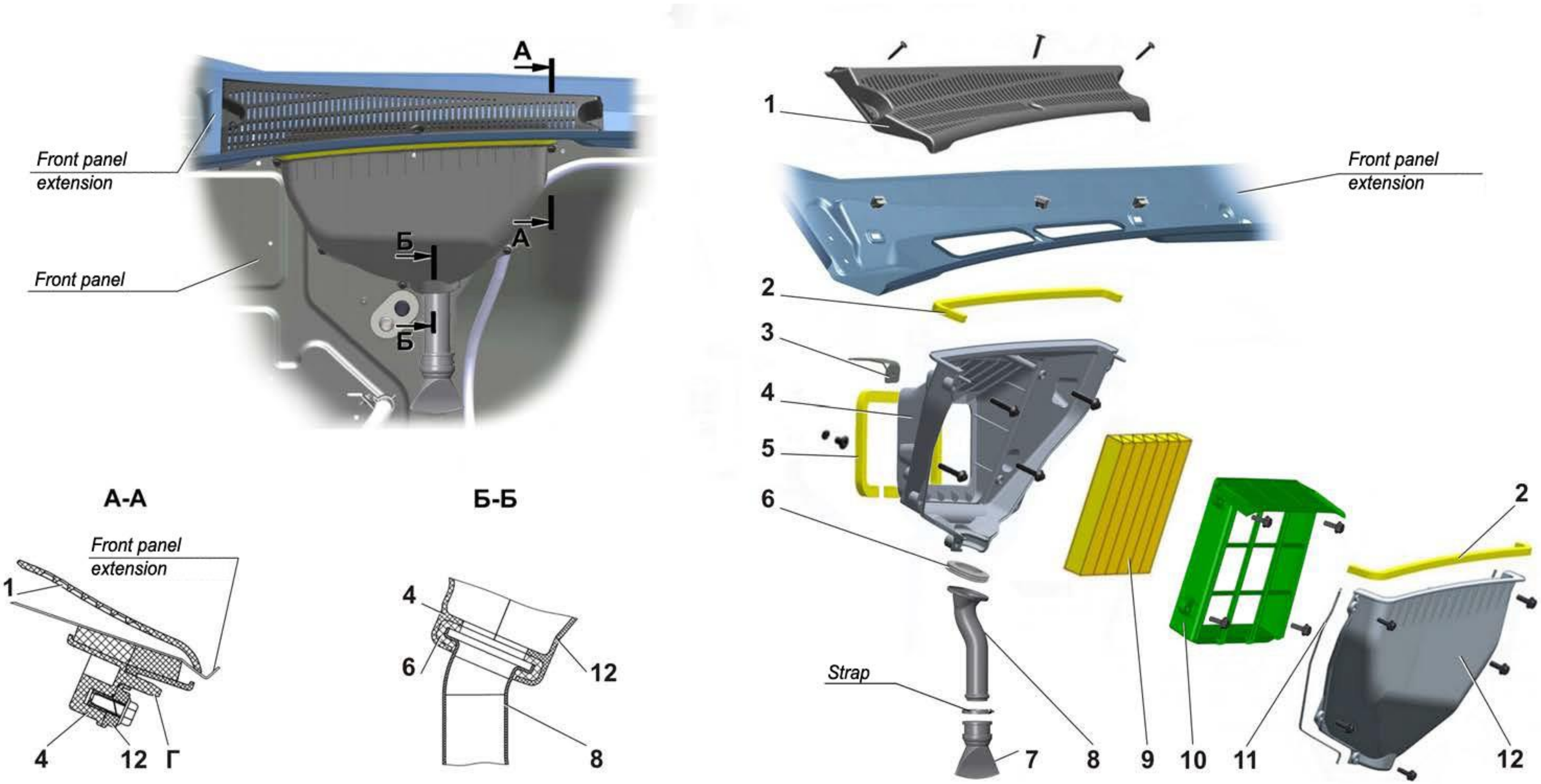


Fig. 8.50. Air intake installation: 1 – air intake cover; 2, 5, 11 – seals; 3 – bracket; 4 – rear air intake duct; 6 – bushing; 7 – water dump valve; 8 – branch pipe; 9 – filter; 10 - filter housing; 11 – front air intake duct; 12 – front air intake duct

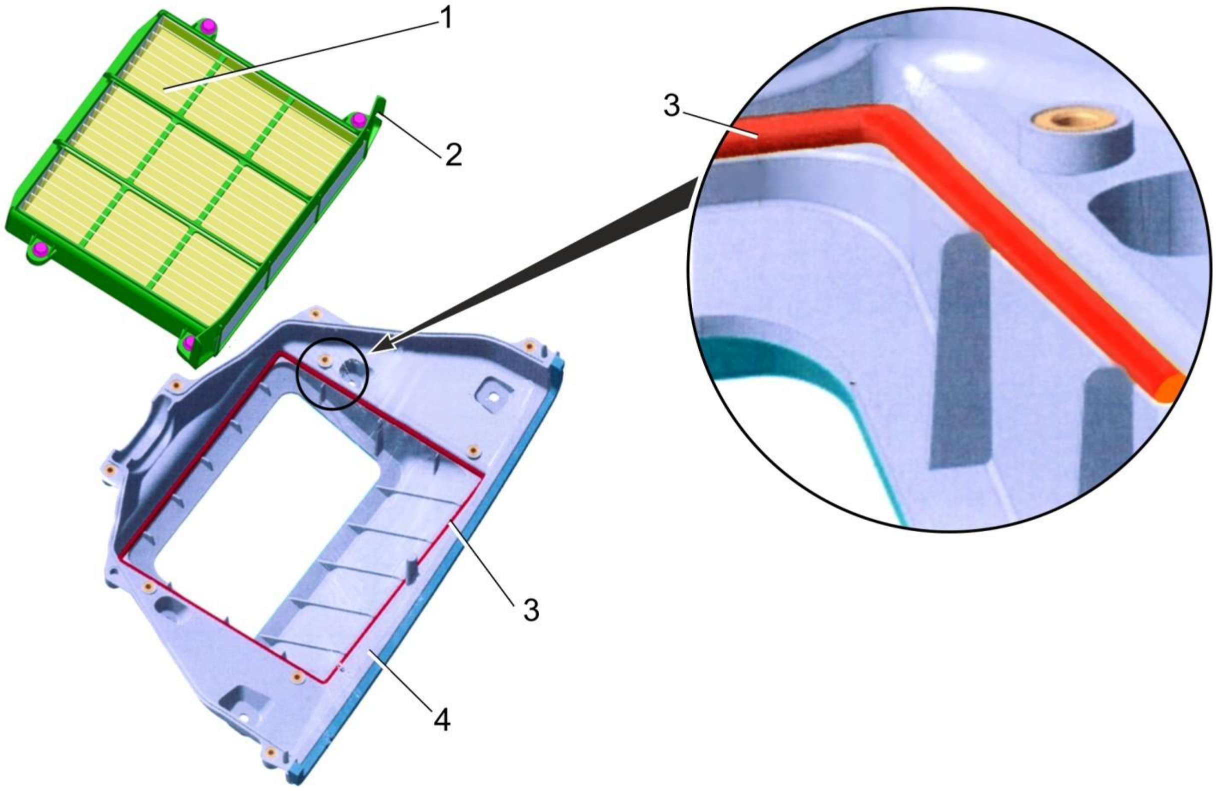


Fig. 8.51. Sealant application to rear air intake duct: 1 – filter, 2 – filter housing; 3 – adhesive sealant; 4 – rear air intake duct

8.3.11.3. Heater control valve

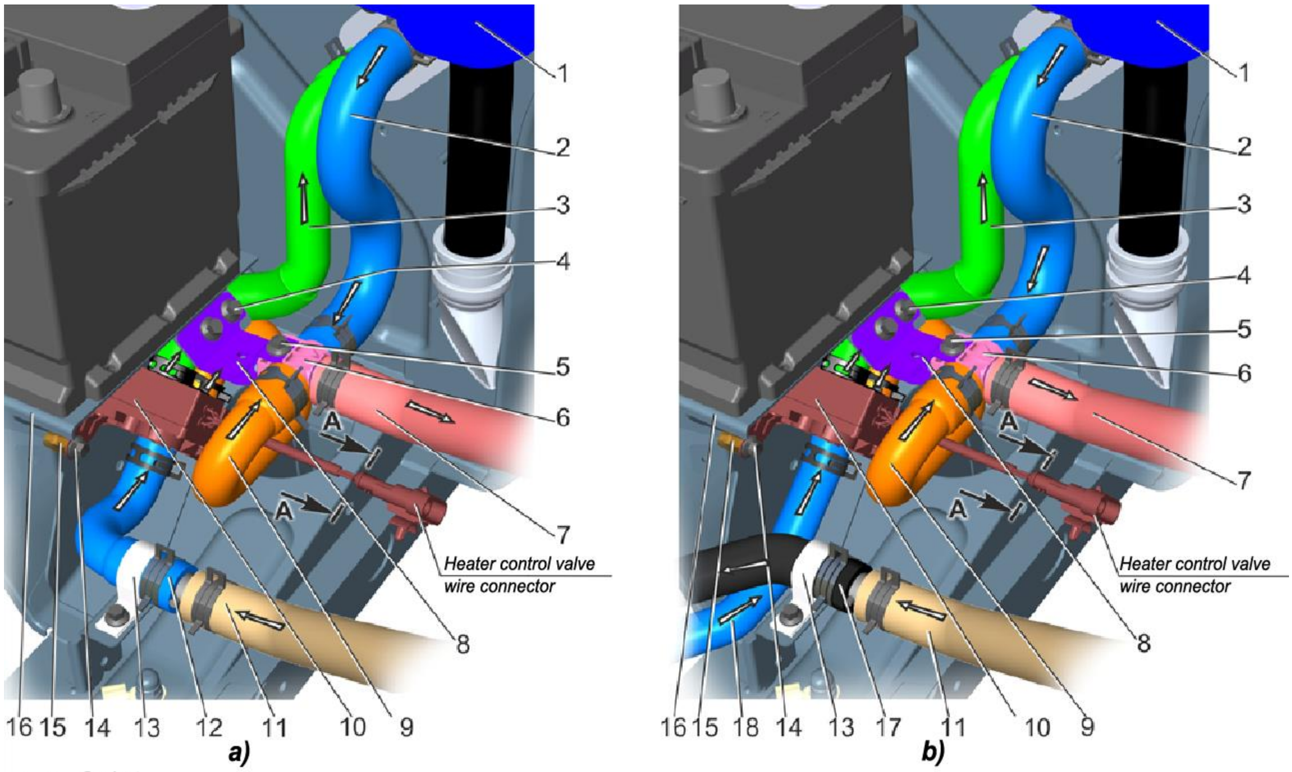
The vehicle is equipped with an electrically driven heater control valve.

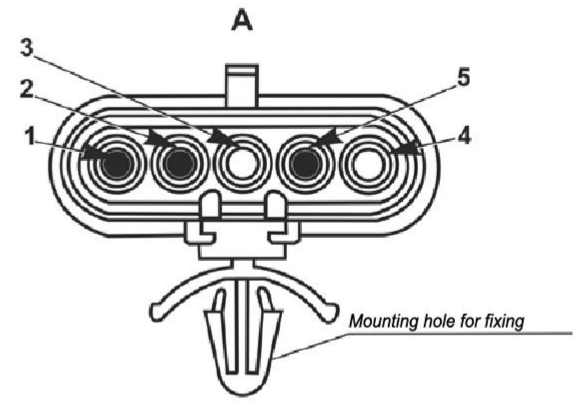
The heater control valve is a non-repairable product.

If the heater control valve fails, replace it with a new one.

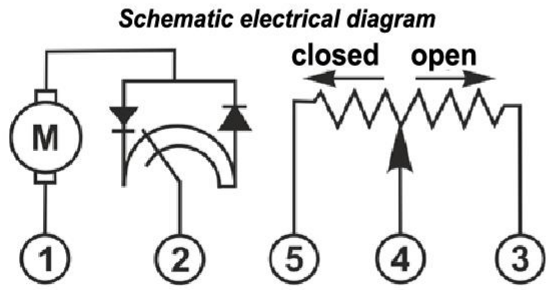
The **heater control valve removal** must be carried out as follows:

- drain the coolant from the engine cooling system (3-4 liters);
- disconnect the wiring harness from the valve;
- disconnect the hoses from the tee 6 (Fig. 8.52), loosening the fastening clamps;
- disconnect from the battery base by unscrewing the two mounting bolts and remove the bracket 8 assembly with tee from the vehicle;
- disconnect the heater control valve 10 from the battery base by unscrewing the two mounting bolts;
- disconnect hoses 12,17 and 3 by loosening the fastening clamps and remove the valve assembly with hose 9 from the vehicle;
- remove hose 9 from the heater control valve by loosening the fastening clamp.





Pins	Wire color
5	White (ground)
4	Sky blue (feedback)
3	Green
2	Black (motor +/-)
1	Red (motor +/-)



1	2	
+	-	open - closed
-	+	closed - open

Fig. 8.52. Heater control valve installation: a – for vehicles not equipped with preheater-heater; b – for vehicles equipped with preheater-heater; 1 – air intake; 2, 3 – heater hoses; 4, 5, 14 – bolts; 6 – tee; 7, 9, 11, 12, 17, 18 – hoses; 8 – bracket; 10 – heater control valve; 13 – clip; 15 – threaded rivet; 16 – battery base

The **heater control valve installation** is carried out in the reverse order of removal.

The tightening torque of the bolts securing the valve to the battery base, the bolt securing the tee bracket to the battery base is 5.5-10 N·m (0.55-1.0 kgf·m).

Hose clamps must be installed at a distance of 4-5 mm from the ends of the hoses.

After installation, check the tightness of the heating system.

8.3.11.4. Preheater-heater and electric pump [1)]

To achieve comfortable conditions in the vehicle cab (interior) and stabilize the temperature conditions of the engine in cold weather, a preheater-heater is installed on the vehicle, which provides heating of the coolant passing through it using the heat from the diesel fuel combustion. The heater includes an electric pump that increases the fluid flow in the heating system, which improves cab heating.

The coolant preheater is installed in the engine compartment in front of the battery on the right side member of the cab near the front fender guard, the fuel dosing pump is installed on the left side member of the frame near the fuel tank.

Description of the design, operation, maintenance, troubleshooting and repair of the heater is set out in the supplier’s documentation.

The preheater is turned on by a switch located on the dashboard when the engine is running and the heater is on. Further, the preheater operates in automatic mode, increasing the temperature of the coolant entering the heating system up to 80-85 °C, thereby increasing the efficiency of its operation in winter.

The preheater is recommended to be turned on when the outside air temperature is below plus 5 °C.

The preheater turns on and off automatically when the engine is running, the heater operation button is turned on, the heating is turned on and the heater fan is turned on.

In the event of malfunctions of the preheater kit components, the cause must be determined using the diagnostic tool and eliminated.

The checking must be carried out by technicians trained in the maintenance of the specified heaters.

Preheater-heater removal and installation

ATTENTION
Before carrying out the work, stop the vehicle engine, turn off the heater and preheater and wait until all hot parts have cooled down.

The preheater removal must be carried out in the following sequence:

- disconnect wires from the battery;
- drain fluid from the engine cooling system (3-4 l);
- disconnect and remove the front bumper panel (see “Front bumper panel removal and installation” subsection);
- remove the strap fastening the electric pump inlet hose;

[1)] - For vehicles equipped with preheater-heater

- disconnect the preheater wire connector;
- loosen the fastening clamp, then disconnect the fuel line 16 (Fig. 8.53) from the preheater connecting hose. Drain the fuel from the fuel line into a container. Lift the disconnected end of the fuel line up and secure;
- disconnect the coolant inlet hose from the electric pump and the outlet hose from the preheater by loosening the fastening clamps;
- disconnect the heater bracket from the cab side member by unscrewing the two bolts. Remove the preheater assembly with brackets, electric pump, muffler, metal exhaust hoses, air intake hose and outlet hose of the electric pump.

The preheater installation must be carried out in the reverse order of removal. The tightening torque of the bolts securing the preheater bracket to the cab side member is 8-12 N·m (0.8-1.2 kgf·m).

After installing the preheater, make sure that there is fuel in the fuel line, test the operation of the preheater and check the tightness of the connections of the fuel supply pipelines and the coolant circulation circuit.

Fuel dosing pump removal and installation

ATTENTION
Before carrying out the work, stop the vehicle engine, turn off the heater, preheater.

The dosing pump removal must be carried out in the following sequence:
- disconnect wires from the battery;
- disconnect the wire connector of the fuel dosing pump 6 (Fig. 8.54);
- disconnect the quick-release connector of the outlet fuel line 3 and the tip of the fuel dosing pump and fix the fuel line above the fuel tank. Disconnect the quick-release connector of the fuel line 5 and the tip of the fuel dosing pump, drain the fuel from the fuel line 5 into a container;
- disconnect from the side member and remove the dosing pump assembly with bracket from the vehicle.

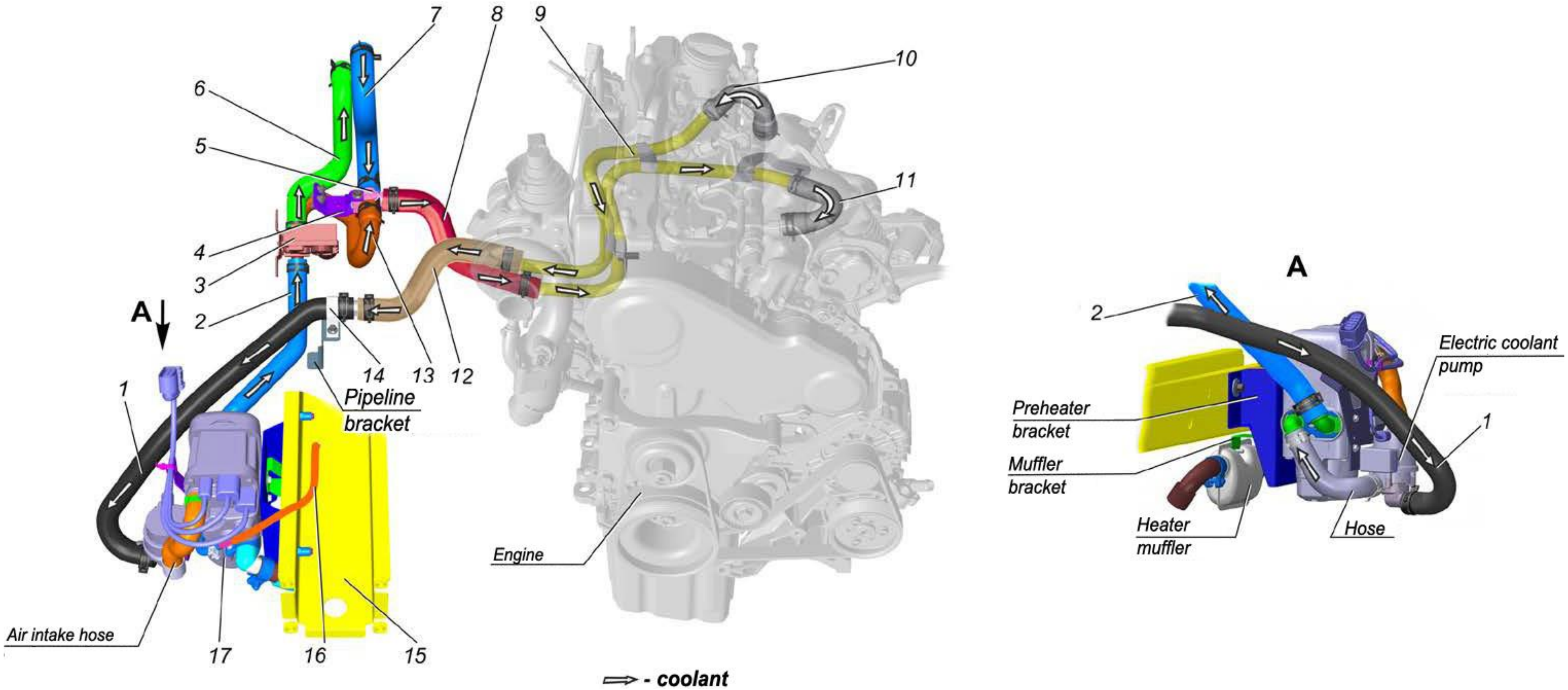


Fig. 8.53. Preheater-heater installation: 1, 2, 6, 7, 8, 10, 11, 12, 13 – hoses; 3 – heater control valve; 4 – bracket; 5 – tee; 9 – pipelines; 14 – clip; 15 – cab side member; 16 – fuel line; 17 – preheater-heater

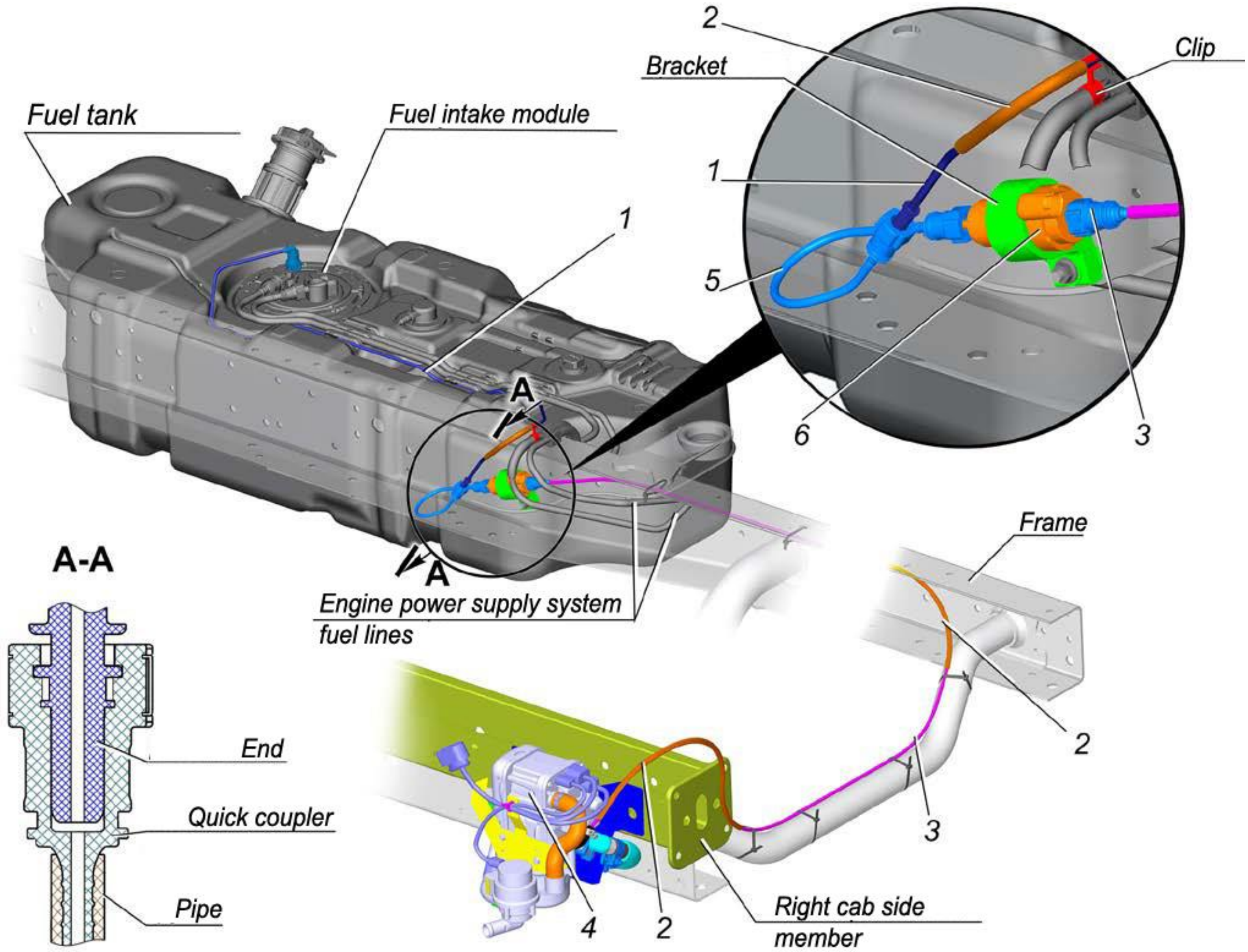


Fig. 8.54. Preheater-heater fuel line installation: 1 – fuel line assembly with clip, mounting bushings and protective pipe; 2 – protective pipes; 3 – fuel outlet; 4 – preheater-heater; 5 – fuel line; 6 – dosing pump

The dosing pump installation must be carried out in the following sequence:

- install the rubber bracket on the dosing pump;
- install the dosing pump on the side member, with the pressure side up with an increase. The angle between the dosing pump axis and the horizontal should be 15-21º. Tightening torque for the bolt and nut securing the bracket to the side member - 6-8 N·m (0.6-0.8 kgf·m);
- connect the quick-release connectors of the fuel line 5 and the outlet fuel line 3 with the tips of the fuel dosing pump;
- connect the dosing pump wire connector;
- connect the wires to the battery;
- fill the preheater line with fuel.

After installing the fuel dosing pump, test the operation of the preheater and check the tightness of the connections of the fuel supply pipelines.

Bleeding fuel line and checking coolant preheater operability

Bleeding the fuel line and checking the preheater operability is carried out in the following sequence:

- connect a special temporary harness for bleeding the heater fuel line to the engine compartment harness connector to the right headlight and the preheater harness connector;
- turn on the emergency brake lights. By characteristic clicks, make sure that the fuel pump is working;
- turn off the emergency brake lights when filling the preheater fuel line with fuel. The line is filled in 2-6 minutes depending on the fuel tank filling. Monitoring is carried out by characteristic fuel pipe vibrations;
- carry out the initial start of the preheater, for which set the quick start key on the mini-timer or the preheater-heater control board to the “max” position, press the preheater power button on the heater/climate control unit control board;
- make sure that the preheater is working according to the following signs: the air blower operation in the preheater, the presence of exhaust gases from the heater muffler (30 s after turning on). After the initial start, let the preheater run for three minutes, then turn off the engine and press the preheater power button;
- in the absence of exhaust and heater operation, turn off the preheater to find out the cause of its inoperability. Checking and diagnostics of preheaters is carried out using a diagnostic tool.

8.3.12. Air conditioning system

Air conditioning system specifications

Climate control unit with front evaporator: Cooling capacity, kW ..≈ 7
Supply air volume
IN dashboard at maximum fan speed
of climate control unit, m^3/h 350

Amount of coolant filled into air
conditioning system lines, g: .... 480±25

Pressure in pipelines at
ambient temperature of .... +20 °C:

operating pressure in high pressure line, atm. (bar) 5-22

operating pressure in low pressure line, atm. (bar) 1.5-3.4

maximum pressure in discharge branch, atm. (bar) 24

Air conditioning system operation principle

The principle of operation of the air cooling system is based on the freon phase transformations.

The air is cooled by the air conditioning system when it passes through the evaporator.

When the vehicle's air conditioning mode is turned on, a signal is sent through the electronic engine control unit, allowing the air conditioning compressor clutch activation.

The compressor clutch activation ensures the circulation of freon through the components of the air conditioning system and its phase transformations in a closed piping system.

The compressor pumps gaseous freon at high pressure and temperature through a high pressure pipeline into the condenser, forced blown by a fan, where it turns into a liquid, giving off the "latent" heat of condensation to the air passing through the condenser. Through the piping system, the liquefied freon enters directly to the thermal expansion valve (TEV) of the evaporator (Fig. 8.55).

In the TEV, liquid freon is sprayed to a misty state with low temperature and pressure.

Further, in the air handling unit module evaporator, the freon converts from a misty state into a gaseous state, taking away the “latent” heat of evaporation and cooling the evaporator. After passing through the evaporator, the gaseous freon is sucked into the compressor and the cycle is repeated.

The diagram of the vehicle air conditioning system is shown in Fig. 8.56.

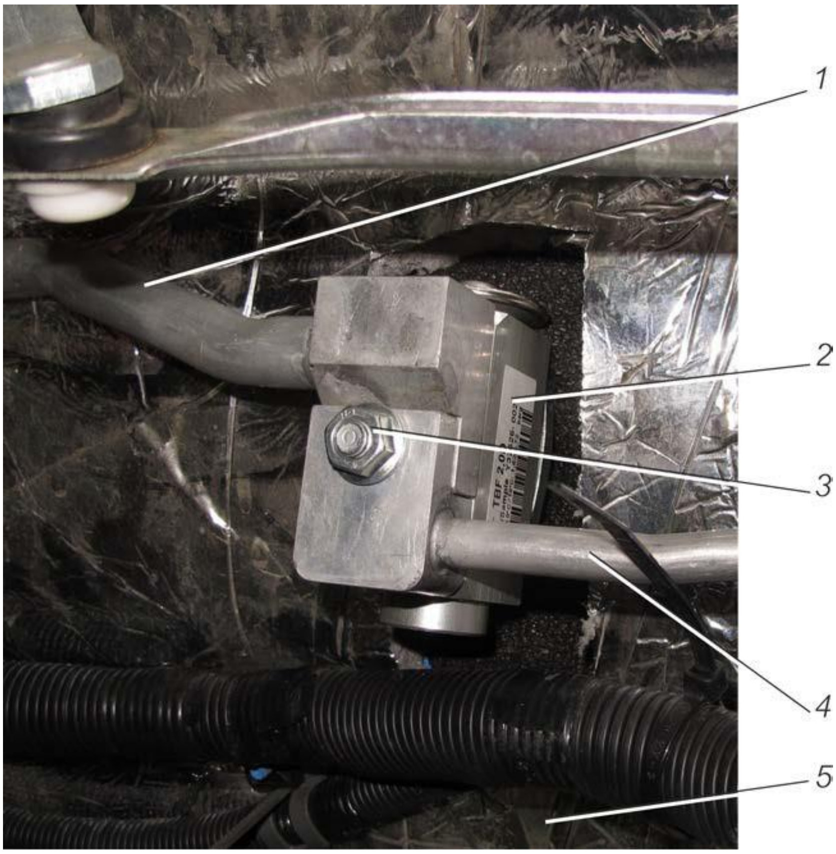


Fig. 8.55. Thermal expansion valve (TEV) of air handling unit module evaporator: 1 – compressor supply pipeline (low pressure pipeline); 2 – evaporator TEV; 3 – nut; 4 – body pipeline (high pressure pipeline); 5 – front panel heat and sound insulation

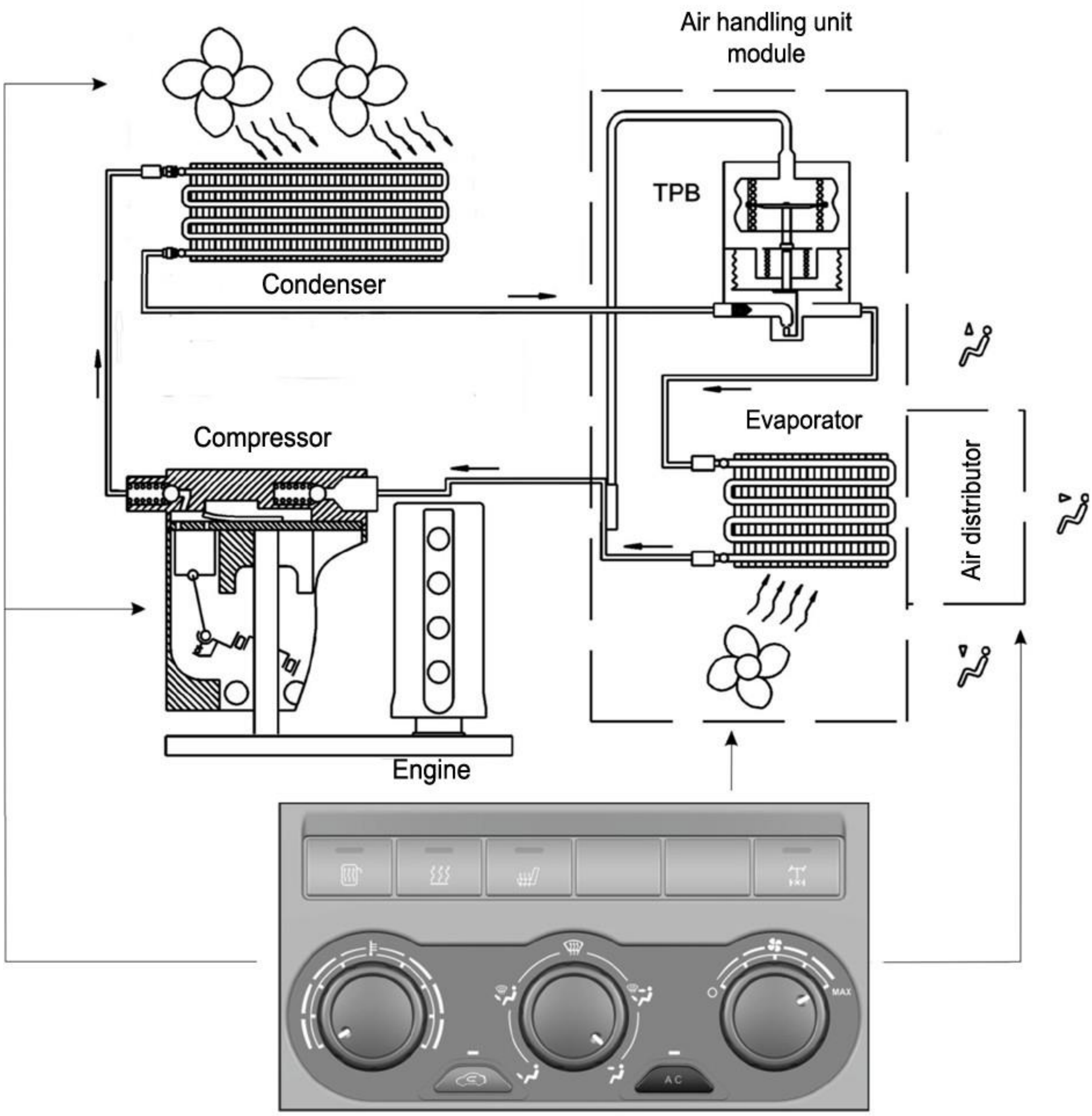


Fig. 8.56. Vehicle air conditioning system diagram

During the air conditioning system operation, the compressor and condenser fan are automatically turned off and on under the following conditions:

- when the pressure in the pipeline system decreases relative to the minimum value, as well as when the pressure in the pipeline system increases relative to the maximum value of the pressure sensor located in the high pressure pipeline. The pressure sensor is connected through the electronic engine control unit with the compressor (turns off the compressor at a pressure below 2.5 atm or over 28 atm) and with the condenser fan (the pressure sensor turns on the condenser fan at a pressure over 15 atm).

Air conditioning system design

The vehicle air conditioning system is designed to cool the air supplied to the vehicle cab and has one cooling circuit (front).

The main components of the vehicle air conditioning systems are shown in Fig. 8.57.

The air is cooled when it passes through the evaporator (Fig. 8.58) with the air conditioning mode on. The evaporator is located in the air handling unit module and is connected by high and low pressure pipelines to the air conditioning system components. The system pipelines are filled with R134a freon.

The main components of the vehicle air conditioning system are shown in Fig. 8.57, including:

- air handling unit module (with evaporator and thermal expansion valve (TEV));
- air conditioning compressor;
- condenser with built-in receiver;
- condenser fans;
- pressure sensor;
- high and low pressure pipelines of the air conditioning system;
- distributor with control board.

The **air handling unit module** 10 (Fig. 8.57) is installed under the dashboard on the front panel of the cab and performs complex treatment of the air entering the cab. The air handling unit module provides fresh air to the cab, air exchange, air recirculation, air temperature treatment (heating or cooling depending on the season and the driver's desire) to achieve comfortable conditions, and eliminates excess humidity.

Compressor 2 (Fig. 8.58) of the air conditioner circulates freon in the air conditioning system components. The compressor is attached to the engine on a bracket on the right side. The compressor clutch is driven by the crankshaft pulley through the V-ribbed belt for driving engine units. The belt is tensioned by an automatic belt tensioner. During operation, the tension mechanism does not require adjustment.

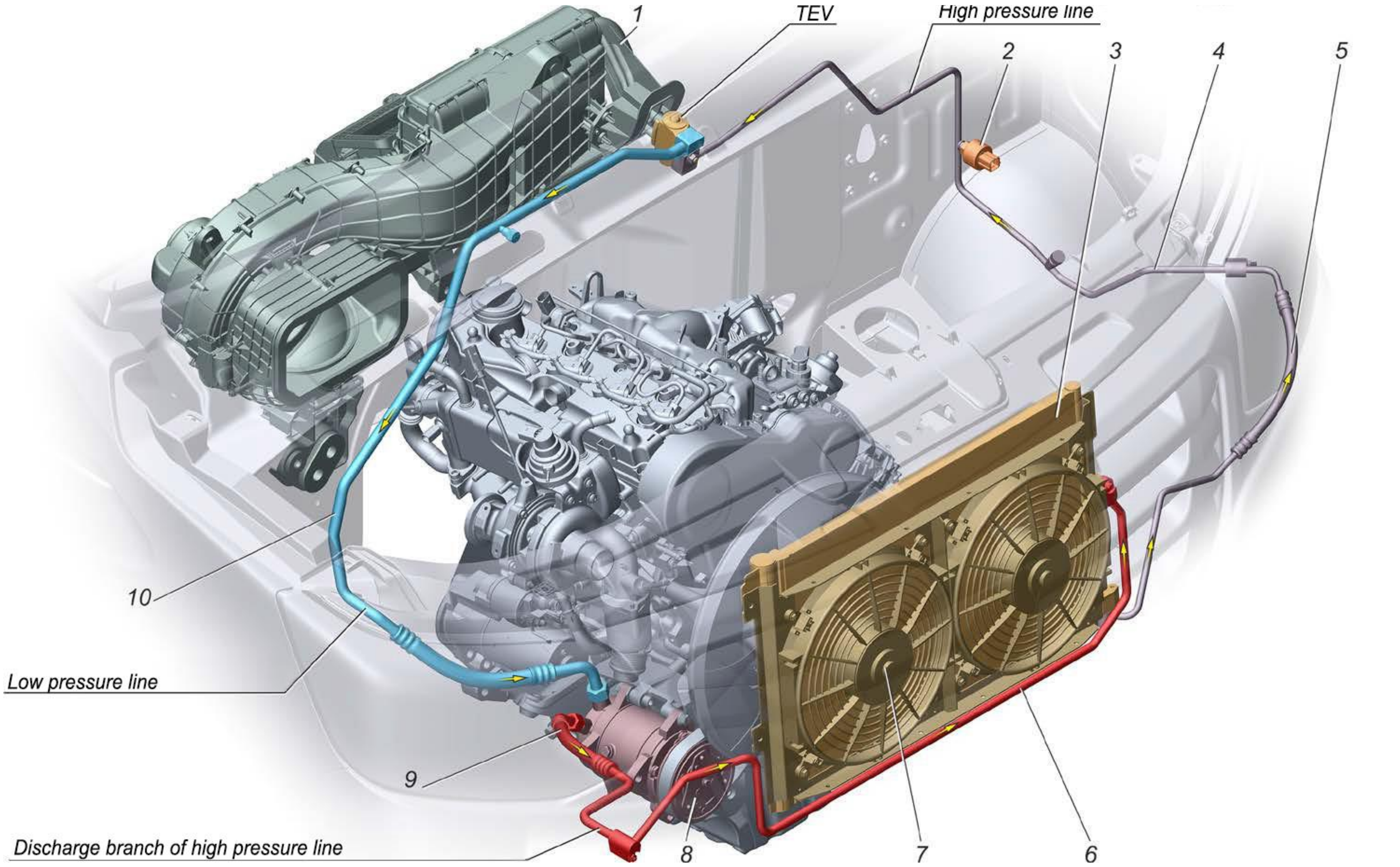


Fig. 8.57. Main components of vehicle air conditioning system: 1 – air handling unit module; 2 – pressure sensor; 3 – condenser; 4 – body pipeline; 5 – condenser outlet pipeline; 6 – condenser inlet pipeline; 7 – fan assemblies with bracket; 8 – compressor; 9 – compressor outlet pipeline; 10 – compressor inlet pipeline

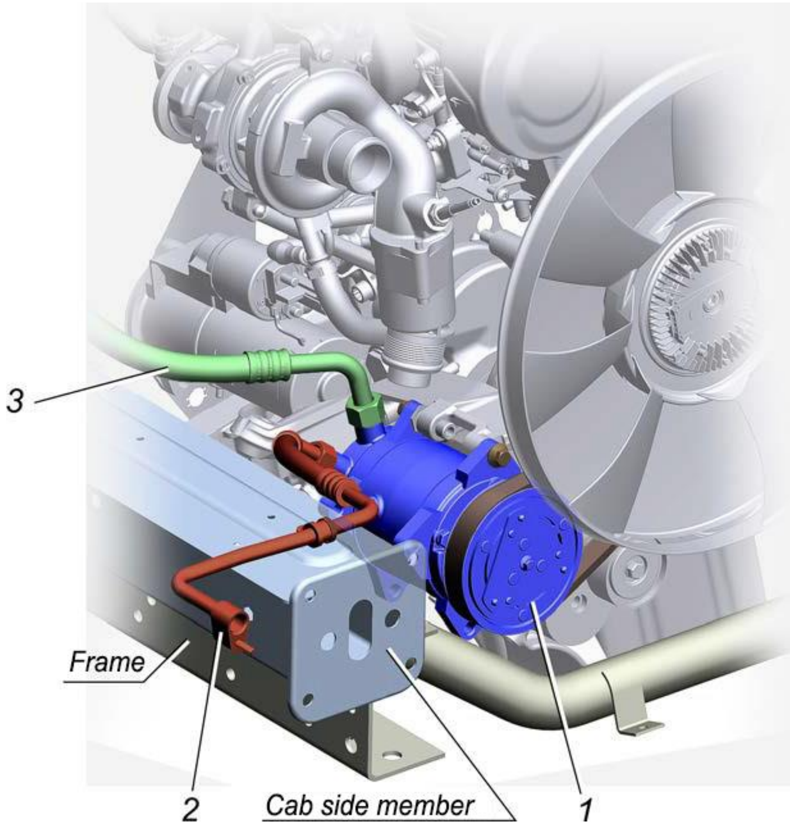


Fig. 8.58. Compressor installation: 1 – compressor; 2 – compressor outlet pipeline; 3 – compressor inlet pipeline;

Condenser 5 (see Fig. 8.57) is fixed to the engine cooling system radiator with brackets. The condenser dissipates the heat released during gas compression. When cooled, the gas turns into a liquid state, remaining under high pressure.

The **condenser fans 3** (Fig. 8.57) are designed to arrange air circulation through the condenser heat exchanger. Outside air, when the vehicle is moving or the condenser fans are turned on, passes through the condenser, cooling its plates and converting the freon passing through the condenser tubes from a gaseous state to a liquid one.
The fans turn on when the pressure in the high pressure line rises.

Pressure sensor 2 (Fig. 8.57) measures the freon pressure in the high pressure circuit and allows controlling the operation of the compressor and fans. The sensor is installed in the high pressure line of the air conditioning system.

The sensor information is transmitted to the electronic engine control unit and to the condenser fans.

High and low pressure pipelines of the air conditioning system are located in the engine compartment of the vehicle, they connect the cooling circuit components and circulate freon through the compressor, condenser and evaporator of the air handling unit module.

Freon draining and filling is carried out through filling fittings of high and low pressure.

The **distributor (with a control board)** is designed to turn on/off the vehicle's air conditioning mode, adjust the cooling degree and distribute air flows passing through the air conditioner evaporator.

Air conditioning control

The air conditioning system is controlled using the control board (Fig. 8.59) located in the central part of the dashboard.

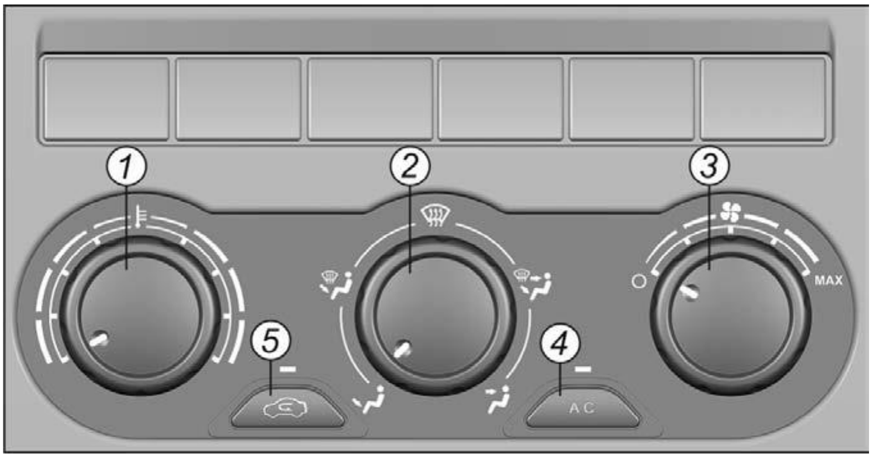


Fig. 8.59. Air conditioner control board: 1 – air temperature regulator knob; 2 – air flow distribution regulator knob. 3 – heater fan speed regulator knob; 4 – air conditioner on/off button; 5 – air recirculation mode on/off button.

To quickly cool the interior, turn on the air conditioner using button 4 and set knob 1 on the control board to the extreme left position, knob 3 to the extreme right position, and knob 2 to position  shown in Figure 8.60.

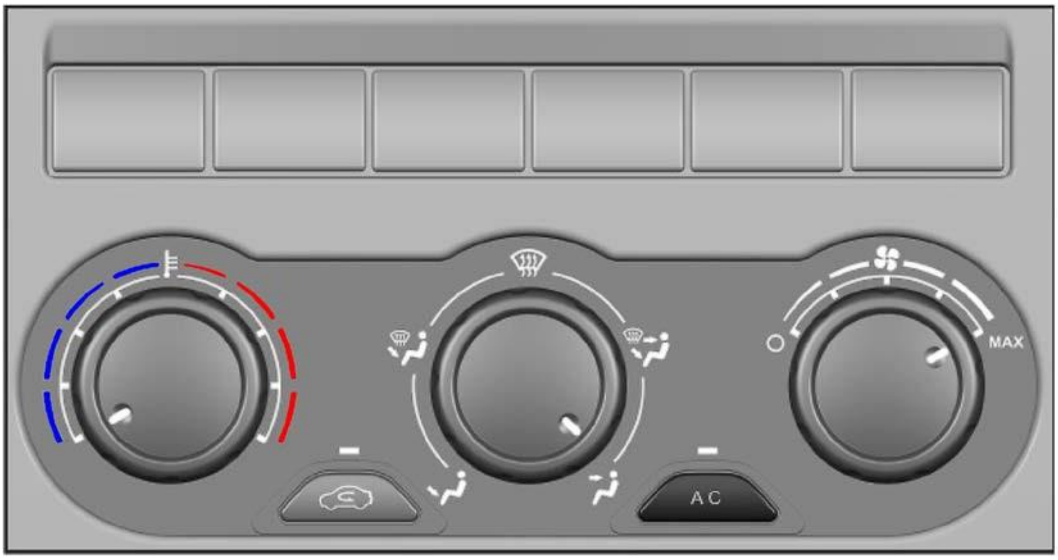


Fig. 8.60. Position of knobs for quick cooling of passenger compartment

To achieve maximum air conditioning efficiency, as well as to isolate the interior from unpleasant odors and smoke, turn on the recirculation mode by pressing button 5 (Fig. 8.59). The recirculation mode will automatically turn off after 10 minutes. Forced deactivation of the recirculation mode is carried out by pressing button 5 again. After stopping and then starting the engine, the recirculation damper automatically switches to the outside air intake mode.

ATTENTION
Do not use the recirculation mode for a long time, as in this case, the flow of fresh air into the interior stops, which can lead to deterioration of health, as well as fogging of the windows.

When the interior is sufficiently cooled, set the fan speed knob 3 to the middle position, the air distribution knob to a position corresponding to a comfortable air distribution, and adjust the temperature by moving the temperature control knob 1 within the blue zone (Fig. 8.60).

After a long parking of a closed vehicle in sunny hot weather, it is recommended to open the doors or windows for a few minutes, ventilate the interior, and only then turn on the air conditioner.

The air conditioner is switched off by pressing button 4 again (Fig. 8.59).

To ensure the normal operation of the air conditioner, it is recommended to turn it on at least once a month for 5-10 minutes. This is necessary to lubricate the air conditioner assemblies with oil dissolved in the coolant. This procedure must be carried out in the winter season, but subject to a positive ambient temperature.

Maintenance and repair safety measures

The R134a coolant filled into the air conditioning system pipelines is a harmless, transparent, volatile gas under normal atmospheric conditions. Thus, at normal temperature and pressure, it evaporates intensively. The process of its evaporation is explosion- and flameproof. However, when handling the R134a coolant during the refilling and repairing the vehicle air conditioning system, precautions should be taken.

During the climate control unit maintenance, it is necessary to protect the eyes and the skin surface, since contact of the skin and mucous membranes of the eyes with the liquid coolant may cause frostbite.

If the coolant gets into the eyes or on the skin, immediately rinse the affected area thoroughly with plenty of cold water or a dilute boric acid solution. Then lubricate the damaged surfaces with vaseline oil and immediately consult a doctor.

When handling coolant:

- avoid storing coolant cylinders in the sun, open flame heating to temperatures above 38 °C or freezing;
- transport coolant cylinders in a vertical position;
- wear protective goggles and special gloves (e.g., made of fluoroelastomer). Leather, cloth or rubber gloves are not suitable.

If the coolant comes into contact with an open flame or hot surfaces, it releases toxic gases (fluorine, phosgene), which are recognized by their pungent odor.

The coolant contains PAG oil, which can irritate the skin.

Do not allow the coolant to come into contact with shiny coated metals. Otherwise, the metal surface will be covered with corrosion spots.

It is undesirable to release the coolant from the system into the atmosphere during the repair work. It must be pumped to a filling station.

In exceptional cases, release the coolant from the system slowly and carefully. Otherwise, along with the coolant, there will be a burst of oil from the system and compressor.

It is necessary to drain the coolant when drying a painted vehicle in a chamber at temperatures above 100 °C.

General requirements for air conditioning system maintenance and repair

The air conditioning system includes a number of complex assemblies interconnected by pipelines with increased tightness requirements and therefore needs timely and qualified maintenance. All work on maintenance, inspection, filling and repair of the air conditioning system must be carried out only by trained specialists who have read and understood these instructions.

Be careful during repair work, do not allow any mechanical damage to the components and assemblies of the air conditioning system.

When carrying out repair work on a vehicle, it is allowed to remove individual components of the air conditioning system without disconnecting the pipelines.

Before disconnecting the pipes, it is necessary to remove the coolant from the air conditioning system using a filling station and clean the connections from dust and dirt.

Low and high pressure fittings located in the engine compartment are used to remove freon (see Fig. 8.64).

After disconnecting the pipelines, it is necessary to install plugs in the openings of pipelines and units in order to prevent ingress of contaminants into the system. Remove the plugs immediately before connecting the system components.

When carrying out repair work, the air conditioning system components to be replaced (compressor, condenser, evaporator, pipelines, etc.) must be stored in the spare parts warehouse with plugs to prevent moisture and dust from entering the internal cavities.

It is necessary to store the compressor in a warehouse, transport it to the installation site and place the removed compressor in the engine compartment during repair work in a horizontal position with the fittings up.

The plugs of the compressor suction and discharge ports must be removed slowly and carefully to avoid a burst of oil from the compressor. In necessary cases, add only PAG oil through one of the fittings.

When adding oil, do not keep the oil filling tank and compressor fittings open for a long time, as the oil absorbs moisture from the surrounding air quite intensively.

Mount the compressor on the engine with a plug, which must be unscrewed only before the immediate connection of the discharge and suction pipelines.

After installing the pipelines on the vehicle, they are not allowed to come into contact with the elements of the vehicle cab and engine in order to avoid their grinding and the system depressurization, a burst of freon from the climate control unit and its failure.

O-rings in pipeline joints must be lubricated with PAG oil before connection. When reusing pipelines, it is recommended to replace the O-rings in the joints with new ones. An example of pipeline connection is shown in Fig. 8.61.

Below are the designations of the O-rings used in the air conditioning system:

O-ring VW 7.6 ×1.82   EPDM
O-ring 6.7×1.8 HNBR green
O-ring 8.1×1.6 HNBR yellow or brown
O-ring size 08 10.9×2.43 HNBR
O-ring 10.8×2.4 HNBR green
O-ring 13.1×1.6 HNBR Brown

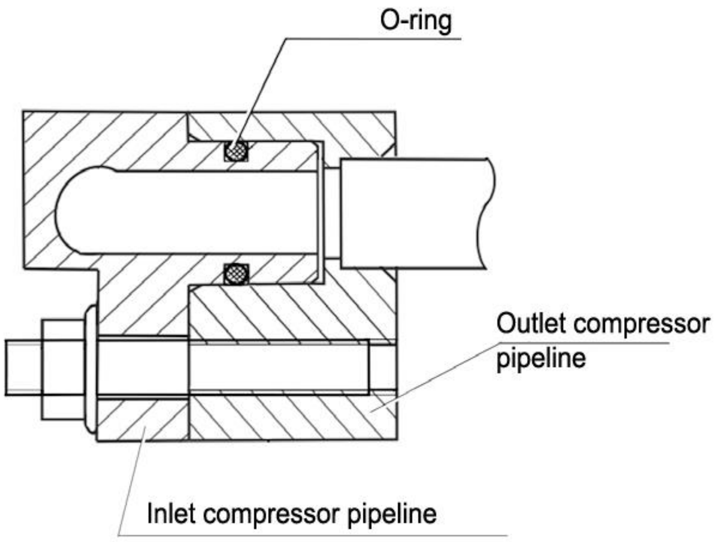


Fig. 8.61 Pipeline connection diagram

The tightening torque of the nuts of studs and bolts securing the air conditioning system pipeline joints is 5.5-10.0 N·m (0.55-1.0 kgf·m).

Air conditioning system maintenance

During maintenance of the air conditioning system, the operation of the air conditioner, the condition of the hoses, filling fittings, fastening of the hoses, pipelines and the condenser are checked.

Since the coolant is a highly fluid substance, and the process of its leakage is natural, the air conditioner must be filled at intervals of once in 1-2 years (as the cold released during its operation weakens).

To ensure the normal coolant condensation, it is necessary to ensure that the condenser radiator is always clean and air can freely pass between its fins, thereby cooling it. If the condenser radiator is clogged, it must be cleaned with compressed air.

ATTENTION
Never use a high-pressure car washer to clean the condenser radiator, as this may damage it.

Checking air conditioner operation

First of all, it is necessary to check the electromagnetic clutch activation. To do this, start the engine and turn on the air conditioning system using one of the above methods in turn. Then, the electromagnetic clutch anchor should attract to the driven pulley disk with a characteristic click.

Visually check the tightness of the connections. In places of leaks, oil stains will be visible. Leaks are eliminated by tightening the connections, replacing the O-rings of the pipelines or replacing the faulty components.

Check for coolant leakage using an electronic leak detector.

After that, check the operation of the fans in all modes.

Make sure that air flows in all directions in the air conditioning mode from the control board on the dashboard.

To check the air conditioning system efficiency:

- start the engine, turn on the air conditioning system, maintaining the engine crankshaft speed within 1300-1500 rpm. Turn on the fan of the air handling unit module at maximum speed. Direct all air flow on the dashboard through the ventilation grilles. Turn on the recirculation mode on the control board.

After 3-5 minutes of operation, check the compressor fittings or the hoses connected to them by touch. The suction part must be cold, the discharge part must be hot.

Next, measure the air temperature at the outlet of the ventilation air grilles on the dashboard. The temperature must correspond to the values given in Table 8.1.

Table 8.1

	Ambient temperature, °C		
	15-20	20-25	25-30
Cooled air temperature at outlet of dashboard ventilation grilles, °C, max.[1]:	12	14	16

Filling system with freon and oil

After completing the repair of the climate control unit and tightening all connections, it must be filled with R134a freon using a filling station for air conditioning systems in accordance with the instructions attached to the station and observing the safety measures given in the instructions.

IT IS STRICTLY FORBIDDEN TO
fill the climate control unit with freons of any other type.

The amount of coolant filled in the air conditioning system lines is given in the Vehicle Operation Manual.

The filling station is connected to a filling fittings of high and low pressure located in the vehicle engine compartment. Before filling the air conditioning system, it is necessary to evacuate the system to remove air and moisture from the air conditioning system lines.

After filling the system, the filling fittings must be closed with screw plugs, and all joints must be carefully checked for leaks with an electronic leak detector.

When replacing as a result of repair of the components included in the air conditioning system, it is necessary to add PAG oil for R134a freon to the line. Oil can be added to the system either through the fill port in the air conditioning compressor or through filling stations able to add oil while the system is being filled with coolant.

The amount of oil to be added should be:

- when replacing the vehicle condenser – 10 ml;
- when replacing the air handling unit module evaporator – 10 ml;
- when replacing the air conditioning system pipelines – 2-3 ml per 1 m of pipeline length.

The total amount of oil circulating in the air conditioning system should be 170-190 ml. When replacing a failed compressor, no oil is added to the air conditioning system lines. The compressors are supplied as spare parts filled with oil.

One of the air conditioning system malfunctions may be a coolant leak from the air

[1] Parameters will be specified according to test results

conditioning system pipelines or components. At the leakage points, oil is released along with the coolant. Once the problem has been eliminated, the system will need to be refilled with coolant and, depending on the size of the oil stains found at the leaks, oil will also need to be add[1]ed to the system.

[1] - Parameters will be specified according to test results

Possible malfunctions of air conditioning system and remedies

Malfunction cause	Remedy
Malfunctions during air handling unit (AHU) module operation	
No air supply from dashboard ventilation grilles with AHU module fan on	
No signal from air conditioner control board	Check the wiring. Check the control board serviceability by connecting a new control board to the system; if necessary, replace the control board.
Heater fan rotation speeds 1,2,3 do not switch	Replace auxiliary heater fan resistor
Heater fan speed 4 does not turn on	Check and if necessary replace the fuse
Heater fan does not work	Replace the fan
Air conditioning system on, module fan running, no cooled air supply from dashboard ventilation grilles	
No signal is sent from the temperature control knob of the control board to the temperature control damper actuator	Check the wiring. Check the serviceability of the air conditioner control board and replace if necessary
Temperature control damper actuator does not work	Replace the actuator (to test the actuator operation, perform the control board setup)
Air conditioning system cooling circuit does not work	See “Air conditioning system cooling circuit malfunctions” subsection
Air distributor cannot be controlled	
No electrical signal from the mode controller of the control board to the leg damper actuator	Check the wiring Check the serviceability of the control board and replace if necessary
Leg damper actuator does not work	Replace the actuator
Cable drives disconnected from console or levers	Check the connection of cable drives with the control board or levers

Malfunction cause	Remedy
Air recirculation does not work	
No electrical signal from the control board to the recirculation damper actuator	Check the wiring Check the serviceability of the control board; replace if necessary
Recirculation damper actuator does not work	Replace the actuator
Air conditioning system cooling circuit malfunctions	
To determine the malfunction, it is necessary to connect a pressure gauge unit to the filling fittings of the air conditioning system. The nature of the malfunction is determined by the pressure values in the discharge and suction lines. Operating pressure at an ambient temperature of +20 °C, see the "Air conditioning system specifications" subsection	
Compressor does not start	
Damaged or disconnected electromagnetic clutch circuit	Check the fuse in the dashboard fuse box Check the wiring
Breakage of the drive belt of engine units	Replace the belt (see engine maintenance and repair documentation)
Low voltage at electromagnetic clutch and on-board electric system terminals	Eliminate the cause of the vehicle's electrical system malfunction
Insufficient air cooling	
Slippage of the drive belt of engine units	Replace the belt or the belt tensioner (see engine maintenance and repair documentation)
Freon leakage from the system	Find leaks, eliminate leaks by tightening joints or replacing faulty parts. Fill the system with coolant. Top up the system with PAG oil if necessary (see "Filling system with freon and oil" subsection).

Malfunction cause	Remedy
Condenser outlet pipe is cold, although pressure in high-pressure pipes is high according to pressure gauge (over 17 atm. at ambient temperature of +20 °C)	
Excessive coolant	Check the amount of coolant Bring the amount of coolant to normal
Condenser fan not working	Check the wiring. Check and, if necessary, replace the fuse. Replace the fan
Very high temperature (over 80 °C) of condenser inlet pipe	
Clogged pipeline	Determine the clogging location and replace the pipeline
Receiver clogged	Replace the condenser receiver
Faulty TEV	Replace TEV
Low coolant level	Check the amount of coolant, refill the system if necessary
Condenser receiver output path is very cold or covered with sleet	
Receiver clogged	Replace the condenser receiver
Insufficient coolant flow to evaporator. Pipe section from TEV to evaporator is covered with rime	
Faulty TEV	Replace TEV
Compressor runs continuously or intermittently. Suction fitting heating	
Condenser cooling surface contaminated	Clean and blow out the condenser cooling surface with compressed air
Condenser fan not working	Check the wiring. Check and, if necessary, replace the fuse. Replace the condenser fan
Faulty TEV	Replace TEV
Excessive freon supply. Evaporator tube is covered with rime (may be normal if the humidity is high)	
Faulty TEV	Replace TEV
Excessive coolant	Check the amount of coolant, refill the system if necessary
When testing compressor operation, low pressure gauge reading is too low (below 1 atm. at ambient temperature of +20 °C)	
Faulty TEV	Replace TEV

Malfunction cause	Remedy
Receiver clogged	Replace the condenser receiver
Faulty evaporator frost sensor Faulty receiver	Check the wiring. Replace the frost sensor Replace the condenser receiver
When testing compressor operation, low pressure gauge reading is too high (over 3 atm. at ambient temperature of +20 °C)	
Faulty TEV	Replace TEV
Little difference between low and high pressure gauge readings	
Faulty compressor Faulty evaporator frost sensor Faulty control board Faulty pressure sensor	Replace the compressor Check the wiring. Replace the frost sensor Check the wiring. Replace the control board Check the wiring. Replace the pressure sensor

Air conditioning system repair

The installation and repair of the air handling unit and condenser module are described in the supplier's documentation.

ATTENTION
Before carrying out the work, stop the vehicle engine, turn off the air handling unit module and the preheater-heater.

Air handling unit module removal and installation

Removal of the air handling unit module 2 (Fig. 8.62) must be carried out in the following sequence:

- drain fluid from the engine cooling system (3-4 liters). The expansion tank plug must be removed, and the heater valve must be opened (switch off the ignition when the heater is on);
- disconnect wires from the battery;
- remove freon from the pipelines of the air conditioning system using a filling station. Low and high pressure fittings are used to remove freon (see Fig. 8.64).
- disconnect the inlet and outlet hoses from the radiator tubes of the air handling unit module by loosening the fastening clamps;
- unscrew the retaining nut and disconnect the high and low pressure pipelines of the air conditioning system from the air handling unit module;
- remove the dashboard (see "Dashboard" subsection);
- disconnect the drain branch pipe 11 (Fig. 8.62) from the front panel by unscrewing the mounting bolts;
- disconnect two wire connectors from the air handling unit module gear motors;
- disconnect the connector from the air handling unit module temperature sensor;
- unscrew the bolts securing the air handling unit module and the air handling unit module tube bracket to the front panel;
- unscrew the nuts securing the air handling unit module to the air handling unit bracket and the fan bracket;
- remove the air handling unit module from the vehicle.

Install the air handling unit module in the order reverse to removal. The tightening torque of the bolts securing the air handling unit module, the air handling unit module pipe bracket and the drain pipe to the front panel – 8-12 N·m (0.8-1.2 kgf·m); nuts securing the air handling unit module to the air handling unit bracket and the fan bracket, bolts securing the drain flange to the front panel – 5.5-10 N·m (0.55-1.0 kgf·m).

After installing the air handling unit module and filling the heating and air conditioning systems, check the tightness of the joints.

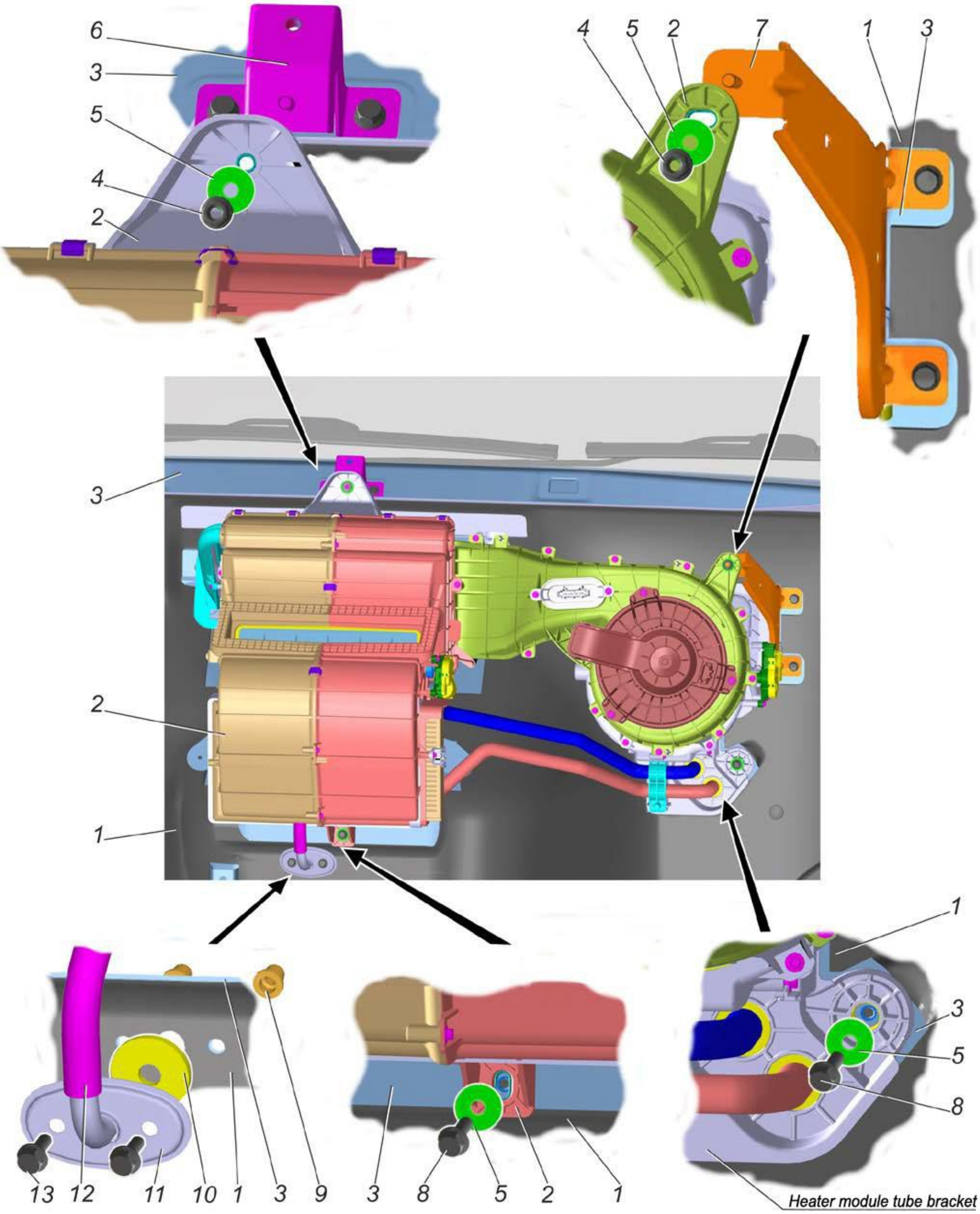


Fig. 8.62. Air handling unit module installation: 1 – front panel sound insulation; 2 – air handling unit module; 3 – front panel; 4 – nuts; 5 – washers; 6 – bracket; 7 – fan bracket; 8, 13 – bolts; 9 – threaded rivet; 10 – drain branch pipe seal; 11 – drain branch pipe; 12 – condensate drain pipe

Condenser removal and installation

Removal of the condenser 5 (Fig. 8.63) must be carried out in the following sequence:

- disconnect wires from the battery;
- remove freon from the pipelines of the air conditioning system using a filling station;
- disconnect and remove the front bumper panel (see “Front bumper” subsection);
- disconnect the front bumper panel mounting brackets from the frontend;
- disconnect the electrical connectors of the electric fan wires;
- unscrew the screw securing the condenser outlet pipe from the radiator frame base (frontend);
- unscrew the bolt securing the inlet pipe from the left bracket of the condenser;
- disconnect the inlet and outlet pipelines from the condenser by unscrewing the mounting bolts;
- unscrew the nuts and bolts securing the fans to the condenser brackets, remove the fan assemblies with the bracket and the condenser from the vehicle.

The condenser must be installed in the reverse order of removal.

The tightening torque of the nuts securing the electric fan bracket to the right condenser bracket – 5.5-10 N·m (0.55-1.0 kgf·m), bolts securing the electric fan bracket to the left condenser bracket – 8-12 N·m (0.8-1.2 kgf·m), bolts securing the pipelines to the condenser – 5.5-10 N·m (0.55-1.0 kgf·m).

After installing the condenser and filling the air conditioning systems, check the tightness of the joints.

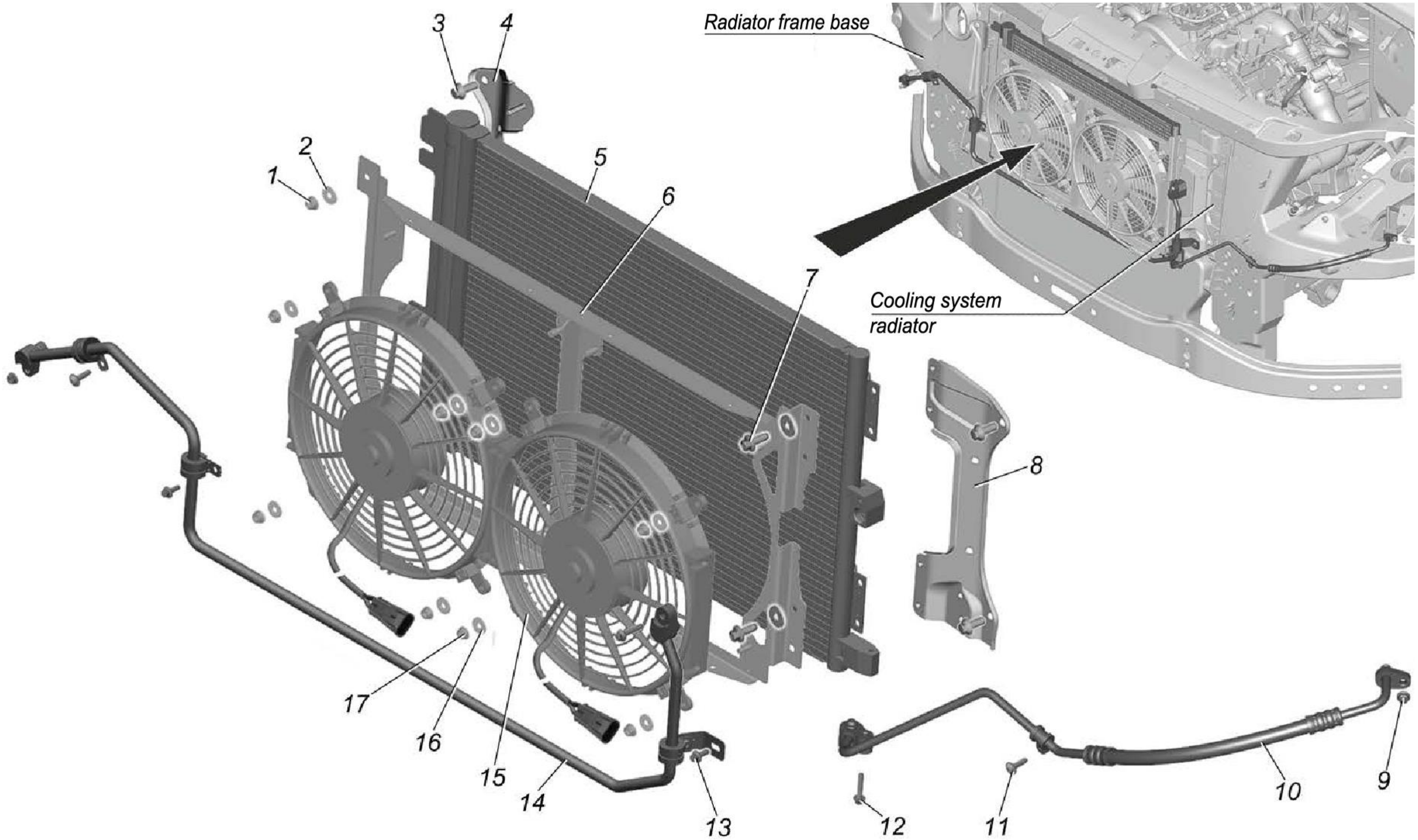


Fig. 8.63. Condenser installation: 1, 9, 17 – nuts; 2, 16 – washers; 3, 7, 12, 13 – bolts; 4, 8 – condenser brackets; 5 – condenser; 6 – fan bracket; 10 – condenser outlet pipeline; 11 – screw; 14 – condenser inlet pipeline; 15 – fan

Air conditioning compressor removal and installation

The air conditioning compressor removal must be carried out as follows:

- drain fluid from the engine cooling system. The expansion tank plug must be removed, and the heater valve must be opened (switch off the ignition when the heater is on);
- drain the oil from the power steering system after removing the plug from the power steering tank;
- disconnect wires from the battery;
- remove freon from the pipelines of the air conditioning system using a filling station;
- disconnect and remove the front bumper panel (see “Front bumper” subsection);
- disconnect and remove the front bumper panel mounting brackets from the frontend;
- disconnect and remove the front bumper base;
- disconnect the condenser inletpipeline from the compressor outlet pipeline by unscrewing the retaining nut;
- disconnect the condenser outlet pipeline from the body pipeline by unscrewing the retaining nut;
- disconnect and remove the radiator frame base (frontend) (see “Engine” section);
- disconnect the terminal block from the pressure sensor and the air filter mass air flow sensor;
- disconnect the air preheater with the crankcase ventilation hose from the air filter duct hose;
- disconnect from the turbocharger and the air filter mass air flow sensor and remove the air filter air duct hose;
- disconnect from the branch pipes of the turbocharger and the boost cooler and remove the hoses of the boost cooler assembly with the outlet pipe and the air temperature sensor;
- disconnect and remove the clutch with the fan from the engine;
- remove the engine accessory drive belt (see engine maintenance and repair documentation);
- disconnect the wiring harness connector from the air conditioning compressor;
- disconnect the high and low pressure pipelines from the air conditioning compressor by removing the bolts);
- remove the air conditioning compressor from the engine by unscrewing the mounting bolts.

The air conditioning compressor installation must be carried out in the reverse order of removal. The tightening torque of the bolts securing the air conditioning compressor to the engine is 16-36 N·m (1.6-3.6 kgf·m), nuts securing the outlet pipeline to the compressor - 20-22 N·m (2.0-2.2 kgf·m), nuts securing the inlet pipeline to the compressor - 24-26 N·m (2.4-2.6 kgf·m).

High and low pressure pipeline removal and installation

The pipeline dismantling must be carried out in the following sequence:

- drain fluid from the cooling system. The expansion tank plug must be removed, and the heater valve must be opened (switch off the ignition when the heater is on);
- drain the oil from the power steering system after removing the plug from the power steering tank;
- disconnect wires from the battery;
- remove freon from the pipelines of the air conditioning system using a filling station;
- disconnect and remove the front bumper panel (see “Front bumper” subsection);
- disconnect and remove the front bumper panel mounting brackets from the frontend;
- disconnect and remove the front bumper base;
- disconnect the condenser inlet pipeline from the compressor outlet pipeline by unscrewing the retaining nut;
- disconnect the condenser outlet pipeline from the body pipeline 2 (Fig. 8.84) by unscrewing the retaining nut;
- disconnect and remove the radiator frame base (frontend) (see “Engine” section);
- disconnect the terminal block from the pressure sensor and the air filter mass air flow sensor;
- disconnect the air preheater with the crankcase ventilation hose from the air filter duct hose;
- disconnect from the turbocharger and the air filter mass air flow sensor and remove the air filter air duct hose;
- disconnect and remove the air filter;
- disconnect from the branch pipes of the turbocharger and the boost cooler and remove the hoses of the boost cooler assembly with the outlet pipe and the air temperature sensor;
- disconnect the inlet and outlet pipelines from the compressor by unscrewing the mounting bolts.
- disconnect the compressor outlet pipeline clip from the cab side member and remove the compressor outlet pipeline;
- disconnect the air conditioning system pressure sensor wire block;
- disconnect the hoses from the expansion tank;
- unscrew the nut securing the pipelines of the high and low pressure lines to the air handling unit module;
- remove the wiring harness from the studs attaching to the front panel;
- disconnect the high-pressure pipeline brackets from the front panel (two points)

and from the front base (one attachment point) and remove the high-pressure pipeline;

- disconnect the wiring harness from the valve;
- disconnect the heater outlet hose to the engine from the heater valve;
- remove the front air intake duct;
- disconnect from the front panel and remove the branch pipe assembly with water dump valve from the rear air intake duct;
- disconnect the compressor supply pipeline clips 7 (Fig. 8.64) from the brackets and the front panel and remove the compressor supply pipeline;

Install the pipelines in the reverse order of removal.

Dismantling and installation of pipelines can be carried out both separately and several at once.

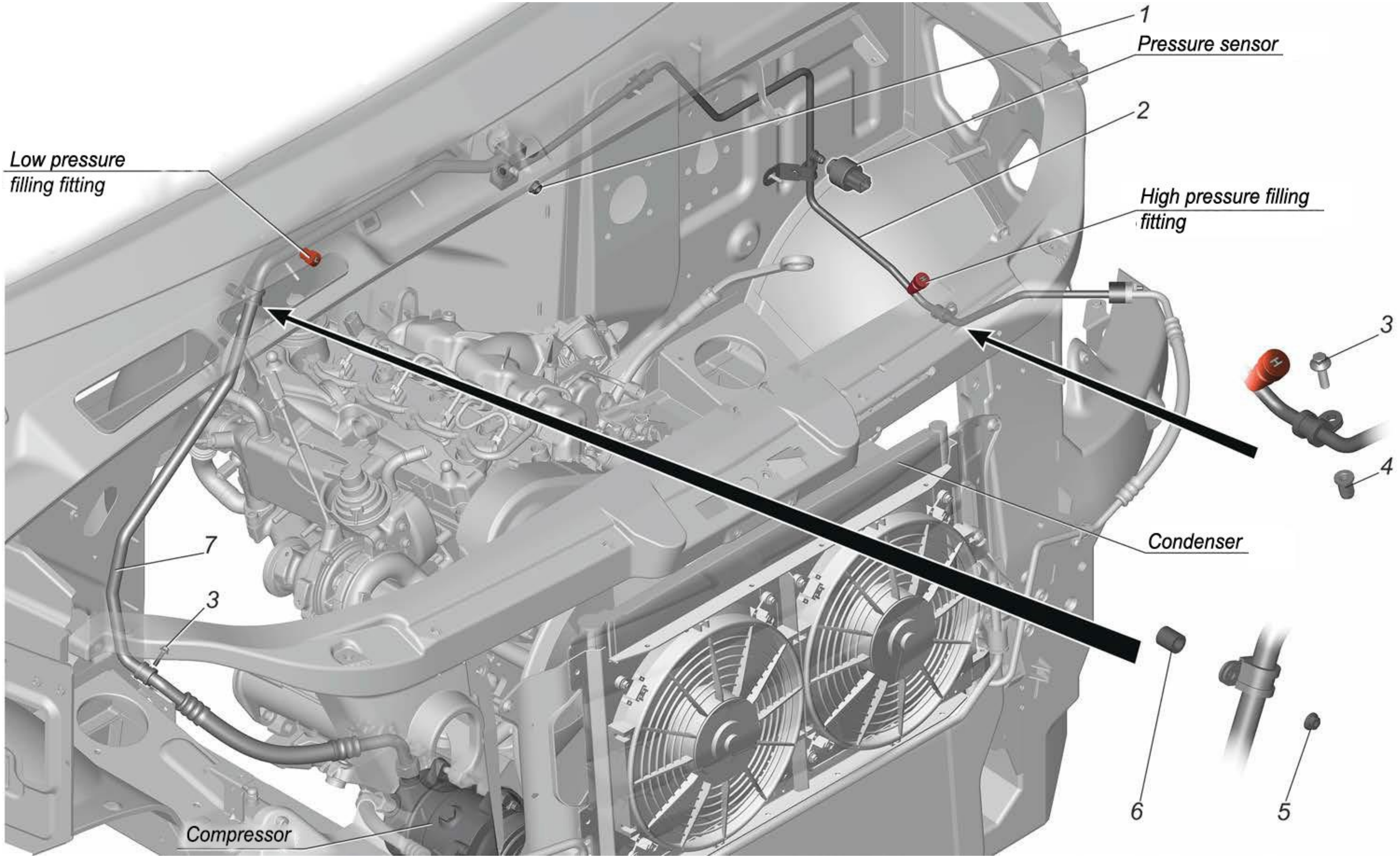
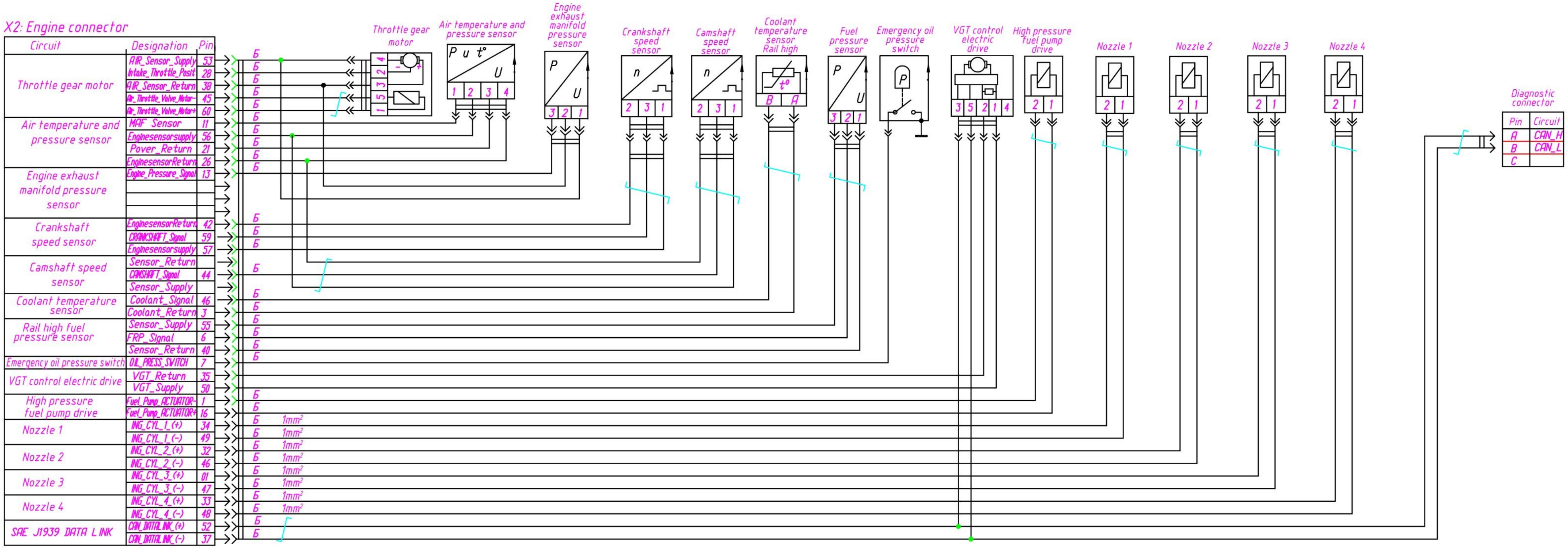


Fig. 8.64. Body pipeline installation: 1, 5 – nuts; 2 – body pipeline; 3 – bolts; 4 – threaded rivet; 6 – bushing; 7 – compressor supply pipeline;

9. APPENDICES

9.1. Electrical diagrams



1. *Unspecified wire cross-sections are 0.75 mm².*

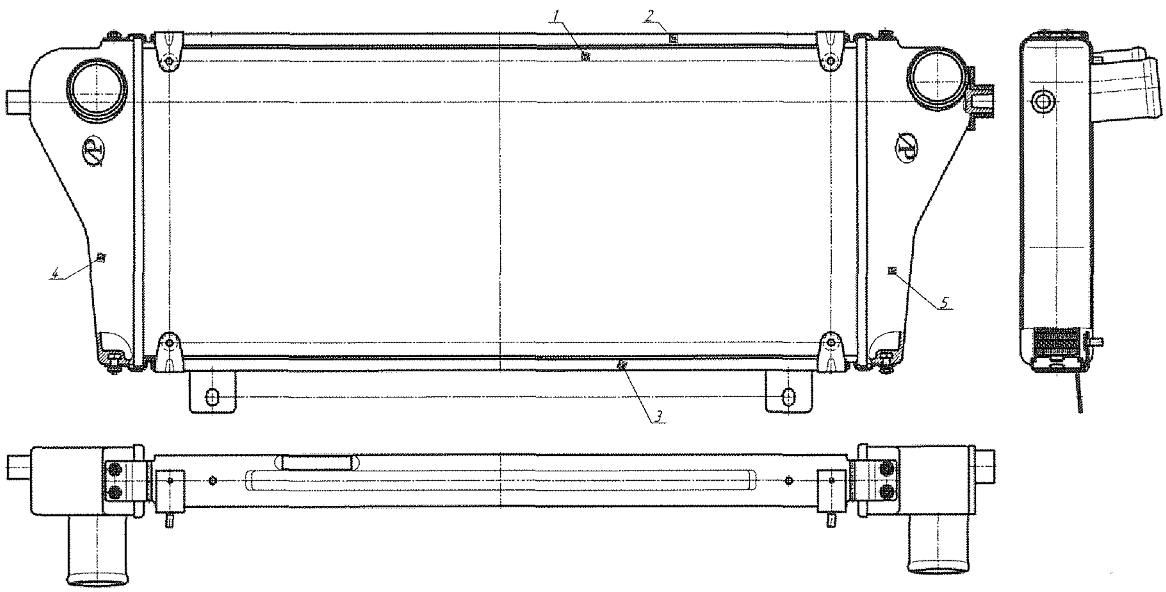
Engine control schematic electrical diagram

9.2. Charge air cooler

9.2.1. Instructions for operation, diagnostics and repair of charge air coolers A21R22.1172012

1. Design of charge air cooler A21R22.1172012

Charge air cooler A21 R22.1172012 is an aluminum heat exchanger designed for charge air cooling and consists of the following principal parts and assemblies shown in the figure:



1 - cooler frame (a set of air-conducting tubes soldered into one piece, cooling plates and turbulence stimulators inside the tubes);
2, 3 - upper and lower plates designed for installing the cooler on the vehicle and attaching additional structural elements to them);
4, 5 - cooler manifolds designed for supply and exhaust of cooled air.

2 Operation of charge air cooler A21 R22.1172012

The cooler operation must be carried out in accordance with the requirements of the service manual for the vehicle for which it is intended. The cooler is designed for operation in areas with a cold, temperate and tropical climate at an ambient temperature of +50 to -40°C and a relative humidity of up to 98% at a temperature of +25 °C.

! During the cooler installation and operation, take precautions to prevent damage to the cooler and clogging of internal cavities.

3. List of malfunctions and diagnostic methods

1. Broken tightness:
- destruction of the cooler frame cooling tubes;
- leakage of soldered and welded seams of the cooler.

The broken cooler tightness can be caused by:
- mechanical damage resulting from careless handling during cooler transportation or installation on a vehicle;
- poor-quality soldering and welding of cooler parts and assemblies.

The method for diagnosing leaks of the cooler under service enterprise conditions is to check its tightness at a maximum overpressure of 2.5±0.5 kg/cm^2 with immersion in a water bath and holding for 30...60 seconds. Air leakage (bubbles) is not allowed.

Other methods for detecting cooler leaks (without immersion in a water bath) are not informative (it is impossible to determine the exact location of leaks).

2. Blistering of the cooling tubes with collapse of the cooling plates in the cooler frame, which leads to a decrease in the cooler thermal performance (decrease in the charge air cooling efficiency).

The diagnostic method is a visual inspection of the cooler frame surface.

3. Clogging of the cooler frame cooling elements (cooling plate channels) during the operation of the cooler as part of the vehicle, which leads to a decrease in the cooler thermal performance (decrease in the charge air cooling efficiency).

The diagnostic method is a visual inspection of the cooler frame front surface.

3 Troubleshooting

1. Due to the design feature (aluminum alloys), the repair of a leaky cooler shall be carried out by soldering or welding only under the manufacturing plant conditions. Under the service enterprise conditions, it is impossible to eliminate the cooler leakage and the product must be disposed of.
2. It is not possible to eliminate blistering of the cooling tubes with collapsed cooling plates and the product must be disposed of.
3. The cooler clogging is eliminated by removing accumulated dust and dirt from the front surface of the cooler frame with a directed jet of compressed air or running water.

9.2.2. Requirements for scope of maintenance and repair documentation for purchased component not subject to repair “Charge air cooler”A21R22.1172012-20

Requirements for scope of maintenance and repair documentation
for purchased component not subject to repair
“Charge air cooler”
A21R22.1172012-20

1. Product design and operation description

The charge air cooler (hereinafter referred to as CAC) is designed to cool the air flow heated during compression in the compressor. It consists of an aluminum brazed core and aluminum tanks.

2. Product maintenance

If the outer surface of the CAC is contaminated, blow out the cooling cells with compressed air at a pressure of max. 0.5 MPa and rinse with a jet of water at a pressure of max. 7.8 MPa at a distance from the nozzle to the core surface of min. 0.5 m at an angle to the core front surface of 90... 85 degrees.

3. Possible malfunctions, detection methods (diagnostics) and remedies under service enterprise conditions:

Defect / malfunction	**Detection method (diagnostics)**	**Defect location**	**Causes**	**Test method**	**Remedy**
Cooling system pressure loss	Pressurize the engine cooling system and locate the leak. The CAC must be sealed at an excess air pressure of 0.2+0.05 MPa (2.0+0.5 kgf/cm^2)	Point of connection between the CAC branch pipes and the hoses.	Clamps loose, hose damaged	Check the clamp for tightness, the hose for damage	Tighten the clamps. If the problem persists, replace the hose, if necessary, replace the clamp.
		Charge air cooler core [-1]		Return to the warehouse for research [-2]	Replace the charge air cooler
		Free surface of the CAC cast aluminum tank	External mechanical damage during vehicle operation	Check for dents, chips, cracks	1. Dismantle the CAC. 2. It is allowed to eliminate leaks[-3] by argon-arc braze welding[-4] directly at the place of leakage on the CAC tanks. 3. Carry out a CAC tightness test at an excess air pressure of 0.2+0.05 MPa (2.0+0.5 kgf/cm^2) in a water bath. In case of repeated leakage after repair, replace the entire CAC. 4. Install the CAC. 5. Re-pressurize as part of the vehicle. In case of repeated leakage of the CAC in the vehicle, replace the CAC.

Reduced boosting system efficiency	Visually determine the CAC cell contamination	Charge air cooler core [-1]	Contamination of the CAC cooling cells.	Visually	Blow out with compressed air and rinse with a jet of water. Permissible water pressure is max. 7.8 MPa (max. 78 bar), the distance from the nozzle to the core surface is min. 0.5 m
CAC vibration, noise, crackling	Visually inspect the attachment points of the CAC and adjacent surrounding components (fan casing, front end)	Crack or detachment of the welded threaded stud fastening the casing	External mechanical damage during vehicle operation	Visually	Replace the charge air cooler
		Bottom steel bracket threaded connection	Loose torque	Visually	Tighten the threaded connection with the tightening torque established by the regulatory documentation
		Bottom steel bracket for attaching the CAC to the front end	External mechanical damage during vehicle operation	Check for dents, chips, cracks, deformation, tears or detachment	Replace the charge air cooler

Note.

1 In the absence of visible external mechanical damage.
2. In case of routine maintenance (after warranty expires), a return to the warehouse is not made.
3. A significant breakage of the mounting and functional geometry of the CAC caused by argon-arc welding repair is unacceptable: bending of the brackets, distortion/curving of the core plane, misshape and misalignment of the support and threaded joints. Warranty obligations of the manufacturer do not apply to the CAC restored after repair of tanks and mounting elements of the CAC.
4. Material of CAC tanks: foreign aluminum alloy AC4A (as per JIS H5202).

9.3. Requirements for scope of maintenance and repair documentation for purchased component not subject to maintenance "cooling radiator" No. A21R22.1301010-11

1. Product design and operation description

The radiator is designed to cool the coolant of the engine cooling system. It consists of an aluminum brazed core, plastic tanks and steel casing brackets.

The radiator is a horizontal 1-way heat exchanger with a 22mm single-row core with internal reinforcing plates (12 pcs.), 12 pcs. of core tubes soldered to the end parts - 3 pcs. for every outermost 6 core tubes on each side (4 places).

The radiator fastening elements for the vehicle are made as follows: inlet pipe on the right tank in the upper part, outlet pipe on the left tank in the lower part and steam outlet pipe on the left tank in the upper part. The front side of the left and right radiator tanks has attachment points for M8x1.25 bolted connections with a condenser (for modifications with an air conditioning system).

The upper and lower aluminum core has steel fastening elements of the casing with M6x1.0 welded screws.

The drain hole is made in the extreme right lower position in the branch pipe with the outlet drain pipe together with the tank directed vertically downwards. Drain plug — a special plug with a M14x2.0 threaded section, a head shape resembling a butterfly wing and an internal rubber O-ring.

2. Product maintenance

If the radiator outer surface is contaminated, blow out the cooling fins (corrugations) with compressed air and rinse with a jet of water. Change the coolant in accordance with the regulations for the vehicle and engine maintenance. When topping up and changing the coolant, use a coolant approved by the manufacturer. When replacing a product, check that the manufacturer's label is on the product being replaced.

3. Possible malfunctions, detection methods (diagnostics) and remedies under service enterprise conditions

Defect / malfunction	**Detection method (diagnostics)**	**Defect location**	**Causes**	**Test method**	**Remedy**
Cooling system leak	Pressurize the engine cooling system and locate the leak. The radiator must be sealed at an overpressure of 0.149-0.15 MPa (1.49-1.5 kgf/cm^2)	Point of connection between the radiator branch pipes and the hoses.	Clamps loose, hose damaged	Check the clamp for tightness, the hose for damage	1. Tighten the clamps. 2. Start the engine for 5-10 minutes. 3. Make sure visually that there are no leaks at the connections and radiator branch pipes. 4. If the leak has stopped, the connection between the radiator branch pipes and the hoses is tight. If the leak continues, replace the hose, if necessary, replace the clamp.
		Radiator core [-1]		Return to the warehouse for research [-2]	Replace the radiator

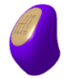
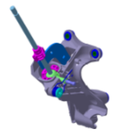
		Drain plug [-3]	Insufficient tightening torque	Check the tightening	Tighten the plug, tightening torque 2.0+2.5/-0 N/m
Engine overheating	Visually determine the radiator cell contamination	Radiator core[-1]	Contamination of the radiator cooling fins (corrugations).	Visually	Blow out with compressed air and rinse with a jet of water perpendicular to the core front surface. Permissible water pressure is max. 7.8 MPa (max. 78 bar), the distance from the nozzle to the core surface is min. 0.5 m
Radiator vibration, noise, crackling	Visually inspect the attachment points of the radiator and adjacent surrounding mounting elements from the vehicle side (fan casing, condenser attachment points)	Crack or detachment of the welded threaded stud fastening the casing	External mechanical damage during vehicle operation	Visually	Replace the radiator
		Crack or detachment of a plastic tank element	External mechanical damage during vehicle operation	Visually	Replace the radiator

Note.

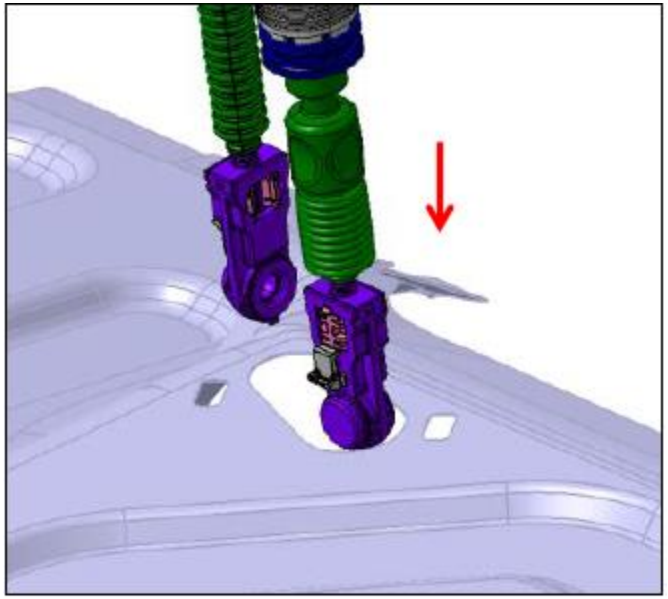
1. In the absence of visible external mechanical damage.
2. In case of routine maintenance (after warranty expires), a return to the warehouse is not made.
3. The drain plug of the engine cooling radiator is an integral part of the radiator and cannot be replaced as a spare part, as it is designed for repeated use when servicing the cooling system during the entire warranty period of the radiator. If the cause of the defect/malfunction is an abnormal condition of the drain plug (including wear of the plug O-ring, wear/deformation of the threaded connection), replace the entire radiator using the method described above.

9.4. Joystick and cable drive

(1) Spare parts list

	Spare part	Image	Spare part number
1	Handle		H300-AR5-B010
2	Retainer ring		H129-AR5-B010
3	Spring		H112-AR5-B010
4	Boot		H150-AR5-B010
5	Rubber ring		H316-SNA-B010
6	Lever subassembly		H100-AR5-B010
7	Damper		H117-SNA-A010
8	Bushing		H120-SNA-B010
9	Cables		A31R22.1703016
10	Fixing member A		H811-AR5-A010
11	Fixing member B		H812-AR5-A010

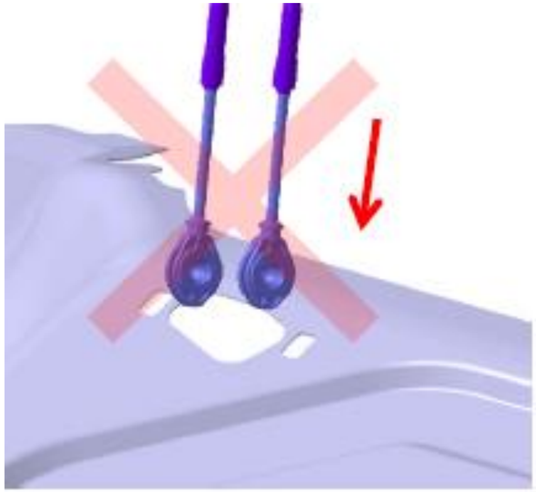
(2)-1 Assembly of large assemblies



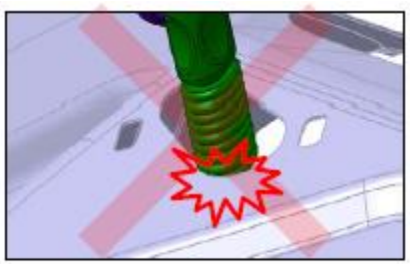
Pass the cable through the hole in the floor panel from the passenger compartment. Pass the cables one by one.

Attention

Pay attention to the cable direction

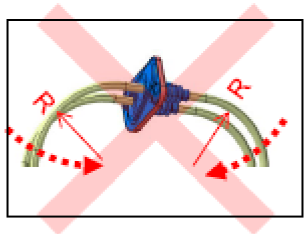


Attention



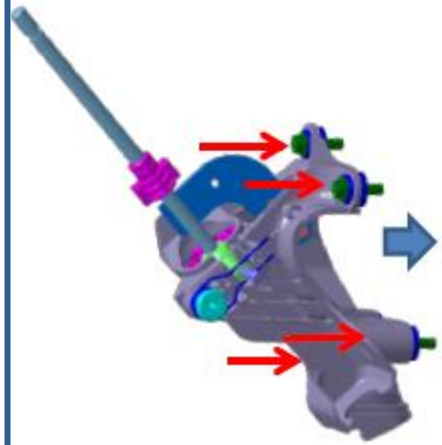
Do not damage the cable by hitting or touching the panel.

Attention



Do not bend cable less than R80. In the case of transportation or storage, it is allowed to bend the cable no less than R350

(2)-2 Assembly of large assemblies.



Attach the joystick to the vehicle by screwing 4 bolts

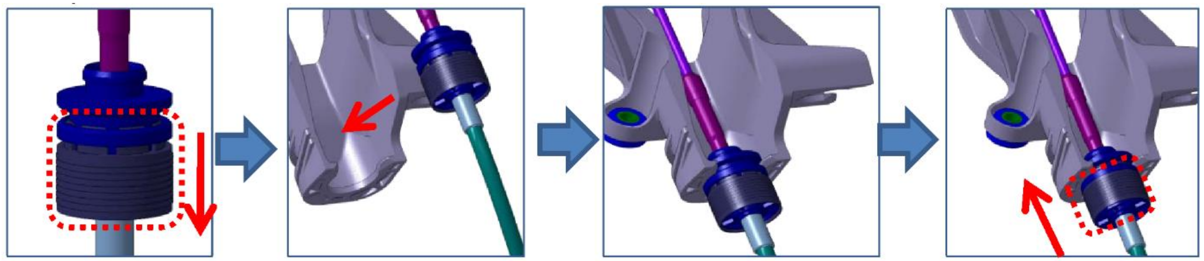
Attention

Tightening torque

12~14 N-m

Installing cable on joystick

<Activation cable>

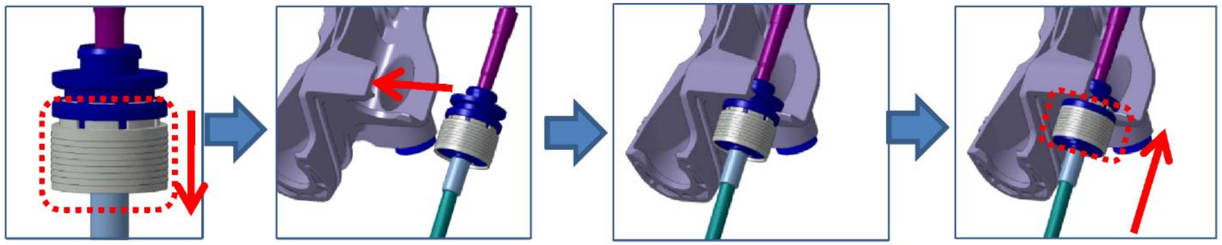


Slide the black bushing.

Insert the bushing into the master support body with the slid off cover.

Release the bushing and the cable will be fixed on the support

<Selector cable>

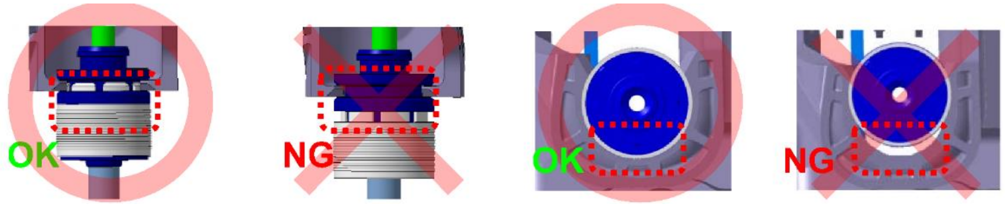


Slide the white bushing..

Install the bushing on joystick support

Release the bushing and the cable will be fixed on the support

Attention

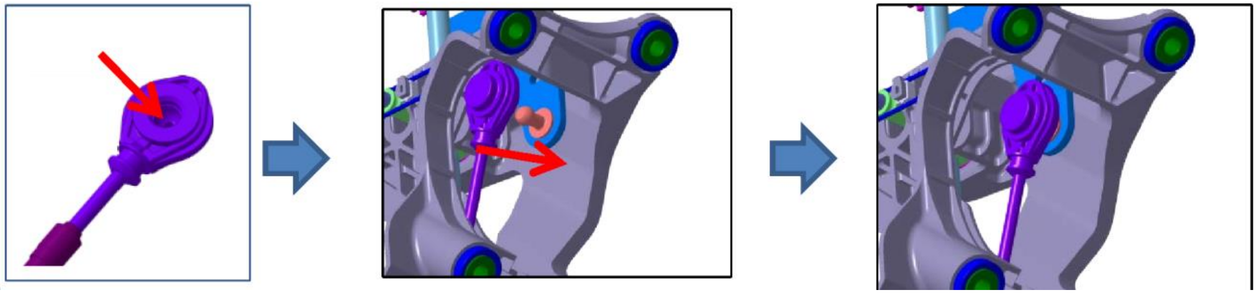


After assembly, check visually that the bushing is fixed on the support.
Then, check manually that the bushing is fixed on the support.

(2)-3 Assembly of large assemblies.

Mounting cable end to support

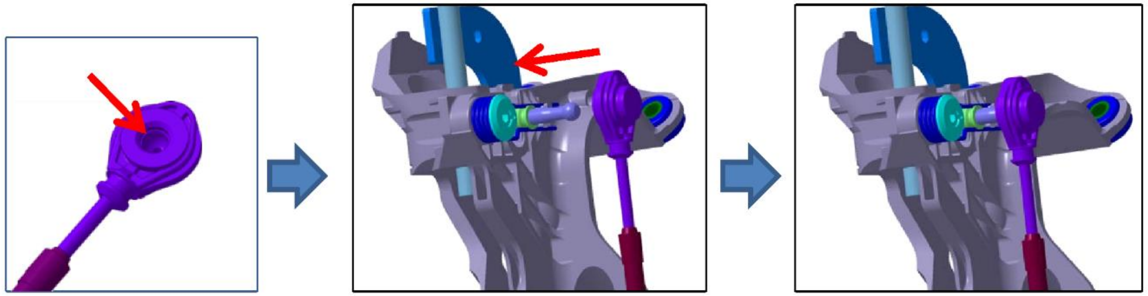
< Activation cable >



Apply certain amount of lubricant

Put cable end onto joystick ball joint

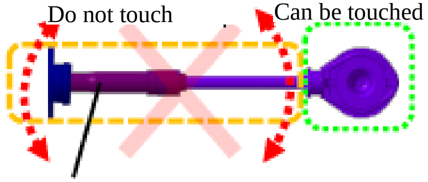
<Selector cable>



Apply certain amount of lubricant

Put cable end onto joystick ball joint

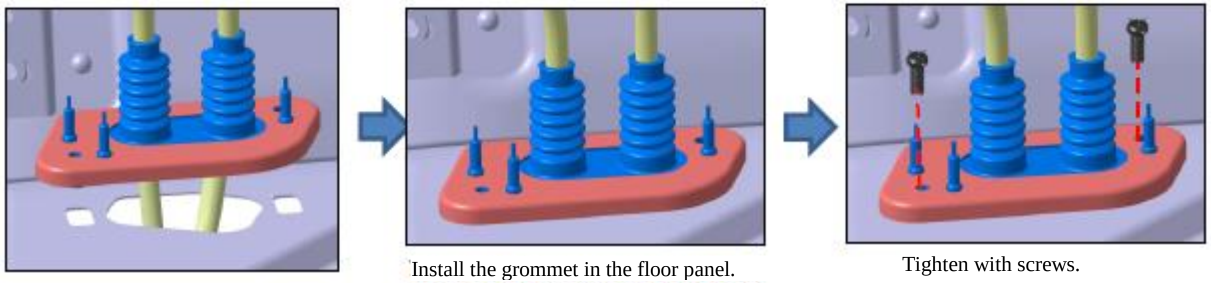
Attention



Do not bend the cable end and cable housing.

(2)-4 Assembly of main assemblies.

Fastening the grommet to the floor panel.



Install the grommet in the floor panel.

Tighten with screws.

Attention

Correct

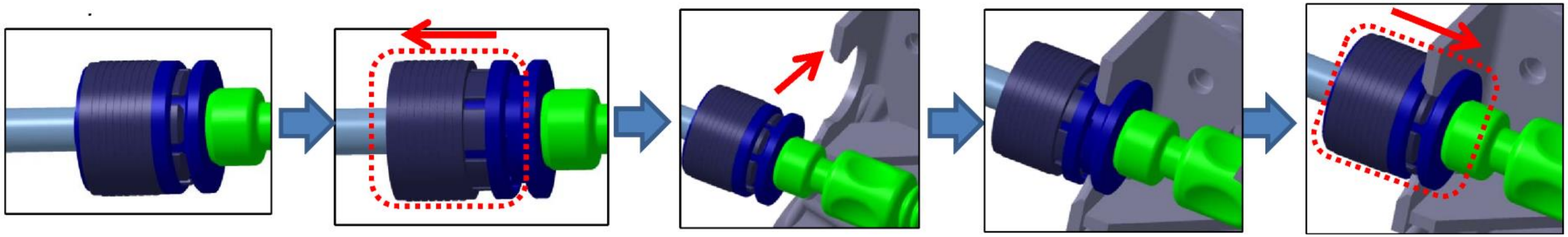
Incorrect

Do not assemble grommet in reverse order

(2)-5 Assembly of main assemblies.

Mounting cable bushing on transmission bracket

< Activation cable >

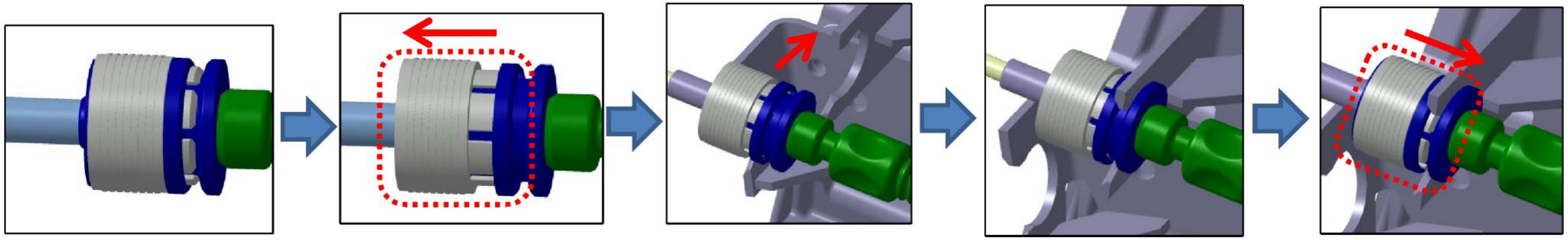


Move the bushing aside

Install the bushing on transmission bracket

Release the bushing and the cable will be fixed

<Selector cable>

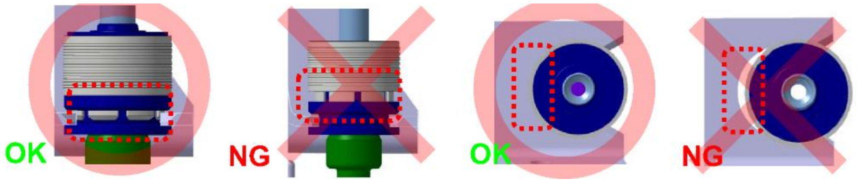


Move the bushing aside

Install the bushing on transmission bracket.

Release the bushing and the cable will be fixed.

Attention

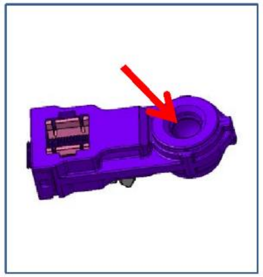


After assembly, check visually that the bushing is fixed on the support.
Then, check manually that the bushing is fixed on the support.

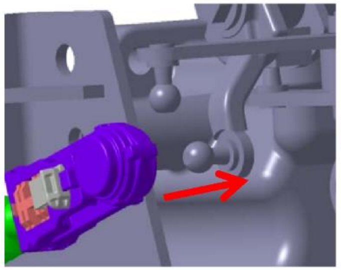
(2)-6 Assembly of main assemblies.

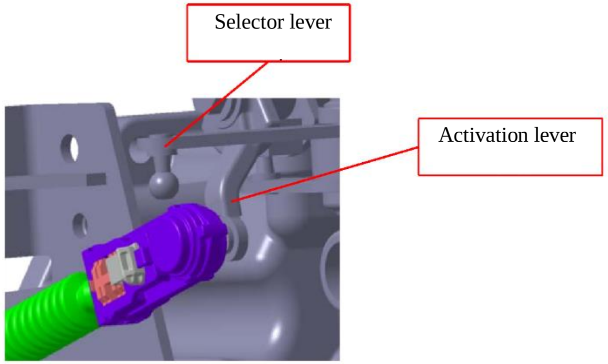
Mounting cable end on transmission

< Activation cable >



Apply lubricant to cable end.

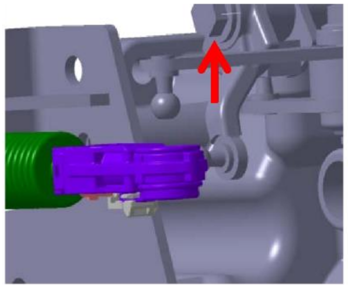


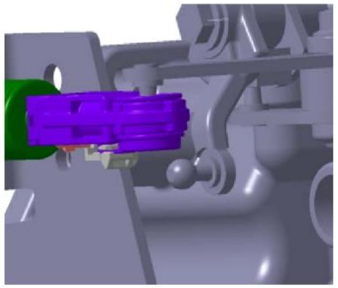


Install cable end onto transmission ball joint.

<Selector cable>

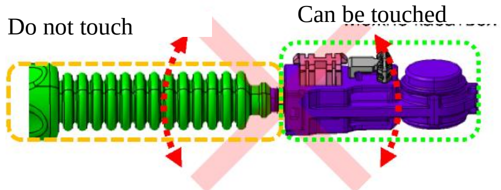
Apply lubricant to cable end.





Install cable end onto transmission ball joint.

Attention



Do not bend the cable end

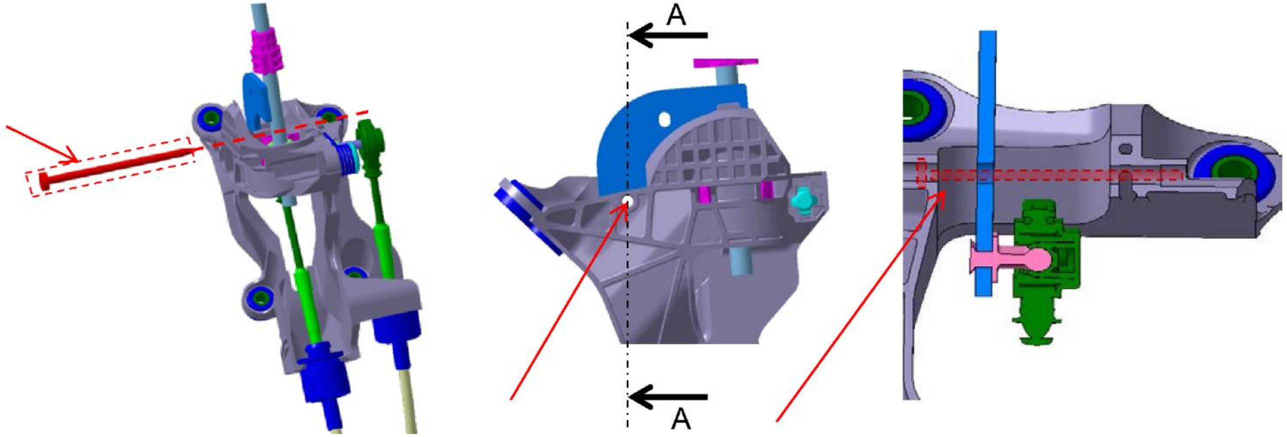
(2)-7 Assembly of large assemblies.

Setting joystick and selector to “neutral” position

<Joystick>

Pin for setting to “neutral” position

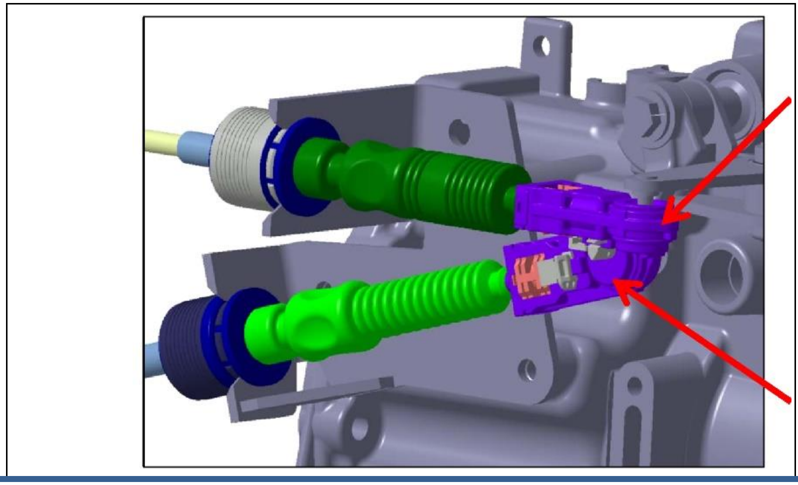
Install the pin in the master support to lock the lever in the “neutral” position.



Section A-A

<Transmission>

Retaining pin hole



Set the selector lever to neutral position

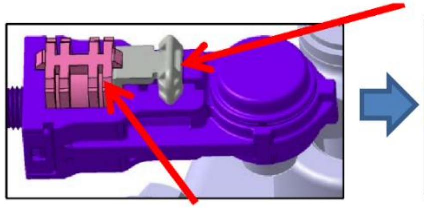
Set the activation lever to “neutral” position

(2)-8 Assembly of large assemblies.

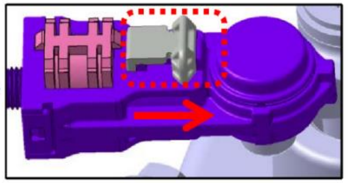
Fixing required cable length.

<Activation cable>

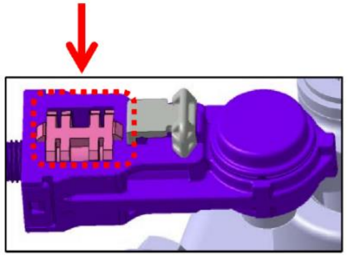
Fixing member (White)



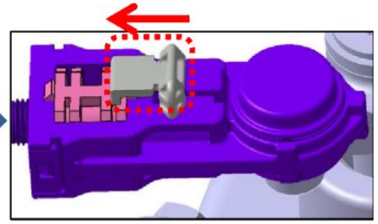
Fixing member
(Pink)



Slide the fixing member (white)

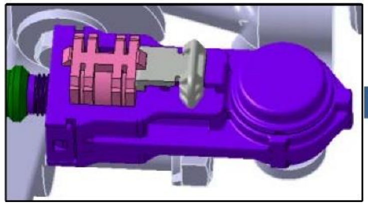


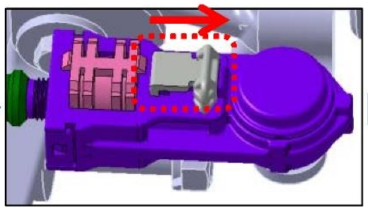
Sink in the pink fixing member (pink)



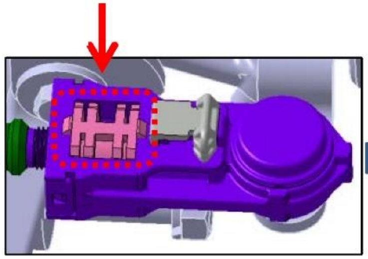
Slide the white fixing member (white)

<Selector cable>

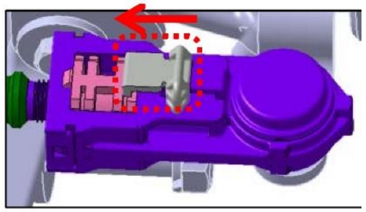




Slide the white fixing member

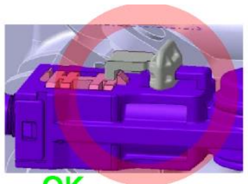


Sink in the pink fixing member

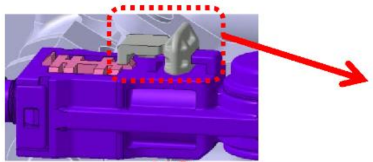


Slide the white fixing member

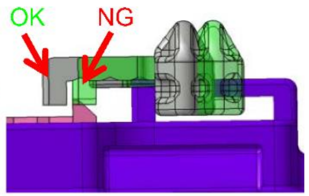
Attention



OK



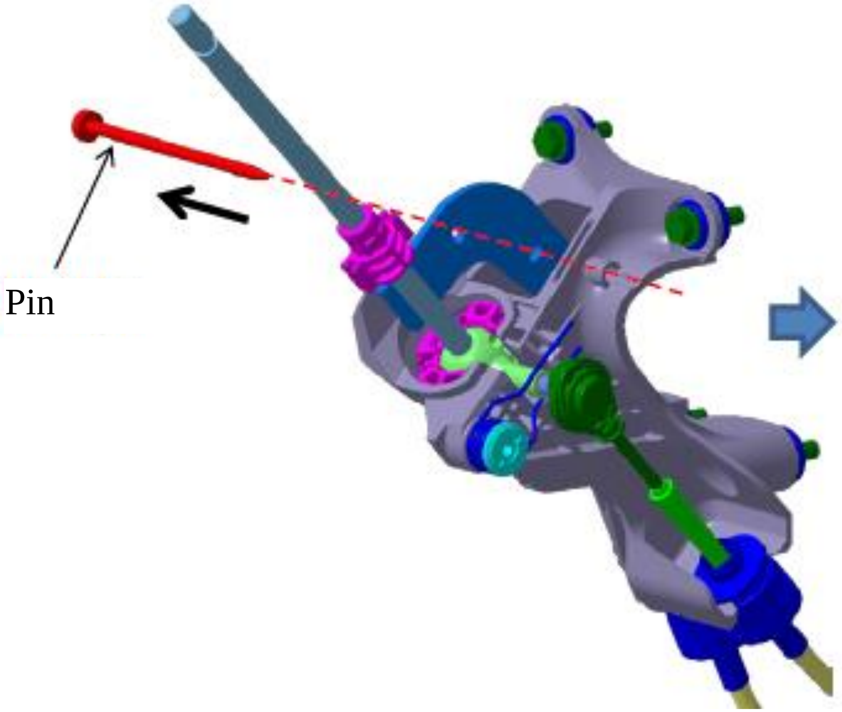
NG

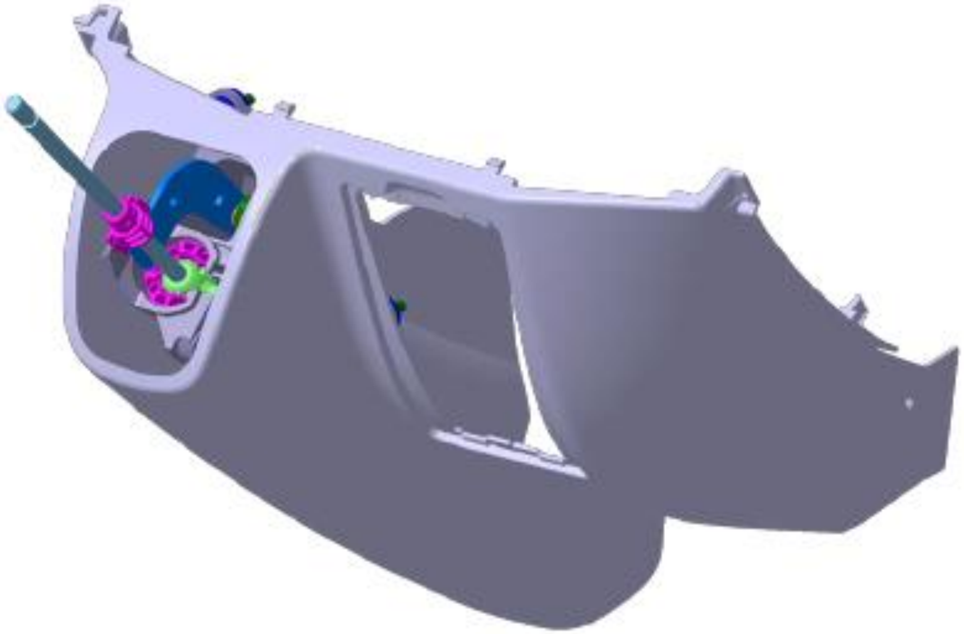


After the assembly, visually verify that the fixation has occurred.
After that, manually verify that the fixation has occurred.

(2)-9 Assembly of main assemblies.

Installing joystick on dashboard.

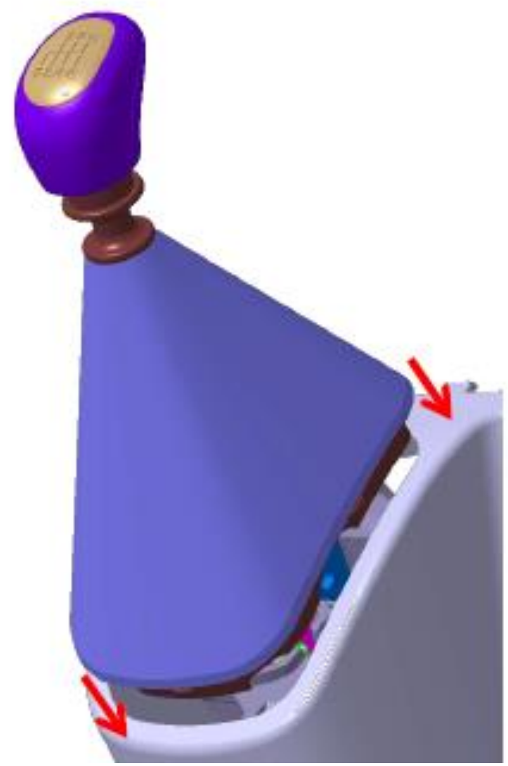




Pull the retaining pin out of the master support.

Install the dashboard and secure with mounting screws.

(2)-10 Assembly of main assemblies



Attach the frame to the panel.

After fixing the frame

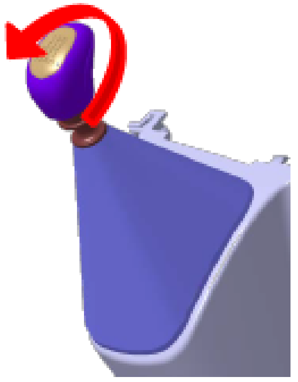
Attention

4-side fixation

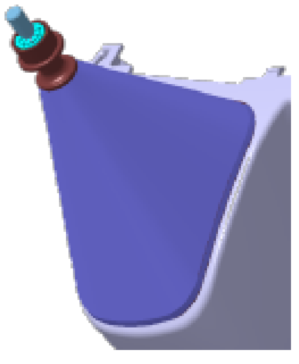
Inside view

(Boot and panel)

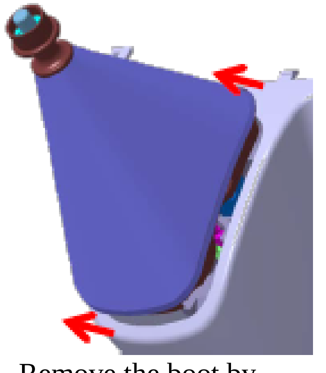
(3)-1 Disassembly of main assemblies



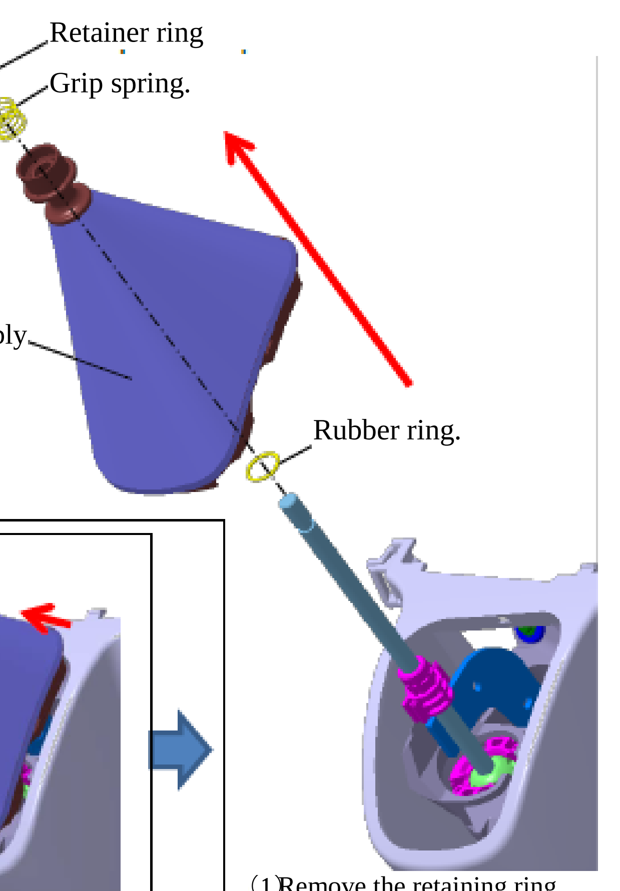
Unscrew the handle.



Remove the handle



Remove the boot by unfastening it from the panel



(1) Remove the retaining ring.
(2) Remove the grip spring.
(3) Remove the boot assembly.
(4) Remove the rubber ring

Attention

4-place fixation
Inside view
(Boot assembly and panel.)

Attention

Handle assembly

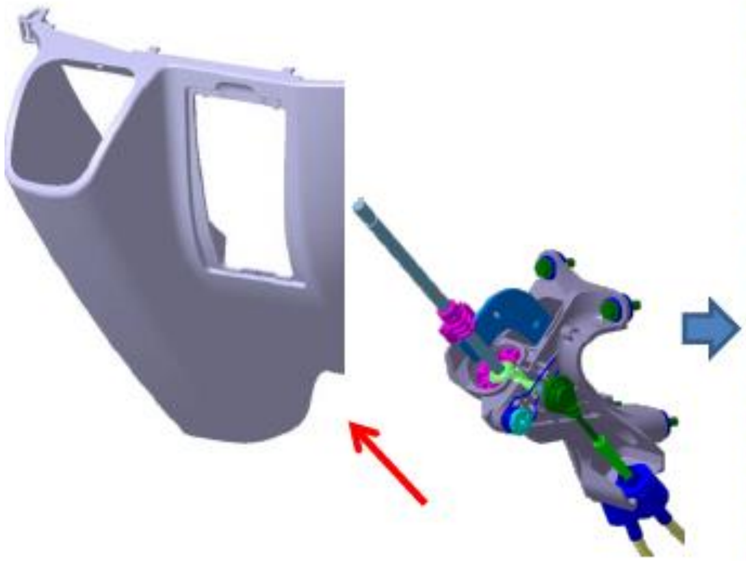
Tightening torque 5N-m MIN

Number of revolutions

11 ~ 13

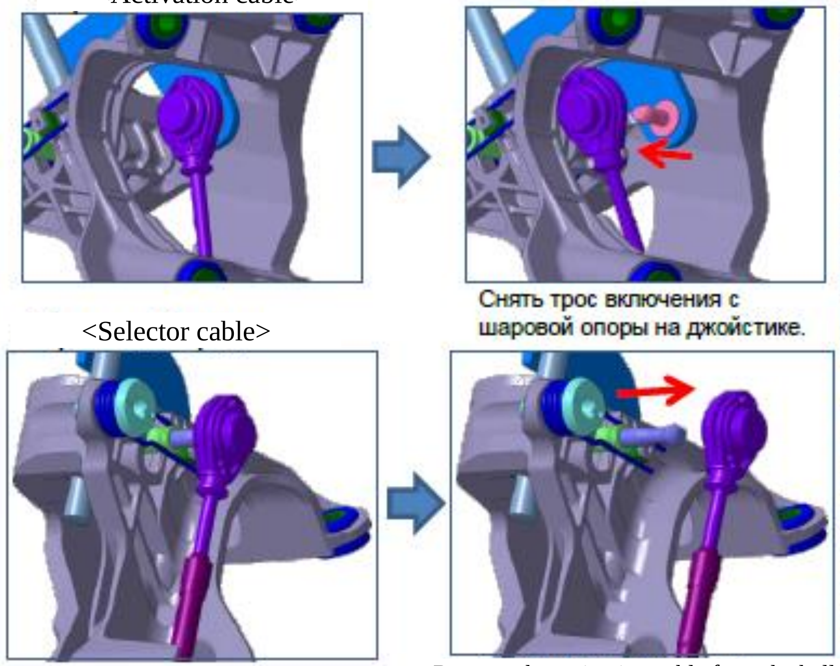
At handle revolutions over 13, it will be difficult to engage reverse gear

(3)-2 Disassembly of main assemblies



Disconnect the panel

<Activation cable>



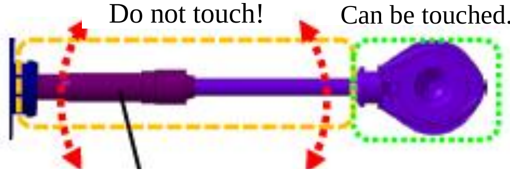
Remove the activation cable from the ball joint on the joystick.

Details on next page

Attention

Do not touch!

Can be touched.



Cable housing

Do not bend the cable end.

In detail: Cable removal instructions.

<Tool>

Cable removal tool. (See Fig.1 and Fig.2)

Same as for 5 MT

< Fig. 1>

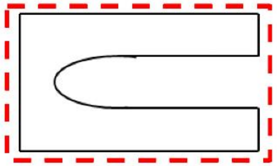


Fig. 2 Design version

< Fig. 2>

<Cable end removal.>
(Selector lever)

< Fig. 3>

Fig.3
Lock the lever as shown in the figure

Cloth or piece of leather

< Fig. 4>

Lay a piece of cloth between the cable and the tool to avoid damage.
(see Fig. 4)

Removal direction

Disassembly tool.

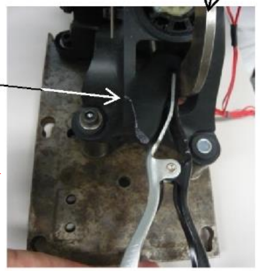
< Fig. 5>

(Activation lever)

Cloth or piece of leather

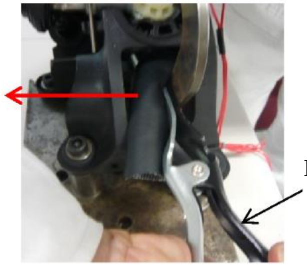
As in Fig. 6, cover with a piece of leather or cloth and place the tool between the cable and the tool.

Plastic



< Fig. 6>

Directions for removal



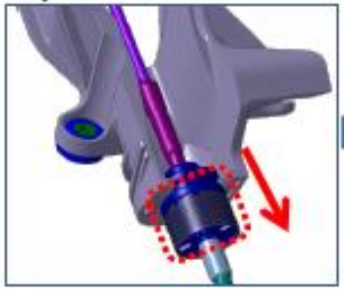
< Fig. 7>

Disassembly tool

(3)-3 Disassembly of main assemblies.

Removing bushing from joystick.

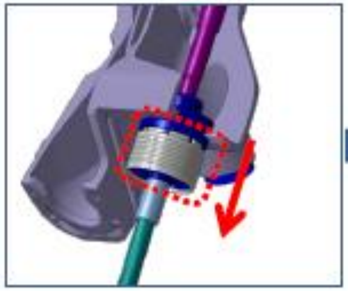
<Activation cable>



Move the bushing aside.

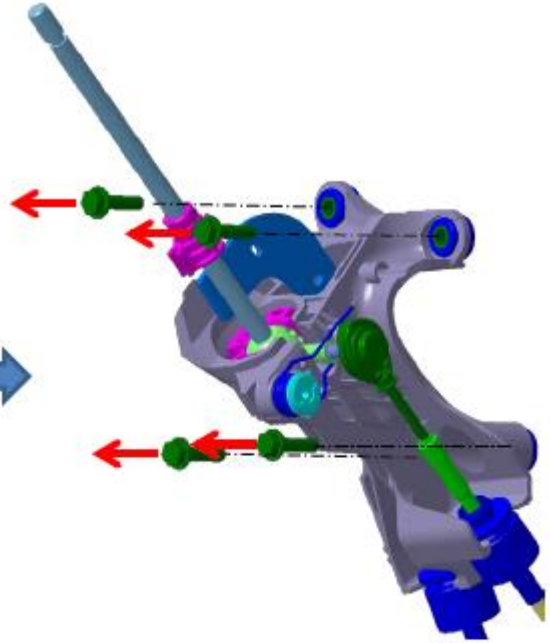
Remove cable

<Selector cable>



Move the bushing aside.

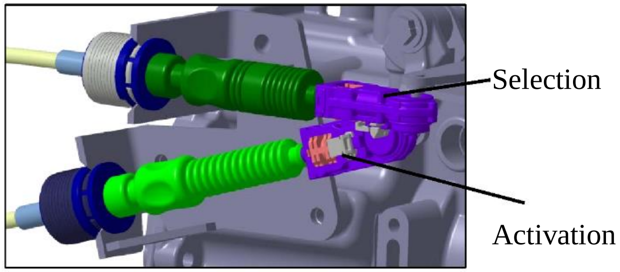
Remove cable



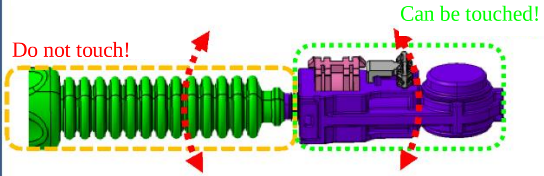
Remove the mounting bolts, remove the joystick from the vehicle.

(3)-4 Disassembly of large assemblies.

<Transmission>

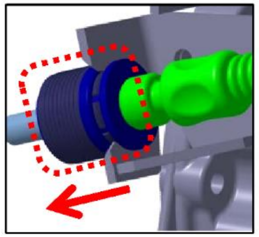


Attention!

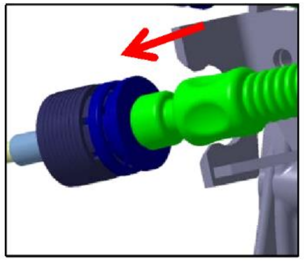


Do not bend the cable end!

<Activation cables>

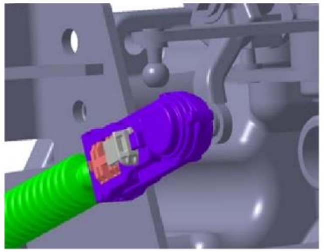


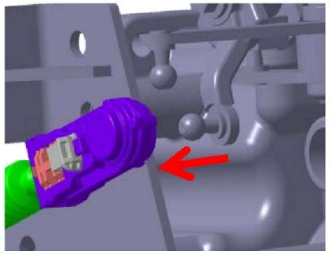
Move the bushing aside



Remove bushing from transmission bracket.

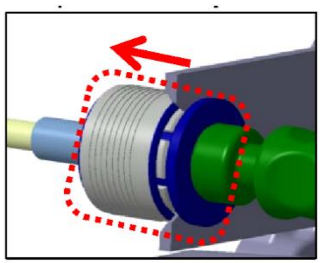
<Activation cable>



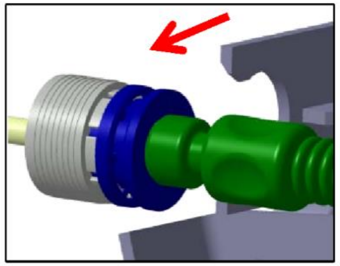


Remove cable end from transmission.

<Selector cable>

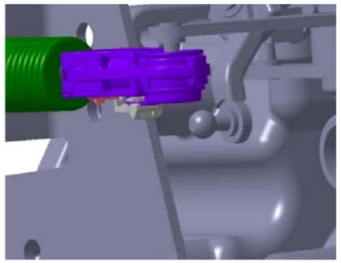


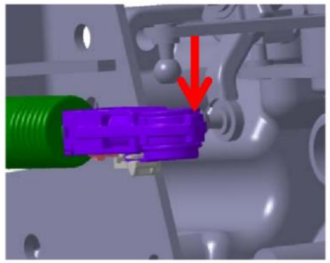
Move the bushing aside



Remove bushing from transmission bracket.

<Selector cable>

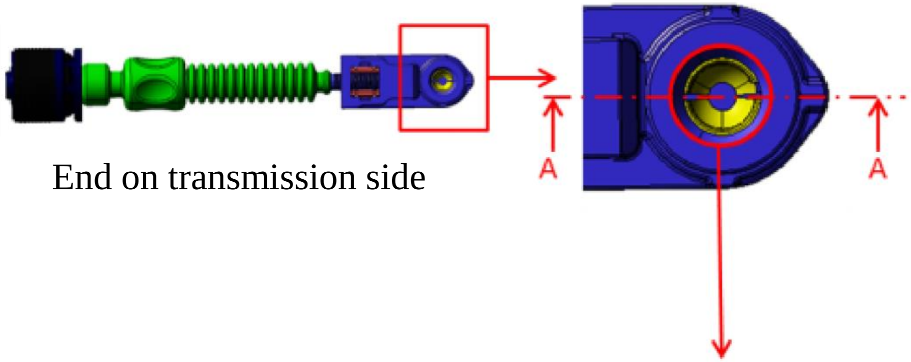




Remove cable end from transmission.

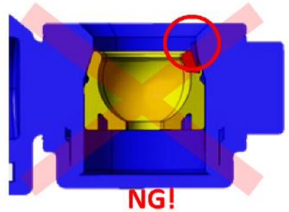
(3)-5 Disassembly of main assemblies.

< Cable installation and dismantling >

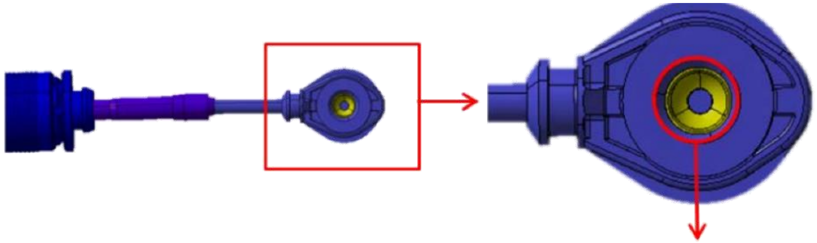


End on transmission side

Scratches at cable attachment point



※Important points: Mounting location (yellow area)
-> Make sure there are no scratches.



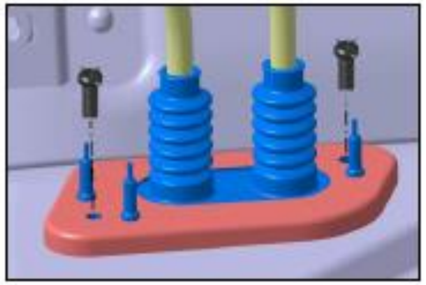
Examples of scratches are the same as the end on the TRANSMISSION side.

End on joystick side

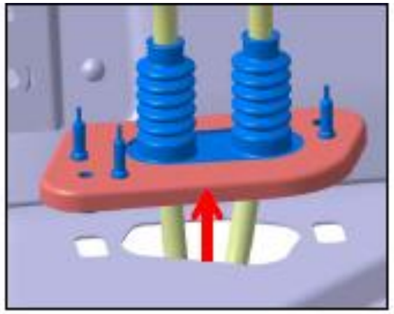
※Important points: Mounting location (yellow area)
-> Make sure there are no scratches.

Important! According to the above, it is possible to assemble the cable 2-3 times if there are no scratches on the mounting surfaces.

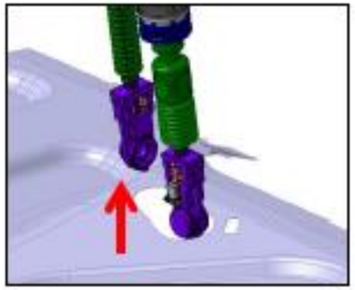
(3)-6 Disassembly of large assemblies.



Unscrew the screws.

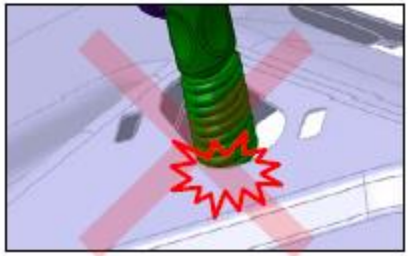


Carefully remove the grommet.



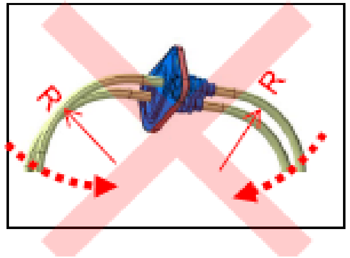
Pull out the cables one by one without damaging the panel.

Attention!



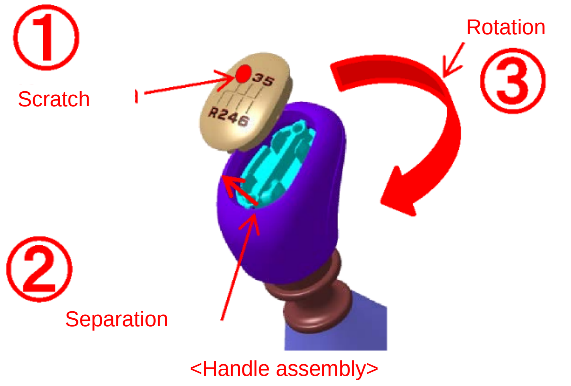
Do not damage the cable with the vehicle panel!

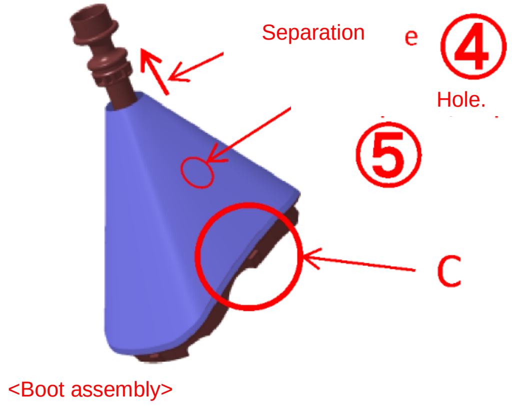
Attention!

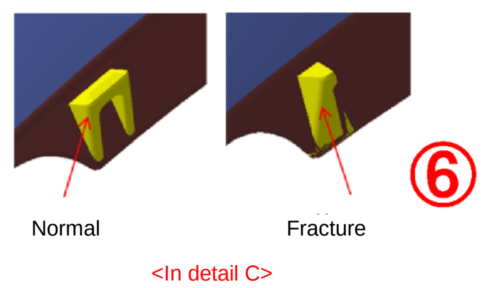


Do not bend cable less than R80. In the case of transportation or storage, it is allowed to bend the cable no less than R350

(4) Main malfunctions and troubleshooting.



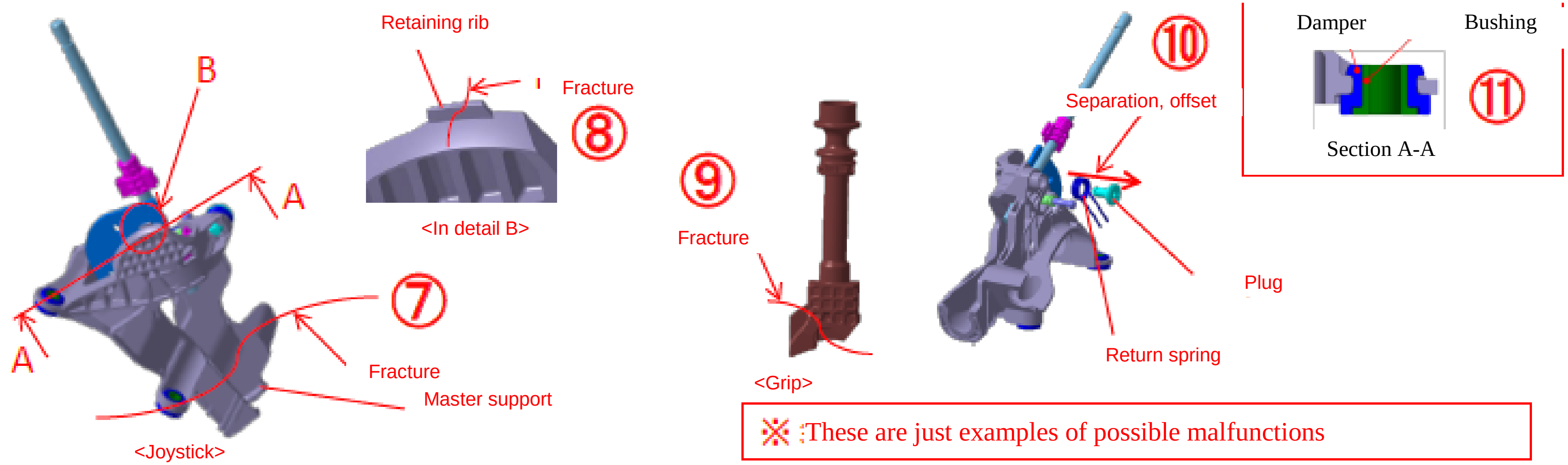




※These images are only an example for displaying malfunctions.

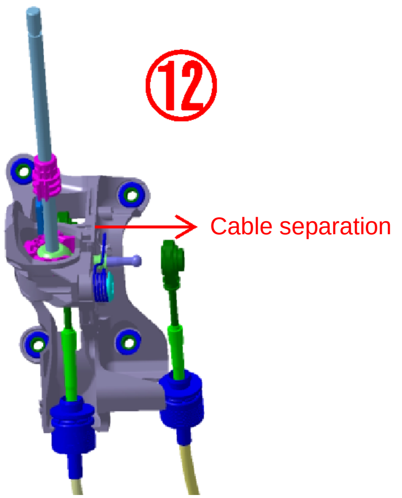
Malfunction	Cause	Remedy
Handle assembly scratch	Handle assembly deformation (Ref. 1)	Handle replacement (page 23)
Handle assembly separation (pad)	Handle assembly deformation (Ref. 2)	Handle assembly replacement (page 23)
Handle assembly rotation play	Handle assembly deformation (Ref. 3)	Handle assembly replacement (page 23)
Boot assembly separation	Boot assembly fracture (Ref. 5)	Boot assembly replacement (page 23)
Boot assembly through damage	Boot assembly damage (Ref. 5)	Boot assembly replacement (page 23)
Inability to fix boot assembly	Boot assembly mount fracture (Ref. 6)	Boot assembly replacement (page 23)

(4) Main malfunctions and troubleshooting.

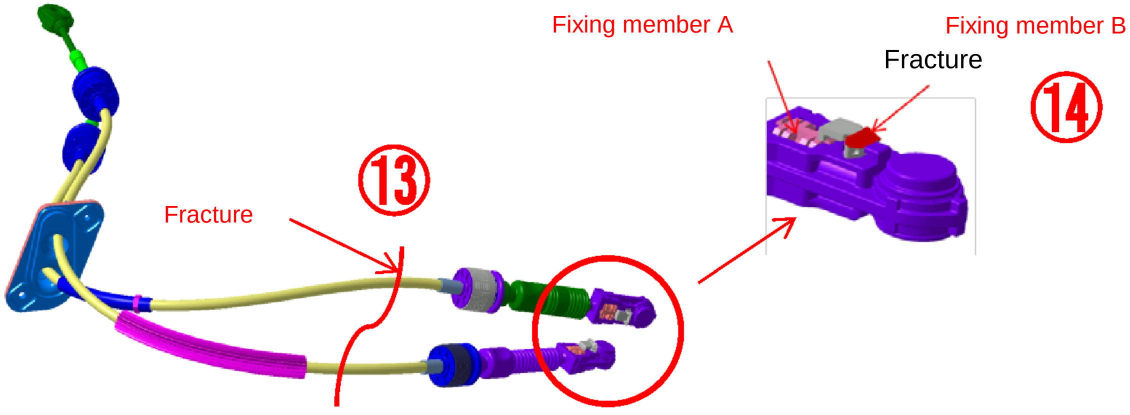


Malfunction	Cause	Remedy
Inability to change gear	Master support fracture (Ref. **7**)	Joystick replacement (page 23)
Inability to fix lever in reverse gear	Retaining rib fracture (Ref. **8**)	Joystick replacement (page 23)
Inability to change gear without using a grip	Grip fracture (Ref. **9**)	Boot assembly replacement (page 23)
Inability to return to neutral position	Separation of plug from spring (Ref. **10**)	Joystick replacement (page 23)
Extraneous noise	Damper or bushing fracture (Ref. **11**)	Damper or bushing replacement (page 23)

(4) Main malfunctions and troubleshooting.



<Joystick and cable>

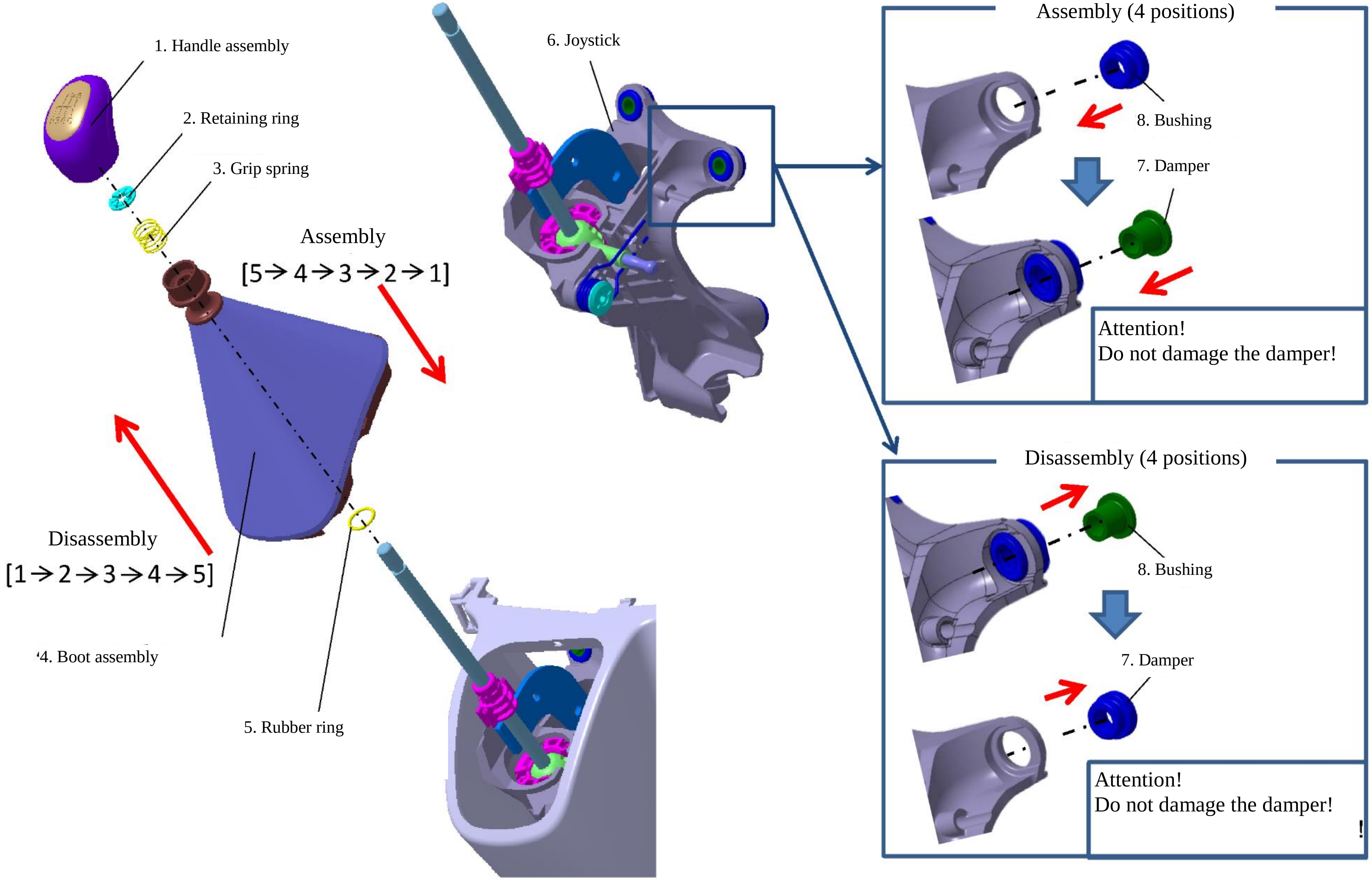


<Cable assemblies>

※These are just examples of possible malfunctions

Malfunction	Cause	Remedy
Inability to change gear	Transmission cable assembly separation (Ref. **12**)	Cable replacement (page 23)
	Transmission cable assembly fracture (Ref. 13)	Cable assembly replacement (page 23)
	Transmission cable fixing member fracture (Ref. 14)	Fixing member replacement (page 24)

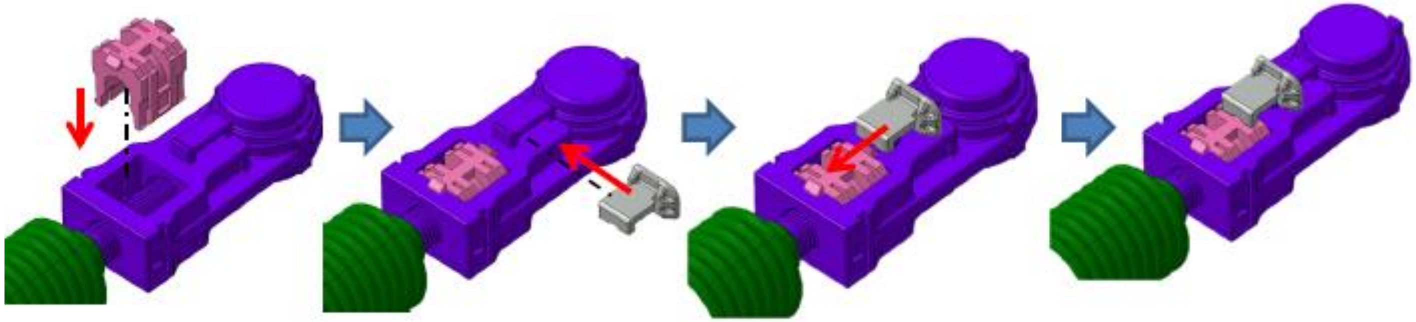
(5)-1 Spare parts assembly and disassembly procedure.



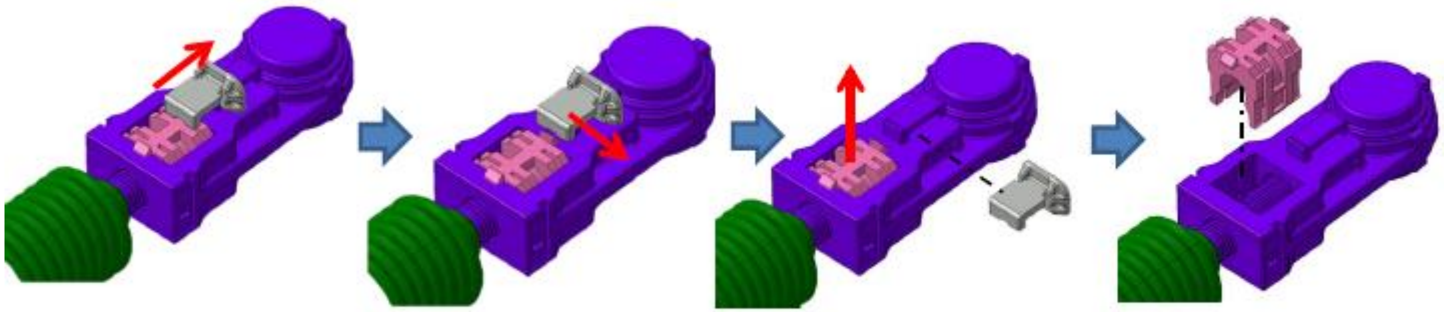
(5)-2 Spare parts assembly and disassembly procedure.

Installing spare parts in cable ends.

Assembly



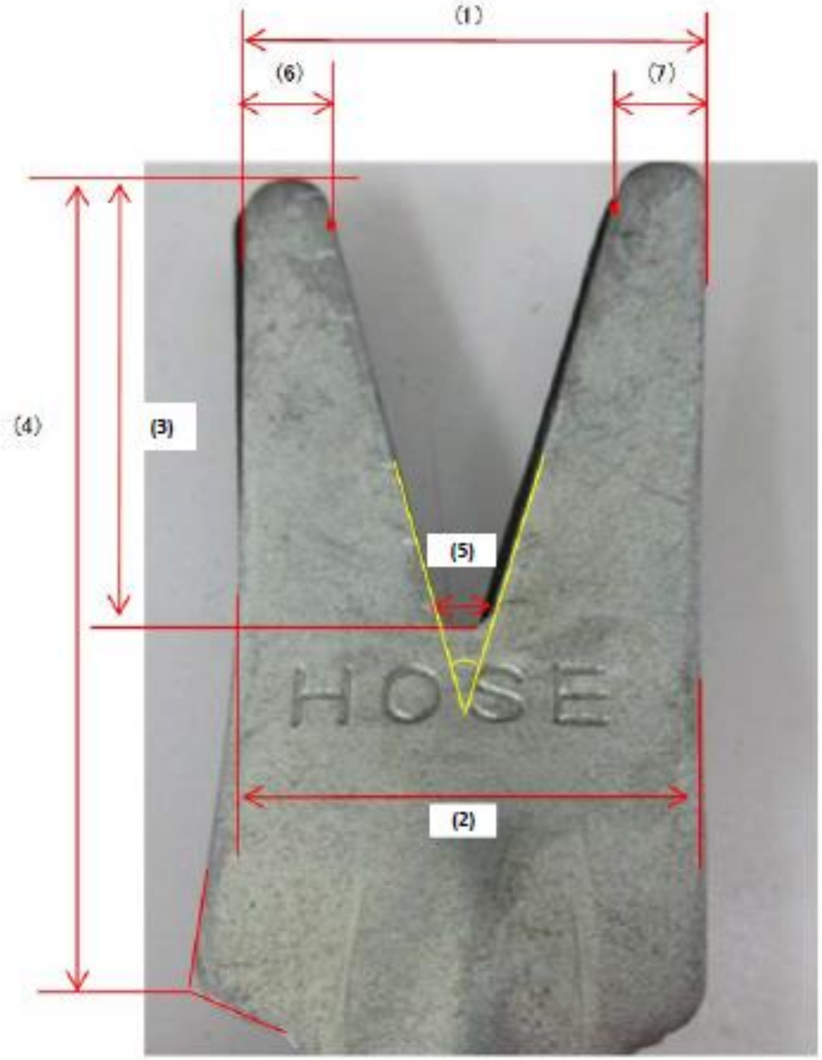
Disassembly



<Appendix>

<Transmission cable dismantling tool dimensions>

Reference



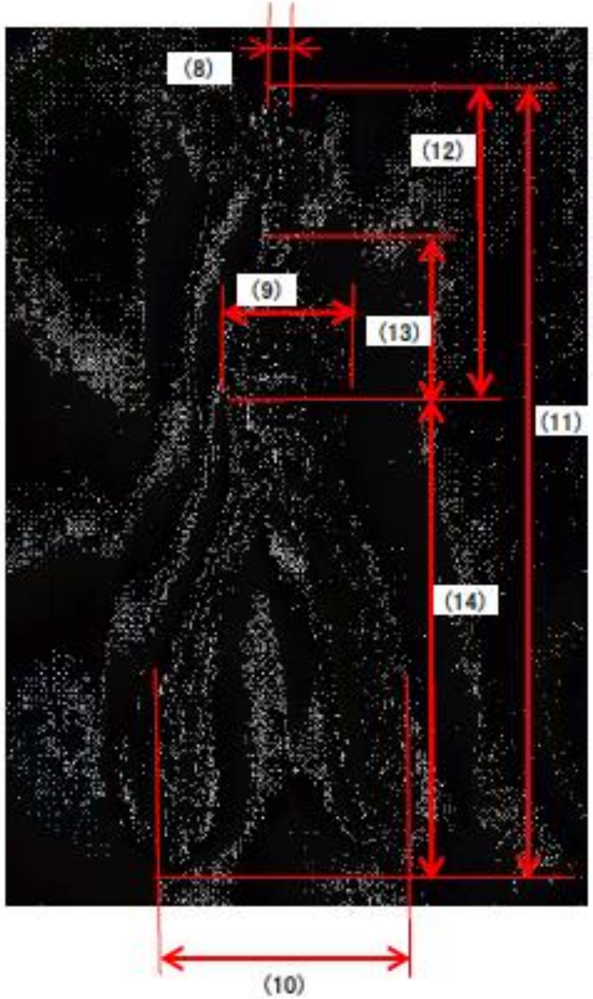
(Unit : mm)

Place	Dimension
(1)	26.4
(2)	25.2
(3)	31.3
(4)	54.1
(5)	36°
(6)	5
(7)	5
thinkness	2.5

< Transmission cable dismantling tool dimensions >

Reference

View A



(Unit : mm)

Place	Dimension
(8)	5.1
(9)	32.8
(10)	66.1
(11)	197.1
(12)	70.8
(13)	39.5
(14)	126.4

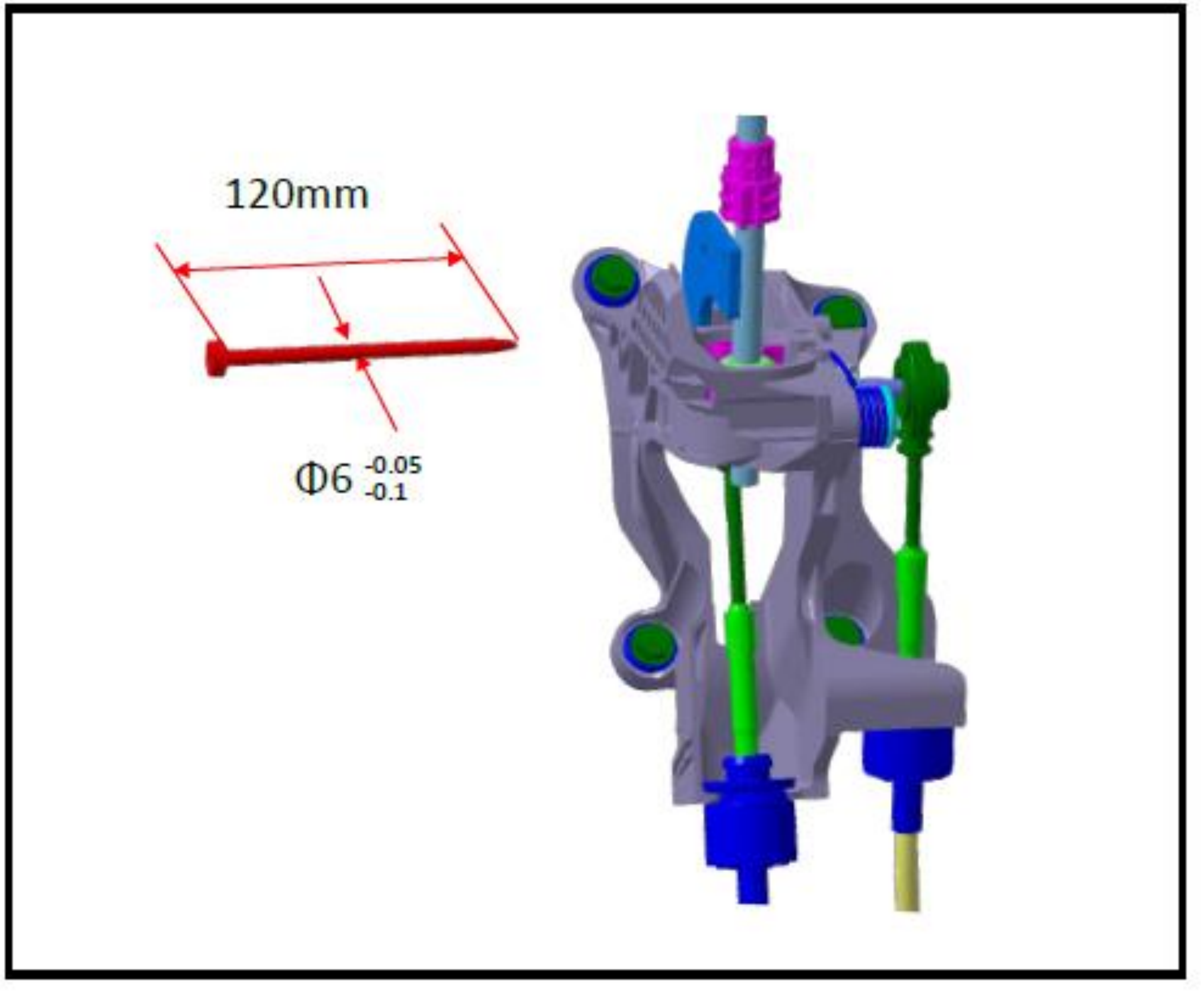
View B

(Unit : mm)

Place	Dimension
(15)	24.4
(16)	21.0
(17)	17.0

< Lever neutral position pin dimensions >

Reference



Cable drive check and adjustment instructions

1. Set the lever in the cab to the neutral position
2. Unlock the ends of the activation and selector cables

from the gearbox side, without removing them from the ball pins of the gearbox levers, move the valve in the arrow direction to the right until it stops (Fig. 1), and push out the latch (do not remove) in the arrow direction (Fig. 2)

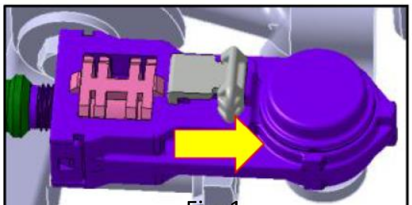


Fig. 1

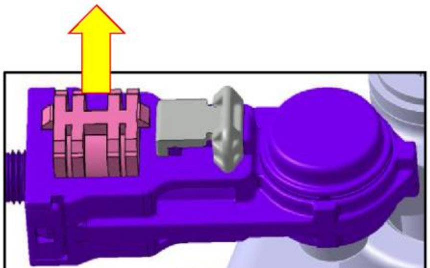


Fig. 2

3. Dismantle the frame together with the boot from the decorative casing
4. Lock the master support lever in the neutral position

In this case, use a cylindrical rod with diameter of 6 mm, which must be installed so that it is simultaneously in three process holes (2 holes in the body and 1 hole in the lever) (Fig. 3), if necessary, dismantle the decorative casing.

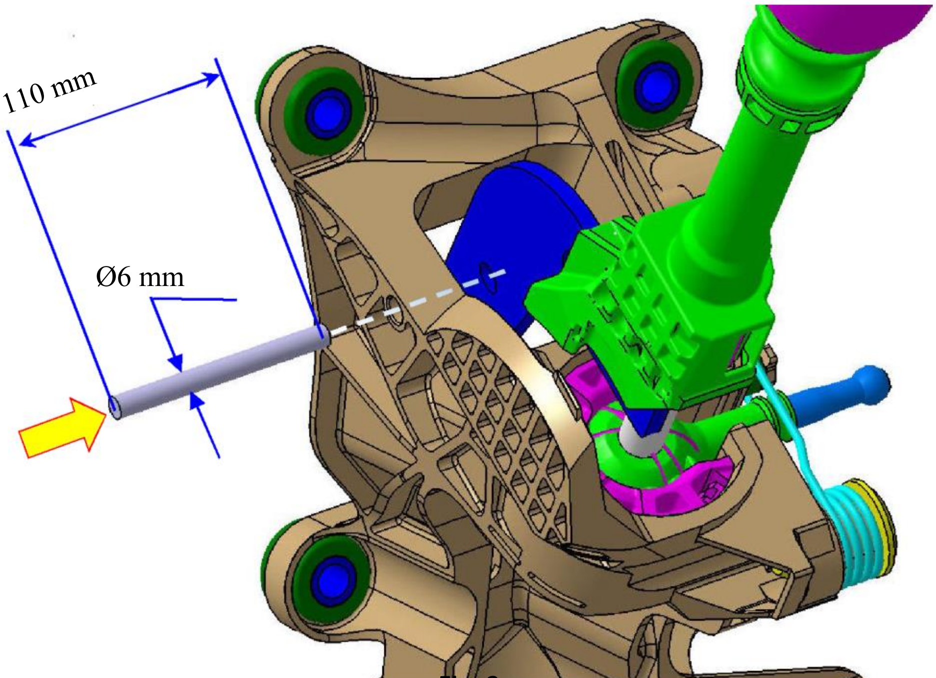


Fig. 3

5. Install a feeler gauge between the restrictive platform and the lever.

The feeler gauge thickness is 6 mm. After installing the feeler gauge, tilt the lever and press it against the feeler gauge, hold it in this position as shown in Fig.4.

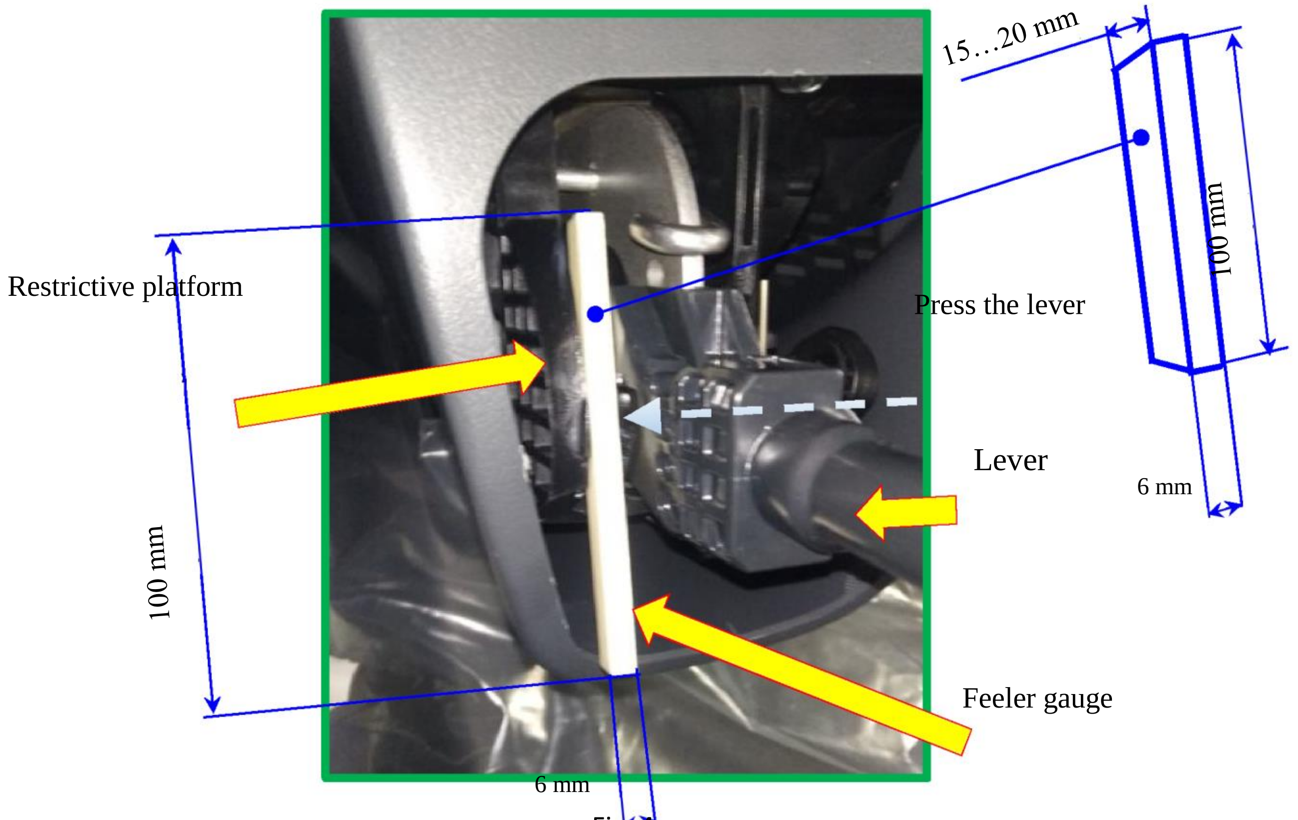


Fig. 4

6. Fix the cable ends.

Perform the operation of fixing the cable ends from the gearbox side (Fig. 7 and Fig. 8) with the feeler gauge installed and the lever pressed (see p. 5)

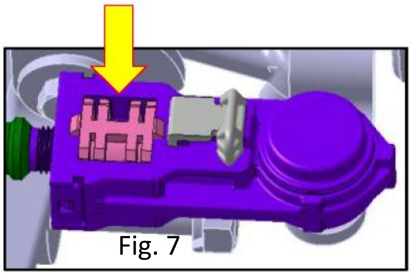


Fig. 7

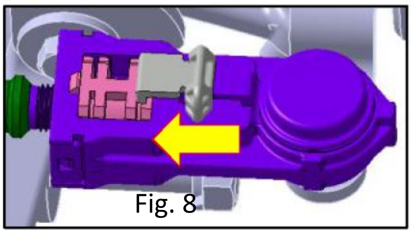
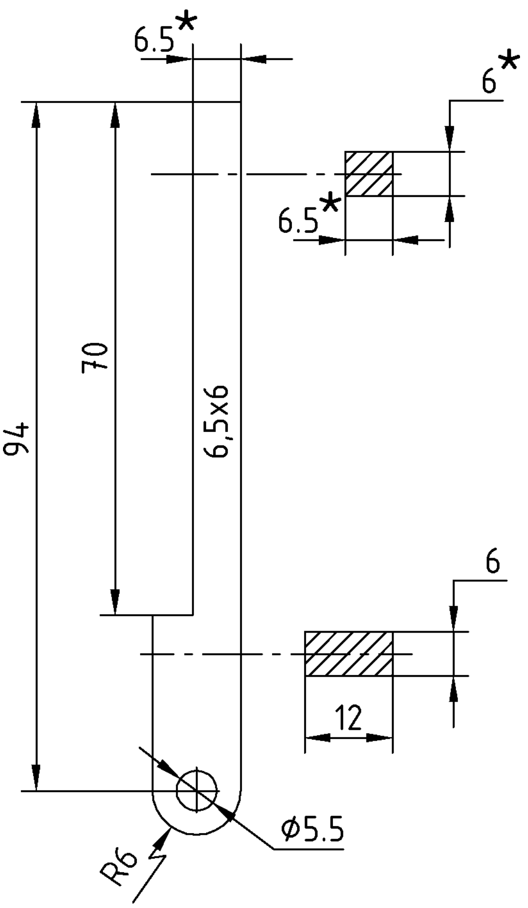


Fig. 8

7. Carry out a gear shift test.

To do this, remove the rod and feeler gauge from the master support, depress the clutch pedal, move the master support lever to the left in the direction of selecting gears 1-2 all the way to the stop on the master support, engage gears 1 and 2. The gears should shift without difficulty. Check that all gears are engaged. If necessary, start the engine. After the check, install the frame with a boot in a regular place.



1. Mark with font 4-Pr3
2. Marking depth min. 0.3 mm
3. *Deviations max. ±0.1 mm

Rev.	Sheet	Doc. No.	Sign.	Feeler gauge No. 9	Letter	Weight	Scale
							1:1
					Sheet 1	of Sheets	
				Caprolon			

Primary usage

Ref. No.

Sign. and date

Repl. Inv. No.

Copy Inv. No.

Sign. and date

Orig. Inv. No.

9.5. Cardan drive

1. Safety precautions

All warnings in this document have been prepared as a result of detailed research for the safe use of the product. Misuse and incomplete/incorrect maintenance may result in both sudden damage to the product and may result in damage to the product during normal use.

The technical specifications (maximum torque, rotational speed, placement angle, length, etc.) of the products must in no case exceed the normal values. Exceeding these specifications may result in damage to the product and the vehicle.

Any changes made without the written permission of TIRSAN KARDAN company will void the warranty.

The product is shipped ready for installation. Cardan shafts are balanced, painted and lubricated to operate in accordance with the vehicle manufacturer's specifications.

All assembly, dismantling and maintenance work on the product must be carried out by authorized service personnel only.

1.1. Transportation and Storage Conditions

To prevent slipping in the spline joint, cardan shafts must be transported and stored in a horizontal position.

In order to prevent the cardan shaft from rolling off during transport, appropriate wedge stoppers must be used.

Cardan shafts must not be held at the flange or U-joint side. Otherwise, the flange movement may cause compression and injury to a person during transportation.

Do not apply any axial load to the spline joint during transport. Otherwise, some displaced parts of the spline joint may cause injury.

A multi-shaft cardan drive must not be lifted when supported from only two ends. Under transport and storage conditions, as a result of large angles at the intermediate pivot, loads on the cross-piece can lead to permanent deformation.

For better transport of the product, **see Figure 1.1** below, use only strong nylon ropes or lifting straps when transporting. When using steel belts, keep the belt away from sharp corners.

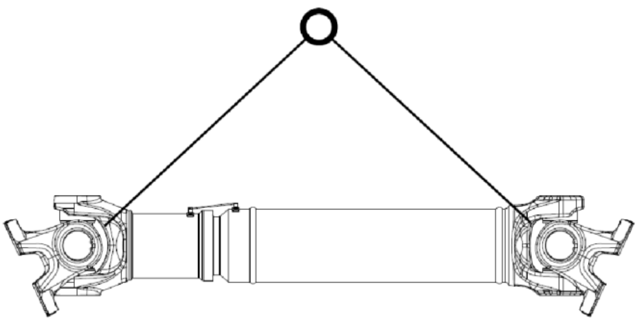


Figure 1.1

During transportation, sudden shocks, high vibrations and impacts should be avoided.

During transport and storage of the cardan shaft, avoid stress on the spline joint (boot, seal and Rilsan coating), **see Figure 1.2**

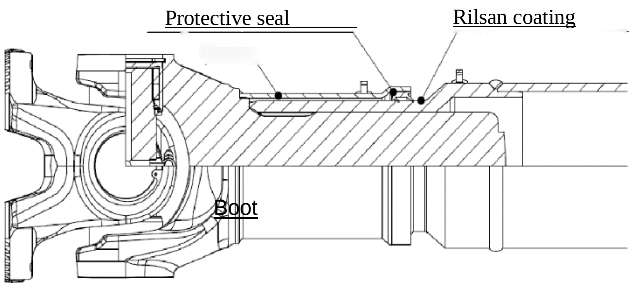


Figure 1.2

The cardan shafts must be supported as shown in the bottom drawing **(see Figure 1.3).** All supports can only be used near the pipe weld area.

Avoid stress on the spline joint and in the middle of the pipe. Do not hang any equipment, weight, etc. on the spline joint and on the pipe.

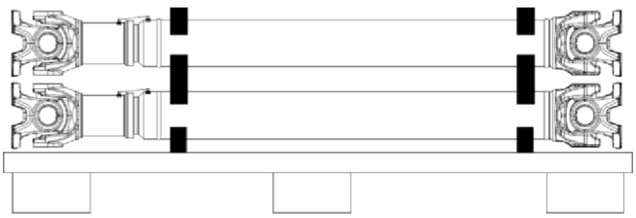


Figure 1.3

Do not remove the spline joint safe transport bundle until the cardan drive is installed on the vehicle. For vertical storage of cardan shafts, additional precautions must be taken to prevent the cardan shafts from falling.

Cardan shafts must be stored in dry places, avoid high and low temperatures and high humidity. (Recommended storage temperature: 0-50 °C)

1.2. Installation, Dismantling and Position

All safety equipment on the vehicle, brake lines, cables, hydraulic and fuel lines must be installed so that they are not damaged by defective cardan shafts.

The cardan shaft structure is designed for operational use at an ambient temperature of -40 °C to +80 °C (sometimes they can be exposed to an instantaneous temperature of up to +120 °C for a short period). However, different ambient temperatures may require the use of different greases.

Cardan shafts should be located away from heat sources such as exhaust pipes, mufflers and retarder. If, in some designs, the cardan shaft is installed near the heat sources, a heat shield must be used to prevent the cardan shaft overheating.

It is advised to mount a special frame around the cardan shaft so that it cannot move in order to prevent damage to other parts in case of a possible breakage/failure when transporting a multi-shaft cardan drive.

In order to ensure safe and correct installation, the cardan shaft flange joint surfaces must be free from dirt, grease and paint.

Before installation, it is forbidden to clean the anti-corrosion coating lubricated by the company. If there are other protective boots and coverings of connecting parts, they must be removed before assembly.

Before installing the cardan shaft on the vehicle, the safety clamp must be removed. The cardan shaft is balanced by welded parts (plates) connected to bundles. Therefore, these parts must be kept.

During installation, the arrows on the spline joint should be facing each other **(see Figure 1.4).** The spline joint is designed to work properly in this position. Do not change the spline joint parts or install in a different angle position.

For proper mounting of a multi-shaft cardan drive, the gearbox and differential flanges must be in the correct position. Avoid changing the spline joint angle.

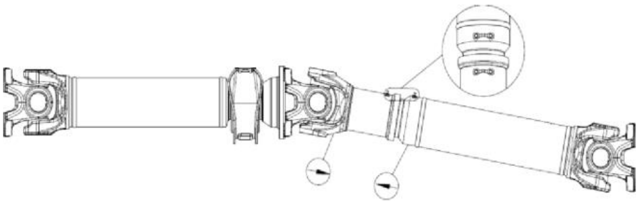


Figure 1.4

The cardan drive spline must be protected as best as possible from dirt and water. This protection increases the overall service life and performance of the cardan shaft. Usually, when installing the cardan shaft on a vehicle, the spline joint seal is directed downwards as shown in the figure. Installing a spline joint on top will keep dirt and water from accumulating in the seal.

Cardan shaft flanges are manufactured according to DIN or SAE standards. It is necessary to pay attention to the compliance of the opposite parts with the same standards and the compliance of the axial-radial position of these parts.

In order to rotate the pivot, do not insert any instruments into the cross-piece cavity. This may damage grease cups and protective seals.

The Rilsan coating on the spline joint **(see Figure 1.5)** must be protected from paint, heat, any solvent/corrosive chemicals and mechanical damage.

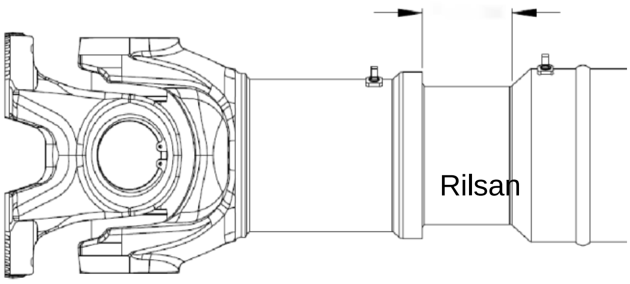


Figure 1.5

Cardan shafts must not be cleaned with corrosive chemicals or high-pressure water jets. Protective seals may be damaged; dust, dirt, water, or any other material may enter the internal areas of the cardan drive.

The front cardan shafts are shipped ready to install with an intermediate support. The tightening torque for the intermediate support bearing and the intermediate flange of the front cardan shaft intermediate support are shown in the table below **(see Table 1.1).** Also, the intermediate support bearing and the intermediate flange of the multi-shaft cardan drive are tightened to the torques indicated in the table. During installation, it is necessary to be very careful. After disassembly for service, the intermediate support should be installed with appropriate equipment and tightening torque.

Table 1.1

Intermediate support number	Tightening force (Nm)
CB.06036.xx.02	600 ±50
CB.06536.xx.02	700 ±50
CB.06523.xx.02	130 ±5
CB.06022.xx.02	230 ±10
CB.03514.xx.02	55 ±2.5
CB.03517.xx.02	55 ±2.5
CB.03013.xx.02	48 ±7
CB.03015.xx.02	66 ±6

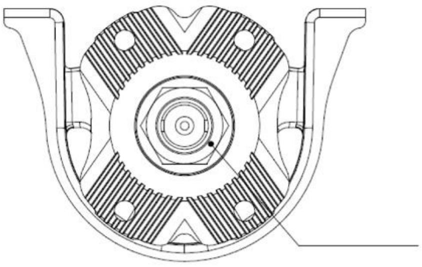


Figure 1.6

Use of a locknut in an intermediate group **(see Figure 1.6):** when replacing an intermediate support, the locknut must also be replaced with a new one. Tighten the new locknut to the correct torque **(see Table 1.1)** and lock at both ends.

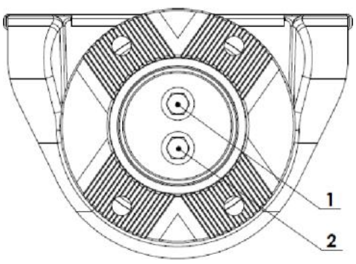


Figure 1.7

Use of two bolts in an intermediate group **(see Figure 1.7):** tighten bolts number 1 and 2 to the appropriate torque **(see Table 1.1),** then tighten bolt number 1 again to the appropriate torque (tightening order is 1-2-1).

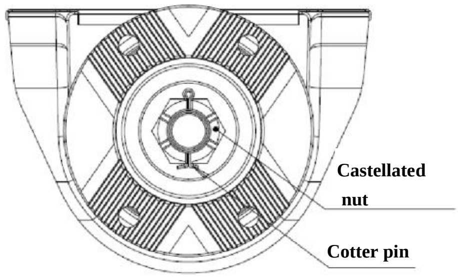


Figure 1.8

Use of the castellated nut and cotter pin in the intermediate group **(see Figure 1.8):** after the castellated nut has been tightened to the minimum torque tolerance **(see Table 1.1)**, continue to tighten the castellated nut until the first possible installation of the cotter pin. After installation, the cotter pin ends must be carefully bent to lock.

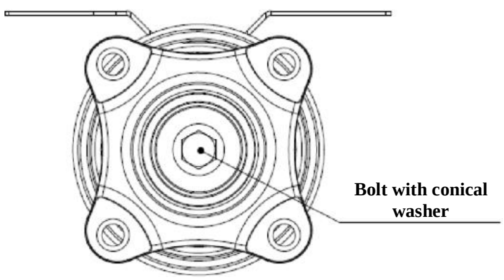


Figure 1.9

An intermediate group without a locking mechanism uses a bolt with a conical washer **(see Figure 1.9).** Before installing the bolt, apply a chemical (LOCTITE) to the tooth profile and tighten the bolt to the correct torque. The chemical (LOCTITE) prevents loosening of the bolts.

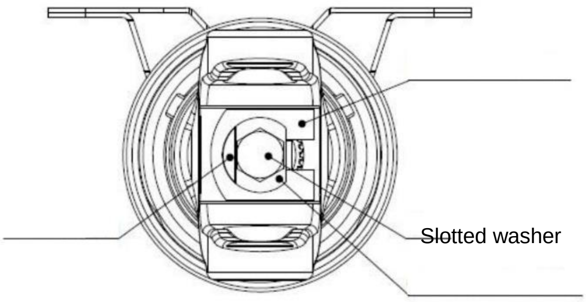


Figure 1.10

Use of a lock washer in an intermediate group **(see Figure 1.10):** after the bolt has been tightened to the minimum torque tolerance, continue to tighten the bolt until the first possible installation of the key mechanism. In the proper orientation, bend the lock washer locking mechanism up and lock the bolt. In an intermediate group with a slotted washer, the slotted washer projection must be at the top.

Note that in an intermediate group with a slotted washer, the slotted washer projection must point downwards (towards the spline clearance).

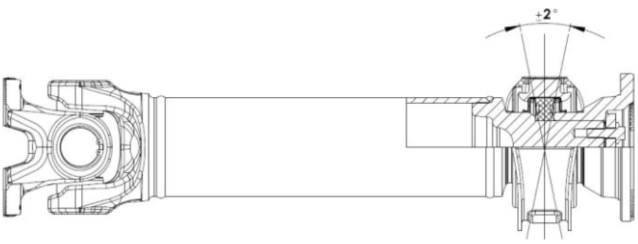


Figure 1.11

It is recommended to install the cardan shaft intermediate support pin vertically to the perpendicular axis of the cardan shaft front part **(see Figure 1.11).** The maximum allowable angle between the intermediate support vertical position and the front cardan shaft horizontal axis is 90°±2°. (For intermediate support CB.06523.xx.02 the maximum allowable angle is 90°±3°).

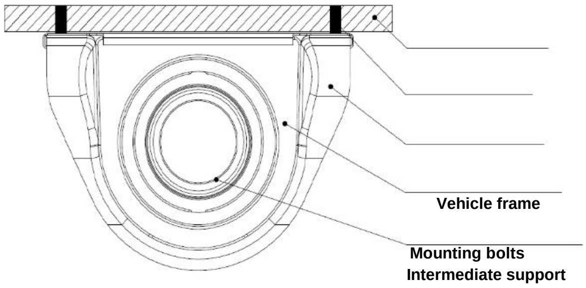


Figure 1.12

Make sure the intermediate support is firmly connected to the vehicle frame with the appropriate bolts and washers **(see Figure 1.12)**. For safe installation, use bolts and washers prescribed only by TIRSAN KARDAN company and the vehicle manufacturer.

The cardan shaft intermediate support must be installed to the vehicle after installing the cardan shaft flanges to the gearbox and the differential.

The connecting flanges at both ends of the cardan shaft must be screwed in with appropriate bolts and with a torque prescribed only by the company and the vehicle manufacturer. Bolts are screwed in transverse position.

In a bolt and nut installation, it is recommended to place the bolts on the side of the intermediate or differential flanges.

During any of the installation or dismantling stages, in order to prevent the U-joint deformation, do not let the joint rotate until it is mechanically limited. If required, support the cardan shaft with a belt or platform. When disassembling, prevent a possible fall of the cardan shaft. The bolts must be completely removed after the cardan shaft is supported.

Before disassembling the flanges and bolts, mark the position of the flanges and bolts when assembled.

1.3. Flange joints

1.3.1. DIN flanges

Cardan bolts quality class 10.9 as per ISO 7647.

Hex Bolts: DIN 960-10.9

Hex Nuts: DIN 980-10

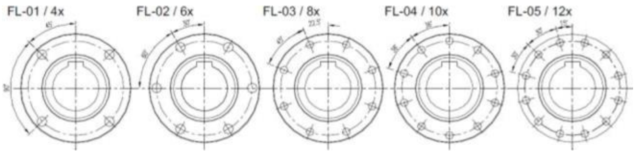


Figure 1.13

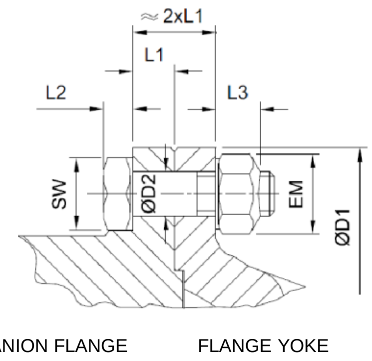


Figure 1.14

Table 1.2

ØD1 mm	*L1 mm*	*ØD2 mm*	*Flange*	*Bolt* Type	SW mm	EM mm	L2 mm	L3 mm	Mt Nm
58	4	Ø5	FL-01 (4)	M5x15	8	8.8	3.5	5	9
65	5	Ø6	FL-01 (4)	M6x20	10	11.1	4	6	14
75	6	Ø6	FL-02 (6)	M6x20	10	11.1	4	6	14
90	8	Ø8	FL-01 (4)	M8x1x25	13	14.4	5.3	8	36
100	8	Ø8	FL-02 (6)	M8x1x25	13	14.4	5.3	8	36
120	10	Ø8 Ø10	FL-03 (8)	M8x1x30 M10x1x30	13 17	14.4 18.9	5.3 6.4	8 10	36 70
150	12	Ø10 Ø12 Ø14	FL-03 (8) FL-04 (10) FL-05 (12)	M10x1x35 M12x1.5x40 M14x1.5x45	17 19 22	18.9 21.1 24.5	6.4 7.5 8.8	10 12 14	70 120 190
180	14	Ø12 Ø14 Ø16	FL-03 (8) FL-04 (10) FL-05 (12)	M12x1.5x45 M14x1.5x45 M16x1.5x50	19 22 24	21.1 24.5 26.8	7.5 8.8 10	12 14 16	120 190 300
225	15	Ø16	FL-03 (8) FL-05 (12)	M12x1.5x50 M16x1.5x50	19 24	21.1 26.8	7.5 10	12 16	120 300
250	18	Ø18	FL-03 (8)	M18x1.5x60	27	30.2	11.5	18	450
285	20	Ø20	FL-03 (8)	M20x1.5x65	30	33.6	12.5	20	620
315	22	Ø22	FL-03 (8)	M22x1.5x75	32	35.8	14	22	830
350	25	Ø22	FL-04 (10)	M22x1.5x75	32	35.8	14	22	830
390	28	Ø24	FL-04 (10)	M24x1.5x85	36	40	15	24	1100
435	32	Ø27	FL-04 (10)	M27x1.5x95	41	45.2	17	27	1600

1.3.2. SAE flanges

Cardan bolts quality class 10.9 as per ISO 7646.

Hex Bolts: DIN 960-10.9

Hex Nuts: DIN 980-10

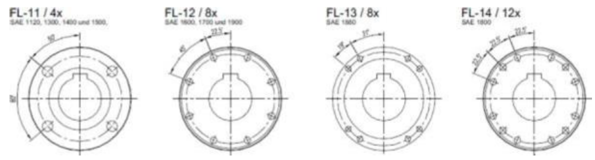


Figure 1.15

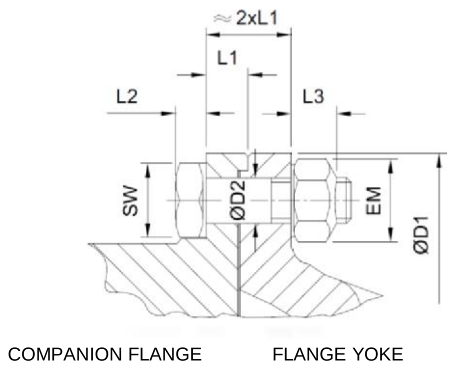


Figure 1.16

Table 1.3

ØD1 mm	*SAE Type*	*L1 mm*	*ØD3 mm*	*Flange*	*Bolt* Type	*SW*	*EM*	*L2*	*L3*	*Mt Nm*
90	*1100*	**6**	Ø8	FL-11 (4)	M8x1x25 5/16"x1"	13	14.4	5.3	8	36
96	*1300*	**7**	Ø10 Ø9.5	FL-11 (4)	M10x1x30 3/8“x1 3/16“	17	18.9	6.4	10	70
116	*1400*	8	Ø12 Ø11.2	FL-11 (4)	M12x1.5x40 7/16“x1 5/8“	19	21.1	7.5	12	120
150	*1500*	8	Ø14 Ø12.7	FL-01 (4)	M14x1.5x45 1/2“x1 3/4“	22	24.5	8.8	14	190 120
175	*1600*	**10**	Ø10 Ø9.5	FL-12 (8)	M10x1x30 3/8“x1 3/16“	17	18.9	6.4	10	70
203	*1700* *1800*	11	Ø12 Ø11	FL-12 (8) FL-14 (12)	M12x1.5x40 7/16“x1 5/8“	19	21.1	7.5	12	120
245	*1880*	15	Ø16	FL-13 (8)	M16x1.5x50	24	26.8	10	16	300
250	*1900* *GS*	**18**	Ø12	FL-14 (12)	M12x1.5x50 7/16“x1 5/8“	19	21.1	7.5	12	120
276	*1900*	**18**	Ø16	FL-12 (8)	M16x1.5x60	24	26.8	10	16	300

1.3.3. KV/XS flanges (cross-toothed)

Cardan bolts quality class 10.9 as per ISO 12667 and ISO 8667.

Hex Bolts : DIN 960-10.9

Hex Nuts : DIN 980-10

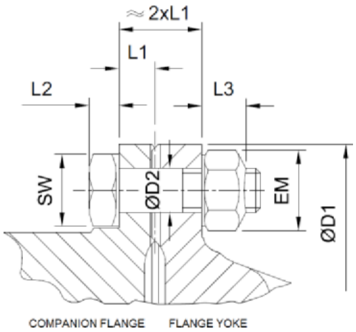


Figure 1.17

Table 1.4

Ø D1 mm	*L3 mm*	*Ø D2 mm*	***Bolt***					
			Type	Sl/K *mm*	*EM mm*	*L2 mm*	*L3 mm*	*Mt Nm*
100	10	Ø8	M8x1x30	13	14.4	5.3	8	36
120	14	Ø11	M10x1x40	17	18.9	6.4	10	70
150	16	Ø13	M12x1.5x45	19	21.1	7.5	12	120
180	18	Ø15	M14x1.5x55	22	24.5	8.8	14	190
200	20	Ø15	M14x1.5x55	22	24.5	8.8	14	190

2.1.1. Flexible coupling

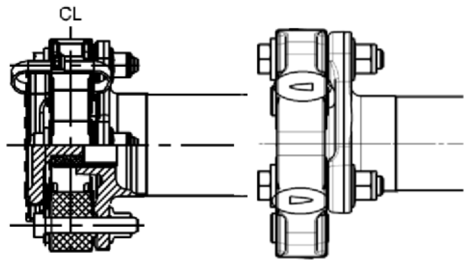


Figure 1.18

Flexible coupling cardan shafts are used with centering plate and without centering plate according to flange joint.

The bolts are placed in accordance with the markings on the flexible coupling rubber part and tightened in accordance with the nuts.
Hex Bolts : DIN 960-10.9
Hex Nuts : DIN 980-10

Bolt Type	Torque
M12x1.75	100±10 Nm
M14x1.5	180±20 Nm

2. Maintenance

For a long life of the cardan shaft in better conditions, the shaft maintenance must be regular.

The scope and intervals of cardan shaft maintenance may vary depending on the type, operation type, vehicle load and environmental conditions. All maintenance details must be written in the vehicle maintenance manual. Vehicle owners should be informed.

Vehicle manufacturers are advised to coordinate cardan shaft maintenance intervals in accordance with other vehicle components or with periodic vehicle inspections in accordance with the table below **(see Table 2.1).** The recommended maintenance of cardan shafts is divided into two groups; Minor and Major Maintenance.

Table 2.1

		Maintenance Intervals*	
		Minor Maintenance	**Major Maintenance**
Commercial Carriers	**Long Distances** (Mileage of 80,000 km or more per year)	50,000 km 1 year	200,000 km 3 years
	City (Mileage of 20,000-80,000 km per year.)	25,000 km 1 year	150,000 km 3 years
	Off-road / Construction (Mileage of 20,000 km or less per year.)	20,000 km 3 months	50,000 km 1 year
Buses	**Long Distances** (Mileage of 100,000 km or more per year)	50,000 km 1 year	150,000 km 2 years
	City (Mileage of 100,000 km or less per year.)	25,000 km 6 months	100,000 km 2 years

* Valid for mileage or deadline.

recommends a very detailed inspection when changing ownership of the vehicle or in the event of an accident.

All maintenance and repair work on the cardan shaft and its components must be recorded in the Cardan Shaft Maintenance Record (see appendix).

2.1 Minor Maintenance

Minor maintenance consists of general cardan shaft maintenance. General inspection and maintenance of the cardan shaft shall be carried out directly on the vehicle or industrial equipment, without dismantling.

Before any inspection or intervention in the vehicle, make sure that the engine is off and that the vehicle cannot be started by unauthorized personnel.

1. The cardan shaft should be cleaned of adhering dirt or other mixtures that create an imbalance in the shaft and contribute to vibration. This procedure for cleaning the cardan shaft is recommended to be carried out after the departure of vehicles from construction sites, quarries, wetlands.

2. The connecting bolts of the cardan shaft and the intermediate support must be well checked. If required, re-tighten them with the appropriate torque. With the intermediate support bolts loose, before tightening them, check that the intermediate support is properly aligned and the washers are not crushed. Damaged bolts and washers must be replaced with new ones.

3. The condition of the retaining rings on all cross-piece bearings should be checked. There must be no deformation or rotation on the retaining ring. It should be ensured that all the teeth holding the press-fitted cross-pieces are in good condition (no tears or breaks).

4. Check that the cross-piece seals are in good condition and in correct place. Grease cups and their protective inserts at serviced cross-pieces must be in place and intact. Dirty grease cups should be cleaned.

5. All connections should be manually checked for any visual or tactile play shown in **Figure 2.1.** To detect play, check every connection, and in all directions. If any play is found, the assembly operation must be repeated with different types of retaining rings (thicker or thinner), depending on the type of play. Play may cause imbalance, vibration and noise.

6. All cross-piece bearings should be checked by hand in all directions to prevent play **(see Figure 2.1).** Play in the cross-piece create vibration, noise and balance changes.

7. Balance plates and connection axles (on the spline joint) must be in place and intact.

8. Intermediate support, cross-piece and spline joint seals must be in place without corrosion/tearing, etc.

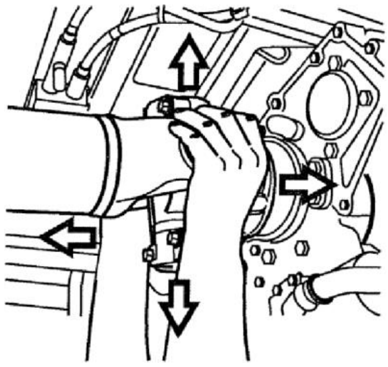


Figure 2.1

9. The condition of the intermediate flange in the intermediate group must be checked manually using manual force.

10. The Rilsan coating on the spline joint must be clean and free of any visible damage (no deviations or corrosion).

11. The spline joint clearances must be checked

by hand using manual force.

12. The cardan drive shafts should be checked for signs of impact, dents, dips, or any deformation.

13. The intermediate areas of the earpieces to which the cross-pieces are connected should be checked for traces of friction that may result from an increase in the articulation angle.

14. The flexible coupling bolts should be checked for looseness. The coupling must be checked in case of play by applying force manually.

15. The flexible coupling rubber must be checked for possible superficial damage on the surface and the inner winding must not be visible. Small surface cracks on the rubber part, do not affect the actual coupling performance.

In case of any negative readings on the driveline and its parts, a major maintenance should be applied.

2.2 Major Maintenance

Major maintenance consists of detailed needs and maintenance procedures for the cardan shaft. Every major maintenance should be preceded by a minor maintenance. Then, the cardan shaft is removed from the vehicle or industrial equipment for major maintenance.

1. Play and stiffness in the cross-piece bearings must be checked by moving the flanges in the vertical and horizontal direction.

2. The condition of the grease cups and the sealing of the bearings in serviced cross-pieces must be checked visually and manually. If cracks, tears or any deformation are found on the seals or other rubber parts, the cross-piece must be replaced by an authorized service.

3. The cross-pieces are lubricated with company approved greases. The cross-piece must continue to be lubricated until the grease has leaked from all seals. If the grease does not leak from the seals or leaks out with water, dirt or rust, send the cardan shaft to an authorized service for the necessary maintenance.

4. The spline joint should be completely disassembled and the internal surfaces, Rilsan coating and deformations on the spline parts should be examined.

5. The protective seal on the spline joint should be checked visually and manually. If cracks, tears or any deformation are found on the seals or other rubber parts, the seal must be replaced by an authorized service.

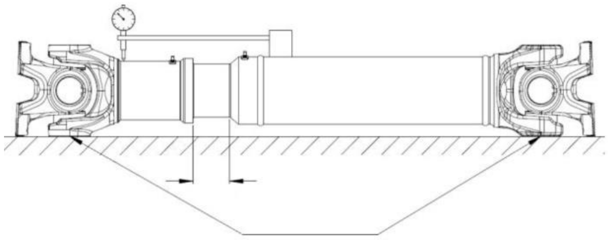


Figure 2.2

6. To check the spline joint clearance, the cardan shaft must be expanded by approximately 50 mm and laid horizontally as shown in the figure **(see Figure 2.2).** In order to calculate the deviation, a pressure gauge dial should be used, fixed with a pressure gauge dial holder to the pipe at the containment weld.

The maximum permissible deviation of the cardan shaft in the lying position and raised from the middle (center of gravity) is 0.2 mm. **Note:** to measure cardan shafts with spline joint strokes below 110 mm, expand the spline joint by half the spline stroke.

7. If there is damage or incorrect clearance in the spline joint, send the cardan shaft to an authorized service center. Whole spline joints should be lubricated with greases recommended by the company and set according to the relative position of the arrows.

8. In cardan shafts with intermediate support; check visually and manually the intermediate support, rubber part and bearing. There must be no cracks, tears or deformations on the cover and cushion of the intermediate support, and on the connecting plates.

9. The intermediate support bearing rotation is checked by rotating the intermediate support around the cardan shaft. The bearing must rotate smoothly and without spaces. If any defect is found on the intermediate support, the intermediate support must be replaced by an authorized service center.

10. When replacing an intermediate support, damaged dust plates must also be replaced with new ones.

11. Intermediate flange clearances are manually checked.

12. The connecting elements on the intermediate flange must be tightened to the appropriate torques specified in the cardan shaft maintenance documentation.

13. The flexible coupling bolts must be tightened to the rated torque. After disconnecting the cardan shaft, the bolts and nuts must be replaced with new ones.

After all maintenance/changes done to the cardan shaft, before installing the cardan shaft on the vehicle, it must be re-balanced.

If the cardan shaft is damaged, deformed (twisted or bent) due to overload, it must not be used or repaired. It should be replaced with a new one.

3. Lubrication

Cardan shafts manufactured by the company are divided into two groups: maintainable and maintenance-free. Maintenance-free cardan shafts are designed and manufactured to require no lubrication during their entire service life.

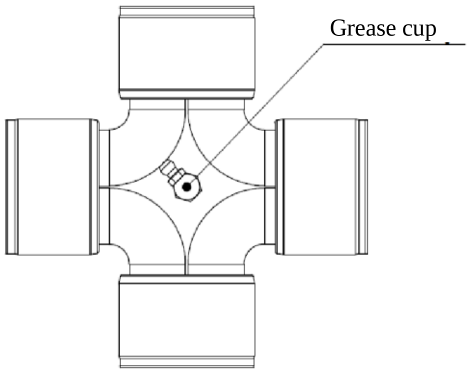


Figure 3.1

The serviced cardan shafts have cross-piece with grease cups **(see Figure 3.1)**, the grease nipple of which complies with TS 10687 (TS 10687, DIN 71412). The lubrication must be carried out with the appropriate lubrication equipment. The standard spline joint type is maintenance-free. But some models may have grease cups on a spline joint.

For long service life, maintainable cardan shafts should be lubricated with the appropriate intervals and greases specified in the cardan shaft maintenance documentation. To re-lubricate the spline joint, make sure the spline joint is fully closed.

Before lubricating, make sure the grease cups are clean. Do not carry out the lubrication with a pressure pump (avoid overpressure). Lubricating pressure <15 bar. After the lubrication, the protective caps of the grease cups must be reinstalled. Damaged or missing caps must be replaced with new ones.

In intermediate supports produced without grease cups, the intermediate support bearing is protected by special seals and filled with grease. The bearing is designed so that it does not require further lubrication. The intermediate supports with grease cups must be lubricated at the same time as the spline joint.

Maintainable cardan shafts that have been stored for more than six months before commissioning should be lubricated with grease before first use.

The grease cups must not be coated with substances other than those approved by the manufacturer, and no substances (such as water, air, etc.) or solvents should be applied to the grease cups.

3.1 Greases

The cardan shaft must be lubricated with oils in accordance with cold, normal or hot climatic conditions, according to the Table:

Table 3.1

Specific Property	Climatic conditions				
	Arctic climate	Cold climate		Temperate climate	
Temperature range	-60/+100 °C	-40/+180 °C	-45/+130 °C	-30/+150 °C	-20/+150 °C
Viscosity	Lithium Complex	Polyurea	Lithium Complex	Lithium Complex	Lithium Complex
NLGI Grade	1-2	2	2	2	2
Penetration	280/310 (Pw60/DIN ISO 2137)	280 (DIN ISO 2137)	max.40 (Pw 60 / DIN ISO 2137)	265-295 (Pw60/DIN ISO 2137)	265-295 (25°C ASTM-D217)
Drop point	>180 °C (IP 396)	>260 °C (DIN ISO 2176)	>180 °C (IP 396)	> 250°C (IP 396)	min. 250 °C (ASTM-D 2265)
Recommended greases	*FUCHS RENOLIT S2*	*FUCHS LUBRITECH URETHYN XHD2*	*FUCHS GLEITMO 585-K*	*FUCHS RENOLIT LX-PEP2*	*SHELL GADUS S3 V220 C2*

For other recommended greases, check the company standard number ÜRG.TL.00116.

Greases with different viscosity types should never be mixed with each other during the lubrication. Use only lithium complex grease with NLGI Grade-2. MoS2 (molybdenum disulfide) additives must not be used.

3.2 Lubrication intervals

Cardan shafts must be lubricated at the standard intervals indicated in the table below or at the nearest appropriate vehicle inspection period with a grease approved by the company.

Table 3.2

Operation Type		Lubrication Intervals
		Cross-Piece and Spline Joint
Commercial Carriers	**Long Distances** (Mileage of 80,000 km or more per year)	50,000 km 6 months
	Mixed (Mileage of 20,000-80,000 km per year.)	25,000 km 6 months
	City (Mileage of 20,000-80,000 km per year.)	25,000 km 3 months
	Off-road / Construction (Mileage of 20,000 km or less per year.)	12,500 km 3 months
Buses	**Long Distances** (Mileage of 100,000 km or more per year)	50,000 km 6 months
	Mixed (Mileage of 100,000 km or less per year.)	25,000 km 6 months
	City (Mileage of 100,000 km or less per year.)	25,000 km 3 months

* Valid for mileage or deadline.

(Valid only for maintainable cardan shafts.)

For better performance, it is recommended to reduce the cardan shaft lubrication intervals for vehicles operating in hot environments.

It is intended to use a serviced cross-piece for amphibious vehicles designed for the defense industry or special purpose vehicles. In such applications, after each amphibious operation, it is necessary to lubricate the grease using the greases listed in **Table 3.1** to flush out liquids that may have leaked into the cross-piece grease.

4. Repair

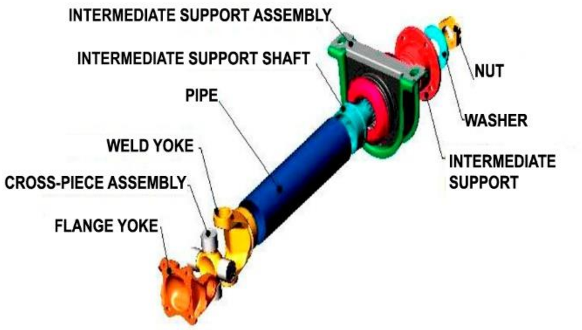
Cardan shafts manufactured by the company must be repaired only in authorized service centers of the vehicle or in other service centers that are authorized by the company. Any interventions and repairs by unauthorized service centers will void the warranty. Repairs must be carried out using only original spare parts.

When assembling and disassembling the cardan shaft on the vehicle, all the instructions prescribed in this technical documentation must be observed. Before repairs, cardan shafts must not be cleaned with high-pressure water or steam jets. When cleaning, do not use corrosive cleaners or solvents.

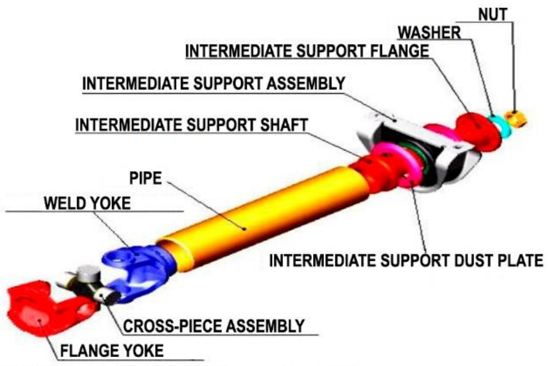
When painting a cardan shaft on a vehicle, make sure that the Rilsan coated parts and all seals are protected from the paint. All modifications (changing the wheelbase, installing a retarder, changing or modifying a gearbox or differential, increasing the vehicle weight or engine power, etc.) made on the vehicle change the load on the cardan shaft. With such changes, written permission from the company should be taken and all changes should be made in authorized services.

5. Cardan shaft components

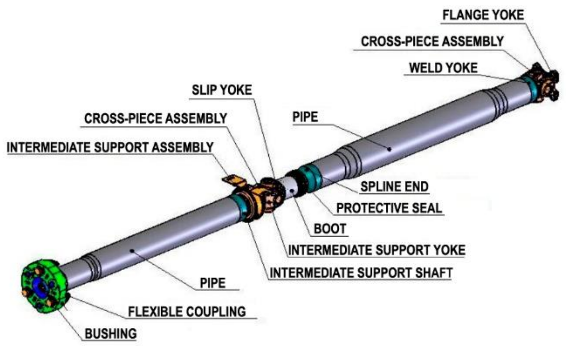
SAE SERIES - SHAFT WITH INTERMEDIATE SUPPORT (FS)



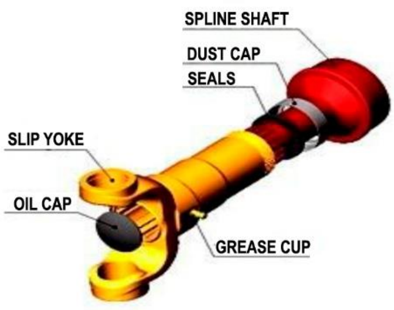
DIN SERIES (WITH FACE SPLINES) - SHAFT WITH INTERMEDIATE SUPPOR



TWO-SHAFT CARDAN DRIVE -(TW) IA –(TW)



SPLINE JOINT - SAE (SA)



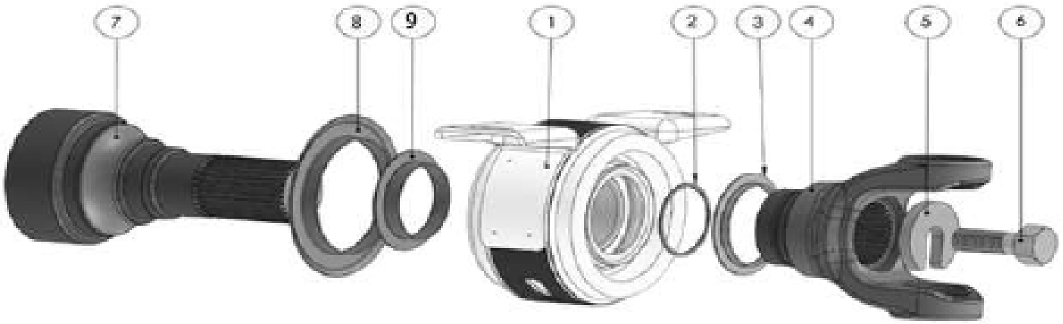
MAINTENANCE

INTERMEDIATE SUPPORT
(KIT CB.04022.09.99) REPLACEMENT
INSTRUCTIONS FOR SERVICE CENTERS

Date of issue: 08.06.2020
Revision: 1

MAINTENANCE

Intermediate support kit contents
CB.04022.09.99



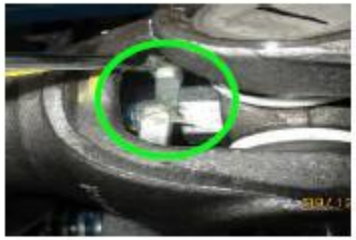
1. Intermediate support:CB.04022.09.02	6. Bolt: BL.00000.34.02
2. Washer: WA.00000.32.02	7. Intermediate support shaft: not Included
3. Dirt deflector: FL.03517.03.02	
4. Intermediate support yoke: not Included	8. Dirt deflector: FL.01350.02.02
5. U-shaped washer:WA.00000.26.02	9. Dirt deflector: FL.04022.03.02

MAINTENANCE

Intermediate group disassembly

1 - Mark mutually spaced arrows on the intermediate support shaft (7) and on the intermediate support yoke (4).

2 - Loosen the bolt (6).



3 - Release the U-shaped washer (5) from its place using the special tool.

MAINTENANCE

Intermediate group disassembly

4 - Remove the U-shaped washer (5).

5 - Remove the intermediate support yoke (4) from the intermediate support shaft spline (7).

6 - Loosen the bolt (6) to the end.

MAINTENANCE

Intermediate group disassembly

7 - Insert the bearing puller onto the intermediate support shaft (7) from the pipe side.

8 - Remove the intermediate support (1) from the intermediate support shaft (7) using a bearing puller, which should press on the intermediate support (1) from the pipe side.

9 - Release the U-shaped washer (5) from its place using the special tool.

MAINTENANCE

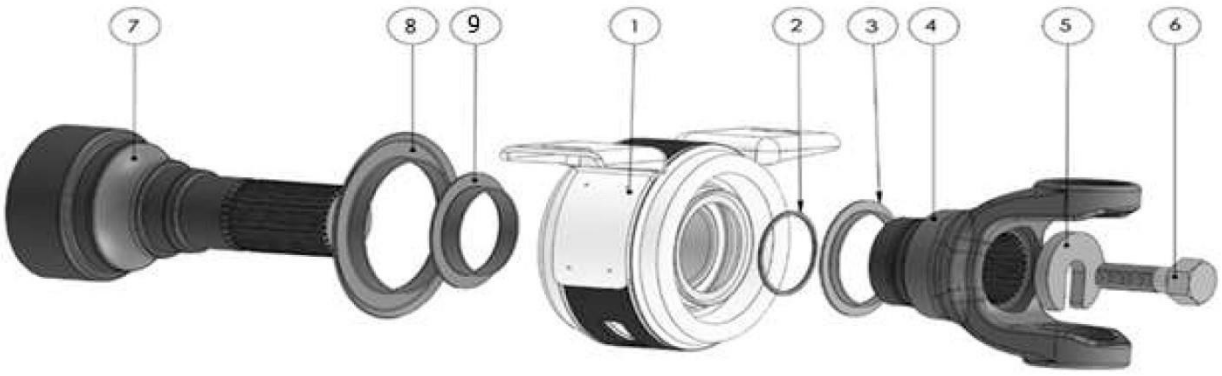
Intermediate group disassembly

10 - If the dirt deflector (8) is not damaged when dismantling the intermediate group, it is possible not to remove the dirt deflector (8).

11 - Remove the washer (2) at the intermediate support yoke (4).

MAINTENANCE

Replacement of consumable spare parts



1. Intermediate support: Replace
2. Washer: Replace
3. Dirt deflector: Replace
4. Intermediate support yoke: Non-replaceable
5. U-shaped washer: Replace
6. Bolt: Replace
7. Intermediate support shaft: Non-replaceable
8. Dirt deflector: Optional

MAINTENANCE

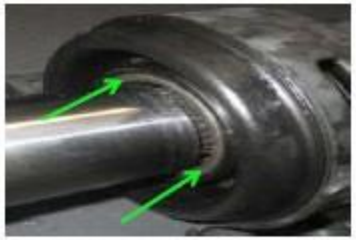
Intermediate group assembly

1 - Both sides of the intermediate support (1) must be lubricated with FUCHS RENOLIT CX EP2 grease or equivalent.

2 - Replace the dirt deflectors (3) from the intermediate support shaft and intermediate support yoke.

MAINTENANCE

Intermediate group assembly



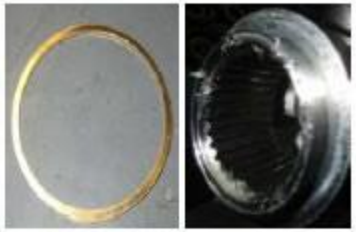
3 - Insert either side of the intermediate support (1) into the intermediate support shaft (7).

4 - Install the intermediate support (1) on the intermediate support shaft (7) using a special tool, which should press on the bearing inner race. It is proposed to use a hydraulic or pneumatic press. Impacts on the bearing race can cause damage to the bearing.

MAINTENANCE

Intermediate group assembly

5 - Install the bolt (6) on the intermediate support shaft (7) so that 4-5 threads remain unscrewed.



6 - Apply grease to the intermediate support yoke (4) as shown in the photo.

7 - Install the washer (2) on the defined area on the intermediate support yoke (4).

MAINTENANCE

Intermediate group assembly

8 - Install the intermediate support yoke (4) onto the intermediate support shaft (7) so that the marked arrows are opposite each other.

9 - Install the U-shaped (5) washer on the bolt (6).

10 - Tighten the bolt (6) with a torque wrench to 100 ± 10 Nm.

11. BALANCING INSTRUCTIONS

The assembled cardan shaft must be dynamically balanced according to the balancing instructions:

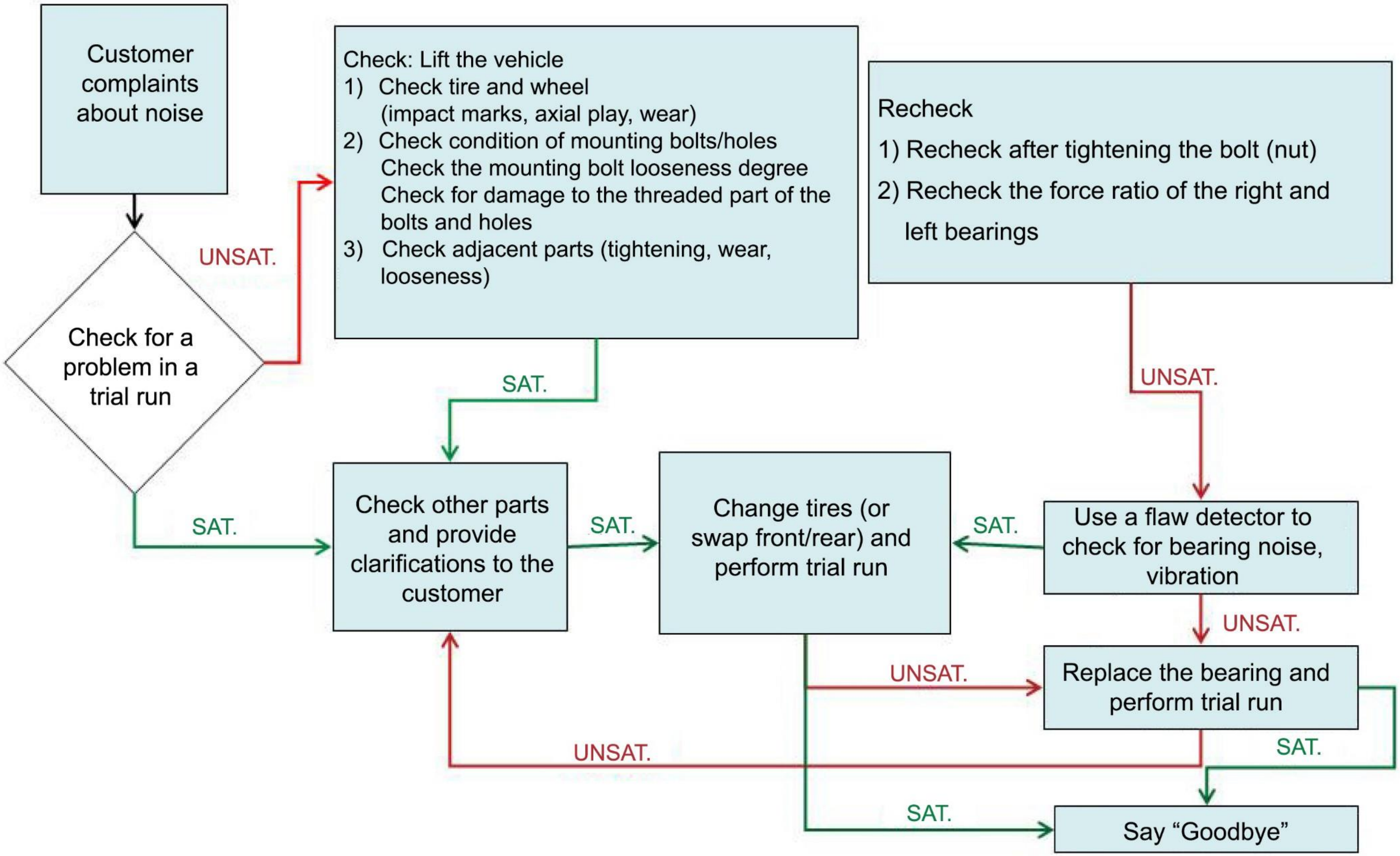
- Rotation frequency: 5000 rpm
- The cardan drive is fixed in 3 places.
- The measurement is made in 3 planes (from the pivot side of the front shaft FS, and from 2 sides of the rear shaft RS).
- The maximum residual unbalance at any re-installation is max. 20 g·cm in each balancing area.
- The number of plates in each balancing plane is not more than 3 pcs.

9.7. Operation manual. Front hub bearing

Operation manual

Front hub bearing

Wheel hub bearing service



Operation manual - Control methods for detecting possible bearing malfunctions

Trial tun - bearing noise while driving

- vehicle speed 40 - 60 km/h (use high gears to reduce engine noise)

- when driving at higher speeds, it is difficult to check for bearing noise because the vehicle makes other sounds (vehicle noise, wind noise, tire rolling noise, etc.)

- if a hum is heard from under the body while driving straight and on a turn, this may indicate a malfunction of the bearing raceways and rollers (for example, pitting corrosion)

Manual turning test

- Roller bearing rotation monitoring is a function-oriented procedure for assessing the free movement and noiselessness of bearings,

- When turning the bearings by hand, they must move freely, they must not be moved jerkily.

- This test can also be used to determine if a bearing friction test needs to be performed.

Noise check

- Check the bearing for noise with a flaw detector by turning it by hand

- Clicks may indicate a malfunction of the bearing raceways and rollers (e.g., pitting corrosion).

Manual check of friction force in bearings

Check procedure:

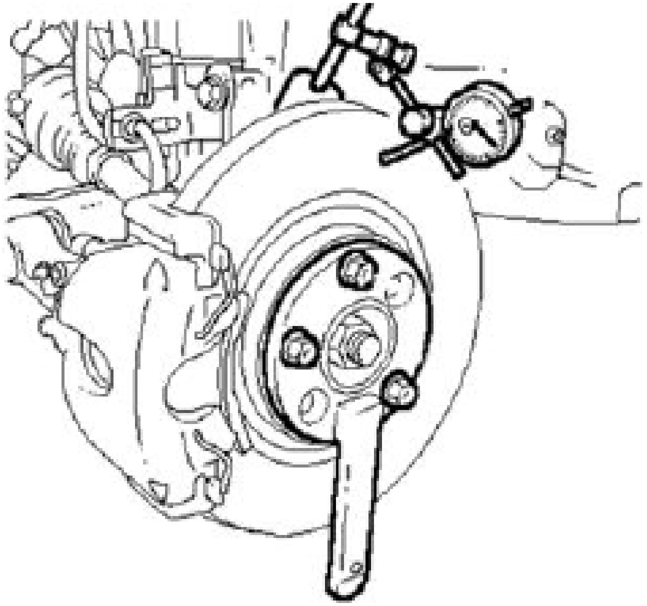
- measure the distance between the studs (pitch circle diameter 170 mm)
- fasten the appropriate dynamometer to the hub studs
- pull the dynamometer before the rotation starts and record the applied force
- calculate the bearing friction torque using the formula M= F x ½ PCD

Criteria:

- bearing friction torque greater than the specified value of 5 Nm can indicate various bearing malfunctions (corrosion, contamination, foreign particles)
- very low bearing friction torque indicates a loss of bearing preload (bearing play); it is necessary to check the lateral oscillation (rolling) of the bearing

Bearing lateral oscillation measurement

Lateral oscillation of the bearing can be checked manually beforehand. If signs of transverse oscillation are found, accurate measurements must be taken.



Check procedure:

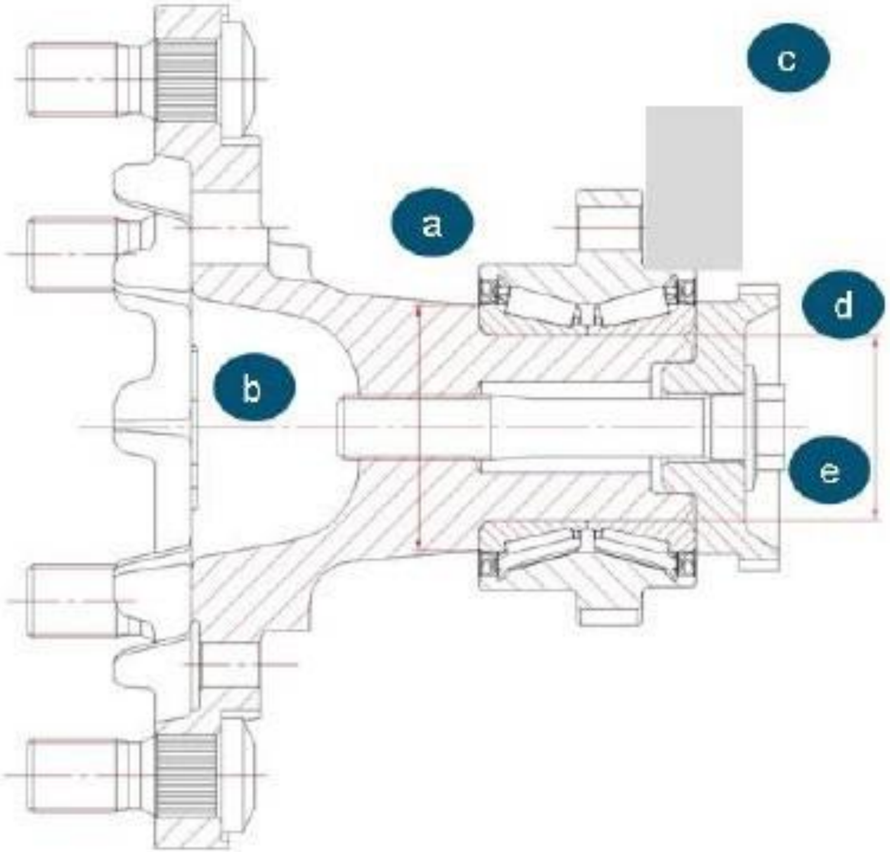
- install a 500 mm lever on the hub
- fix the dial indicator on the fracture line using a magnetic base
- position the dial indicator on the brake disc at a diameter of 200 mm (flat surface)
- check for lateral oscillation of the bearing by slightly moving the lever (approx. 30 kg)

Criteria:

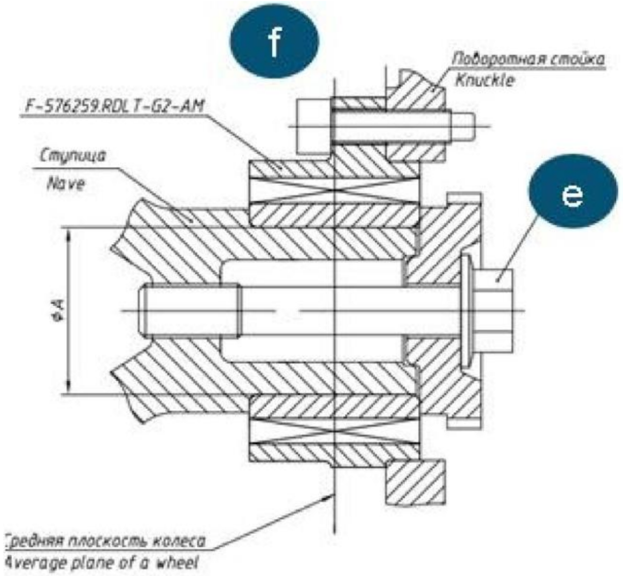
- maximum bearing lateral oscillation of 0.050 mm is allowed
- greater lateral oscillation of the bearing is the preload loss result
- due to weakening of the compressive load or malfunction of internal parts (raceway, roller)

Operation manual –
Bearing replacement

Front hub assembly diagram and parts list

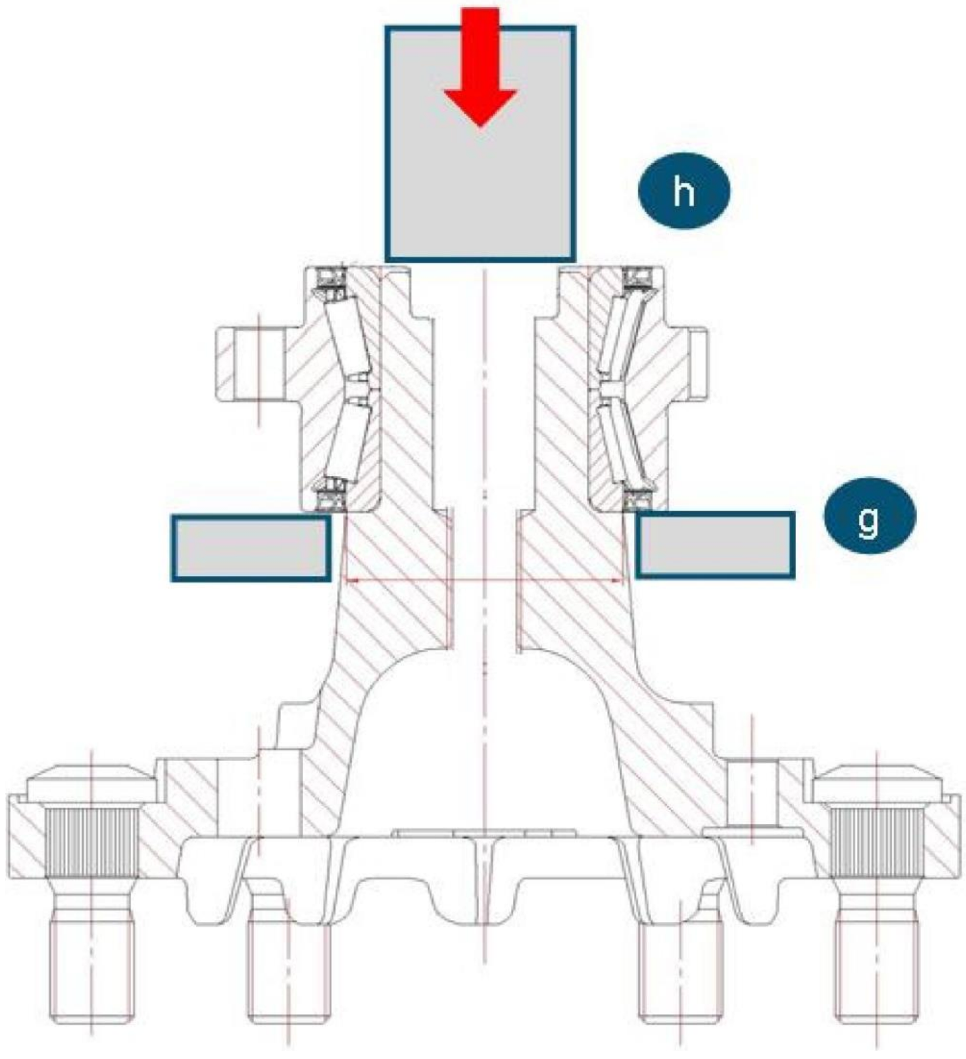


a. Wheel hub bearing
b. Hub
c. Rotary bracket
d. ABS sensor ring or adapter
e. Tie bolt
f. Draw bolt 5 pcs.; M10x6g



Dismantling

1) Remove the wheel
2) Remove the brake caliper (it may not be necessary to remove the brake disc from the hub)
2) Remove bolt [f]
3) Separate the hub with bearing assembly
4) Loosen bolt [e] with pneumatic tool, min. torque 410 Nm
5) Remove the ABS ring or adapter [d]
6) Press the hub out of the assembly using the bearing pulley [g] and the clamping mandrel [h]
7) Replace the bearing

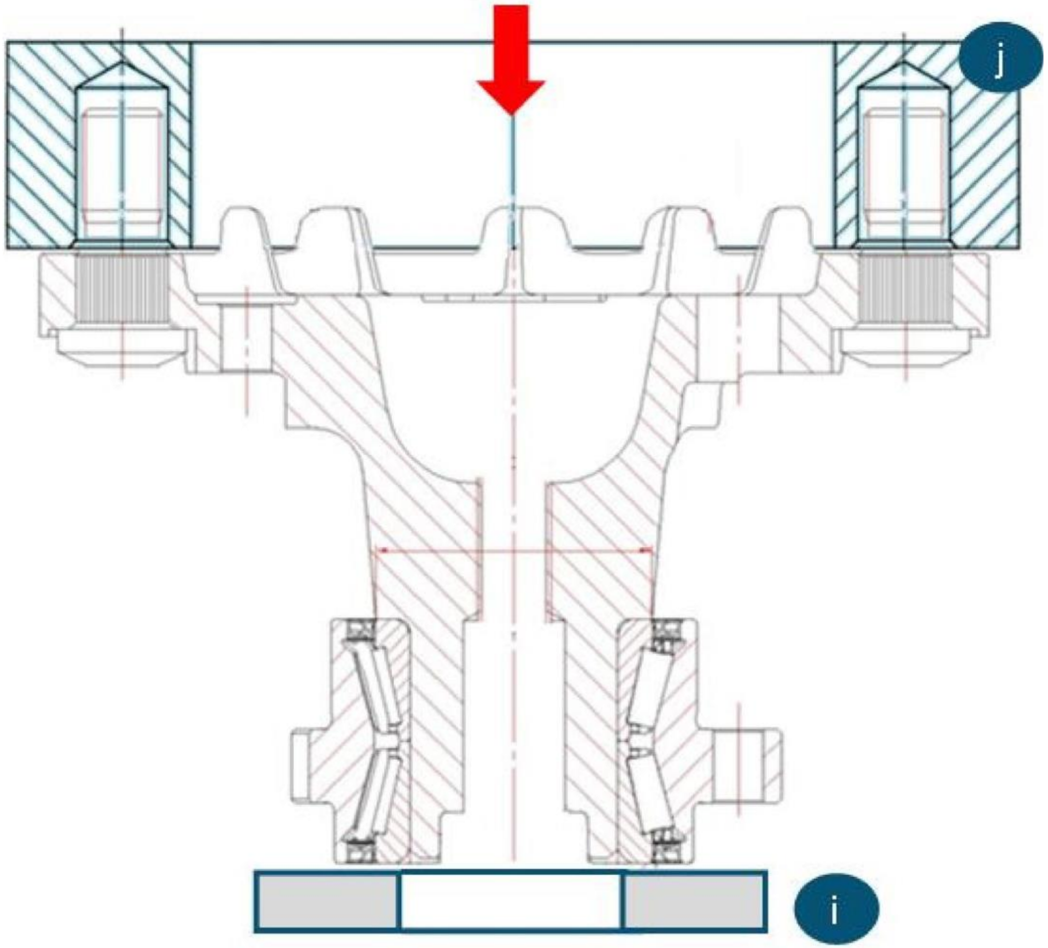


g. Bearing pulleys (two parts)

h. Clamping mandrel: Ø 48.5 mm (max.) x 55 mm (min.)

Assembly

8) Press the bearing into the hub using the bearing pulley [i] and the clamping mandrel [j]
9) Install the ABS ring or adapter [d]
10) Tighten the bearing hub assembly with the bolt [e] Torque: 274—314 Nm; rotate the bearing or hub while tightening
11) Install the hub assembly on the pivot [c]
12) Tighten bolt [f] Torque: 52-59 Nm
13) Install the brake caliper
14) Install the wheel

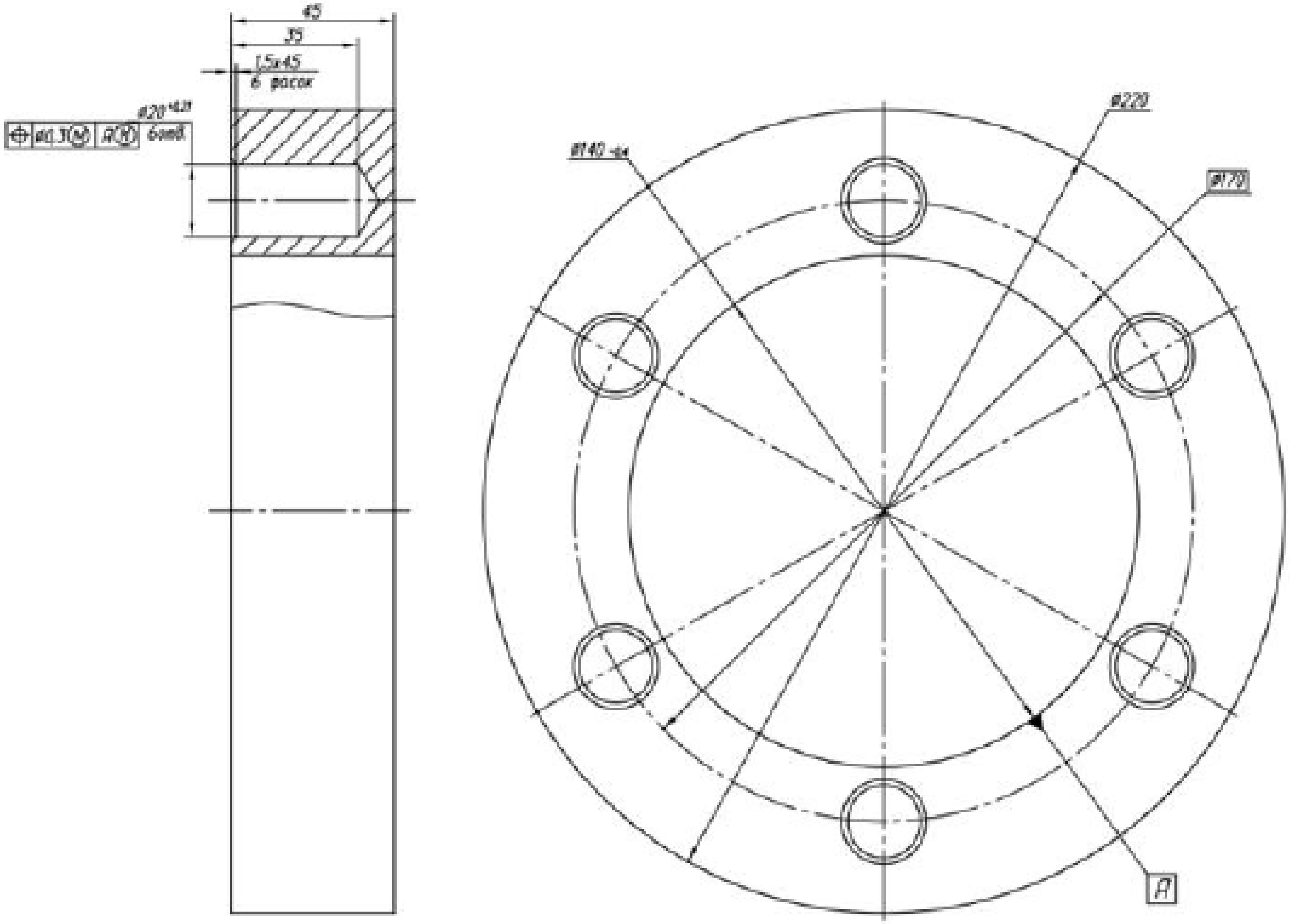


i. Bearing pulley (ring or flat plate)

j. Clamping mandrel (see drawing on next page)

Assembly

Clamping mandrel [j] for bearing assembly



Sketch of washer for pressing hub into bearing

9.8. Shock absorbers. Operation manuals

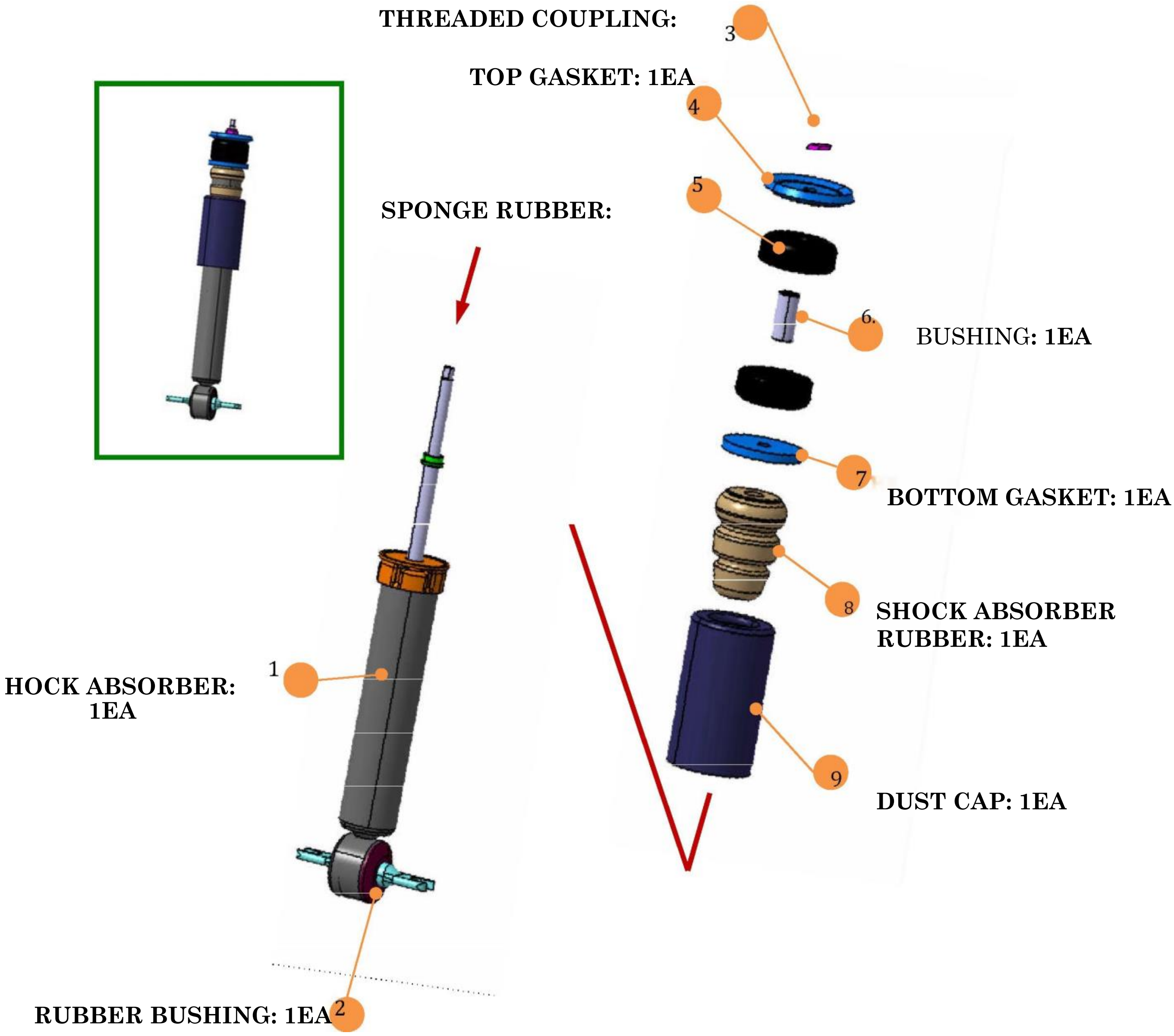
SHOCK ABSORBER
Operation manual

Suspension Engineering Center

Table of Contents

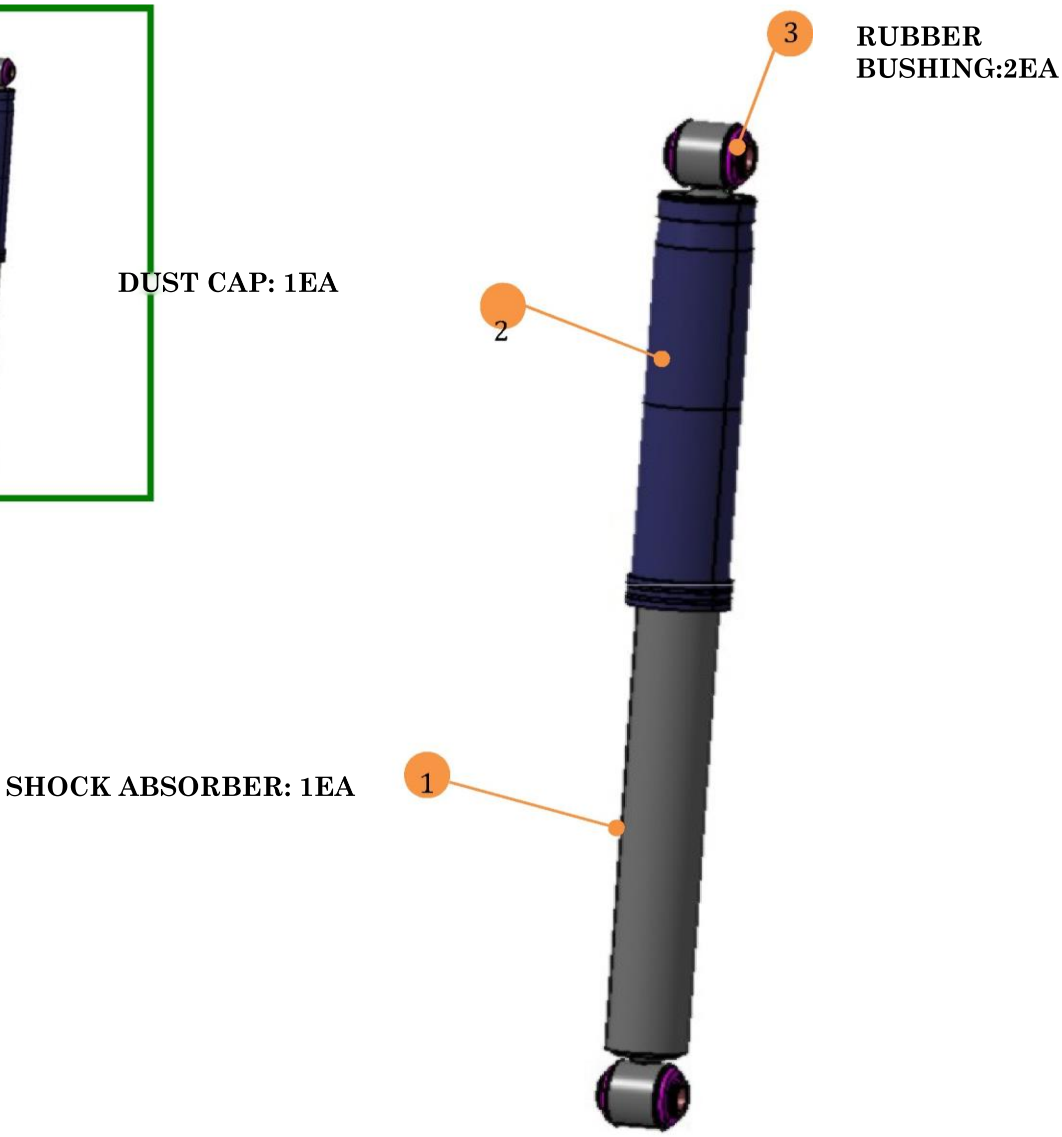
1. Visual material list

FRONT SHOCK ABSORBER

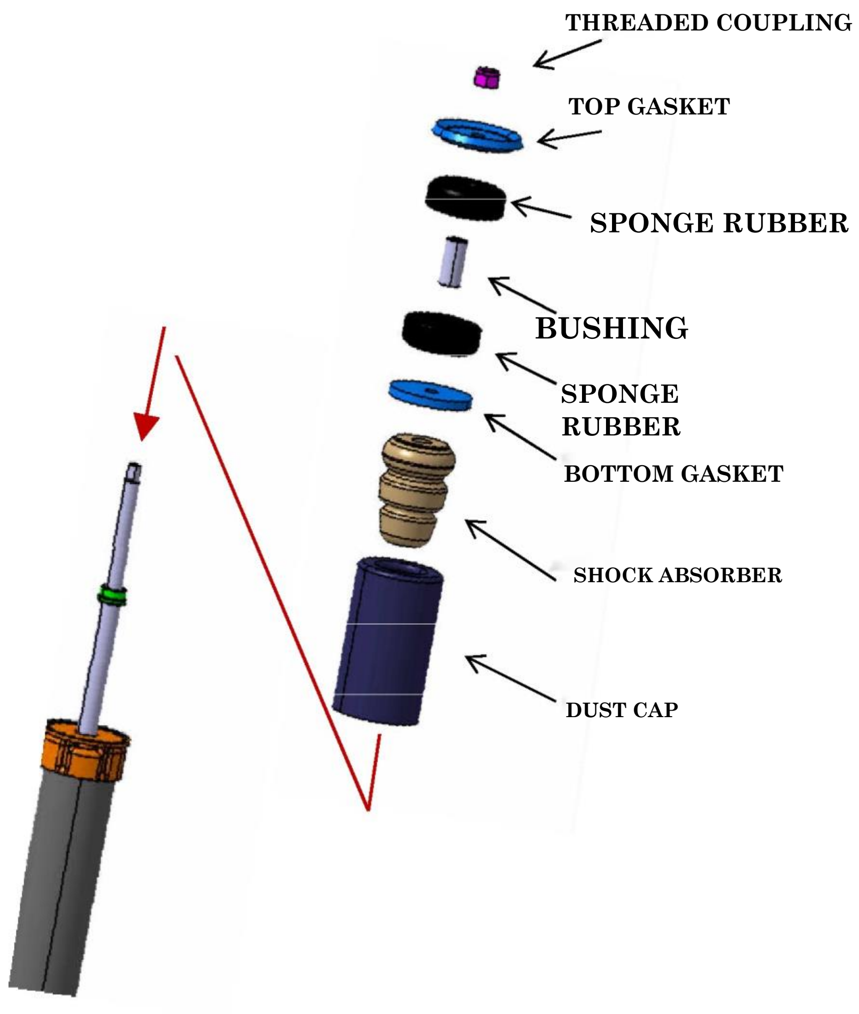


1. Visual material list

REAR SHOCK ABSORBER

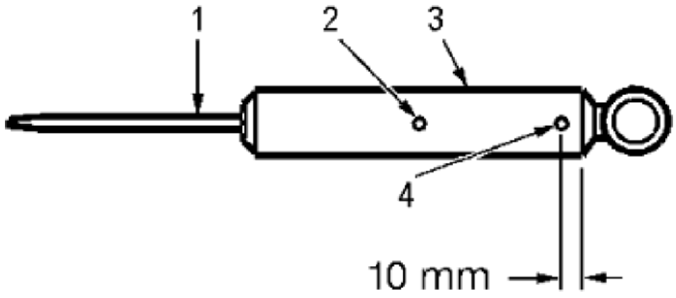


2. REPAIR PARTS KIT

DESIGNATION	QTY	COMPONENT DESCRIPTION
REPAIR PARTS KIT	1 SET	

3. Shock absorber decommissioning

Caution: To avoid physical injury, wear and do not remove protective goggles when punching and drilling the shock absorber. Be careful not to puncture the shock absorber tube with the center punch.



1. Make a mark at a distance of 10 mm from the lower edge (4) of the tube (3) using a center punch.

2. Fix the shock absorber with the fully extended rod (1) horizontally in the clamping device.

3. Drill a hole in the shock absorber at the mark (4) with a center punch using a 5 mm drill bit. When the drill penetrates the shock absorber, gas or a mixture of gas and oil will be released. Use shop towels to clean up leaked oil.

4. Make a mark in the middle (2) of the tube (3) with a center punch.

5. Drill a second hole in the shock absorber at the mark (2) with a center punch using a 5 mm drill bit. When the drill penetrates the shock absorber, gas or a mixture of gas and oil will be released. Use shop towels to clean up leaked oil.

6. Remove shock absorber from clamping device. Hold shock absorber horizontally with holes down over oil pan. Insert and remove the rod (1) from the tube (3) several times to remove any remaining oil from the shock absorber.

4. Service manual and specifications

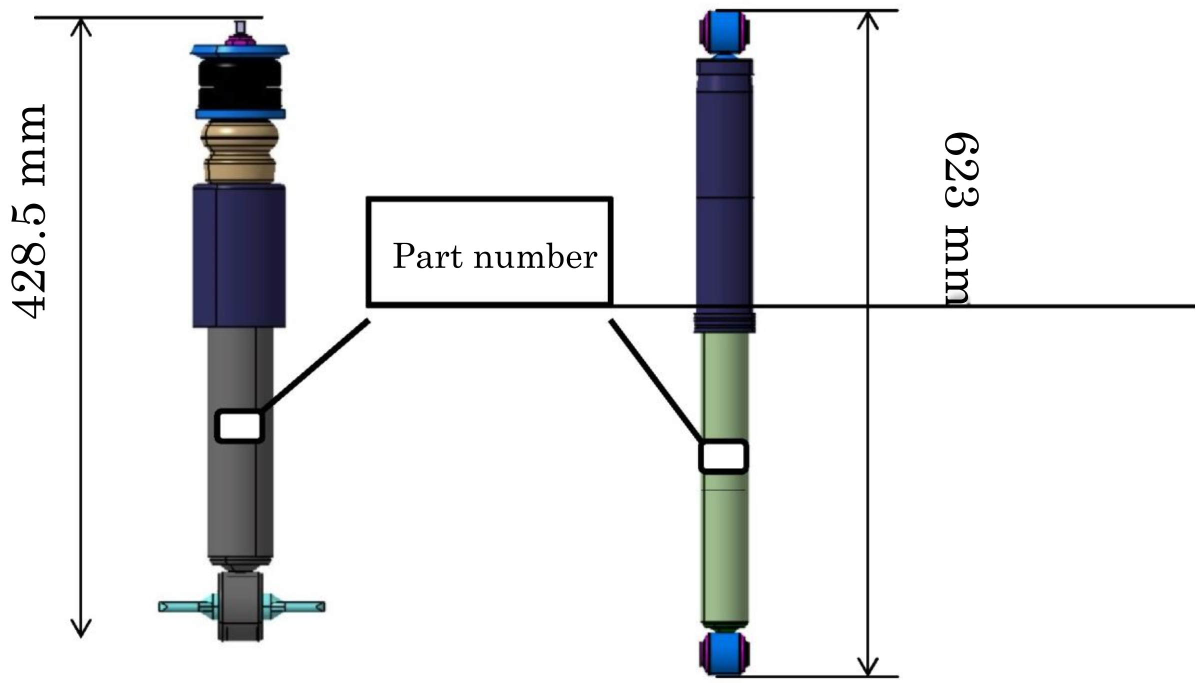
1) Service manual

- The shock absorber must properly pull and push the attached devices.

2) Specifications

- Check the part number on the shock absorber.
- Check the maximum length of the shock absorber.

□ A21R23.2905004 (front shock absorber) □ A21R23.2915004 (rear shock absorber)



	Front	Rear shock absorber
Part number	A21R23.2905004	A21R23.2915004

5. Possible malfunctions and detection methods

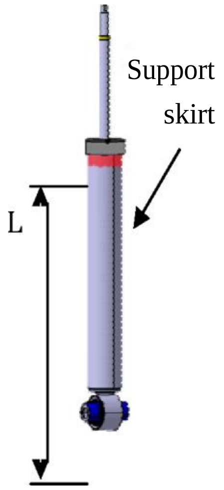
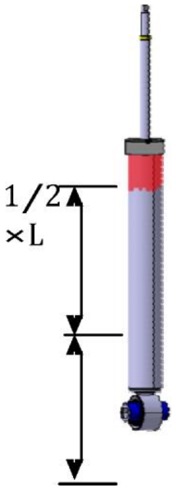
1) External damage

- Oil leakage from the shock absorber

* Possible causes

□ Damage to internal parts caused by sand or dust

□ Damage to internal or external parts due to vehicle collision, accident or impact.

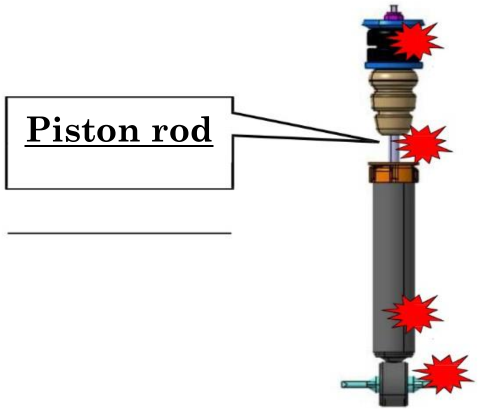
<table>
<tr><td></td><td colspan="2">Normal</td><td colspan="2">Oil leak</td></tr>
<tr><td rowspan="3">Condition</td><td colspan="2">• There is no need to replace the shock absorber</td><td colspan="2">• Shock absorber needs to be replaced</td></tr>
<tr><td colspan="2">• 1, 2: Oil covers less than 1/2xL of the support skirt length from the top
(L : support skirt length)</td><td colspan="2">• 3: Oil flows out
• 4: Oil covers the entire support skirt surface</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>Figure</td><td>
</td><td>
</td><td></td><td></td></tr>
</table>

In case 1) it may be necessary to replace the shock absorber with a serviceable one.

6. Parameters for determining serviceable and faulty shock absorbers

1) Check by external signs

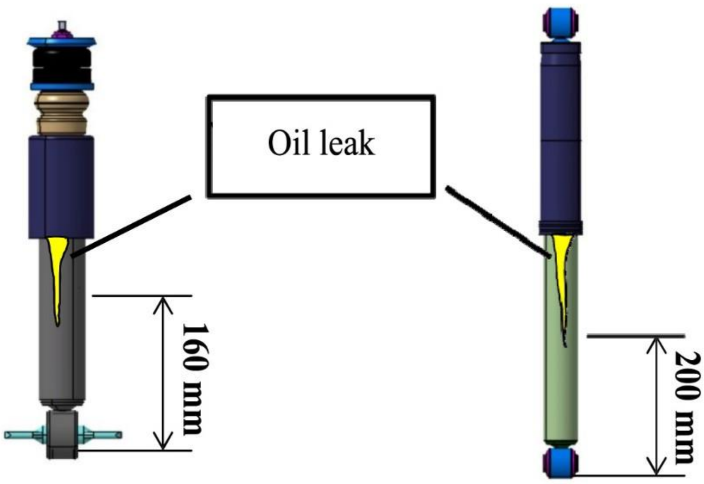
□ The shock absorber, especially the piston rod, must be free of nicks and damage



□ Oil leak

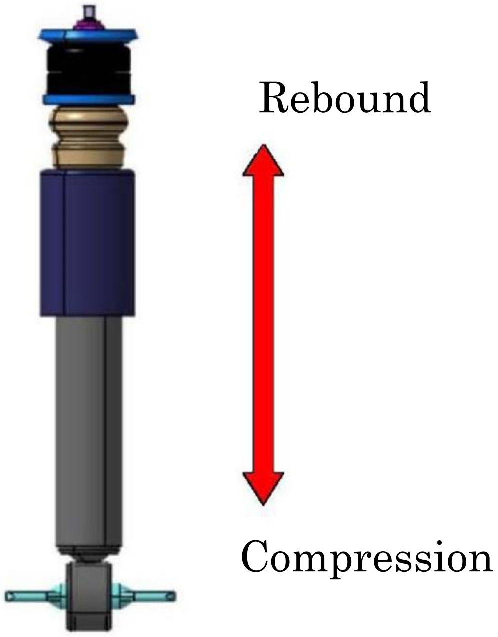
- The shock absorber is faulty if the leaked oil covers more than half of the shock absorber body

Front shock absorber Rear shock absorber



2) Operability

The shock absorber rod should move smoothly with a noticeable effort throughout its entire stroke. When moving the rod, there should be no knocks, squeals and jamming throughout the entire length of the full stroke with any relative rotation of the moving parts.


Rebound
Compression

7. Parts usability check

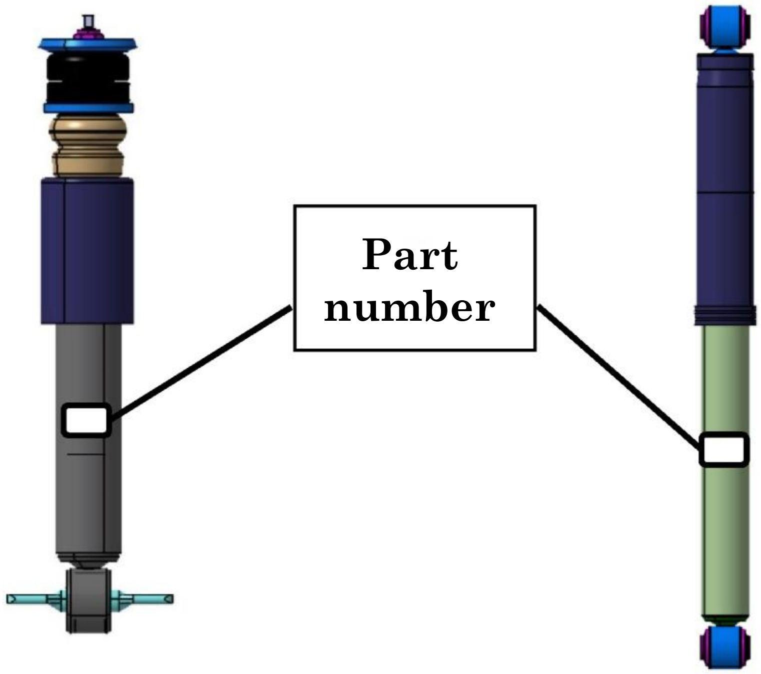
1) Check the shock absorber part number

□A21R23.2905004

(front shock absorber)

□A21R23.2915004(RR)

(rear shock absorber)



	Front	Rear shock absorber
Part number	A21R23.2905004	A21R23.2915004

2) When replacing the shock absorber, make sure that the part number matches.

Shock absorber malfunction detection instructions

Customer:

Part number and customer information:

- A31R32.2905004
- A31R32.2915004
- C40R13.2905004-02
- C40R13.2915004-02
-

Revision 2
Date: 30.04.2020
Total pages: 7

- **General notes on evaluating warranty claims for shock absorbers.**

1. It is necessary to provide the ability to trace the binding of each shock absorber to a specific vehicle (by chassis number, warranty start date, etc.) This information must be provided with each faulty shock absorber.

2. The warranty start date for the shock absorber will be determined based on the vehicle warranty period

3. Faulty shock absorbers must have the following information on them: FS logo, tracking number and part number. This information must be affixed to the shock absorber body or the warranty will be void **(Fig. 1)**.

4. Damage to the shock absorber rod surface during the warranty period is atypical (subject to paragraph 5 of section 1), otherwise shock absorber fluid will leak.
Note: Scratches on the rod surface can occur as a result of improper adjustment of the suspension angles, in particular the toe angle and camber angle, and are not a defect

- **How to investigate and verify warranty claims for shock absorbers**

5. Obvious defects, such as deformation of the shock absorber body and rod **(Fig. 3)**, damage to sealing parts by external objects, change of connecting parts relative to their original state, deformation of the rod thread **(Fig. 4)**, cutting, welding, etc., are not included in the warranty.
    - Point 1: deformation of the rod surface caused by external objects (for example, by the wrench impact during assembly) **(Fig. 5)** is not covered by the warranty if it causes oil leakage.
    - Point 2: deformation and rupture of the oil seal by external objects, which leads to leakage, is not included in the warranty. **(Fig. 6)**

6. In case of a shock absorber claim due to a performance problem (no leakage, no mechanical noise, etc.), its damping force must be tested according to Table 1 (Test speed: front and rear and super-frame bus: 0.3 m/s)

- Point 1: the damping force test should not be carried out on a shock absorber with rod sticking.
- Point 2: the damping force test must be done before the oil leakage test.

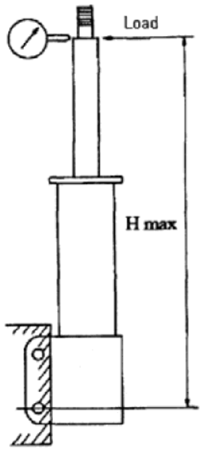
Full name	(Ref.) No.	Drawing Rebound Force (kgf)		Drawing Comp. Force (kgf)		Acceptable change in damping force during warranty %	Rebound force with acceptable change (kgf)		Comp. Force with acceptable change (kgf)	
Vehicle/Van Front	A31R32.2905004	522	682	170	240	20%	417	818	136	288
Vehicle/Van Rear	A31R32.2915004	250	330	115	165		200	396	92	198
Front	C40R13.2905004-02	263.5	346.5	136.5	193.5		211	416	109	232
Rear	C40R13.2915004-02	209.5	276.5	65	95		167.5	332	52	114
Super-Frame Bus Rear	A68R52.2915004-01	170	255	90	134		136	306	72	161

Table 1

7. Abnormal operation of a shock absorber during a manual test is confirmed as a defect if:
   - Damping force tester confirms the shock absorber damping force problem and
   - After the shock absorber is cut off, there is no effect of the impact on the shock absorber bottom valve. **(Fig. 7)**

8. A shock absorber rod sticking is confirmed as a defect, unless the sticking is caused by an unusual external impact that causes the shock absorber to deform.

9. The shock absorber rod radial play is confirmed as a defect if it results in oil leakage. The allowable radial displacement of the rod is 2 mm when a load of 5 kgf is applied to the rod at maximum rebound, as shown in the figure below.



10. The damper rod is quickly moved up and down by hand (about 25 mm) and checked for abnormal mechanical noise. Mechanical noise (e.g., rattling, clanging...) is confirmed as a defect. However, a whistling sound caused by oil flowing through the valves is normal and not a defect.

11. Shock absorber knocking during operation is confirmed as a defect if the change in shock absorber damping force is outside the range specified in Table 1.

12. A crack in the rubber mount (Fig. 8) is confirmed as a defect, and only this part (not the entire shock absorber) needs to be replaced by a service station.

13. Normal deformation of the rubber bushing (Fig. 9) in assembly mode is not a defect.

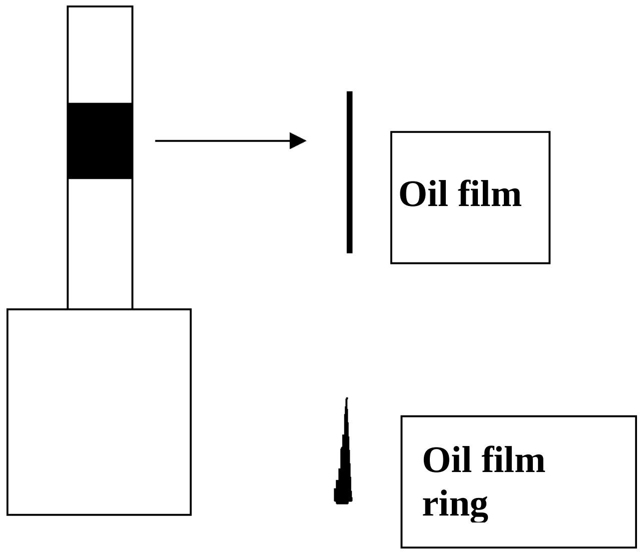
- **Shock absorber oil leakage check criteria**

Test conditions: Frequency 4Hz, stroke length: Lavg ± 25 mm. The leak test is carried out as follows after the shock absorber has been running for 4 minutes.

Definition

- Oil film: There are oil residues on the rod in the form of a thin oil film. No oil leakage on the rod is observed

- Oil film ring. The oil film ring is visible to the naked eye, with oil leakage due to the formation of an excess oil film.



<u>Score</u>

Status	PROCESS	Description
Oil leak	T1	Oil leakage on the rod
Small leak	T2	Oil film ring remains on the rod or an oil film is longer than 5 mm
Large oil film	T3	Oil film ring remains on the rod or an oil film is from 1 to 5 mm
Light oil film	T4	Oil film ring remains on the rod or an oil film is shorter than 1 mm
No oil film	T5	No oil film ring or oil film on the rod

Level T3 and above (i.e., T4 and T5) are acceptable

APPENDIX

Fig. 1.

Fig. 2.

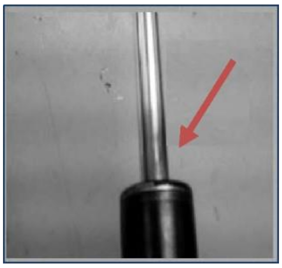


Fig. 3.

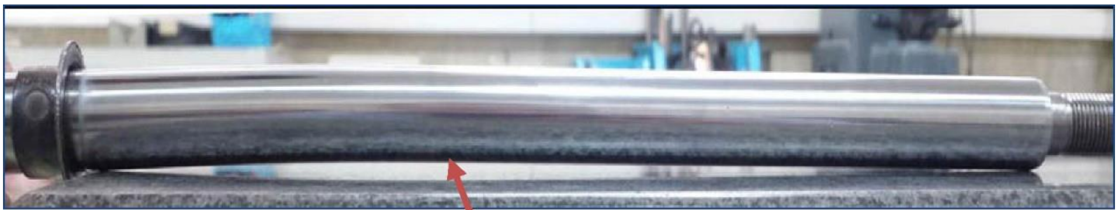


Fig. 4.

Fig. 5.

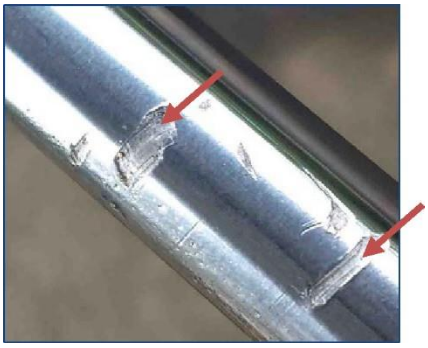


Fig. 6.

Fig. 7.

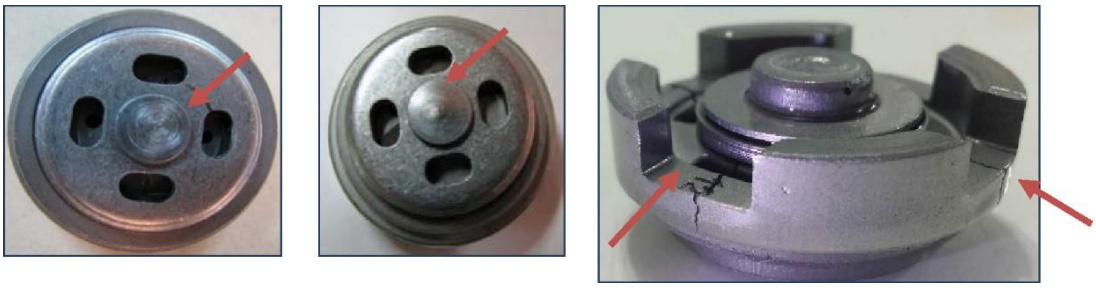


Fig. 8.

Fig. 9.

General disassembly and assembly instructions and precautions

Part number and customer information:

- **-**
  A31R32.2905004
- **A31R32.2915004**
- **C40R13.2905004-02**
- **C40R13.2915004-02**

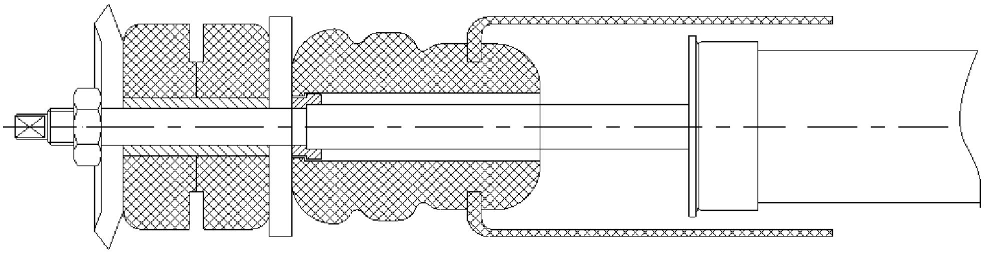
Revision: 1

Date: 30.04.2020

Total pages: 5

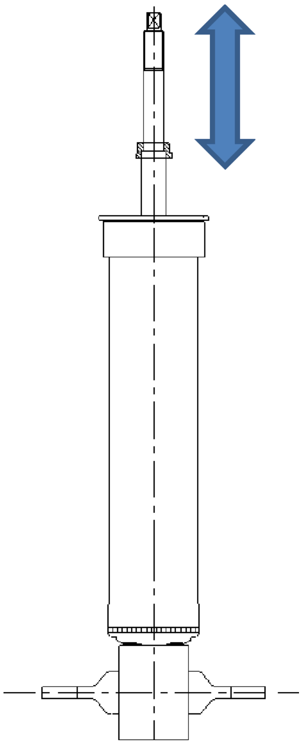
Assembly precautions:

1. Washers and bushings should be replaced in the order shown below.
   Make sure the bushings and washers are in the correct orientation.



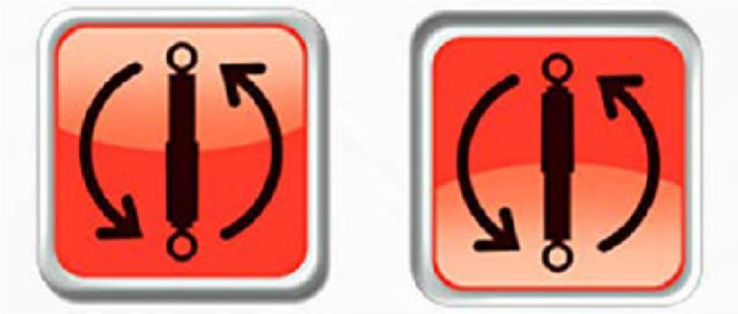
Correct mount direction

2. To properly replace shock absorbers, the new shock absorber must be vented before installation. To do this, it is necessary to move the piston rod back and forth several times in the working direction. This will allow separate the gas from the hydraulic fluid.



3. The fasteners must be tightened to the torque specified in the vehicle manufacturer's instructions. This will ensure proper bushing compression (flex) for normal shock absorber movement in either direction.

4. When assembling the rear shock absorber, be careful to determine the correct assembly direction.



X

√

Wrong direction

Correct direction

5. Installing shock absorbers under tensile stress, or overtightening the mounting nuts, may cause deformation of the shock absorber or bushings. To prevent excessive expansion of the material due to excessive torque, please note that impact wrenches are generally not acceptable for this work.
   When using an impact wrench, use it until you get close to the desired position, then use a hand tool to obtain the final tightening torque.

6. Tightening the shock absorbers (to the specified tightening torque) can only be done after the vehicle is on the wheels or when the wheels are pressed upwards, for example with a hydraulic jack. Cause: the attachment points on the vehicle will not align properly until the vehicle is on the ground.

7. After installing a new shock absorber, the suspension angles should be re-checked for axle alignment. Then conduct a test drive to check the suspension system for correct operation.

Environmental protection and disposal of shock absorbers:

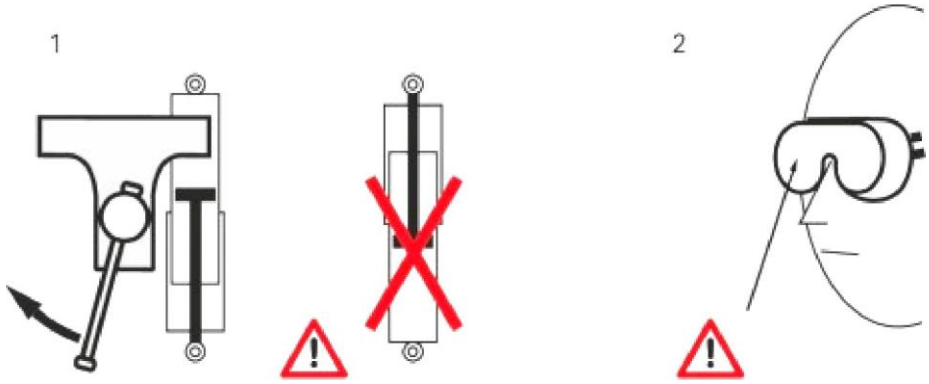
General notes:

- Never open shock absorbers and do not heat them!
- The tank tube may burst and the oil in it may leak out. There is pressure inside the gas shock absorbers.

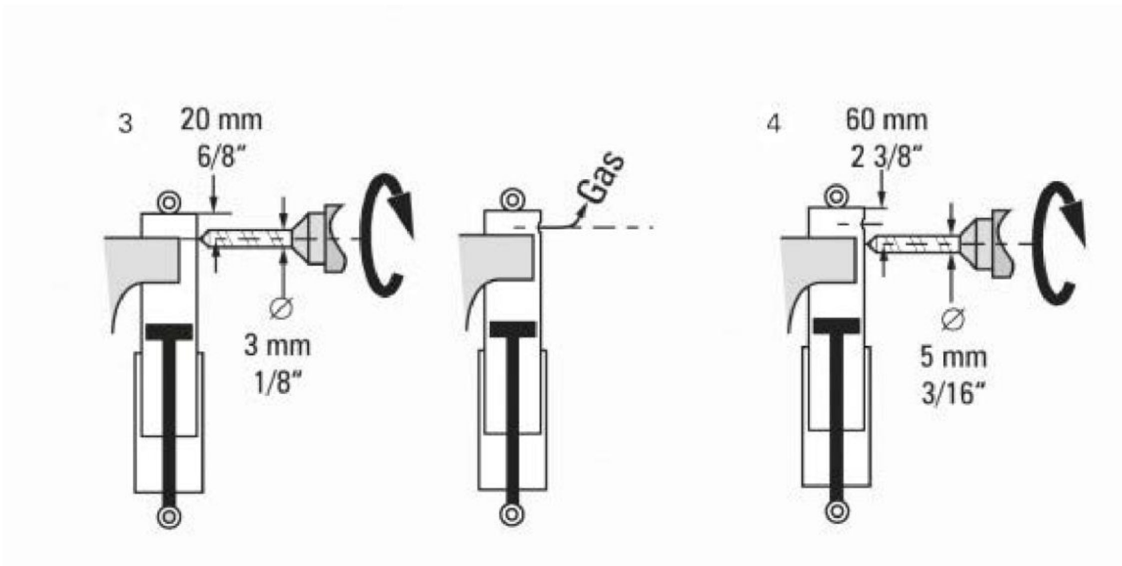
Shock absorbers must not be disposed of without proper precautions, including in domestic waste bins!

- Shock absorbers contain mineral oil, which will cause serious damage to the environment if it gets into the soil, ground water, etc.

To safely dispose of the shock absorber, follow these steps:

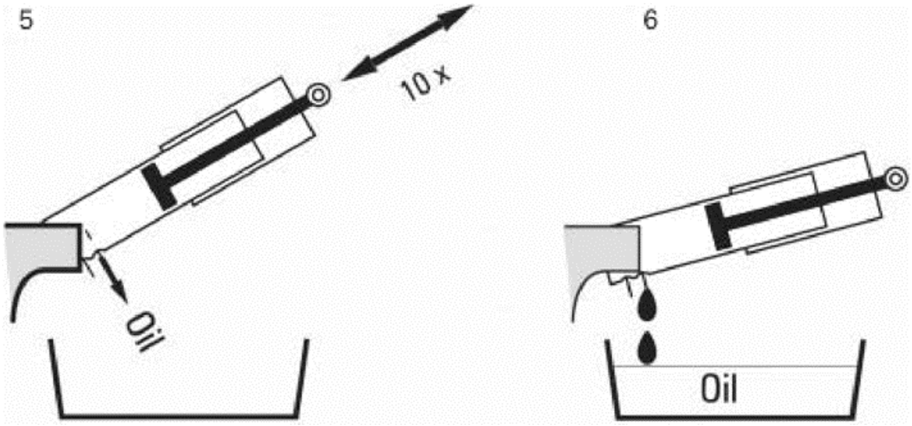


1. Clamp the shock absorber in a vise with the piston rod pointing down.
2. Wear safety goggles.

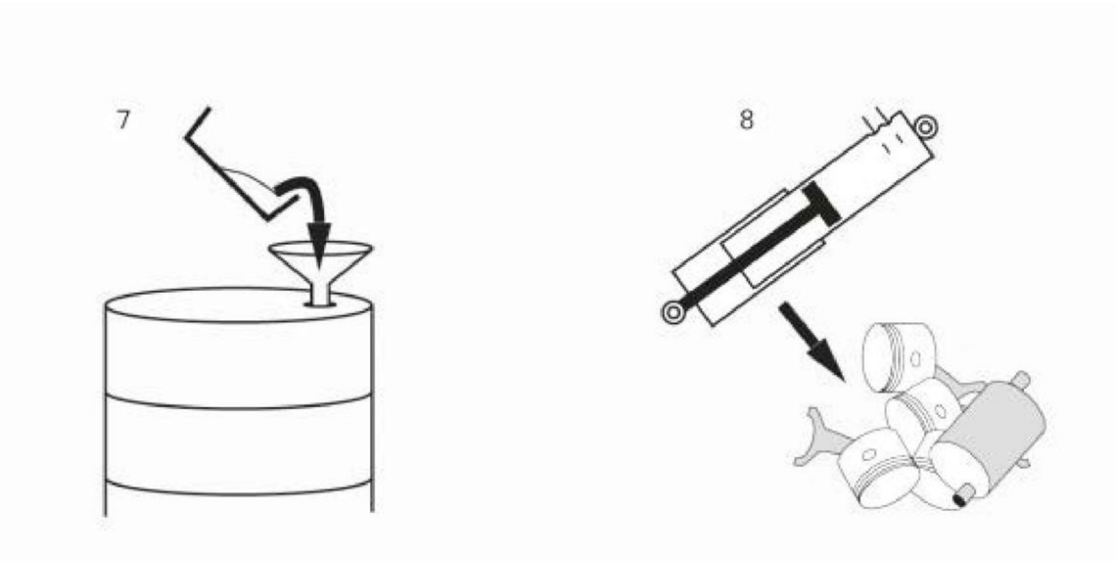


3. Due to the presence of gas pressure in the shock absorber, first drill a hole in the gas cylinder (approx. 0 3 mm) and let the gas out.

4. Drill a hole in the oil chamber (Ø 5 mm).



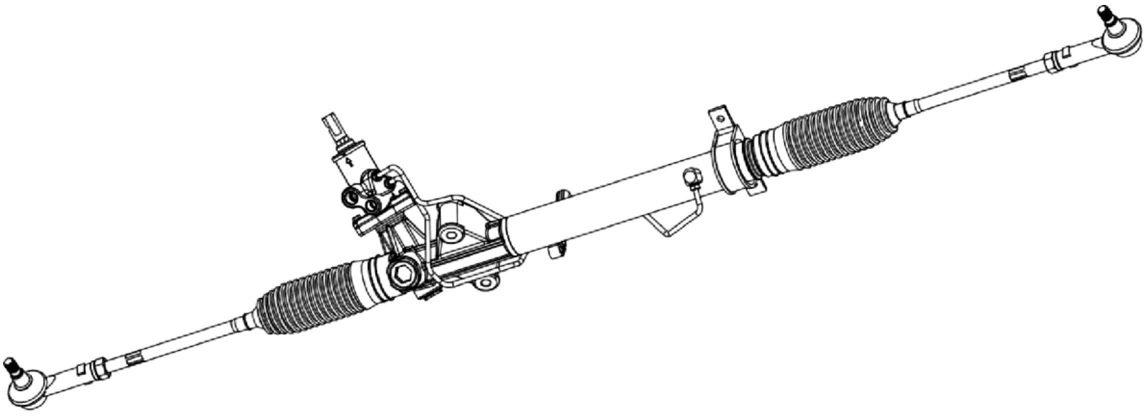
5. Drain the oil into a suitable container.
6. Let the oil drain completely.



7. Dispose of the oil in a special waste oil container.
8. Dispose of the empty shock absorber as scrap metal.

9.9. Hydraulic rack and pinion steering gear Yubei CD4U Maintenance manual

Hydraulic rack and pinion steering gear Yubei CD4U Maintenance manual

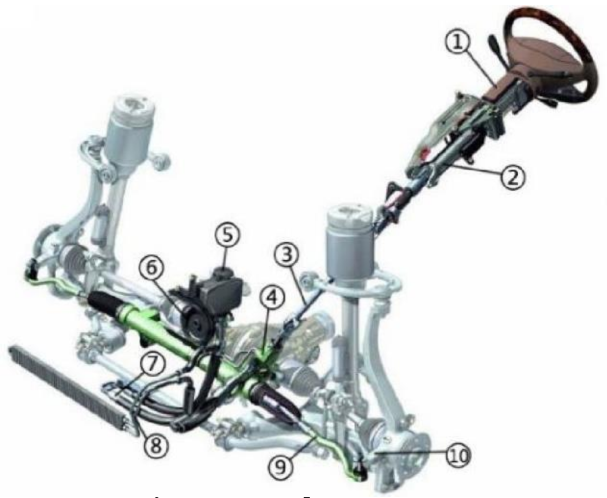


2020.04

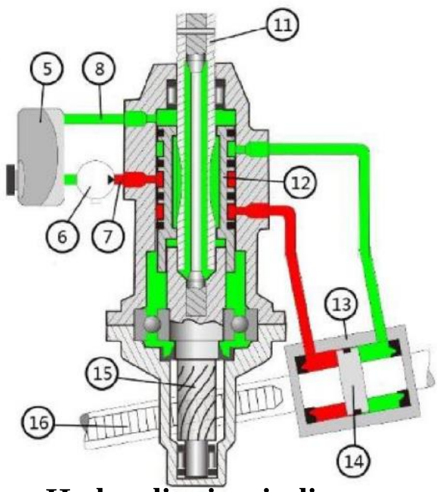
Table of Contents

1. Steering gear operation principle

As shown in the figure, when turning, the driver turns the steering wheel (1), transmits the rotation to the input shaft (11) of the HRP (rack and pinion gear) (4), the rotation moves the rack by engaging the gear (15) with the rack (16), the rack movement drives the tie rod (9), which turns the steering knuckle, thereby ensuring the turning of the steered wheels. At the same time, the power steering system works as follows: the hydraulic fluid tank (5) is connected to a hydraulic pump (6), which through the high-pressure oil line (7) supplies hydraulic fluid to the steering gear at the appropriate flow rate. The steering gear control valve (12) controls the hydraulic fluid flow and direction. The control valve shaft opens a channel for fluid to enter one of the cavities of the hydraulic cylinder (13), setting the piston (14) in motion. The fluid presses on the piston with the rod, due to which the steering rack moves and the wheels turn. The fluid from the second cavity of the hydraulic cylinder through the control valve enters the low-pressure drain line (8) and then into the tank.



Steering system layout



Hydraulic circuit diagram

Table of main steering parameters

The main steering parameters are given in the table. This data can be referred to when repairing or checking the system.

1	Steering gear model	CD4U
2	Stroke	160 mm
3	Ratio	47.78
4	Number of turns	3.35
5	Maximum operating pressure	11.3 MPa
6	Oil pump flow rate	8.5 l/min.
7	Ambient temperature	-40°C~+120°C
8	Theoretical output force	13.5 kN
9	Hydraulic cylinder inner diameter	Ø48 mm
10	Rack diameter	Ø28 mm
11	Tie rod tightening torque	78~98 N.m
12	Hex nut pre-tightening torque	5~10 N.m

3. Maintenance inspection instructions

Maintenance inspection elements

1. Visual inspection: check steering system components for bending, aging, wear, or damage to rubber and plastic parts. Replace damaged parts if necessary;

2. Inspection of fasteners in the steering system: including steering bolt set bolt, steering

bolt and intermediate shaft connecting bolt, tie rod inner hex nut, tie rod outer tightening nut, etc. Parts supplied loose must be tightened to the specified maintenance torque

3. Straightness check: check total steering RPM, center steering by half RPM, and continue to fine tune middle indicator pointer on steering dust cap and indicator pointer on valve body. The arrows must be aligned so as to confirm that the vehicle is in a straight position;

4. Check the clearance between components: make sure that the steering wheel, steering column, intermediate shaft and steering wheel, and other components have clearance when steering. If clearances are not within specifications, perform maintenance to correct discrepancies;

5. External leak check: start the engine and check for power steering fluid leakage from the hydraulic system. In the presence of external leakage, it is necessary to check the joints and fastenings, as well as the seal integrity. If necessary, replace parts to eliminate external leakage;

6. Check the level in the hydraulic fluid tank and make sure it is clean: when starting the engine, the fluid level in the power steering tank should be between the MAX and MIN marks. If the level is low, it is recommended to top up the power steering fluid. If when checking the power steering fluid level in the tank, or when changing the power steering fluid, there are clear signs of foreign objects in the tank, or signs of the hydraulic fluid contamination, it is recommended to replace the tank and power steering fluid;

Note:

1. If it is necessary to top up the power steering fluid for maintenance or other reasons, the specified type of power steering fluid must be used, power steering fluid other than those specified must not be used or mixed with other fluids. Failure to comply with this requirement may result in problems such as seal failure.

2. It is recommended to change the power steering fluid every 20,000 km. When changing the power steering fluid, use only the specified fluid type.

3. The steering wheel must not be in the extreme position for more than 10 seconds to avoid damage to the power steering fluid pump.

4. Issues to be considered when replacing the steering system: ① avoid injury from impact; ② keep the steering system clean and free of foreign objects; ③ mark the position of the corresponding parts in the assembly before disassembly to avoid incorrect installation.

5. The steering system is designed for a certain load on the vehicle front axle, so it is strictly forbidden to overload the vehicle, as this will reduce the power of the hydraulic booster and make steering difficult.

6. A collision may damage the steering gear. Timely check the steering gear for cracks and proper working condition. If necessary, contact the specified service stations for inspection, otherwise it may lead to steering failure.

4. Power steering fluid change

If the steering gear, pump are replaced, if foreign matter is found in the hydraulic fluid, or if the hydraulic fluid is contaminated, it must be changed.

Oil drain

Jack up the front wheels and disconnect the inlet and return branch pipes. Start the engine for about 10 seconds and turn the steering wheel all the way from one end to the other to drain the used fluid. Reinstall the inlet and return branch pipes, tighten the connecting clamps to ensure the joint tightness.

2. Oil filling

Fill with hydraulic fluid in accordance with the equipment manufacturer’s instructions. Add the fluid into the tank until the fluid level reaches 1 cm above the MAX mark. Then start the engine and turn the steering wheel all the way from one extreme position to another until the bubbling of fluid in the tank stops. Add fluid to a level between the MAX and MIN marks on the tank, then close the tank cap.

5. Power steering tank replacement

With a large number of foreign inclusions and contaminants in the hydraulic fluid, resulting in filter clogging, as a result of which the filter capacity of the power steering tank does not correspond to the oil consumption, it is necessary to replace the power steering tank. Replacing the tank is similar to changing the hydraulic fluid, except that after draining the oil, the old tank must be removed and a new tank installed.

6. Steering gear replacement

In the event of such malfunctions in the steering gear operation as breakage, deformation, cracks, oil leakage, etc., the steering gear must be dismantled and replaced as follows:

1. Set the steering wheel to the vehicle straight movement position and dismantle all components and pipelines of the vehicle that may interfere with the steering gear dismantling and installation;

2. Jack up the front wheels and disconnect the inlet and return branch pipes of the steering gear. Start the engine for about 10 seconds and turn the steering wheel all the way from one end to the other to drain the used fluid.

3. Loosen the connecting bolt between the steering gear and the intermediate shaft, tighten the outer tie rod nut and disconnect the intermediate shaft, wheels and steering gear from each other.

4. Unscrew the bolts securing the steering gear to the frame and remove the steering gear;

5. Check whether the installed steering gear is in the middle position (the index arrow on the steering gear dustproof casing is aligned with the arrow cast on the control valve housing);

6. Place the steering gear on the frame and set the steering wheel to the vehicle straight movement position. Connect the intermediate shaft and wheel to the input shaft and steering gear outer ball joint and tighten the fasteners to the torque specified by the vehicle manufacturer.

7. Connect the high and low pressure branch pipes to the steering gear and tighten the clamps to the torque specified by the vehicle manufacturer.

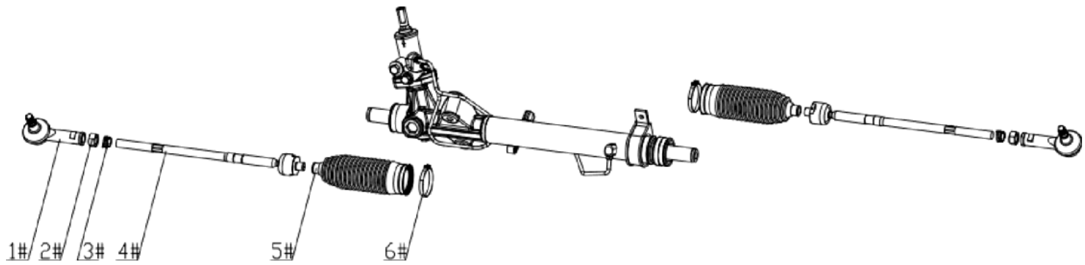
8. Perform the fluid filling operation in accordance with paragraph 4 of this manual. After filling the hydraulic fluid, make sure that the entire steering system has no oil leakage.

7. Spare parts replacement

In order to reduce maintenance costs, if abnormalities such as tie rod bending and damage to the protective bushing in the steering gear are found, only faulty parts such as the tie rod or protective bushing can be replaced. Dismantling steps:

1. Dismount the steering gear from the vehicle. See paragraph 6 of this manual for detailed instructions.

2. Loosen the hex nut (part 2#) on the inner tie rod, dismantle the dimensional clamp (part 3#, 6#) at both ends of the steering gear, and dismantle the outer tie rod (part 1#), hex nut (part 2#), inner tie rod (part 4#) and protective bushing (part 5#). The detail diagram is shown below. Please note that when removing the inner tie rod from the steering gear, the steering gear must be supported and fixed.



After the dismantling of the faulty parts is completed, the corresponding parts are installed on the steering gear. Installation steps:

1. Apply thread fixing adhesive to the threads of the inner tie rod, then tighten the inner tie rod and rack to a tightening torque of 78 ~ 98 N×m. Grease is applied to the groove where the protective bushing is installed on the inner tie rod. Go to the new large chuck, install the protective insert, close the small chuck, and then close the large chuck. After the large chuck is closed, the distance between the clamped parts must be less than 3mm in order to ensure the clamped position.

2. Install the hex nut and outer ball joint to approximately the same position as before disassembly, and tighten the hex nut to a pre-tightening torque of 5 ~ 10 N×m. The final tightening is carried out in accordance with the tightening torque provided by the vehicle assembly factory after adjusting the front beam of the entire vehicle.

8. Diagnostics of main steering malfunctions

Item No.	Symptoms	Possible cause	Remedy
1	When driving, the vehicle drifts (carry out a test drive on a level surface, taking into account road conditions and wind strength)	(1) incorrect position of the front wheels. (2) control valve misalignment. Note: in this case, there is too little force on the steering wheel in the direction of deviation, and the force applied in the opposite direction is normal or increased.	(1) adjustment according to the instructions. (2) replace the steering gear.
2	When the steering wheel is turned sharply to the left or right, there is an instant increase in steering force.	(1) low hydraulic fluid level. (2) oil pump drive belt is slipping. (3) excessive leakage in the oil pump. (4) excess head generated by the steering gear.	(1) add hydraulic fluid as needed. (2) tighten or replace the belt. (3) replace the pump. (4) replace the steering gear.

3	The steering wheel vibrates or vibrates when the engine is running, especially when the steering wheel is at rest.	(1) low hydraulic fluid level. (2) loose the hydraulic fluid pump drive belt. (3) insufficient hydraulic fluid pump pressure. (4) hydraulic fluid pump flow control valve stuck.	(1) top up the hydraulic fluid as needed. (2) adjust the voltage according to requirements. (3) replace the pump. (4) replace the pump.
4	Too high backward or turning play of the steering wheel	(1) air in the steering gear. (2) free steering.	(1) Exhaust gases. Check the tightening torque of the hose clamps and retighten if necessary. (2) Tighten the bolt to the specified tightening torque.
5	Power steering fluid forms a foamy emulsion	When mixed with air.	When mixed with exhaust gases. Check the tightening torque of the hose clamps and retighten if necessary.

6	Slow steering response	(1) Loose steering gear fastening bolt (2) too high steering gear engagement clearance (3) worn tie rod ball pins (4) worn steering knuckle and bushings (5) incorrect wheel bearing adjustment (6) incorrect front wheel alignment (insufficient kingpin tilt back or in, too much front beam tilt)	(1) tighten the bolt (2) adjust the clearance (3) adjust or replace the tie rod end (4) replace the bushing (5) adjust the bearing (6) check and adjust the positioning parameters

9.10. Steering column and cardan shaft

Maintenance and repair documentation

A21 R23.3401100-20 - Steering column

23/08/2021

Index

Description of parts and product design

Steering column - component that:

- Connects the steering wheel to the intermediate shaft assembly (ESP system)
- Transmits rotation from the steering wheel
- Holds the steering wheel and other vehicle components (switches, casing, etc.)

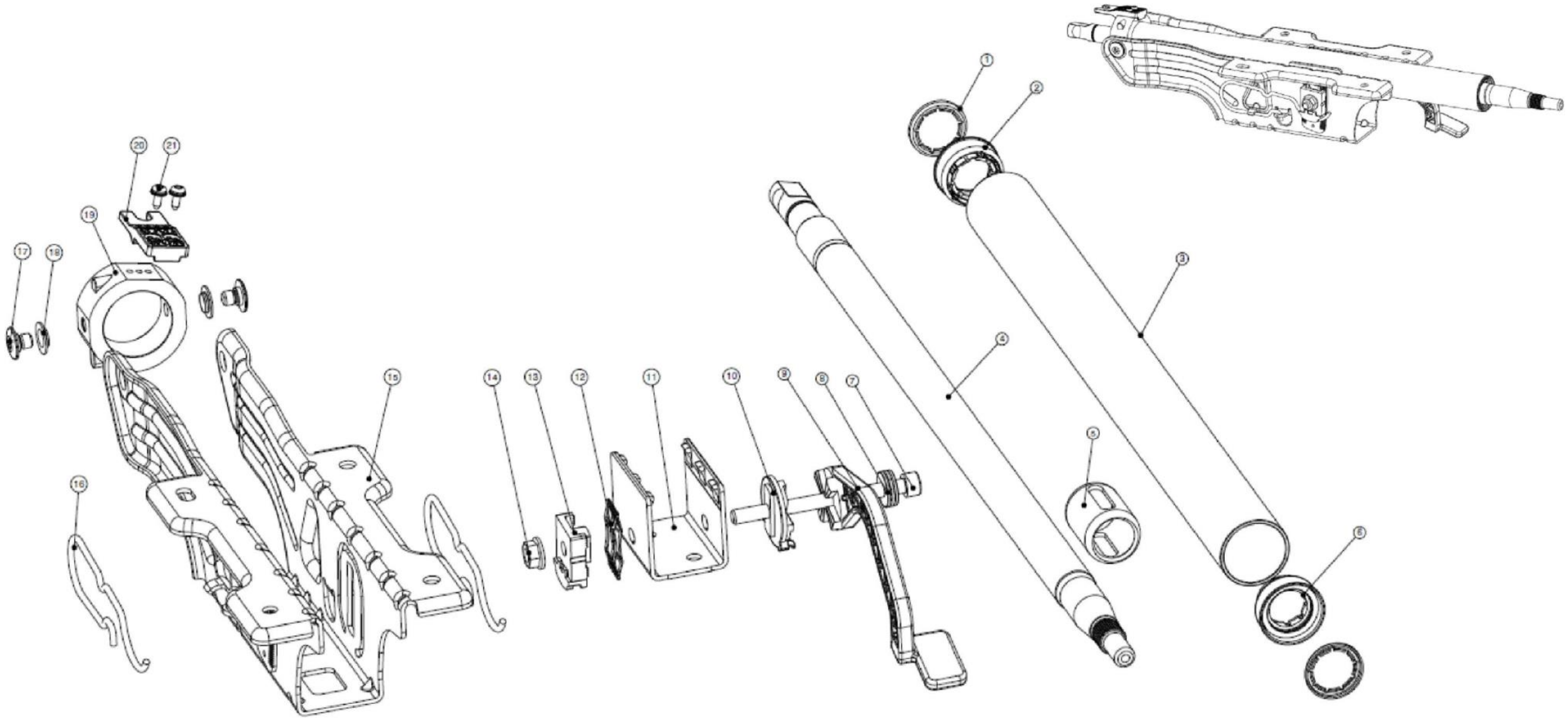
This component is considered a safety element in the vehicle, and in the event of a breakdown or repair, it should be replaced with a completely new part in the first place.

Attempting to adjust or repair a safety element may violate the vehicle’s legal requirements for driver safety and cause permanent damage to the driver.

Assemblies must be replaced by an authorized service center.

Description of parts and product design

01 - Bearing retainer
02 - Lower bearing
03 - Column tube
04 - Column shaft
05 - Anti-theft bushing
06 - Upper bearing
07 - Bolt
08 - Lever bearing
09 - Lever
10 - Eccentric washer
11 - Tube bracket
12 - Spacer spring
13 - Adjustment guides
14 - Nut
15 - Carrier bracket
16 - Spring
17 - Plastic washer
18 - Pivot screw
19 - Axial bearing
20 - Locking plate
21 - Screw M4



Recommended spare parts list

Since the steering column is a safety element, it must be considered as a single piece. The only way to ensure that parts work well is to replace the entire part in case of any failure or when repair is needed.

Taking this into account, the only spare part required is the bolt that connects the top of the steering column to the top of the intermediate shaft.

Bolt DIN 34800 M8x30 10. 9

Assembly/disassembly order

■PRELIMINARY COMMENTS

- Take appropriate safety precautions before starting this procedure.
- This procedure should not replace the manuals; you must use them together.
- This procedure is for trained professional mechanics. Do not attempt to diagnose or correct steering problems unless you have been trained and have the necessary equipment, tools and know-how to do the job correctly and safely.
- When performing any maintenance on this part, the vehicle ignition must be turned off and the key removed to avoid injury to personnel working near this product.

Assembly/disassembly order

TOOL LIST:

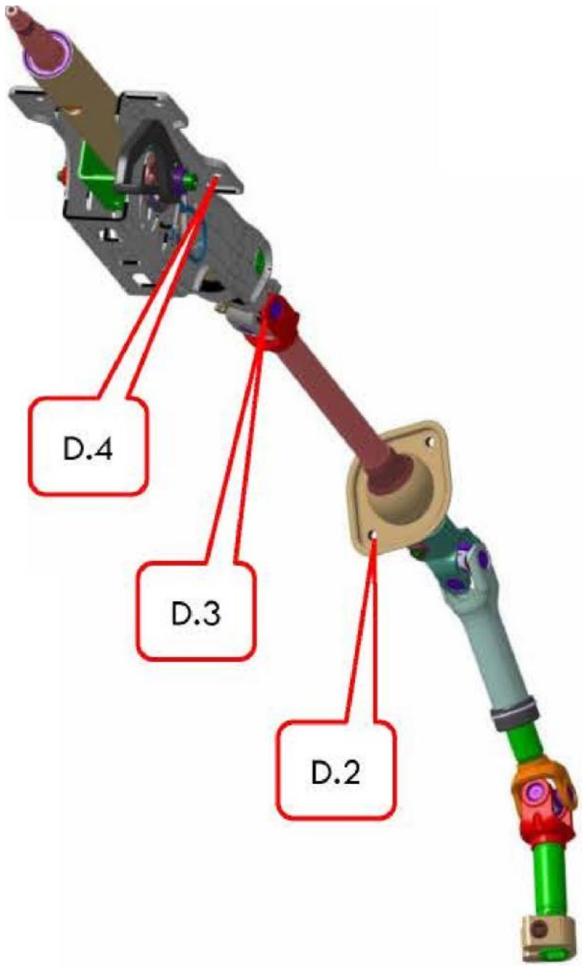
- Appropriate tools for detaching the steering column from the cross bar
- Appropriate tools for detaching all components on the top of the steering column
- Appropriate tools for removing front panel intermediate support bolts
- Torque wrench up to 40 Nm
- Star head E10

DISMANTLING:

D. 1) Disassemble/disconnect the steering wheel, switches, casing, ESP sensor, MSCL and all other components attached to the steering column.

D. 2) Unscrew the two bolts securing the front plate intermediate support assembly to the vehicle's front plate. D. 3) Unscrew and remove the bolt connecting the top of the steering column to the top of the intermediate shaft.

D. 4) Unscrew the four bolts securing the steering column to the vehicle cross bar. D. 5) After the top of the steering column is free of bolts, remove the top of the steering column from the vehicle.



Assembly/disassembly order

TOOL LIST:

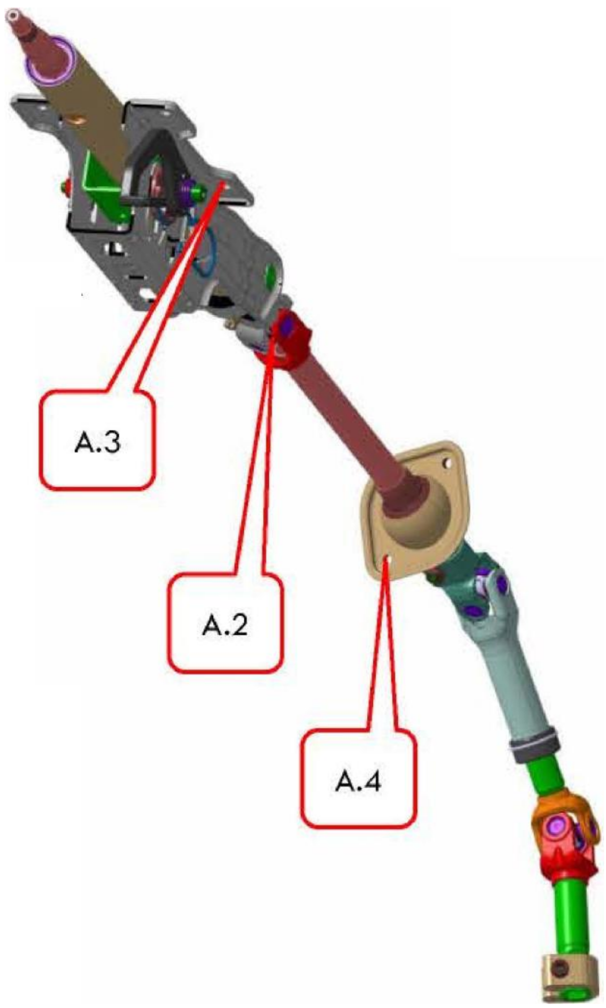
- Appropriate tools for attaching the steering column to the cross bar
- Appropriate tools for fastening all components on the top of the steering column
- Appropriate tools for tightening the front panel intermediate support bolts
- Torque wrench up to 40 Nm
- Star head E10

ASSEMBLY:

A. 1) Pre-assemble all the necessary components on top of the steering column (MSCL, switches, etc.).

Hook the upper intermediate shaft yoke to the steering column fitting and screw in a with a tightening torque of 27.5±4.2 Nm.

Screw in the four bolts securing the steering column to the vehicle cross bar. A.4) Screw in the two bolts securing the front plate intermediate support to the vehicle's front plate. A.5) Assemble the rest of the required components on top of the steering column (steering wheel, casing, etc.).



Possible operation claims

1) Difficulty during the adjustment lever locking/unlocking

- Disassemble the casings and, without unscrewing the bolts, check for parts that may block the lever rotation on both sides of the column where the lever is located:
    - If not OK, remove the blocking components and check if the problem is solved.
    - If OK, go to the next step
- Without disassembling the steering column or any component, check the lever clamp/release load:
    - If load > 87 N, replace the column and check if the problem is solved o If OK, go to the next step
- Replace the column and check if the problem is solved

Possible operation claims

2) Adjustment lever does not lock (loose lever) / Locking system does not hold the steering column
   - Replace the column and check if the problem is solved
3) Tilt noise (lever released)
   - Disassemble the casings and, without unscrewing the bolts, check for components that may block/affect tilt adjustment on both sides of the column:
     - If not OK, remove the blocking components and check if the problem is solved.
     - If OK, go to the next step
   - Replace the column and check if the problem is solved
4) Rigid/locked tilt adjustment (lever released)
   - Disassemble the casings and, without unscrewing the bolts, check for components that may affect tilt adjustment on both sides of the column:
     - If not OK, remove the blocking components and check if the problem is solved.
     - If OK, go to the next step
   - Replace the column and check if the problem is solved

Possible operation claims

5) Steering wheel noise, play or vibration

- Disassemble the casings and check for loose bolts/nuts on components attached to the steering column (steering wheel, MSCL, etc.):
  - If the problem is due to loose bolts, work on those components in accordance with the procedures for those components.
  - If OK, go to the next step
- Check for loose bolts or play in the connections and fastening of the vehicle cross bar:
  - If the problem is due to loose bolts (both the ones securing the steering column to the cross bar and the upper connecting bolt of the intermediate shaft), retighten the bolts as per specification and verify that the problem has been solved
  - If OK, go to the next step
- Replace the column and check if the problem is solved

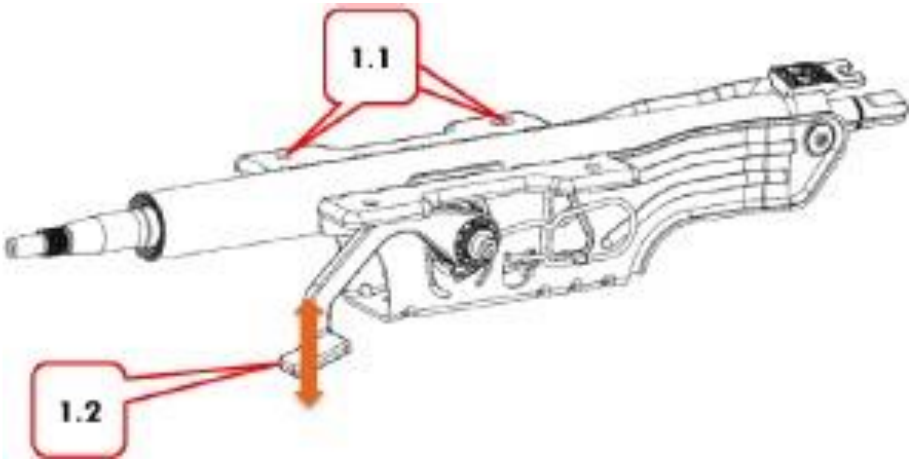
Possible operation claims

6) Difficult column rotation
   - Disassemble the casings and, without unscrewing the bolts, check for parts that may block the rotation of the steering column, upper intermediate shaft or camshaft:
     - If not OK, remove the blocking components and check if the problem is solved.
     - If OK, go to the next step
   - Check for loose bolts/nuts of components attached to the steering column (steering wheel, MSCL, etc.) that may affect the steering column rotation:
     - If the problem is due to loose bolts, work on those components in accordance with the procedures for those components
     - If OK, go to the next step
   - Check for damage or play in the steering column, upper intermediate shaft or camshaft:
     - If there are problems, remove the blocking components and check if the problem is solved
     - If OK, go to the next step
   - Replace the column and check if the problem is solved

Test procedure

1) Tilt mechanism, tilt control: The force to control the lever of the adjustment mechanism should be max. 87 N.

   1.1 Fasten the column to the marked attachment points on the vehicle cross beam.
   1.2 Open and close the lever to actuate the adjustment mechanism.
   1.3 Measure the load used at the tip of the lever.
   1.4 Replace faulty assemblies with new ones.



Test procedure

2) Lock the torque on the column shaft around the tilting bearing when the tilt mechanism is locked: Minimum tightening torque on the column shaft around the tilting bearing when the tilt mechanism is locked: 350 Nm (load ~ 650 N applied to the threaded end of the steering column).

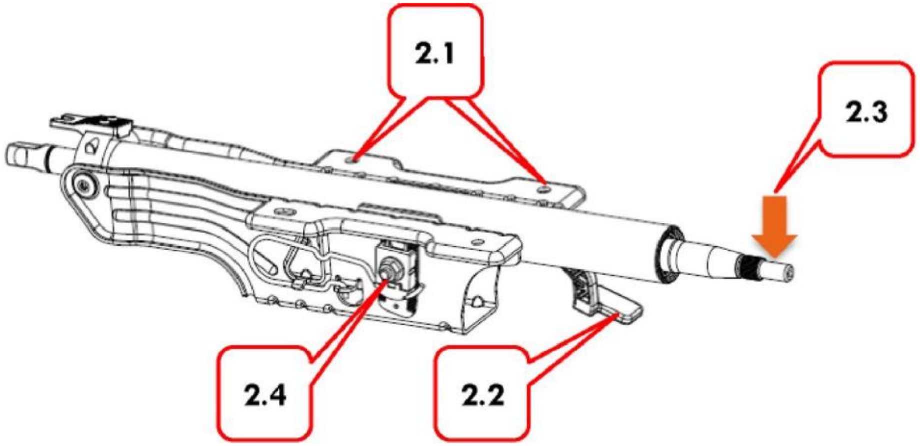
2.1 Fasten the column to the marked attachment points on the vehicle cross beam.

2.2 Close the lever to clamp the adjustment mechanism.

2.3 Apply a vertical load of 650 N to the upper area of the steering wheel shaft.

2.4 Make sure that there is no noticeable slip in the adjustment mechanism.

2.5 Replace faulty assemblies with new ones.



Test procedure

3) Wait for the moment when the tilt mechanism on the column shaft around the tilting bearing is unlocked: maximum torque on the column shaft around the tilting bearing when the tilt mechanism is unlocked: 33.5 Nm (maximum steering wheel force ~ 55N).

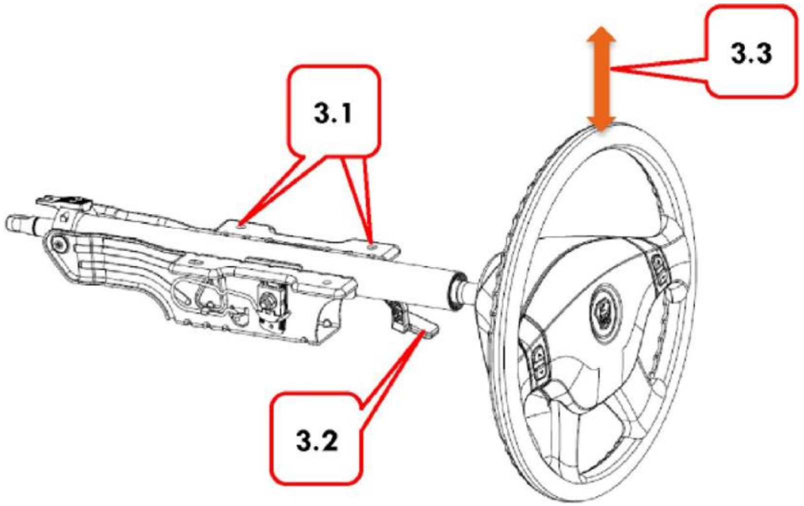
3.1 Lock the column in a horizontal position at the designated points of attachment to the vehicle cross bar and install all peripheral equipment (steering wheel, ESCL, switches, etc.) on the steering column.

3.2 Release the adjustment lever.

3.3 Apply a vertical load (up and down) to the top of the steering wheel.

3.4 Measure the maximum load.

3.5 Replace faulty assemblies with new ones.



Test procedure

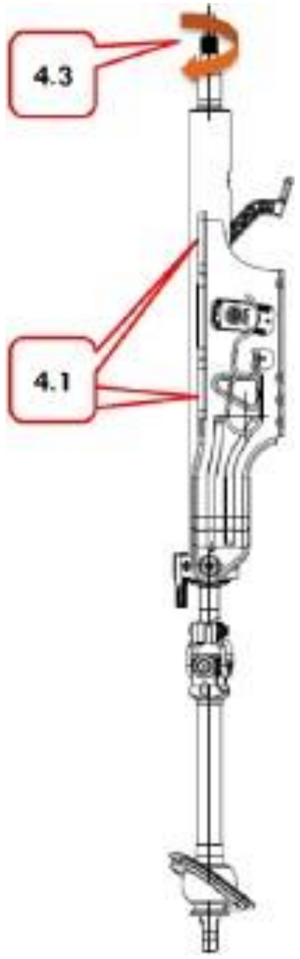
4) Shaft rotation resistance torque: torque max. 0.5 Nm should allow free rotation of the column assembly.

4.1 Fasten the column in a vertical position at the designated attachment points on the vehicle. Leave the front panel intermediate support to rotate freely.

4.2 Make sure that the shaft can be rotated freely by hand.

4.3 Install a torque wrench on the steering wheel shaft and measure the torque required to rotate the shaft.

4.4 Replace faulty assemblies with new ones.



Maintenance and repair documentation

A21 R23.3401205 - Intermediate shaft

23/08/2021

Index

Description of parts and product design

Intermediate shaft - component that:

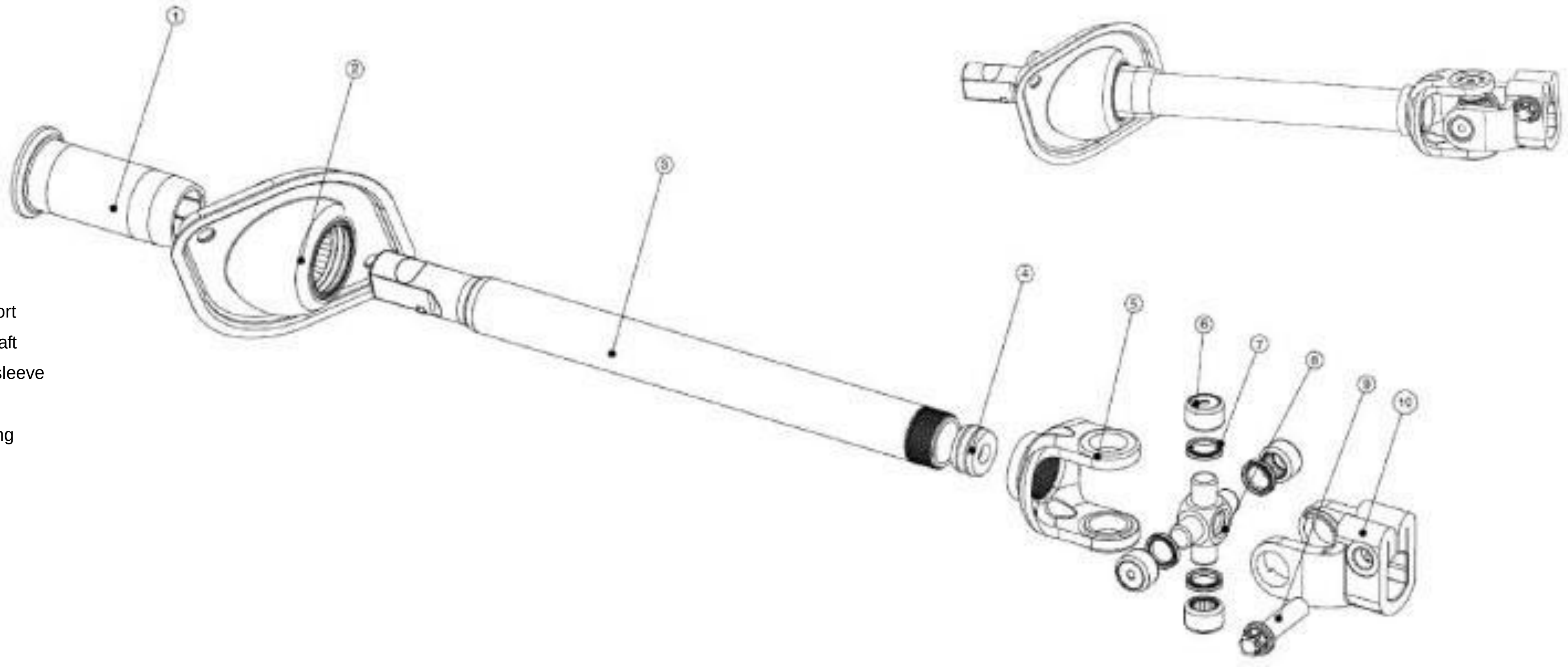
- Attaches the top of the steering column to the camshaft
- Transmits rotation from the steering wheel
- Attaches the column to the front plate

This component is considered a safety element in the vehicle, and in the event of a breakdown or repair, it should be replaced with a completely new part in the first place.

Attempting to adjust or repair a safety element may violate the vehicle’s legal requirements for driver safety and cause permanent damage to the driver.

Assemblies must be replaced by an authorized service center.

Description of parts and product design



01 - Sealing cup
02 - Front plate
intermediate support
03 - Front plate shaft
04 - Intermediate sleeve
05 - Yoke
06 – Needle bearing
07 - O-ring
08 - Cross-piece
09 - Bolt
10 - Column yoke

Recommended spare parts list

Since the intermediate shaft is a safety element, it must be considered as a single piece. The only way to ensure that parts work well is to replace the entire part in case of any failure or when repair is needed.

Taking this into account, the necessary spare parts are the bolts connecting the camshaft to the steering column and to the intermediate shaft.

Bolt DIN 6921-10. 9 Hex flange bolt. Length 35 Bolt securing intermediate shaft to camshaft

Bolt DIN 34800 M8x30 10. 9 Bolt securing intermediate shaft to steering column

Assembly/disassembly order

■ PRELIMINARY COMMENTS

- Take appropriate safety precautions before starting this procedure.
- This procedure should not replace the vehicle manufacturer’s manuals; you must use them together.
- This procedure is for trained professional mechanics. Do not attempt to diagnose or correct steering problems unless you have been trained and have the necessary equipment, tools and know-how to do the job correctly and safely.
- When performing any maintenance on this part, the vehicle ignition must be turned off and the key removed to avoid injury to personnel working near this product.

Assembly/disassembly order

TOOL LIST:

- Appropriate tools for detaching the steering column from the cross bar
- Appropriate tools for detaching all components on the top of the steering column
- Appropriate tools for removing front panel intermediate support bolts
- Torque wrench up to 40 Nm
- Star head E10
- Hex head 13mm

DISMANTLING:

D.1) Disassemble/disconnect the steering wheel, switches, casing, ESP sensor, MSCL and all other components attached to the steering column.

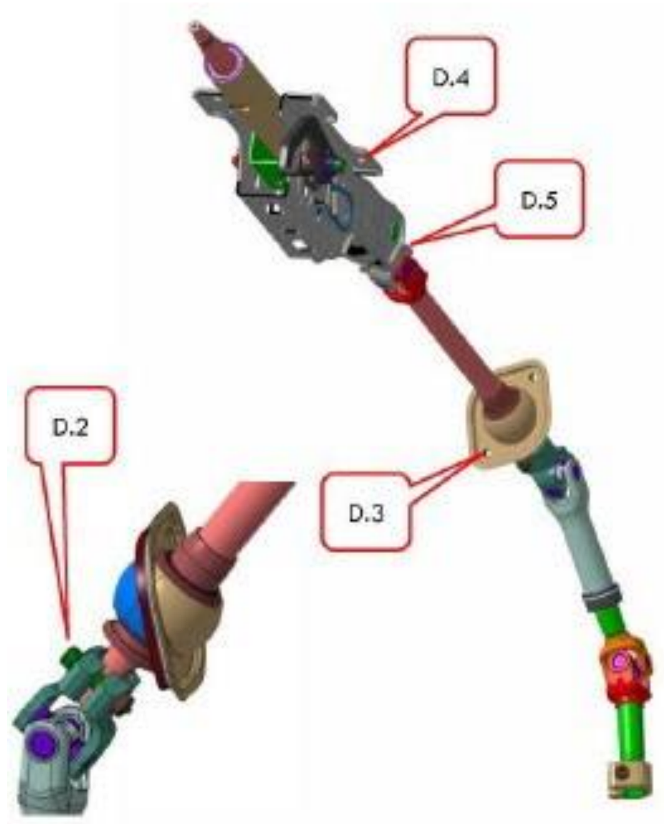
D.2) Unscrew and remove the bolt connecting the intermediate shaft to the camshaft.

D.3) Unscrew the two bolts securing the front plate intermediate support assembly to the vehicle's front plate.

D.4) Unscrew the four bolts securing the steering column to the vehicle cross bar.

D.5) Once the steering column and intermediate shaft are free of bolts, remove the entire assembly from the vehicle by pulling it out through the hole in the front plate.

D. 6) Unscrew and remove the bolt connecting the upper steering column to the intermediate shaft and unstick both assemblies



Assembly/disassembly order

TOOL LIST:

- Appropriate tools for attaching the steering column to the cross bar
- Appropriate tools for fastening all components on the top of the steering column
- Appropriate tools for installing the front panel intermediate support bolts
- Torque wrench up to 40 Nm
- Star head E10
- Hex head 13mm

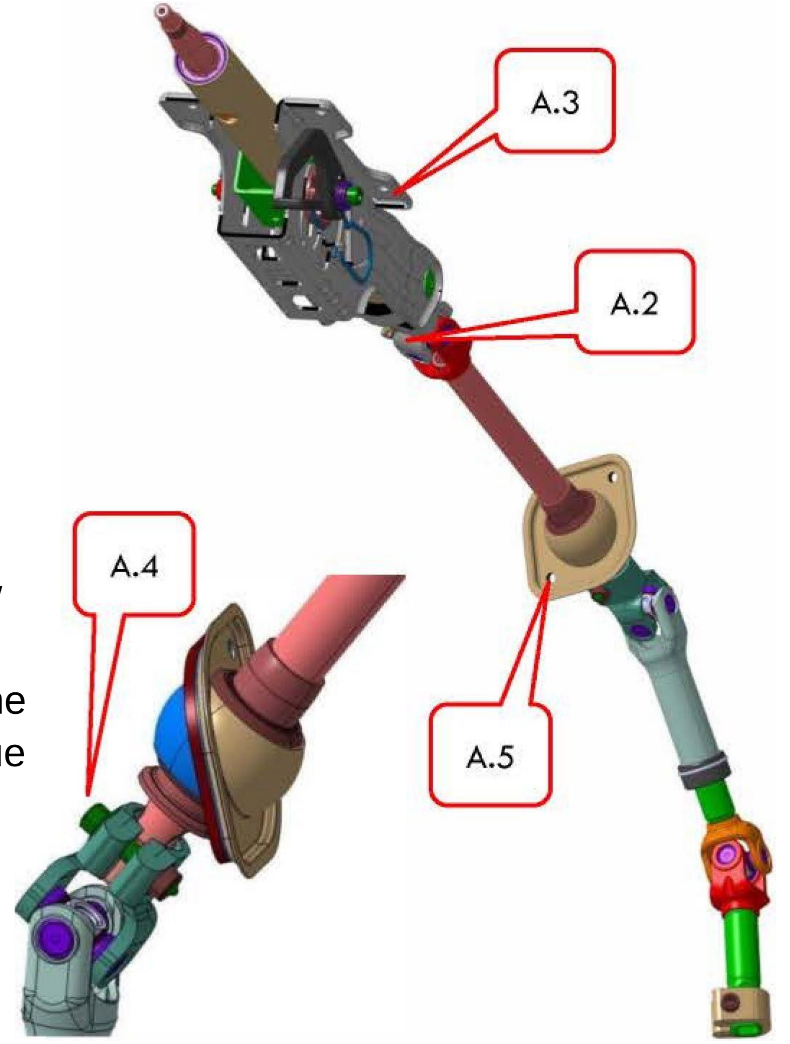
ASSEMBLY:

A. 1) Pre-assemble all the necessary components on the upper steering column (MSCL, switches, etc.).

A. 2) Hook the upper intermediate shaft yoke to the steering column fitting and screw in a new bolt with a tightening torque of 27.5±4.2 Nm. _

A. 3) Screw the four bolts securing the steering column to the vehicle cross bar. A. 4) Install the intermediate shaft on the upper camshaft yoke and screw in a new bolt with a tightening torque of 27.5±4.2 Nm.

A. 5) Screw in the two bolts securing the front plate intermediate support to the vehicle's front plate. A. 6) Assemble the rest of the required components on top of the steering column (steering wheel, casing, etc.).



Possible operation claims

1) Steering wheel noise, play or vibration

- Check for loose bolts or play in joints, pivots and front panel intermediate support:
  - If the problem is caused by loose bolts, retighten the bolts as per specification and check if the problem is resolved.
  - If the problem is related to play between the front panel intermediate support and the shaft, replace the intermediate shaft and check if the problem is solved.
  - If OK, go to the next step
- Verify that the noise, play or vibration are caused by the intermediate shaft:
  - Replace the intermediate shaft and check if the problem is solved.

  If problem persists, check other steering circuit components

Possible operation claims

2) Difficult column rotation

- Disassemble the casings and, without unscrewing the bolts, check for parts that may block the intermediate shaft rotation:
  - If there is a malfunction, remove the blocking components and check if the problem is solved. If OK, go to the next step
- Check for loose bolts or play in joints, pivots and front panel intermediate support:
  - If the problem is caused by loose bolts, retighten the bolts as per specification and check if the problem is resolved.
  - If the problem is related to play between the front panel intermediate support and the shaft, replace the intermediate shaft and check if the problem is solved.
  - If OK, go to the next step
- Verify that the rotation blocking is caused by the intermediate shaft:
  - Replace the intermediate shaft and check if the problem is solved
  - If problem persists, check other steering circuit components

Possible operation claims

3) Knock

■ Disassemble the intermediate shaft and check the slip load between the sealing cup and the front plate intermediate support:

- If the slip load is < 50 N, replace the intermediate shaft and check if the problem is solved
- If OK, go to the next step

■ Check the yoke rotation angle on the yoke and U-joint:

- If the angle is < 40°, replace the shaft and check if the problem is solved.
- If OK, go to the next step

■ Testing the front plate intermediate support resistance torque during the shaft rotation:

- If the torque is > 0.2 Nm, replace the shaft and check if the problem is solved (shaft turns easily).
- If OK, go to the next step

■ Verify that the knock is caused by the intermediate shaft:

- Replace the intermediate shaft and check if the problem is solved
- If problem persists, check other steering circuit components

Test procedure

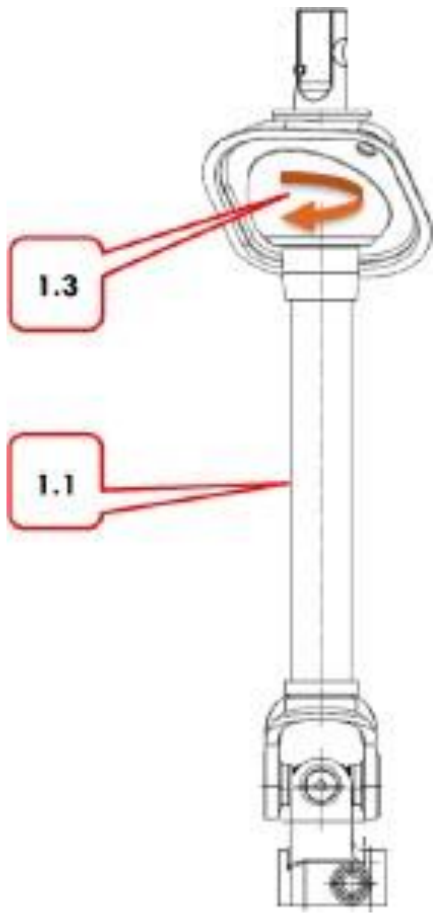
1) **Shaft torque resistance:** The torque for free rotation of the front plate intermediate support assembly on the sealing bushing must not exceed 0.2 Nm.

1.1 Clamp the shaft in a vertical position. Leave the front panel intermediate support to rotate freely.

1.2 Make sure that the front plate intermediate support assembly can be rotated freely by hand.

1.3 Measure the torque required to rotate the front plate intermediate support assembly on the sealing bushing.

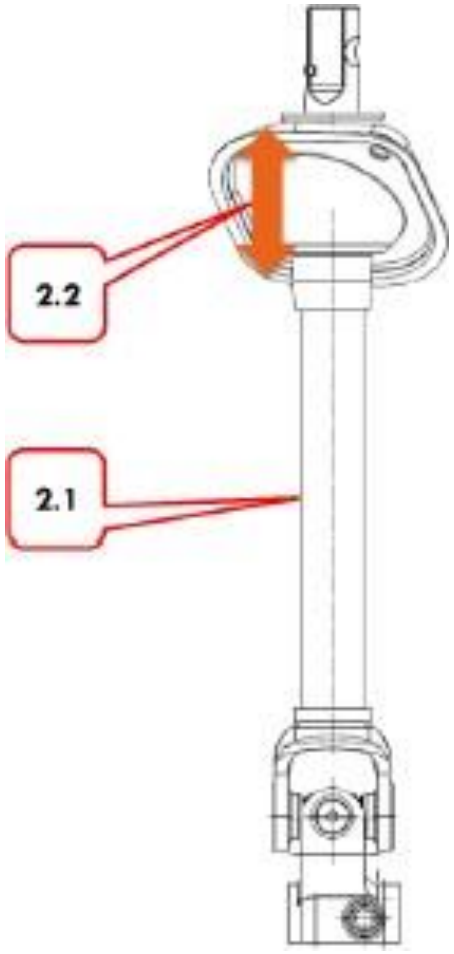
1.4 Replace faulty assemblies with new ones.



Test procedure

2) Axial force when the shaft moves in the front plate intermediate support: The load for moving the front plate intermediate support assembly along the sealing bushing should be max. 50 N.

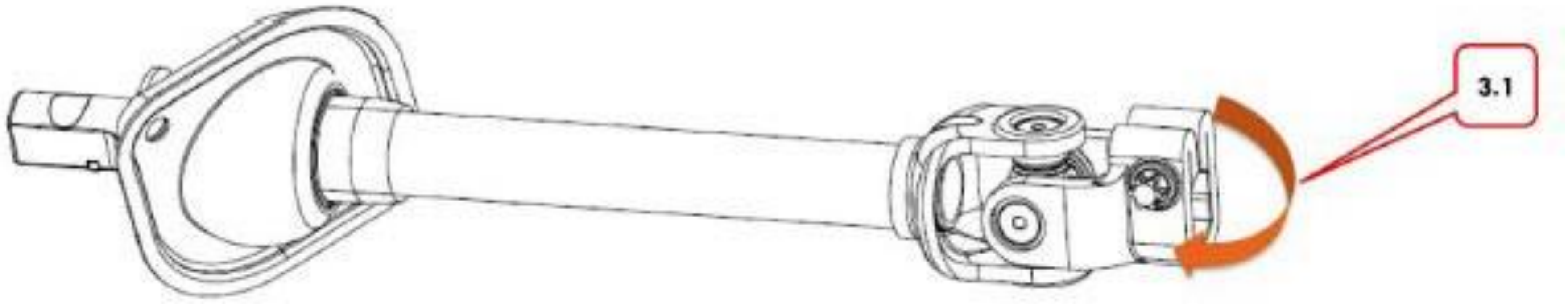
2.1 Hold the intermediate shaft firmly.
2.2 Apply an axial load to the front plate intermediate support assembly to slide it along the sealing bushing on the shaft.
2.3 Measure the force required to move the front plate intermediate support assembly.
2.4 Replace faulty assemblies with new ones.



Test procedure

3) Yoke rotation angle: The minimum cardan yoke rotation angle must be 40°.

3.1 Rotate the yoke by hand and check the maximum angle.
3.2 Replace faulty assemblies with new ones.



Maintenance and repair documentation

A21R23.3422014 - Intermediate shaft

23/08/2021

Index

Description of parts and product design

Intermediate shaft - component that:

- Attaches the top of the steering column to the pinion shaft
- Transmits rotation from the steering wheel
- Provides slip adjustment between the steering column and the pinion shaft

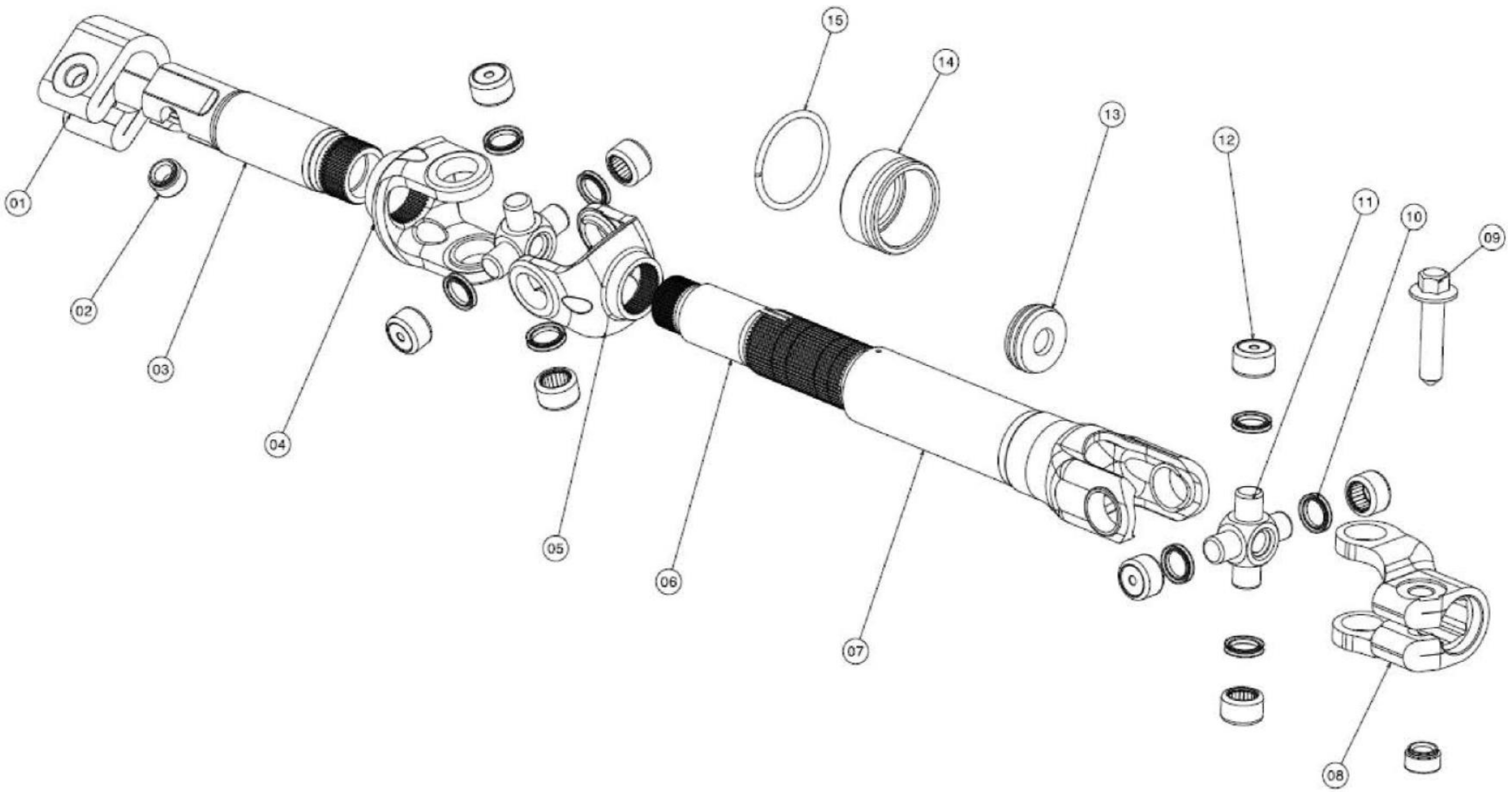
This component is considered a safety element in the vehicle, and in the event of a breakdown or repair, it should be replaced with a completely new part in the first place.

Attempting to adjust or repair a safety element may violate the vehicle’s legal requirements for driver safety and cause permanent damage to the driver.

Assemblies must be replaced by an authorized service center.

Description of parts and product design

01 - Clamp
02 - Clamp nut
03 - Gear extension
04 - Yoke
05 - Yoke
06 - Inner shaft
07 - Outer shaft
08 - Upper yoke
09 - Bolt
10 - O-ring
11 - Cross-piece
12 - Needle bearing
13 - Inner bushing
14 - Outer bushing
15 - Circlip



Recommended spare parts list

Since the intermediate shaft is a safety element, it must be considered as a single piece. The only way to ensure that parts work well is to replace the entire part in case of any failure or when repair is needed.

Taking this into account, the only spare part required is the bolt that connects the steering column to the intermediate shaft.

Bolt DIN 6921-10. 9 Hex flange bolt. Length 35

Assembly/disassembly order

■ PRELIMINARY COMMENTS

- Take appropriate safety precautions before starting this procedure.
- This procedure should not replace the manuals; you must use them together.
- This procedure is for trained professional mechanics. Do not attempt to diagnose or correct steering problems unless you have been trained and have the necessary equipment, tools and know-how to do the job correctly and safely.
- When performing any maintenance on this part, the vehicle ignition must be turned off and the key removed to avoid injury to personnel working near this product.

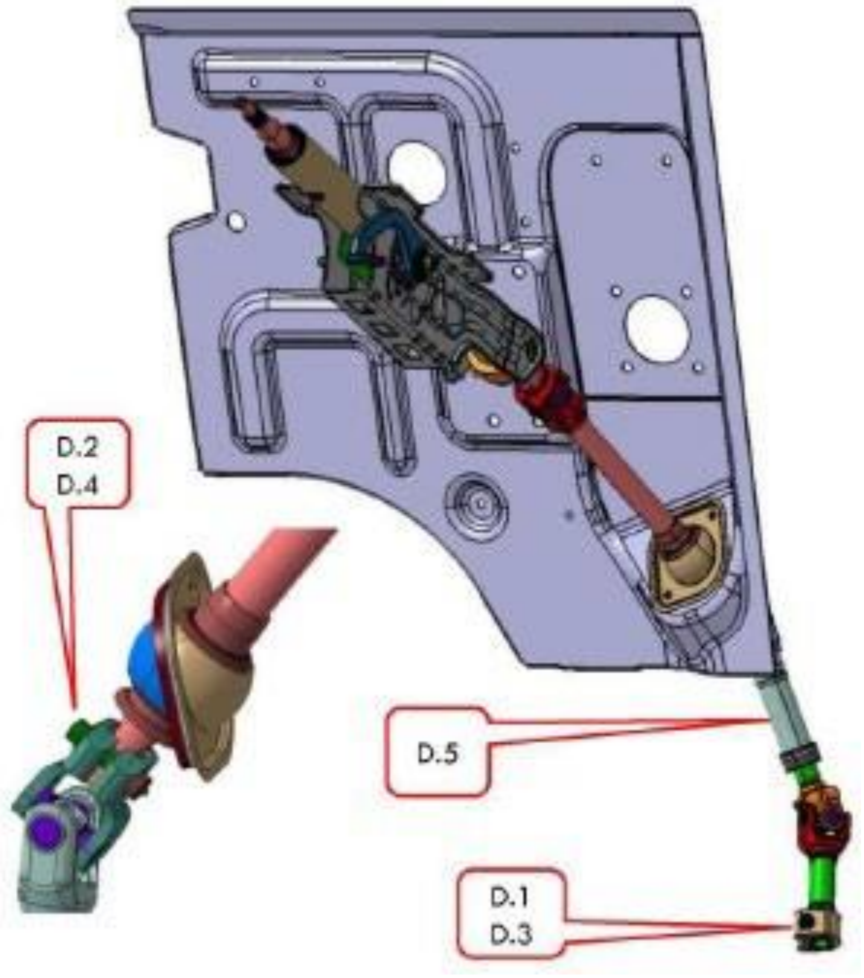
Assembly/disassembly order

TOOL LIST:

- Torque wrench up to 40 Nm
- Hex head 13mm

DISMANTLING:

D.1) Unscrew (without removing) the bolt connecting the intermediate shaft to the pinion shaft.
D.2) Unscrew (without removing) the bolt connecting the intermediate shaft to the steering column.
D.3) Unscrew the bolt connecting the intermediate shaft to the pinion shaft, and separate the two parts.
D.4) Unscrew the bolt connecting the intermediate shaft to the steering column and separate the two parts.
D.5) Remove the intermediate shaft from the vehicle.



Assembly/disassembly order

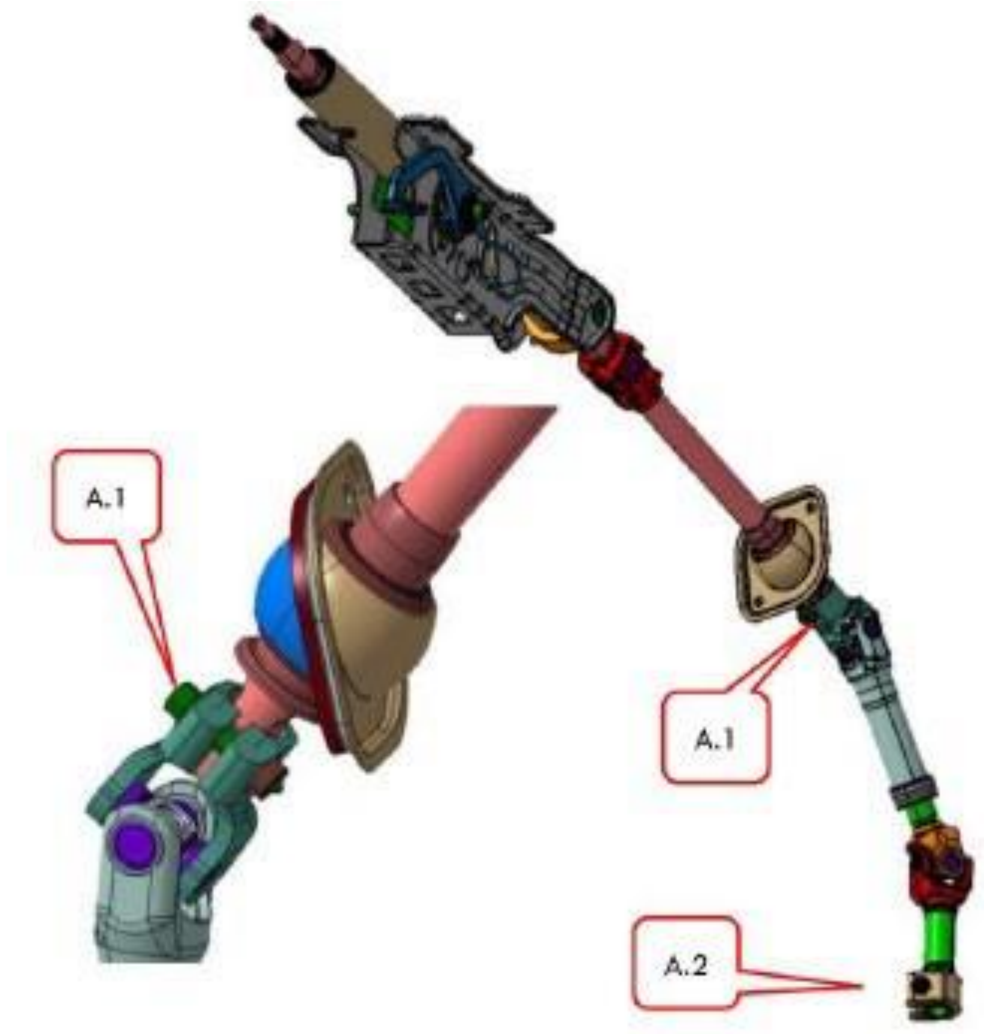
TOOL LIST:

- Torque wrench up to 40 Nm
- Hex head 13mm

ASSEMBLY:

A. 1) Connect the upper fork to the steering column fitting and screw in a new bolt with a tightening torque of 27.5±4.2 Nm.

A. 2) Fix the bottom pinion shaft connection to the bottom pinion shaft connection and tighten the new bolt with a tightening torque of 28±2 Nm.



Possible operation claims

1) Knock

- Disassemble the casings and, without loosening the intermediate shaft bolts, check the joints, pivots and slider for damage or play:
  - If not OK, replace the intermediate shaft and check if the problem is solved.
  - If OK, go to the next step
- Disassemble the intermediate shaft and check the slip load:
  - If the slip load is < 80 N, replace the intermediate shaft and check if the problem is solved
  - If OK, go to the next step
- Check the yoke rotation angle on the yoke and U-joint.
  - If the angle is < 40°, replace the intermediate shaft and check if the problem is solved.
  - If OK, go to the next step
- Replace the intermediate shaft and check if the problem is solved

Possible operation claims

2) Squeal and scratching noise

- Disassemble the casings and, without loosening the shaft mounting bolts, check for damage or play in the joints, pivots, slider and steering column:
  - If the problem is caused by loose bolts (on the steering column and intermediate shaft), retighten the bolts as per specification and check if the problem is resolved.
  - If the problem is related to other causes, replace the shaft.
  - If OK, go to the next step
- Disassemble the intermediate shaft and check the slip load:
  - If the slip load is <20 N, replace the intermediate shaft and check if the problem is solved
  - If OK, go to the next step
- Intermediate shaft angular play test:
  - If the angular clearance is < 20', replace the shaft and check if the problem is solved.
  - If OK, go to the next step
- Replace the intermediate shaft and check if the problem is solved

Possible operation claims

3) Audible metallic noise

- Disassemble the casings and, without loosening the shaft mounting bolts, check for damage or play in the joints, pivots, slider and steering column:
  - If the problem is caused by loose bolts (on the steering column and intermediate shaft), retighten the bolts as per specification and check if the problem is resolved.
  - If the problem is related to other causes, replace the shaft.
  - If OK, go to the next step
- Disassemble the intermediate shaft and check the slip load:
  - If the slip load is <20 N, replace the intermediate shaft and check if the problem is solved
  - If OK, go to the next step
- Intermediate shaft angular play test:
  - If the angular play is < 20', replace the intermediate shaft and check if the problem is solved.
  - If OK, go to the next step
- Replace the intermediate shaft and check if the problem is solved

Possible operation claims

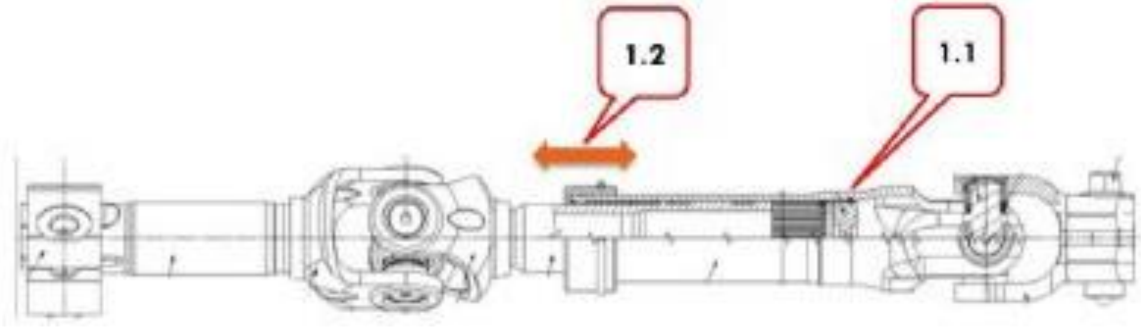
4) Steering wheel vibration

- Disassemble the casings and, without loosening the shaft mounting bolts, check for damage or play in the joints, pivots, slider and steering column:
  - If the problem is caused by loose bolts (on the steering column and intermediate shaft), retighten the bolts as per specification and check if the problem is resolved.
  - If the problem is related to other causes, replace the shaft.
  - If OK, go to the next step
- Disassemble the intermediate shaft and check the slip load:
  - If the slip load is <20 N, replace the intermediate shaft and check if the problem is solved
  - If OK, go to the next step
- Intermediate shaft angular play test:
  - If the angular play is < 20', replace the intermediate shaft and check if the problem is solved.
  - If OK, go to the next step
- Replace the intermediate shaft and check if the problem is solved

Test procedure

1) Slip load test: The load of outer shaft slip along the inner shaft (tension and compression) must be max. 80 N.

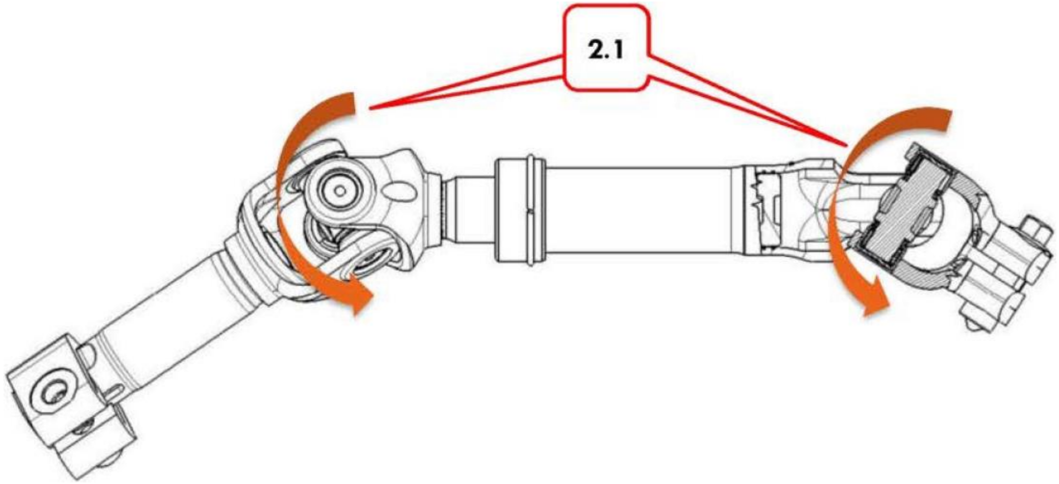
1.1 Hold the intermediate shaft horizontally and clamp the outer tube firmly.
1.2 Apply an axial load to the inner shaft to push it inside the outer shaft.
1.3 Measure the force required for the inner shaft slip.
1.4 Replace faulty assemblies with new ones.



Test procedure

2) Yoke rotation angle: The minimum cardan yoke rotation angle must be 40°.

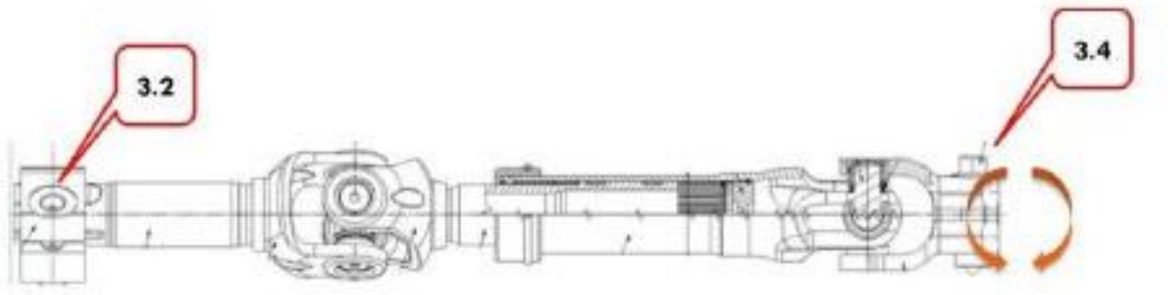
2.1 Turn the yoke and U-joint by hand and check the maximum angle.
2.2 Replace faulty assemblies with new ones.



Test procedure

3) Intermediate shaft angular play: the total measured angular play must be less than 0° 20' at a torque of +/-1Nm.

3.1 Install the part straight with the nominal shaft length according to the drawing.
3.2 Secure one end using fasteners with rated torque.
3.3 Attach the inclinometer to the assembly.
3.4 Apply a tightening torque of +/-1 Nm to the free end.
3.5 Torque and rotation angle are recorded on the X-Y plotter.
3.6 Replace faulty assemblies with new ones.

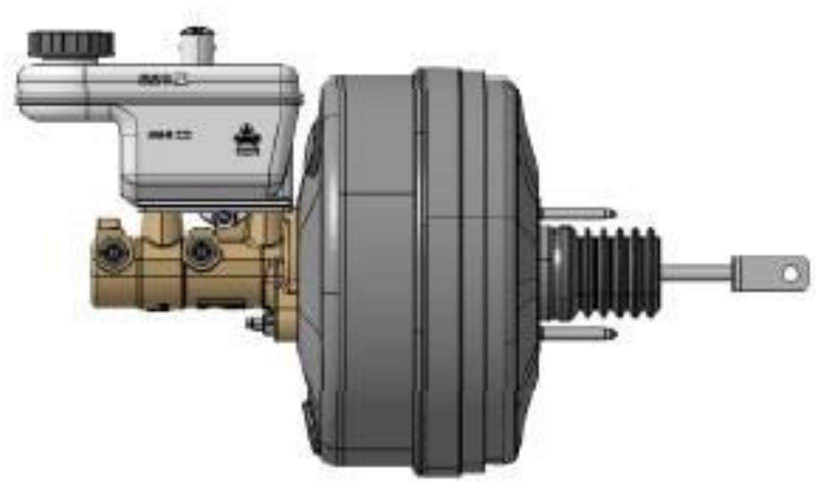


9.12. Recommendations for replacing vacuum booster parts

Parts replacement recommendations

Must be adapted to vehicle environment

BOSCH kit number	Customer number	Product name
0204 798 191	A21R23.3510009	Brake module
0204 814 130	**Must be sent**	Vacuum booster kit
0204 814 132	**Must be sent**	Brake master cylinder+tank kit
0204 255 351	**Must be sent**	Tank cap
0204 127 527	**Must be sent**	Repair kit (O-ring+nuts)



Disassembly process

Important information: Disconnect the check valve from the vacuum booster before disassembly

Nuts must be disposed of after each disassembly, self-locking nuts cannot be reused

Recommendation: Replace the vacuum booster seal after each disassembly

Fastening nuts

Loosen fastening nuts

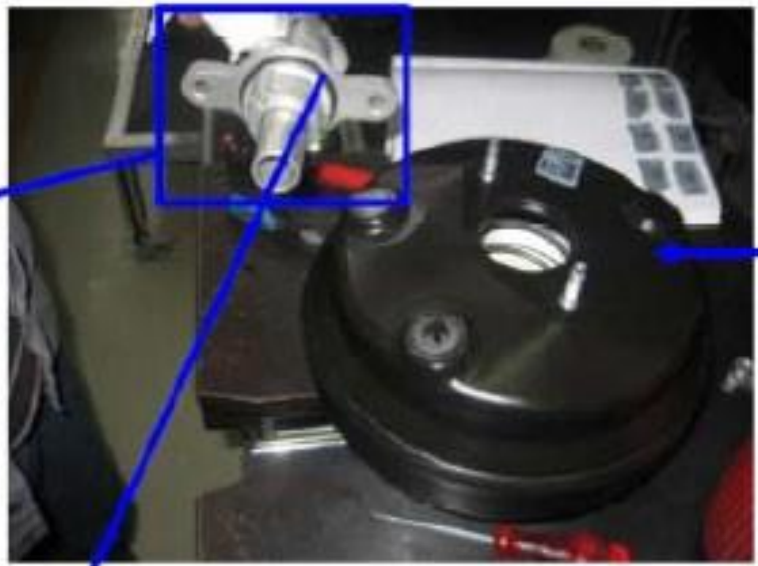
Loosening process

Parts replacement recommendations

Must be adapted to vehicle environment

Disassembly process

Remove the brake master cylinder with a tank from the vacuum booster

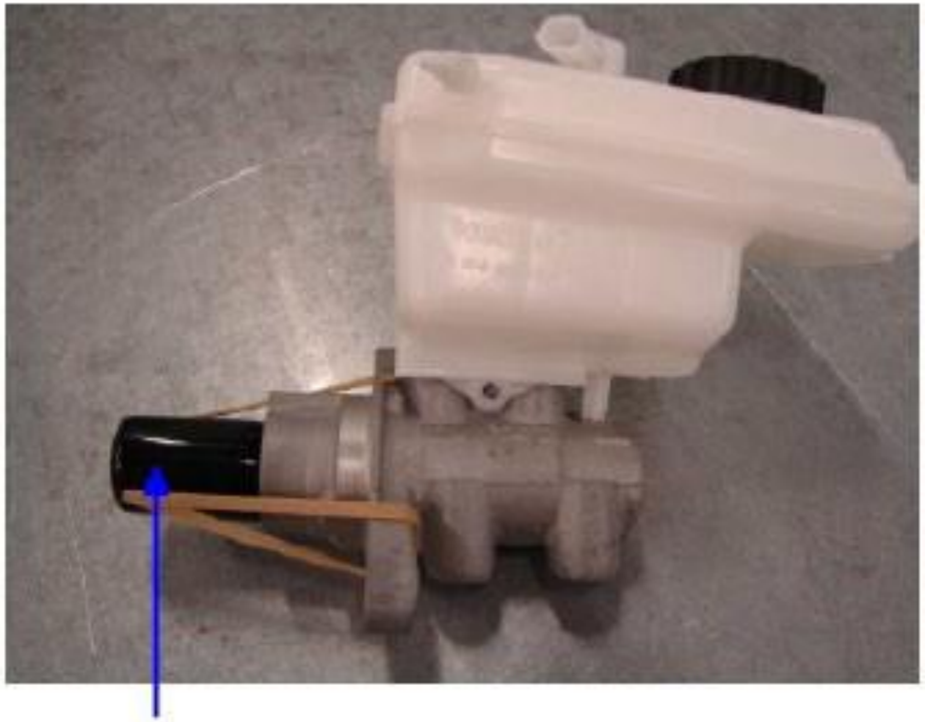


Vacuum booster

Important information: O-ring must be replaced after each disassembly

Parts replacement: aftermarket

Replacement of brake master cylinder with tank



Protective cover must be removed before assembly

Parts replacement recommendations
Must be adapted to vehicle environment

Parts replacement: aftermarket

Assembly of brake master cylinder+tank with vacuum booster

Attention:

- Use the new O-ring included in the kit

- The O-ring must be installed in the correct position and must be assembled carefully (without tension) to avoid vacuum loss.

Correct position

INCORRECT position

Important: Use the new nuts included in the kit.

Parts replacement: aftermarket

Vacuum booster replacement

Check valve hole plug must be removed prior to assembly.

Protection must be removed before assembly with brake master cylinder

Attention:

Use the new O-ring and nuts included in the repair kit

Assembly process

Assembly of brake master cylinder8 + tank with vacuum booster

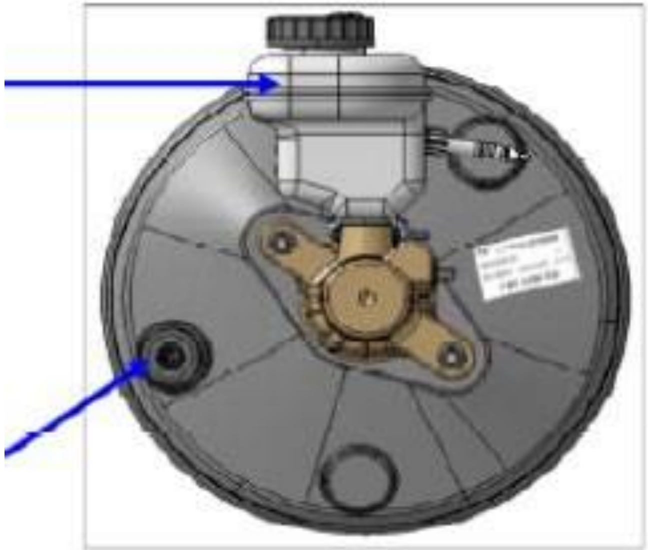
New nuts must be used during assembly

Tightening torque: 17-23 Nm (see drawing)
(Must be measured with a dynamometer)

Overview of parts positioning on vehicle

Vacuum booster + brake master cylinder + tank position

Tank



Check valve hole position

Important: Remove the protective plug before connecting the vacuum pump hose

Parts replacement recommendations

Must be adapted to vehicle environment

Operating recommendations

- For vacuum booster + brake master cylinder + tank
  See paragraph 2.5. in TCD 0204 798 191-TKU

- For vacuum booster kit
  Follow the same recommendations as for vacuum booster + brake master cylinder+tank

- For brake master cylinder + tank kit
  See recommendations on drawing for aftermarket

9.13. Diesel preheater 14TS-10-12-4910, 14TS-10-24-N1, 14TS-10-24-N2

Diesel preheaters:

14TS-10-12-4910
14TS-10-24-ST-N1
14TS-10-24-ST-N2
14TS-10-24-ST-N3

Catalogue of parts and assembly units

May 2020

This catalog of parts and assembly units is intended for organizations and individuals involved in the installation, repair and maintenance of diesel preheaters type 14TS-10 installed on vehicles

The catalog consists of the following sections:

1) The composition of **diesel preheaters** according to the product explosion diagram in Fig. 1 and the list of parts and assemblies in Table 1.

2) The composition of the intermediate assemblies - a **heater with bracket** according to the product explosion diagram in Fig. 2 - Fig. 5 and the list of parts and assemblies in Tables 2 - 5.

3) The composition of **heaters** with control units located in a metal or plastic case according to the product explosion diagram in Fig. 6 and the list of parts and assemblies in Table 6.

The catalog is used to determine the designations of parts and assemblies that failed during the preheater operation. The numbers in the cells indicate the number of pieces in the standard product configuration.

Attention! For convenience and ease of ordering parts and assembly units, use the serial numbers that are listed in the tables.

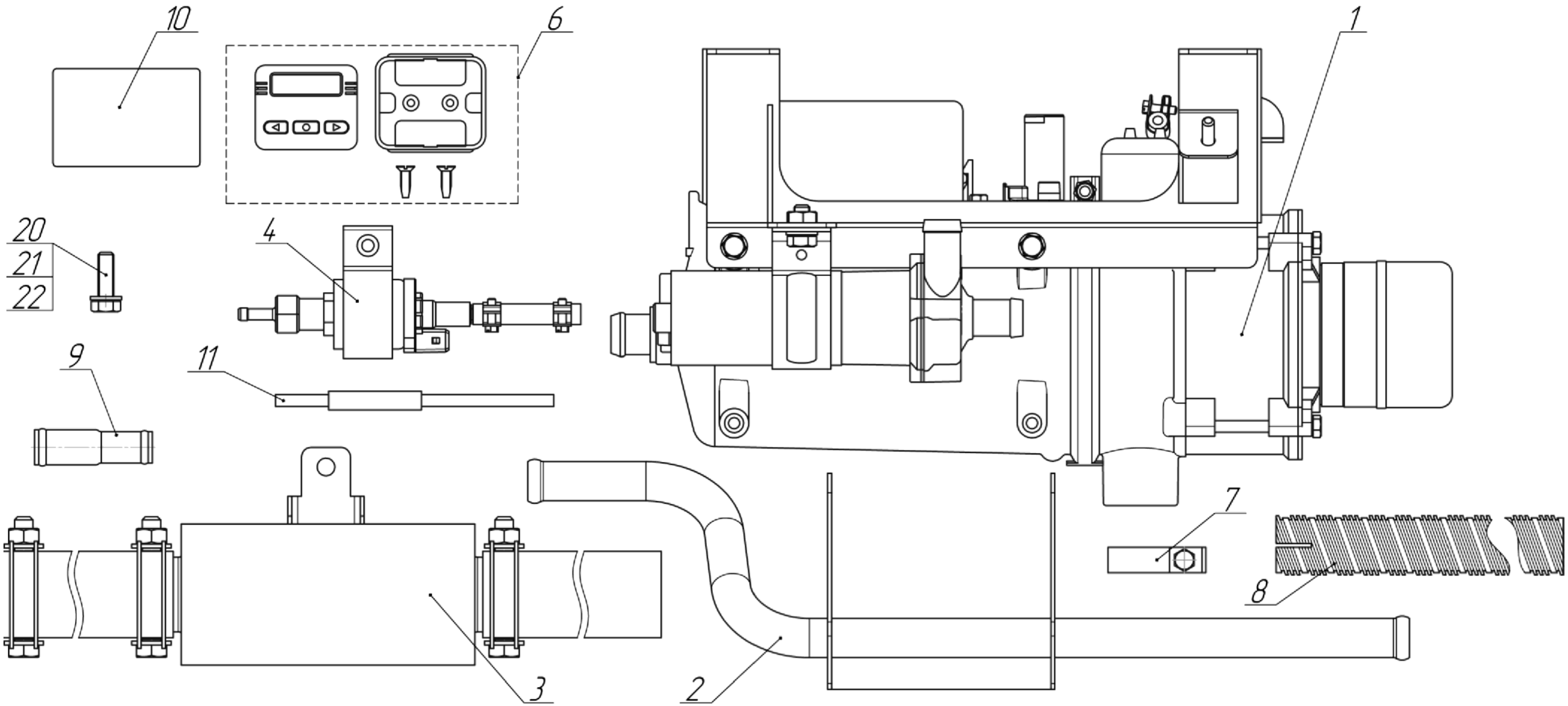


Fig. 1 - Preheater explosion diagram

Table 1

Pos. No.	Name, designation and serial number		Note		Preheaters			
					14TS-10-12-4910 ADVR.285.00.00.000	14TS-10-24-ST-N1 ADVR.138.00.00.000	14TS-10-24-ST-N2 ADVR.138.00.00.000-01	14TS-10-24-ST-N3 ADVR.138.00.00.000-02
	Preheater serial number				1	2	3	4
1	Heater unit							
	ADVR.285.01.00.000	assembly 4911	12V		1			
	ADVR. 138.01.00.000	assembly 3856	24V			1		
	ADVR. 138.01.00.000-01	assembly 4441	24V				1	1
2	Bracket with branch pipes							
	ADVR.285.02.00.000	assembly 4924			1			
3	Muffler							
	ADVR.285.03.00.000	assembly 4926	L=0.955 м		1			
4	Fuel pump (assembly)							
	ADVR.355.00.00.000	assembly 4927	Fuel pump TN11-6.8ml-12V Clamp Coupling Clamp Mikalor 10/9 (2 pcs.)	assembly 4160 assembly 1467 part 5087	1			
6	Control board							
	ADVR.355.00.00.000	assembly 5185	PU-32-12V		1			
	ADVR. 107.00.00.000	assembly 1770	PU-4MR			1	1	1
7	Clamp							
	ADVR.051.03.00.000	assembly 2649				2		
	Clamp Bosal 250-945						2	2
8	Metal jacket							
	ADVR.051.00.00.007-05	part 4321	L=0.55 м			1		
	ADVR.051.00.00.008-05	part 4653	L=0.51 м				1	1
9	Branch pipe							
	04TC.451.00.00.00.006	part 118				1	1	
10	Duplicate label							
	ADVR.285.00.00.001	part 5512			1			
11	Fuel line							
	ADVR.025.00.00.013-02	part 5844	L=5.3 м		1			
	ADVR.193.00.00.002	part 3983	L=0.8 м			1	1	1
20					4			
21	Washer 8				4			
22	Washer 8				4			

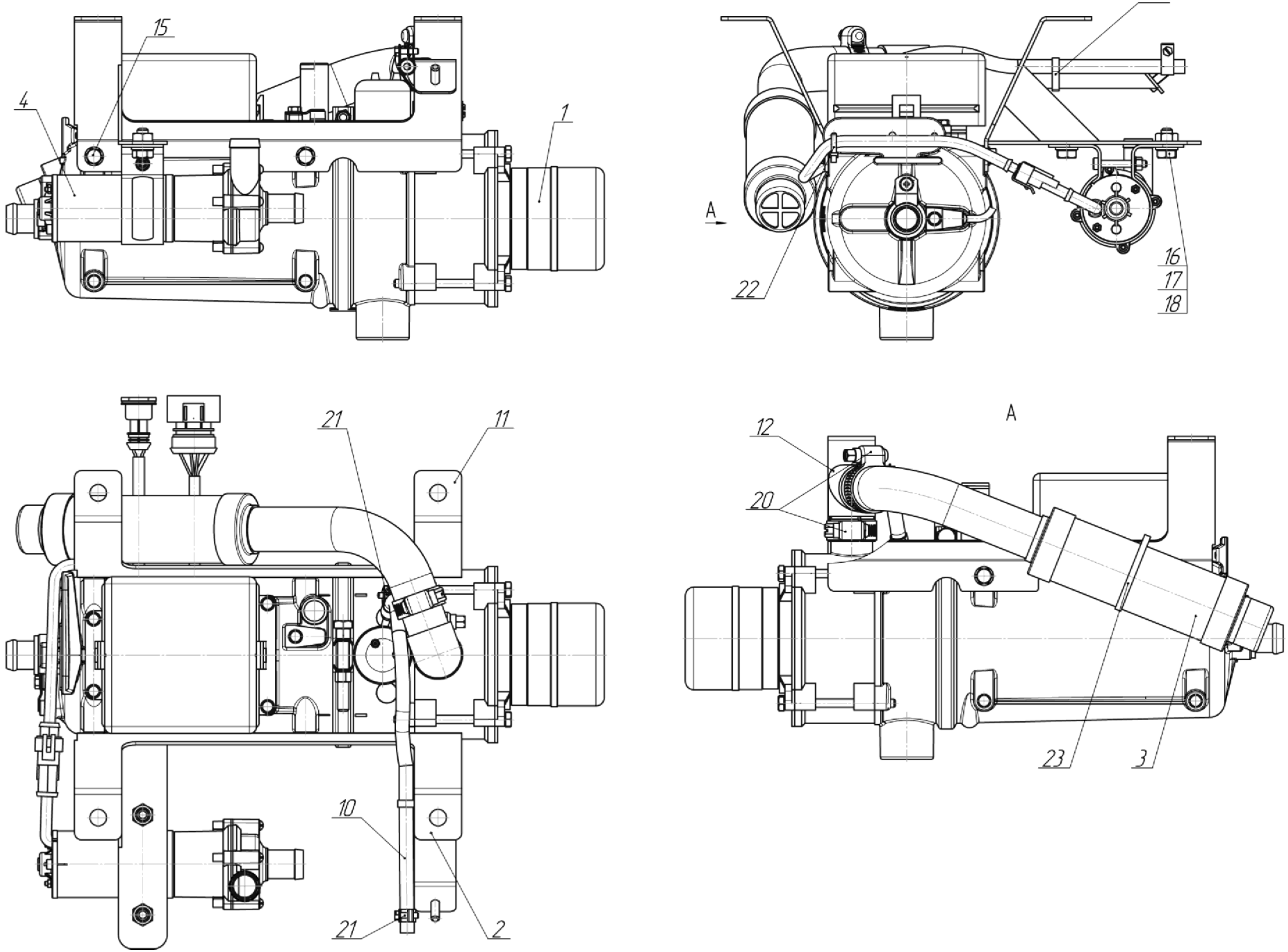


Fig. 2 - Heater-preheater unit 14TS-10-12-4910

Table 2

Pos. No.	Name, designation and serial number		Note	ADVR.285.01.00.000 assembly 4911
1	Heater			
	ADVR.285.01.01.000	assembly 4912		1
2	Right heater bracket			
	ADVR.285.01.03.000	assembly 4929		1
3	Air intake with silencer			
	ADVR.285.01.06.000	assembly 4994		1
4	Electric motor with pump			
	ADVR. 156.00.00.000-09	assembly 4832	P7-T20SK.12V	1
10	Fuel line			
	14TS.451.20.01.00.001-23	part 5259	L=0.4 м	1
11	Bracket			
	ADVR.285.01.00.001	part 5608		1
12	Elbow 30x26			
	ADVR.025.00.00.046	part 5645		
15	Screw M6x16 DIN 7500D			4
16	Bolt M8x16			2
17	Washer 8			2
18	Washer 8			2
20	Clamp Mikalor 20x32/9 C7 W1			2
21	Clamp Mikalor mini 10/9			2
22	Plastic clamp 98x2.5			1
23	Plastic clamp 200x4.5			2

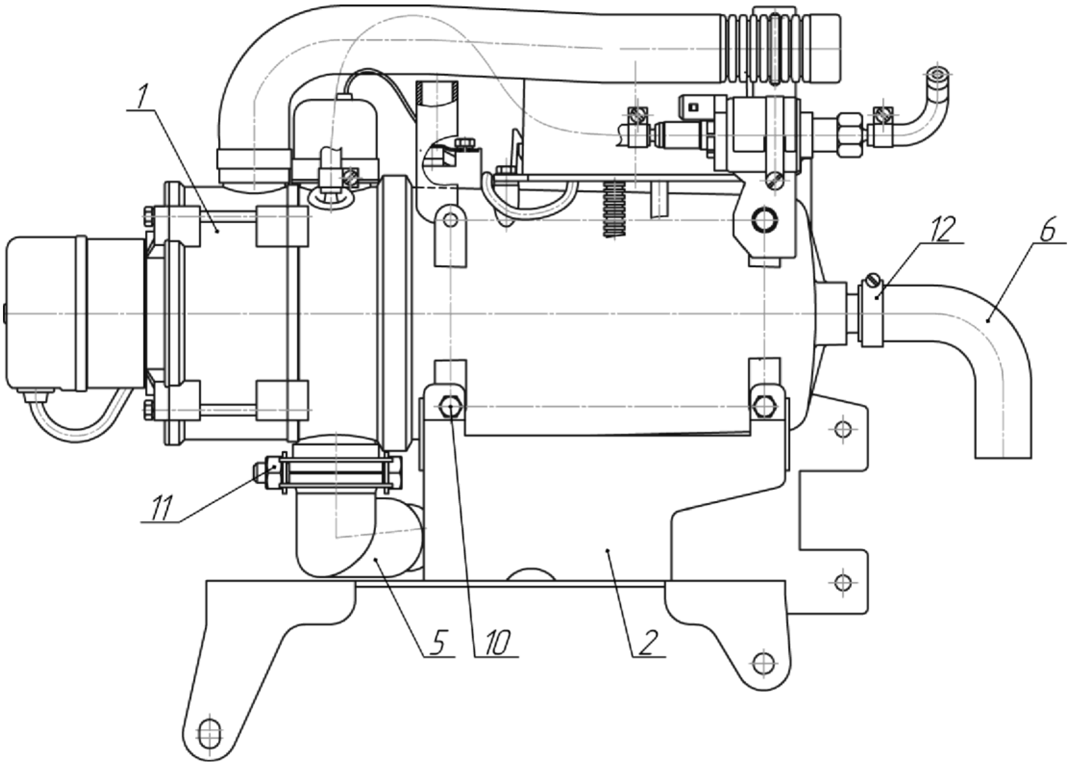


Fig. 3 - Heater unit 14TS-10-24-ST-N1, -N2, -N3

Table 3

Pos. No.	Name, designation and serial number		ADVR. 138.01.00.000 assembly 3856	ADVR. 138.01.00.000-01 assembly 4441
1	Heater			
	ADVR.138.01.01.000	assembly 3857	1	1
2	Bracket			
	ADVR.138.01.02.000	assembly 3858	1	1
5	Exhaust pipe			
	ADVR.138.01.03.000	assembly 3859	1	
	ADVR.138.01.03.000-01	assembly 4442		1
6	Elbow			
	ADVR.138.01.00.001	part 4325	1	1
10	Screw M6x16 DIN 7500D		4	4
11	Clamp Bosal 250-942		1	1
12	Spring clamp MU 25/12		1	1

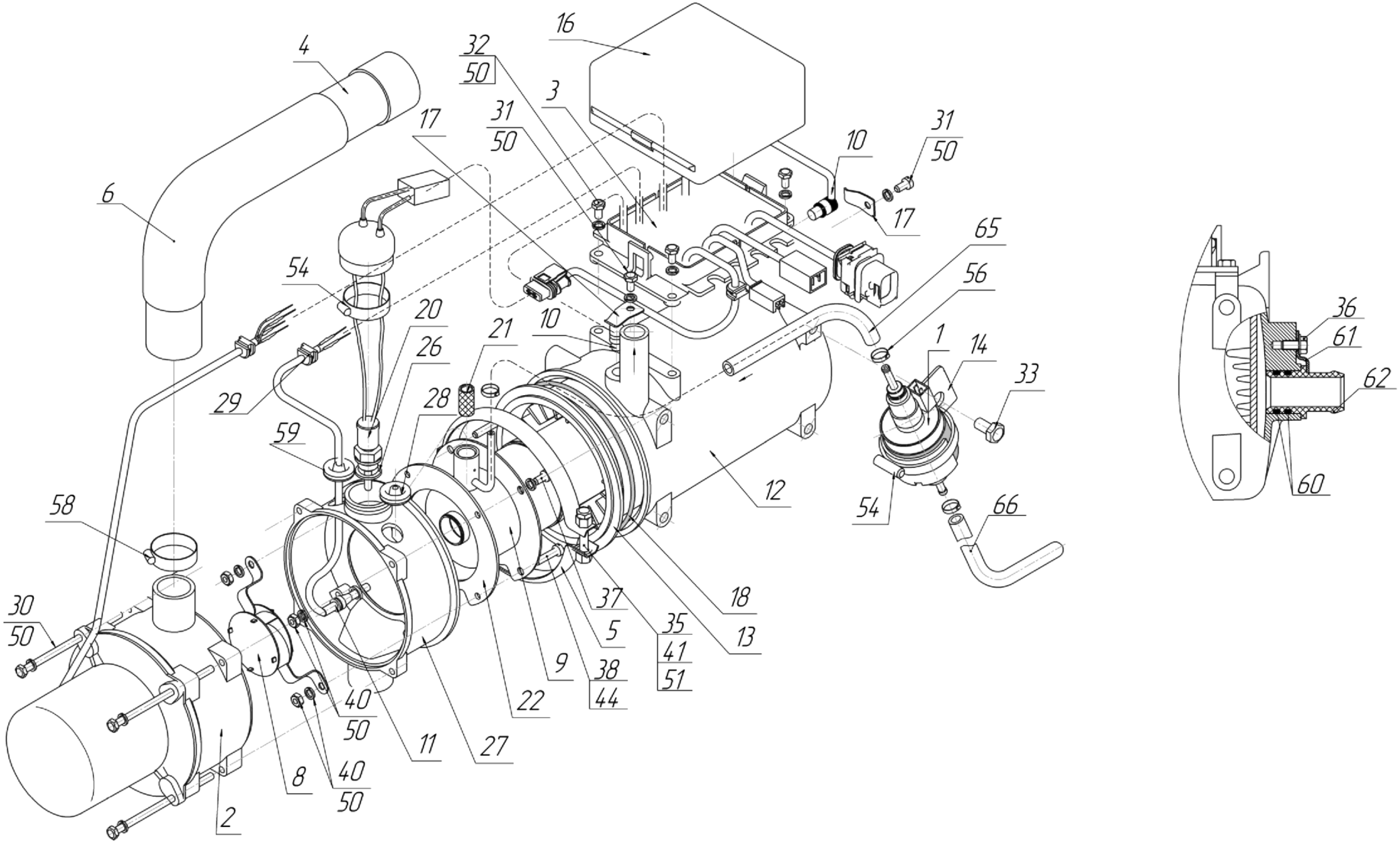


Fig. 6 - Heater explosion diagram

Pos. No.	Name, designation and serial number		Note	Heaters	
				ADVR.285.01.01.000 assembly 4912	ADVR.138.01.01.000 assembly 3857
	Preheater serial number			1	2
1	Fuel pump (as part of the heater)				
	ADVR.209.00.00.000-03	assembly 3645	TN9-6.8ml-24V		1
2	Air blower (repair kit)				
	ADVR.098.06.00.000-01	assembly 1629-01		1	
	ADVR.098.06.00.000	assembly 1405-01			1
3	Control unit				
	ADVR.285.01.02.000	assembly 4939		1	
	ADVR.270.01.01.000	assembly 4117			1
4	Air intake				
	ADVR.020.05.00.000	assembly 410			1
5	Clamp				
	10TC.451.01.05.00.000	assembly 14		1	1
6	Thermal insulation				
	ADVR.010.12.00.000-01	assembly 162			1
8	Swirler				
	14TS.451.12.01.04.000	assembly 65		1	1
9	Combustion chamber				
	14TS.451.01.01.01.000	assembly 238		1	1
10	Sensor (temperature and overheating)				
	14TS.451.01.07.00.000	assembly 160-01		2	2
11	Flame indicator				
	ADVR.038.01.01.500	assembly 1914		1	1
12	Body				
	ADVR.285.01.01.002	part 5525		1	
	10TC.451.01.00.00.001-K or ADVR.159.01.00.001	part 13K or part 2438			1
13	Heat exchanger				
	ADVR.038.01.00.002	part 1138		1	1
14	Bracket				
	ADVR.138.01.01.100	assembly 3988			1
16	Control unit cover				
	ADVR.038.01.00.003	part 1139		1	1
17	Hold-down clamp				
	10TC.451.01.00.00.006	part 18		2	2
18	Ring				
	10TC.451.01.00.00.012	part 59		1	1
20	Plug				
	ADVR.196.00.00.000	assembly 3000		1	1
21	Net				
	10TC.451.01.01.04.000	assembly 49			1
22	Combustion chamber gasket				
	10TC.451.01.00.00.004	part 16		1	1

Pos. No.	Name, designation and serial number		Note	Heaters ADVR.285.01.01.000 assembly 4912	Heaters ADVR.138.01.01.000 assembly 3857
26	Glow plug washer				
	14TS.451.12.01.00.001	part 198		1	1
	Preheater serial number			1	2
27	Adapter				
	ADVR.038.01.01.001 or 14TS.451.01.01.00.001	art 1141 or part 248K		1	1
28	Seal				
	10TC.451.01.00.00.010	part 21		1	1
29	Seal for flame indicator in control unit				
	ADVR.025.00.00.009	part 2066		1	1
30	Bolt M5x80 DIN 912			4	4
31	Bolt M5x10			2	2
32	Bolt M5x14			4	4
33	Screw 6x16 (self-tapping)				1
35	Bolt M8x70			1	1
36	Screw M5x10			1	
37	Bolt M5x20			1	1
38	Bolt M5x25			3	3
40	Nut M5			3	3
41	Nut M8			1	1
44	Flat washer 5 G			4	4
50	Washer 5 (toothed)			15	14
51	Washer 8 (toothed)			2	2
54	Clamp Mikalor 25x40			1	2
56	Clamp Mikalor mini 10/9				4
58	Clamp Mikalor 20x32				1
59	Seal for flame indicator in adapter				
	ADVR.025.00.00.008	part 2065		1	1
60	Ring				
	10TC.451.01.00.00.012-01	part 64		2	
61	Hold-down clamp				
	ADVR.036.01.01.001	part 1060		1	
62	Branch pipe 14TS				
	ADVR.025.00.00.028	part 5172		1	
65	Rubber hose				
	10TC.451.00.00.00.020	part 1475	L=250		1
66	Elbow 5				
	ADVR.025.00.00.016	part 3135			1

Diesel preheater
14TS-10-12-4910,
14TS-10-24-N1,
14TS-10-24-N2

Repair manual

May 2020

Table of Contents

This Repair Manual (RM) is intended for personnel involved in the maintenance and repair of 14TS-10-12-4910, 14TS-10-24-N1 and 14TS-10-24-N2. It contains a procedure for determining malfunctions, as well as methods for determining the suitability of assemblies and parts and the need to replace them.

The Manual provides basic technical data, descriptions of assemblies and their purpose in the preheater, gives recommendations for their maintenance and repair. The Manual provides the main distinguishing features of the models.

When repairing the preheater, it is necessary to additionally use the **operation manual, datasheet, parts catalog and assembly units**.

The Repair Manual may not reflect minor design changes made by the manufacturer after signing this RM for printing.

1 Technical specifications and main components of preheaters

The main technical specifications of the preheaters are shown in Table 1. Technical specifications are given with a tolerance of ±10%, obtained at a temperature of 20 °C and a rated voltage according to Table 1.

Table 1 - Technical specifications of preheaters

Specifications and main components of preheaters	**Models**	
	14TS-10-12	**14TS-10-24**
Heating capacity by modes, kW: -full- -medium- -small-	 12 9 4	 15, 5 9 4
Fuel consumption by modes, l/hour: -full- -medium- - small	 1.4 1.2 0.5	 2 1.2 0.54
Rated supply voltage, V	12	24
Fuel type	- diesel fuel depending on the ambient temperature	
Operation program	“pre-start” or “cost-effective”	

Table 1 (continued)

Power consumption in modes, W (with electric pump):		
-full-	110	132
-medium-	100	101
-small-	77	77
-cooldown-	47	47
at the time of startup	134	156
Heater controls	Control board	
Start-up mode	manual	

2 Safety measures.

2.1 During repairs, the current safety instructions must be followed.
2.2 Violations of the preheater operation rules may cause a fire.
2.3 The workplace must be provided with fire extinguishing equipment.
2.4 Using the preheater with an empty cooling system is strictly prohibited.
2.5 It is prohibited to turn on the preheater without fuel.
2.6 It is prohibited to refuel while the preheater is running.
2.7 It is prohibited to operate the preheater in closed rooms and in rooms with poor ventilation.
2.8 It is prohibited to disconnect the preheater from the power supply before the end of the purge cycle.
2.9 It is prohibited to connect and disconnect connectors to the control board and control unit when the power is on.

3 Design and designation of preheater 14TS-10 main assemblies and its modifications.

3.1 Design, the main assemblies and parts included in the liquid preheater package are shown in the PAUC (Part and Assembly Units Catalog).
3.2 The main assembly in preheaters is the heater.
3.3 The wiring diagram of the preheaters is shown in the operation manual.

4 Possible preheater malfunctions, their causes and remedies.

If a malfunction occurs during the preheater operation, the preheater will stop working, the LED on the control board will flash, and a diagnostic trouble code (DTC) will be displayed on the digital panel (Table 2).

The number of flashes (after a pause) indicates the type of malfunction. The failure causes and troubleshooting methods are given in Table 2a.

Table 2 - DTCs.

DTC	Malfunction description	Comments. Troubleshooting
01	Overheating	1. Check the entire fluid circuit. 2. Check the pump, replace if necessary. 3. Check the temperature sensor and the overheating sensor, replace if necessary. 4. Check the quality of cooling fluid, which should be used depending on the ambient temperature.
02	Possible overheating detected. The temperature difference measured by the overheating sensor and the temperature sensor is too high	
03	Faulty overheating sensor	Replace the sensor
04	Faulty temperature sensor	
05	Faulty flame indicator	Check connecting wires. Check the ohmic resistance between the indicator pins, which should be max. 10 Ohm. In case of malfunction, replace the flame indicator.
06	Faulty control unit temperature sensor	Replace the heater control unit
09	Faulty glow plug	Check the glow plug, replace if necessary.
10	Faulty air blower. RPM below rated value	Check the electric motor wiring. Eliminate the malfunction and replace the air blower if necessary.
12	Shutdown, overvoltage	This defect is possible when the preheater is turned on while the vehicle engine is running. The cause may be a malfunction of the vehicle's voltage regulator.
13	Start attempts exhausted	If the allowed number of start attempts has been used, check the amount and supply of fuel. Check the air intake and the gas outlet pipe. Check the glow plug.
14	Faulty pump	Check the pump electrical wires for short and open circuits, check the pump and replace if necessary.
15	Shutdown, undervoltage	Check the voltage at the heater connector XS2. Check the battery, the vehicle's voltage regulator and the electrical wiring.
16	Ventilation time exceeded	The flame sensor has not cooled down enough during the purge time. Check the air intake and the gas outlet pipe. Check the flame indicator and replace if necessary.
17	Faulty fuel pump	Check the fuel pump wiring for short and open circuits, replace if necessary.
20	No communication with control unit	Check the circuits and pins

DTC	Malfunction description	Comments. Troubleshooting
27	Faulty air blower. Motor does not rotate	Check the wiring, air blower and control unit, replace if necessary.

Table 2a - Number of flashes and types of malfunctions

Number of LED blinks	Malfunction description	Malfunction cause	Recommended remedies
LED does not light up	Preheater does not start.	Faulty battery. Open circuit in wiring. Bad contact in connectors. Broken fuse 25A. Faulty control board.	Replace the battery. Eliminate the open circuit in the power supply. Remove oxidation from connector pins. Replace the fuse. Replace the control board.
1	Overheating Possible overheating detected. The temperature difference measured by the overheating sensor and the temperature sensor is over 20 ºC.	1 No cooling fluid in the cooling system. Air lock in the heater. 2 The applied cooling fluid does not correspond to the season (freezes). 3 Faulty electric pump. 4 Faulty temperature and overheating sensor.	1 Check the entire fluid circuit. 2 Change the cooling fluid 3 Check the pump, replace if necessary. 4 Check the temperature sensor and the overheating sensor, replace if necessary
2	Preheater does not start (two automatic start attempts have been exhausted)	1. There is no fuel in the tank. 2. The applied fuel does not correspond to the season (freezes).	1. Fill the tank with fuel. 2. Change the fuel.
		1. Fuel does not flow to the heater, the fuel pump does not work. 2 Insufficient fuel supply.	1. Check the wiring. Replace the fuel pump if necessary. 2. Eliminate leaks in the fuel line. Check the fuel pump performance, replace if necessary.
		Clogged air intake screen. Clogged gas outlet pipe.	Clean the air intake screen and the gas outlet pipe from possible clogging.
		Insufficient glow plug heating. Faulty glow plug driver in the control unit.	Check the glow plug, replace if necessary. Check the voltage supplied by the control unit to the glow plug, replace the control unit if necessary. (Voltage must be min. 12V).
		Clogged Ø1.5 mm hole in the combustion chamber fitting. The glow plug screen is clogged or not installed all the way in the combustion chamber.	Remove the screen. Clear the Ø1.5 mm hole. If the screen is free of soot, install it or replace it with a new one and install it as shown in Fig. 2

Number of LED blinks	Malfunction description	Malfunction cause	Recommended remedies
3	Flame blowout	1 Fuel line leak. 2 Clogged fuel pump fine filter. 3 Faulty fuel pump. 4 Faulty flame indicator	Check the fuel line tightness. Check the amount and supply of fuel. Check the fuel filter in the fuel pump, replace if necessary. Check the combustion air supply system and the gas outlet pipe. If the preheater starts, check the flame indicator and replace if necessary.
4	Faulty glow plug Faulty air blower motor	Short-circuit to frame. Short or open circuit in the wiring or in the electric motor	Check the glow plug, replace if necessary. Check the wiring and the motor for an open or short circuit, eliminate the malfunction, replace the air blower if necessary.
5	Faulty flame indicator	Short or open circuit in the flame indicator wiring	Check connecting wires. Check the ohmic resistance between the indicator connector pins. The ohmic resistance at 25 °C should be between 26 and 32.5 Ohm. In the event of an open circuit, the ohmic resistance is over 90 Ohm; in the event of a short circuit, the ohmic resistance is below 10 Ohm. In the event of open or short circuit, replace the flame indicator.
6	Faulty overheating sensor Faulty temperature sensor	Short or open circuit in the sensor wiring	Check connecting wires. Check the output voltage. The output voltage is in a linear relationship with temperature (0 °C corresponds to 2.73 V and for 1 °C increase in temperature, the output signal increases by 10 mV). If a malfunction is detected, replace the overheating or temperature sensor.
7	Faulty circulation pump Faulty fuel pump	Short or open circuit in the wiring, or in the circulation pump motor Short or open circuit in the fuel pump wiring.	Check the electrical wires of the circulation pump for a short circuit, check the circulation pump for a short circuit and replace if necessary. Check the fuel pump wiring for a short circuit. Check the resistance at the fuel pump leads. The resistance should be within 14.5 - 16 Ohm. If faulty, replace the fuel pump.

Number of LED blinks	Malfunction description	Malfunction cause	Recommended remedies
9	Shutdown, overvoltage Shutdown, undervoltage	Faulty battery. Faulty voltage regulator.	Check the battery terminals and supply wiring. Check the battery, charge or replace if necessary. Check the vehicle’s voltage regulator operation, replace if necessary.
10	The ventilation is not sufficient to cool the preheater combustion chamber.	During the purge time, the flame indicator in the preheater has not cooled down enough.	Check the air intake and gas outlet pipe, clean from dust and dirt if necessary. Check the flame indicator, replace if necessary. Check the air blower operation, replace if necessary

Attention!! 1 The preheater can be repaired without dismantling it from the vehicle if it is necessary to replace the circulation pump, control board, fuel pump.

2 Heater repair can also be carried out on a vehicle if there is access to replace the control unit, air blower, glow plug, temperature or overheating sensor; flame indicator.

5 Purpose, repair and replacement of heater components.

5.1. Glow plug inspection and replacement.

The glow plug ignites the fuel mixture during preheater startup. Check the performance and replace the glow plug as follows:

- disconnect the connector pos. 1, remove the rubber plug pos. 2 (see Fig.1).
- unscrew the glow plug pos. 3.
- connect the glow plug to a DC source with a voltage of 12 V and after 30 seconds measure the current consumed.

The consumed current should be 3-5.2 A, while the heating element of the glow plug is heated to a bright red color, starting to glow from the tip of the glow plug. The test time is max. 120 sec. The time between switching on is min. 180 sec.

If the glow plug does not meet the listed requirements, it must be replaced.

- when replacing the glow plug, installation should be carried out in the reverse order.

Tightening force of the glow plug pos. 3 is max. (6±0.5) Nm.

Glow plugs with a Japanese incandescent element are made with a supply voltage of 18V (for a 24V product) and 9V (for a 12V product). In this case, the letter designation “GP” is entered in the name of the product configuration.

The glow plugs with an incandescent element with a supply voltage of 12V are similar to previously manufactured glow plugs with a Chinese incandescent element, while no additional designations are introduced in the product name.

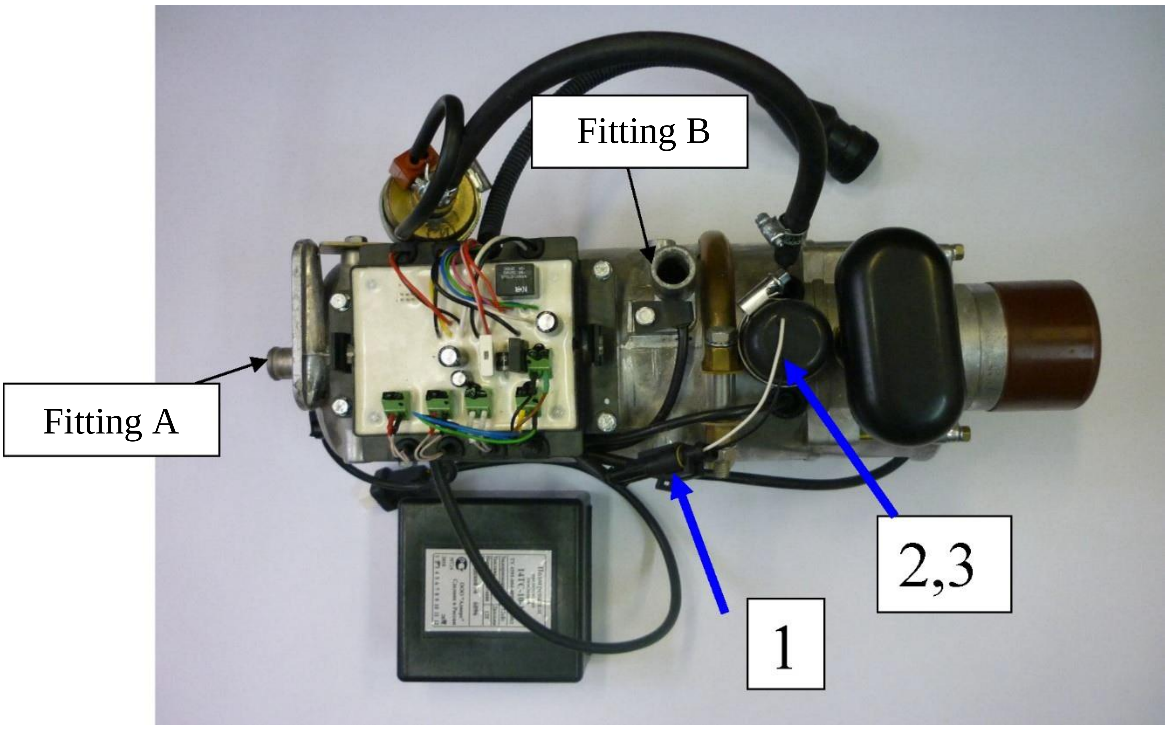


Fig. 1 - Heater

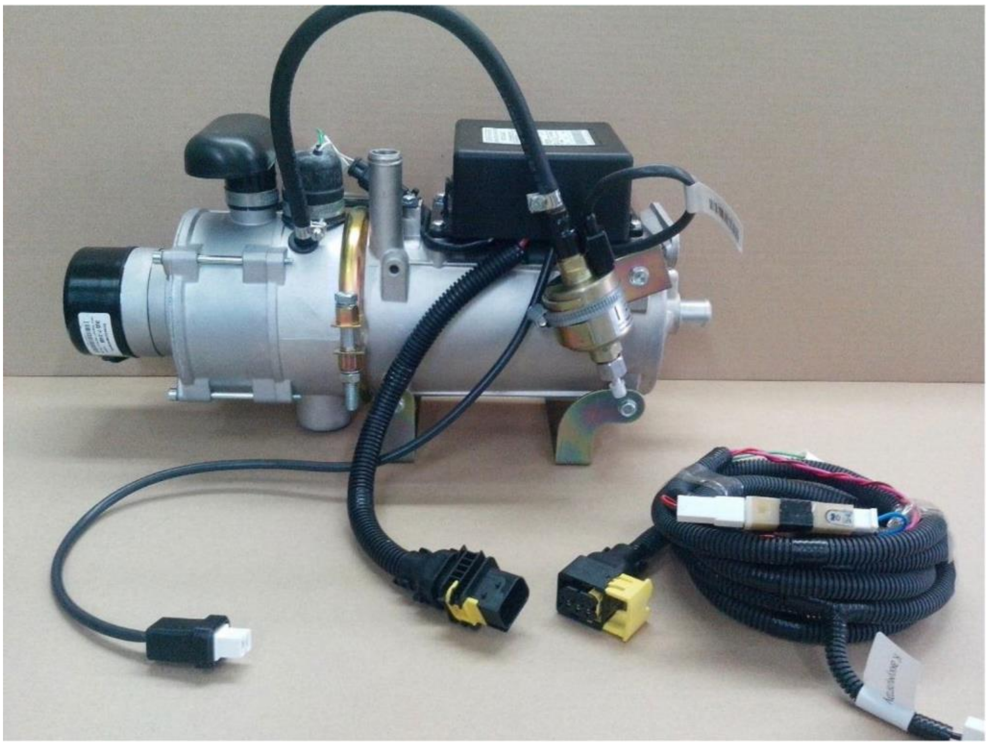


Fig. 2 - Heater
(control unit with new sealed connector)

5.2 Glow plug screen dismantling and replacement.

The screen is designed for uniform supply of fuel to the combustion chamber. When replacing or checking the glow plug, it is necessary to check the screen for soot or clogging. If soot is detected, the screen must be replaced and installed using a mandrel (see Fig. 4) into the combustion chamber fitting until it stops according to Fig. 4, while pre-cleaning the Ø 1.5 mm hole (from possible clogging).

After installing the screen, check dimension A. The dimension should be $10^{+0.5}$ mm (see Fig. 3).

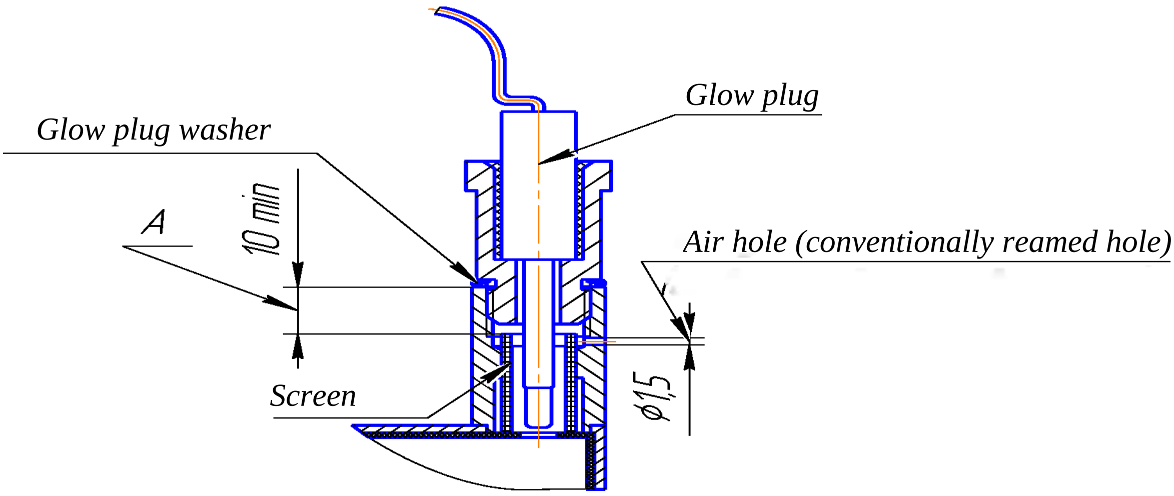
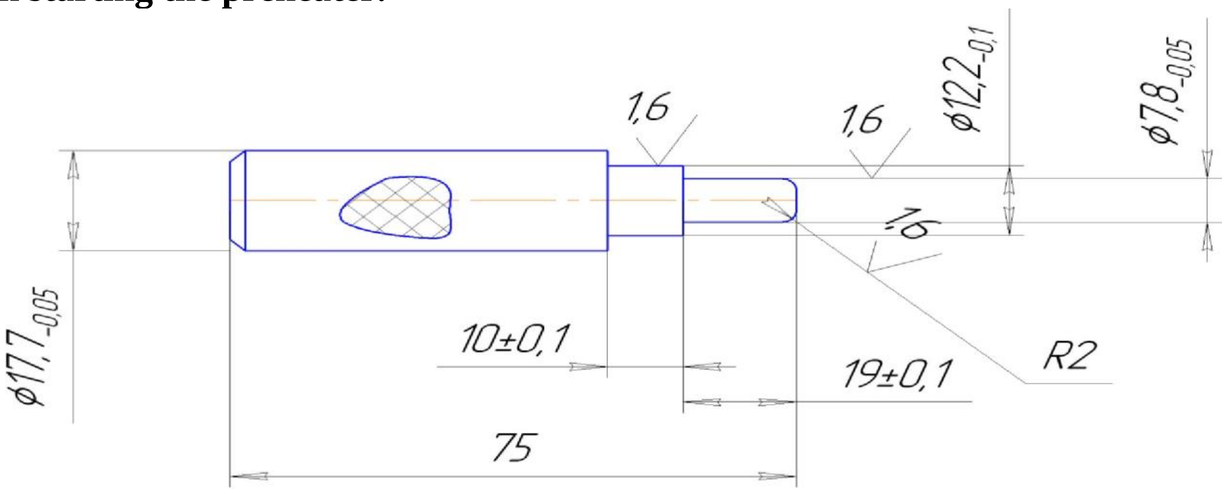


Fig 3 - Diagram of glow plug and screen installation into combustion chamber fitting.

Attention!! The screen must be installed with an interference fit against the stop in the combustion chamber housing using a mandrel.

If the screen is not installed all the way to the end, failures may occur when starting the preheater.



1. Material. Steel 40KhN GOST 4-5T3-71, etc.
2. HRC 45..... 50

Fig. 4 - Mandrel dimensions.

5.3 Inspection, dismantling and replacement of temperature sensor or overheating sensor.

The temperature sensor is used to monitor the temperature of the heated fluid, and the overheating sensor is used to monitor the heating temperature of the heat exchanger.

The fluid temperature sensor and the overheating sensor are identical to each other and are a microcircuit mounted in a metal housing. Structurally, the temperature (overheating) sensor is shown in Fig. 5.

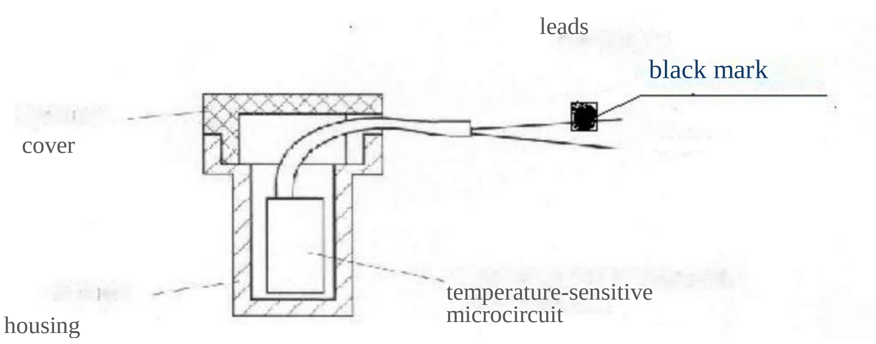


Fig. 5 - Overheating and temperature sensor diagram.

Technical specifications of the temperature (overheating) sensor:

- output signal - voltage;
- output signal change pattern - linear, the signal value increases with temperature;
- sensitivity - 10 mV/deg;
- output voltage value at a temperature of 0 °C - 2.73 V;
- temperature range -45 °C ... +125 °C;
- non-linearity of max. 2 °C.

Check the performance of the temperature sensor and the overheating sensor according to the diagram shown in Fig. 6.

In the event of a short circuit or an output voltage that does not match the measured temperature, replace the sensor. Dismantle and replace the overheating or temperature sensor in the sequence specified in sections 5.3.1 and 5.3.2.

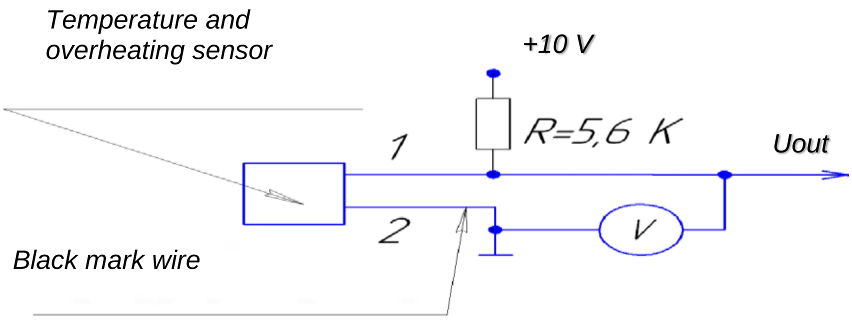


Fig. 6 - Sensor or overheating temperature check diagram

5.3.1 Overheating sensor dismantling and replacement.

The overheating sensor dismantling must be carried out as follows (see Fig. 7):

- drain the coolant from the vehicle system;
- unscrew the screws and remove the cover from the control unit;
- disconnect the overheating sensor wire plugs from the connector after loosening the screws in the connector;
- remove the sensor cable seal from the control unit housing;
- unscrew the screw, remove the hold-down clamp from the sensor and remove the sensor from the heater housing;

- when replacing the overheating sensor, the installation should be carried out in the reverse order, while connecting the wire plug with the black mark wire (or black wire) to the connector socket with a mark in the form of a black dot above the connector socket. After installing the sensor, it is necessary to fill in cooling fluid and remove air from the fluid circuit, guided by the instructions of the vehicle manufacturer.

Fig. 7 - Overheating sensor installation and dismantling

5.3.2 Temperature sensor dismantling and replacement.

The temperature sensor dismantling must be carried out as follows (see Fig. 8):

- drain the coolant from the vehicle system;
- unscrew the screws and remove the cover from the control unit;
- disconnect the temperature sensor wire plugs from the connector after loosening the screws in the connector;
- remove the sensor cable seal from the control unit housing;
- unscrew the screw (see Fig. 8), remove the hold-down clamp from the sensor and remove the sensor from the heater housing;
- when replacing the temperature sensor, the installation should be carried out in the reverse order, while connecting the wire plug with the black mark wire (or black wire) to the connector socket with a mark in the form of a black dot above the socket. After installing the sensor, it is necessary to fill in cooling fluid and remove air from the fluid circuit, guided by the instructions of the vehicle manufacturer.

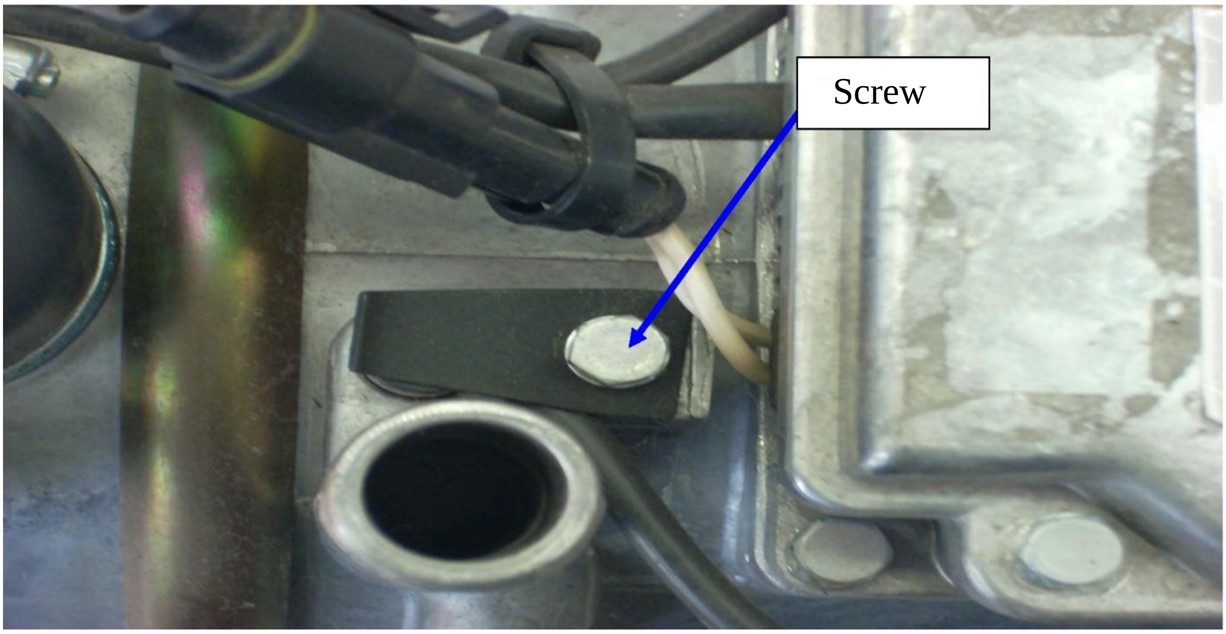


Fig. 8 - Temperature sensor installation and dismantling

5.4 Inspection, dismantling and replacement of flame indicator.

The flame indicator is used to determine the presence of a flame in the combustion chamber. It is a tube with a built-in light bulb with a tungsten filament. The indicator should be placed in the exhaust gas outlet area. Structurally, the flame indicator is shown in Fig. 9.

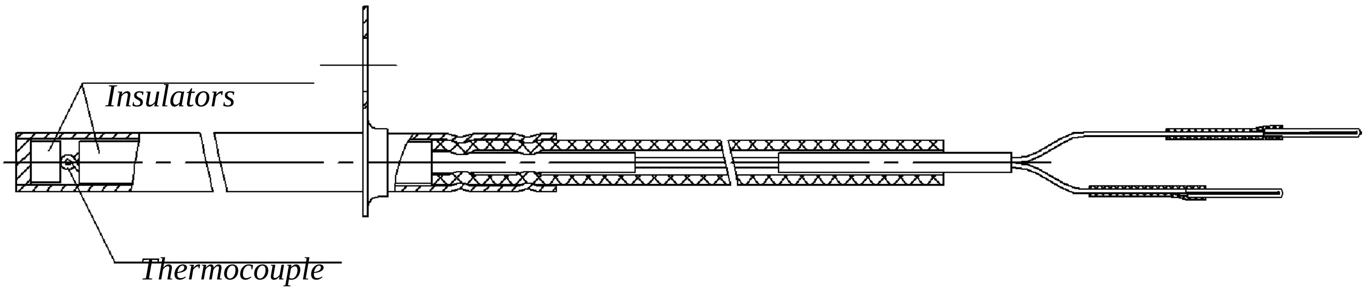


Fig. 9 - Thermocouple flame indicator design diagram

5.4.1 The flame indicator check must be carried out as follows:

- unscrew the screws and remove the cover from the control unit (see Fig. 12);
- disconnect the flame indicator wire plugs from the connector and check the flame indicator performance.

To check the flame indicator performance, measure the resistance between the wire plugs. At a temperature of +25 °C, Rrated should be 26 ... 32.5 Ohm, in case of a short or open circuit, the resistance should be Rshort_circuit < 10 Ohm and Ropen_circuit > 90 Ohm, respectively.

Check resistance between the housing and leads. The resistance must be Rshort_circuit=10 MOhm.

In case of malfunction, replace the flame indicator.

5.4.2 The flame indicator dismantling must be carried out as follows:

- unscrew the screws and remove the cover from the control unit;
- disconnect the flame indicator wire plugs from the connector;

- remove the flame indicator cable seal from the control unit housing;
- unscrew the screws securing the adapter and the air blower and disconnect the air blower;
- unscrew the nut, remove the hold-down clamp from the indicator (see Fig. 10) and remove the flame indicator from the adapter;
- when replacing the flame indicator, installation should be carried out in the reverse order.

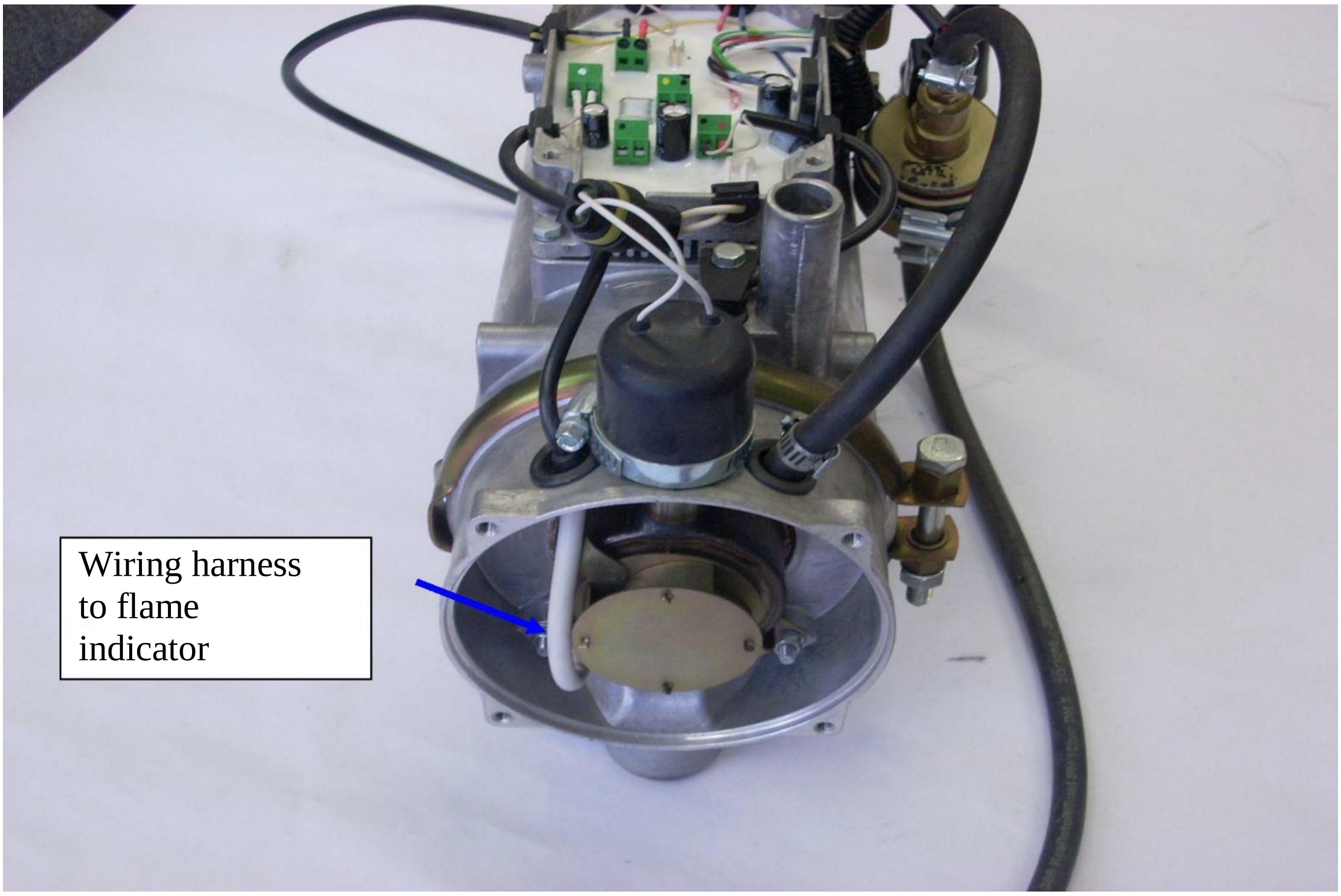


Fig. 10 - Heater with air blower removed to replace flame indicator

5.5 Purpose, dismantling and replacement of air blower.

The air blower (Fig. 11) consists of two parts: a volute and an electric motor with an impeller. Replacement is carried out in a complete set (see PAUC).

The air blower supplies air to the combustion chamber to ensure combustion in all modes. The change in the flow rate of air supplied to the combustion chamber occurs due to a change in the rotation speed of the air blower impeller. The impeller rotation speed is changed by a PWM signal supplied by the control unit in accordance with the program.

The air blower also purges the combustion chamber before starting and ending the combustion process in order to cool the combustion chamber, remove moisture and remaining fuel.

If the electric motor or impeller fails (determined by noise and low air flow pressure), the air blower must be replaced.

The air blower dismantling must be carried out as follows:

- unscrew the screws and remove the cover from the control unit;
- disconnect the air blower wire plugs from the connectors;
- remove the air blower cable seal from the control unit housing;
- unscrew the screws and disconnect the air blower components from the adapter.

When replacing the air blower, the installation should be carried out in the reverse order, while connecting the wire plug with the black mark wire (or black wire) to the connector socket with a black mark in the form of a black dot above the socket.

Attention! The air blower is replaced as a complete set.

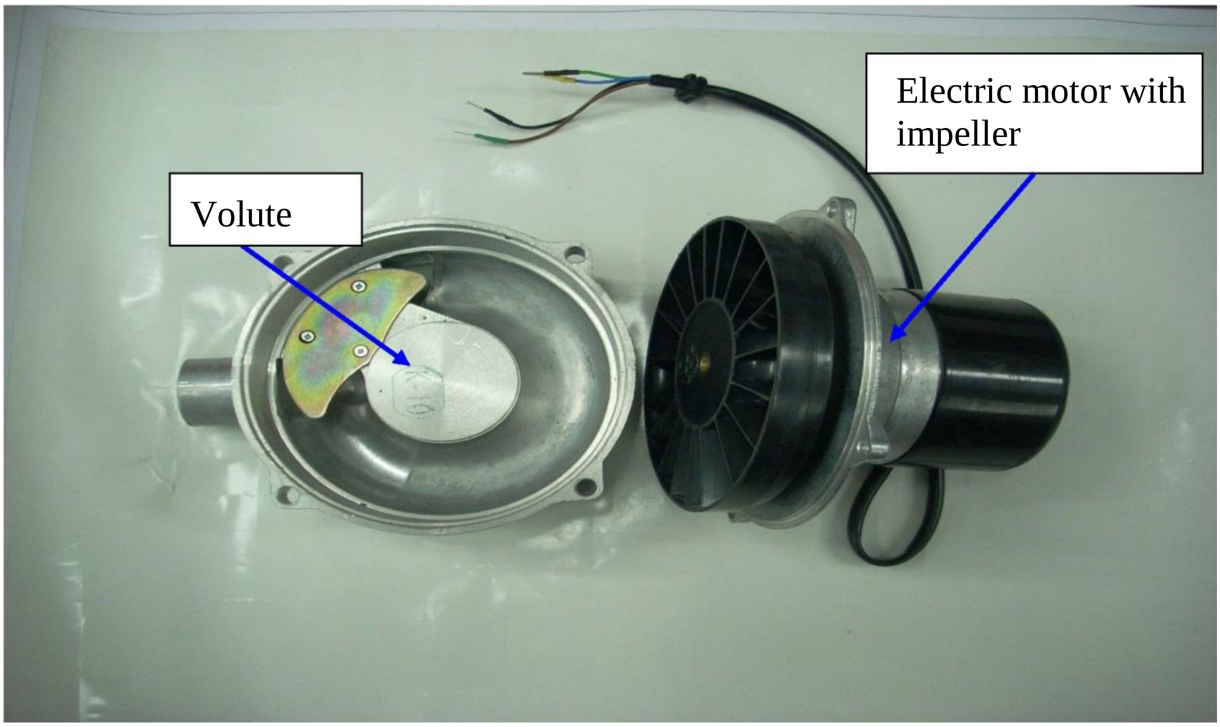


Fig. 11 - Air blower components

5.6 Purpose, dismantling and replacement of combustion chamber.

The evaporative combustion chamber is designed to create and burn an air-fuel mixture. The appearance is shown in Fig. 12 and 13.

An increase in smoke at the heater outlet or increased CO, or flame blowout with all other heater elements in good working order are considered to be the signs of combustion chamber failure.

The combustion chamber dismantling must be carried out as follows (see Fig. 15):

- drain the coolant from the vehicle system;
- remove the heater if disassembly on the vehicle is not feasible;
- unscrew the screws and remove the cover from the control unit;
- dismantle the glow plug in accordance with p. 5.1;
- dismantle the air blower in accordance with p. 5.5;
- dismantle the flame indicator in accordance with p. 5.4;
- unscrew the bolt of the tightening clamp and disconnect the adapter from the preheater housing;
- unscrew the two nuts and remove the swirler;

- unscrew the screws securing the combustion chamber with the adapter and remove the combustion chamber;

If during the combustion chamber inspection burnt parts are found, or the housing burns out, the combustion chamber must be replaced.

- when replacing the combustion chamber, the installation is carried out in the reverse order, while it is necessary to replace the gasket installed between the combustion chamber and the adapter, see PAUC.

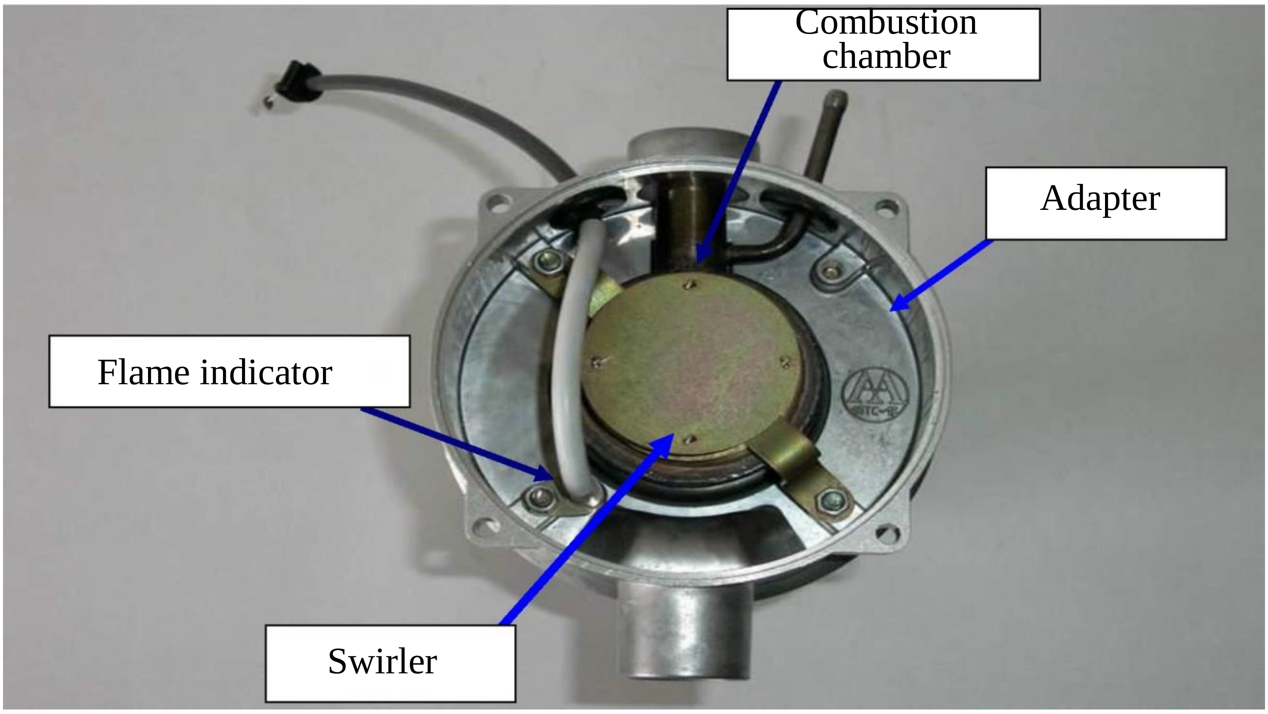


Fig. 12 - Combustion chamber with adapter and flame indicator.

Fig. 13 - Combustion chamber without swirler

5.7 Purpose, dismantling and replacement of heat exchanger

The heat exchanger (Fig. 14) is designed to transfer heat from the hot gas flow formed from the air-fuel mixture combustion to the coolant circulating in the heater liquid jacket.

Malfunctions that may occur during the operation of the heat exchanger are the loss of thermal conductivity due to the deposition of carbon deposits and soot of the diesel fuel combustion products on the inner walls and fins, as well as the loss of tightness. An increase in the temperature of the exhaust gases from the heater above 550 ^{O}C is considered to be the sign of thermal conductivity loss by the heat exchanger.

The heat exchanger dismantling must be carried out as follows (Fig. 15):

- drain the coolant from the vehicle system;
- disconnect the fuel line from the heater;
- dismantle the glow plug in accordance with p. 5.1;
- unscrew the screws and remove the cover pos. 1 from the control unit;
- disconnect the wire plugs coming from the flame indicator and air blower from the control unit connectors;
- remove the air blower, flame indicator cable seal from the control unit housing;
- unscrew the bolt of the tightening clamp pos. 2 and disconnect the combustion chamber with adapter and air blower pos. 3 from the housing;
- remove the heat exchanger from the heater housing;
- after dismantling, clean the inside of the heat exchanger from carbon deposits and soot, and the outer surface from possible deposits;
- installation of the heat exchanger in case of replacement or cleaning should be carried out in the reverse order, while it is necessary to replace the O-ring pos. 4, installed between the heat exchanger and the heater housing. Install the heat exchanger in the housing according to Fig. 15, while it is necessary to combine the recess line on the heat exchanger helical fin with the upper casting protrusion on the housing. After installing the heat exchanger and sensors, and tightening the clamp pos. 2, it is necessary to check the tightness of the heater liquid circuit. The tightness test should be carried out with compressed air at a pressure of 0.25 MPa (2.5 kgf/cm^2). Supply pressure to the fitting A, while plugging the fitting B (see Fig. 1). The test shall be carried out for 5 minutes. Air pressure drop is not allowed.

Fig. 14 - Heat exchanger

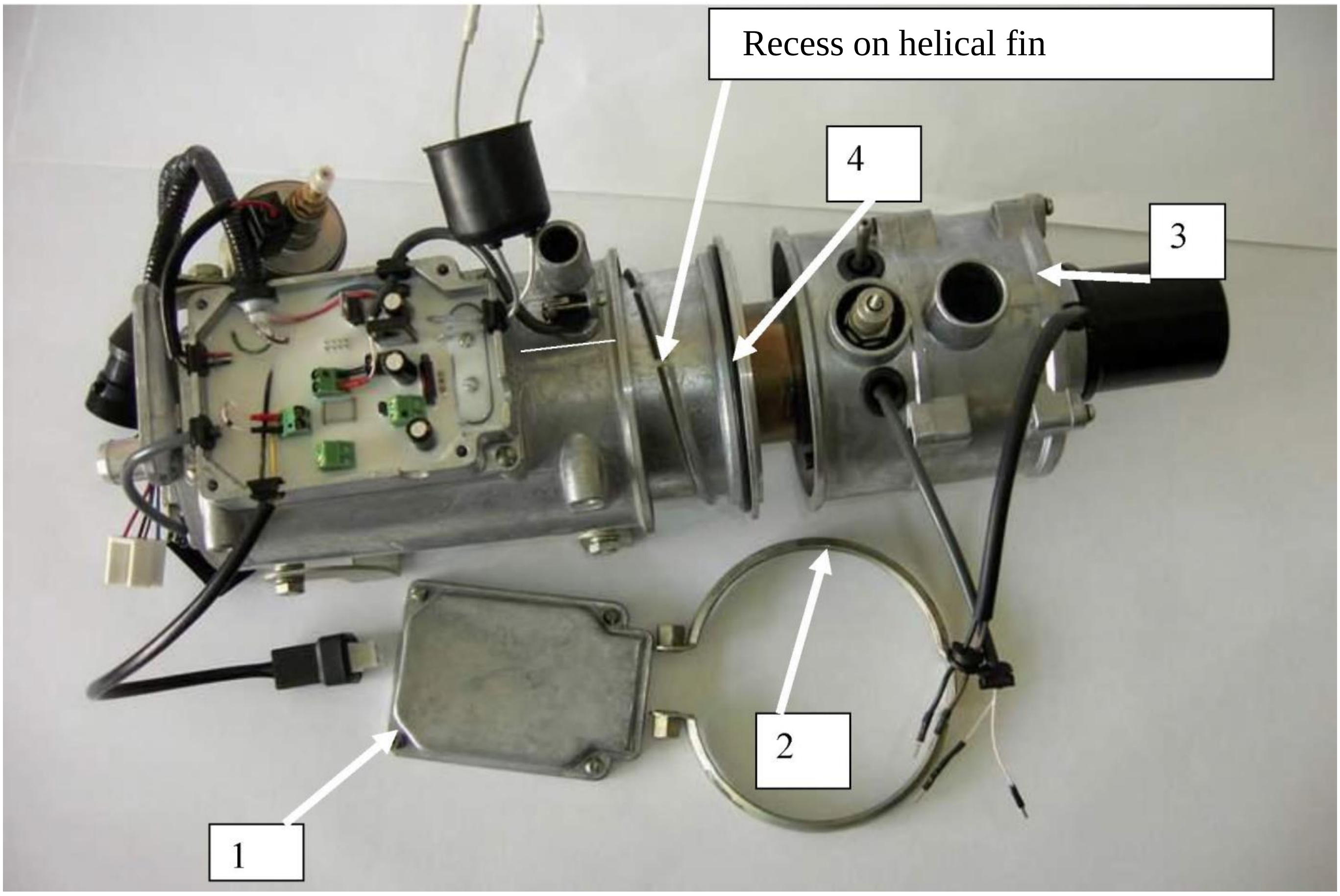


Fig. 15 - Disassembled heater.

6 Repair and replacement of preheater components.

6.1 Purpose, dismantling and replacement of electric motor with pump.
The pump circulates the coolant in the vehicle's cooling circuit and heater (see Fig. 16).
6.1.1 In case of the fluid (cooling fluid) leakage through the pump seals or in the event of the electric motor malfunction (short circuit in the electric motor), the pump should be dismantled and replaced.
6.1.2 Pump dismantling:
- drain the coolant from the vehicle system;
- disconnect the connector between the pump and the heater;
- disconnect the pump from the vehicle fluid system, to do this, loosen the clamps and remove the rubber hoses from the inlet and outlet branch pipes of the pump, while closing the hole in the rubber hoses with a plug;
- unscrew two bolts securing the pump and disconnect it from the attachment point;
- when replacing the pump, installation should be carried out in the reverse order. After installing the pump, it is necessary to remove air from the vehicle fluid circuit, guided by the instructions of the vehicle manufacturer.

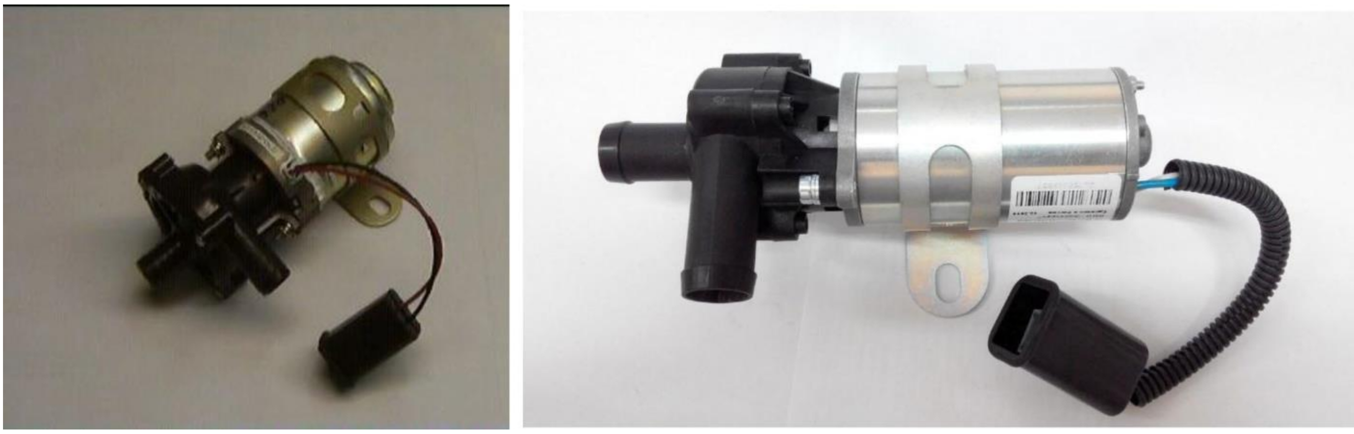


Fig. 16 - Electric motor with pump

6.2 Purpose, fault detection, dismantling and replacement of fuel pump.

6.2.1 The fuel pump (Fig. 17) is used to dose fuel into the combustion chamber.

The main parameters of the fuel pump:

- rated supply voltage - 12 V or 24 V;
- coil resistance:
  a) 4.5 - 5 Ohm (for 12 V fuel pump);
  b) 14.5- 16 Ohm (for 24 V fuel pump).
- Possible types of the heater fuel pump malfunctions:
  a) during the heater startup, fuel does not flow to the heater fuel pipe and no characteristic knocking is heard in the fuel pump;
  b) the fuel pump works, but the fuel does not flow to the heater fuel pipe;
  c) interruption of combustion when the heater reaches the “max” operating mode, i.e. the fuel pump does not provide the necessary performance.

6.2.2 Troubleshooting and determining the fuel pump performance should be carried out as follows:

- before eliminating possible malfunctions, it is necessary to check the presence and quality of fuel in the tank;
- make sure that the wiring and connectors are in good condition;
- make sure that the fuel pump works when the heater is turned on and a characteristic knock is heard from the piston movement inside the pump;

It is allowed to remove the fuel pump and shake it to eliminate possible sticking of the piston inside the pump due to long-term storage or due to failure to take preventive measures according to the operation manual;

- make sure that the fuel line is sealed all the way to the fuel pump and from the fuel pump to the heater;
- make sure that the filter is clean;
- check the tightness of the connection between the fuel pump housing and the inlet fitting (see Fig. 17). Checking should be carried out with air pressure of max. 1 kgf/cm^2. Supply pressure from the inlet and outlet side at the same time. If the connection is leaking, it is necessary to replace the gasket in the fitting (see Fig. 17).

If all of the above malfunctions are eliminated, then it is necessary to check the fuel pump performance. The fuel pump performance should be 6.5 + 7.14 ml per 100 strokes. If the performance is less or more, then the fuel pump must be replaced.

- Fuel pump dismantling and installation:
- loosen the clamps and remove the fuel lines from the fuel pump fittings;
- disconnect the electrical wiring from the fuel pump;
- loosen the screw on the clamp and remove the fuel pump.

When replacing the fuel pump, installation should be carried out in the reverse order.

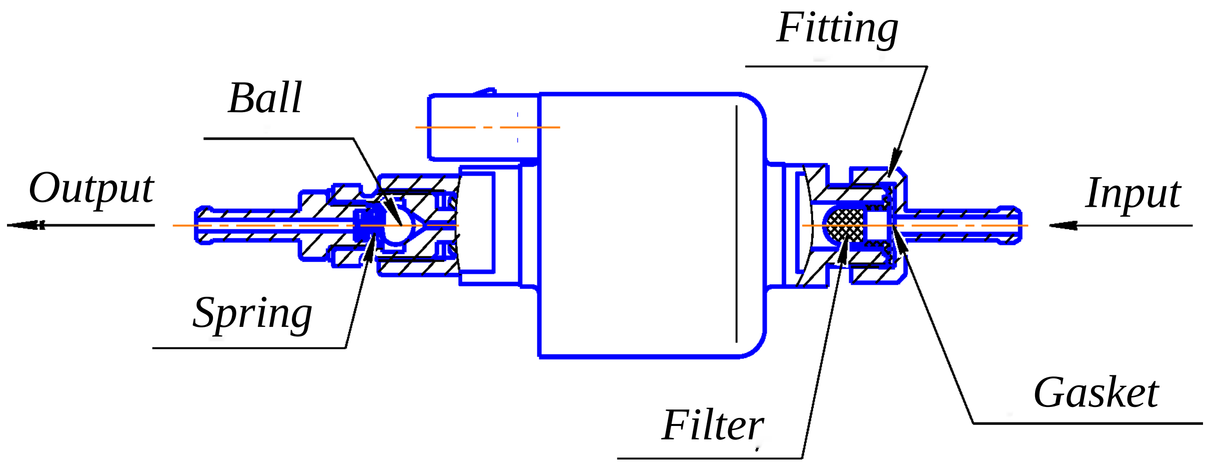


Fig. 17 Fuel pump

6.3 Automatic fuel priming device (not included in preheater package)

6.3.1 Purpose.

The automatic fuel priming device (hereinafter referred to as AFPD, see the diagram in Fig. 18) is designed to fill the fuel line of the preheater with fuel after the latter is installed on the vehicle, or after repair or maintenance work on the preheater in order to prevent the “idle” preheater operation.

6.3.2 Operating procedure:

- disconnect the power harness from the fuel pump;
- remove the fuel line from the heater fuel pipe. When pumping fuel through the fuel line, provide for draining excess fuel into a separate container;
- connect the AFPD harness to the fuel pump;
- connect, observing the polarity, the AFPD power supply harness to the battery or to another source of direct current;
- turn on the AFPD and fill the fuel line with fuel;
- disconnect the AFPD from the power source;
- install and fasten the fuel line to the heater fuel pipe with a clamp;
- disconnect the AFPD harness from the fuel pump;
- connect the power harness from the preheater to the fuel pump

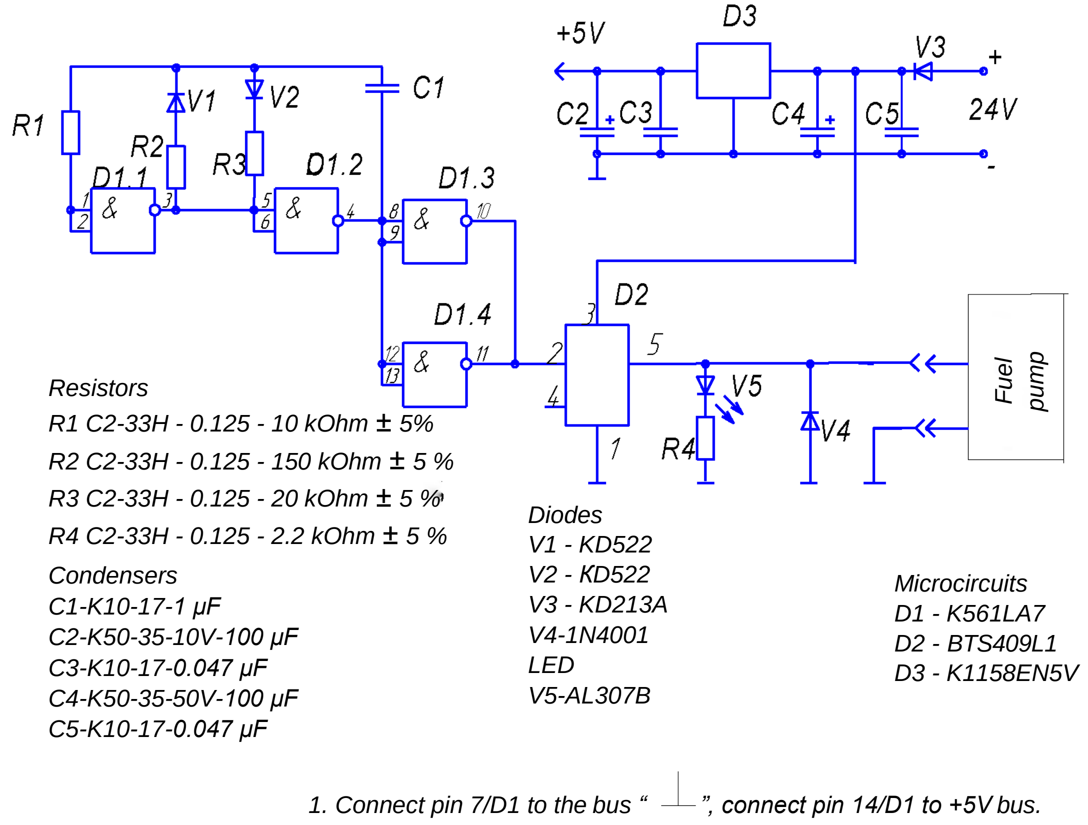


Fig. 18 - Electrical circuit diagram of AFPD

6.4 Control unit dismantling and replacement.

The control unit is mounted on the heater and connected with its connector to the preheater electrical harness.

The control unit is used to automatically control the preheater operation. It provides the following operations:

- initial diagnostics of preheater assemblies at the beginning of startup;
- ignition mode;
- transition from mode to mode (full, medium, small, cooldown);
- turning on the cab heater fan, when the coolant reaches a certain temperature;
- shutdown mode (on expiration of the specified operating time and in the event of a malfunction);

Maintains ongoing monitoring over:

- glow plug serviceability;
- temperature sensor serviceability;
- overheating sensor serviceability;
- flame indicator serviceability;
- fuel pump serviceability;
- pump serviceability;
- air blower serviceability;
- flame blowout in combustion chamber;
- applied voltage value.

When determining the control unit malfunction, it is necessary to make sure that all components of the preheater are in good condition, then replace the control unit, and if the preheater with the new control unit is operational, then the removed one is considered inoperable and must be replaced.

Attention ! Types of manufactured units and software versions for each preheater, as well as a list of manufactured repair kits, are indicated in the PAUC.

The preheater control unit dismantling is carried out as follows:

- release the latches and remove the cover from the control unit;
- disconnect the glow plug connector;
- disconnect the wires of the temperature sensor, overheating sensor, air blower, flame indicator from the connectors;
- disconnect the connector from the fuel pump, pump and harness;
- unscrew the screws securing the control unit housing.

Install the control unit in reverse order.

6.5 Control board dismantling and replacement.

The control board is intended for use as a part of the preheater as a device that provides manual control of the preheater.

To avoid errors in assessing the performance of the control board, it is necessary to replace it with a serviceable control board. If with a new control board the cause of the preheater malfunction is eliminated, the removed control board is considered inoperative and must be dismantled.

The control board dismantling is carried out as follows:

- disconnect the control board connectors from the harness connectors;
- unscrew the mounting screws and remove the control board from the vehicle dashboard;
- when replacing the control board, the installation is carried out in the reverse order.

7 Process equipment for maintenance and repair of liquid preheaters and air heaters.

A fixed inspection bench DV 1105.000 (Fig. 19) manufactured by the company is used for maintenance and repair of preheaters

Bench DV 1105.000 purpose.

1 Bench DV 1105.000 is designed to test preheaters 14TS, air heaters PLANAR-4D-12V/24V and their main components:

- fuel pump;
- air blower;
- temperature and overheating sensor;
- flame indicator;
- glow plug.

2 Checking the preheater and heater operating modes: ignition, low mode, medium mode, full mode, standby mode, purge and stop mode.

3 Testing the 14TS preheater using the diagnostic device:
- fault diagnostics (DTCs);
- supply voltage;
- readings of temperature and overheating sensors;
- flame indicator;
- RPM and setpoint of the air blower motor;
- DTC indication.

The key specifications and rules of work on the bench are described in the Operation Manual for DV 1105.000.

Note. The use of this bench allows to quickly and efficiently carry out repair work of preheaters and heaters.

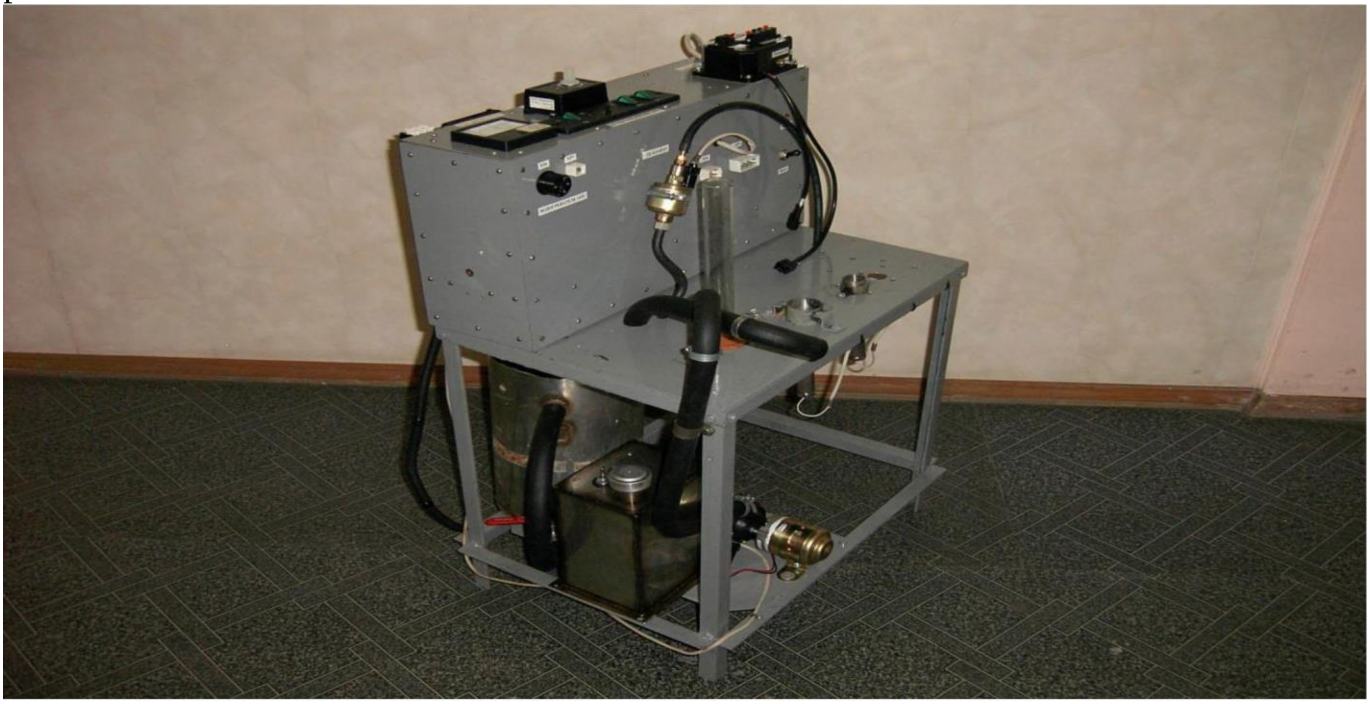


Fig. 19 - Inspection bench for 14TS preheater

8 Inspection of preheater after repair.

8.1 When installing the preheater on a vehicle after repair, it is necessary to ensure:
- tightness of the fluid system;
- tightness of the fuel system fuel lines;
- reliability of fastening of the preheater electrical contacts.

8.2 Fully open the valve of the interior heater. Remove air from the vehicle fluid circuit, guided by the instructions of the vehicle manufacturer.

8.3 Check the preheater for operability by setting the switch on the control board to position "3" or "8", and the power switch to position "I". The preheater startup should follow. Further operation of the preheater takes place in automatic mode for 3 hours or 8 hours. After 3 hours or 8 hours of operation, the preheater will turn off automatically. When checking the performance, the preheater must go through all operating modes ("full", "medium", "small", "cooldown", as well as turning on the cab heater fan when the coolant reaches a temperature of 55 ^{O}C).

At the tester request, the preheater can be turned off earlier by moving the power switch to position “O”.

If for some reason a failure occurs during the preheater startup or operation, the LED will flash. The number of flashes after a pause indicates the type of malfunction.

8.4 Start and operate the preheater with the vehicle engine running.

9 Manufacturer’s warranty.

9.1 The manufacturer’s warranty is retained if the costumer complied with the preheater operation rules specified in the Operation Manual.

9.2 Each preheater that has been repaired at an enterprise authorized by the manufacturer must have a note in the warranty card about the repair work carried out, replacement of components and parts, certified by the stamp or seal of the repair enterprise.

9.3 Use of the preheater for other purposes, as well as its operation in violation of the Service Manual and making any structural changes without the manufacturer’s consent is not allowed. In case of non-fulfillment of the specified conditions, the manufacturer does not accept complaints from customers and does not consider claims.

9.4 The control board, control unit, heater and fuel pump with traces of attempts to repair them are not subject to warranty replacement.