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KAMAZ PUBLICLY TRADED COMPANY



Operation manual

KAMAZ-5490 vehicle

5490-3902203-01 РЭ

Naberezhnye Chelny
2017

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INTRODUCTION

Operation manual includes technical data of KAMAZ-5490 vehicle, recommendations on operation and technical maintenance.

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Page numbering: the first number is a number of the section, the second number is a number of the page.

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Vehicles of «У» version (to be supplied to regions and countries with moderate climate) are designed to operate at ambient air temperatures from minus 40 °C to plus 40 °C, the air relative humidity up to 75 % at plus 15 °C.

Vehicles of «Т» version (to be supplied to regions and countries with tropical dry and wet climate) are designed to operate at ambient air temperature of minus 10 °C to plus 45 °C and relative humidity up to 80 % at 27 °C.

Vehicles may operate at dust content up to 1,0 g/m^3, wind velocity up to 20 m/s and in regions situated at an altitude up to 4500 m, with pass-overcoming ability up to 4650 m, with corresponding change of tractive-dynamic abilities, properties and fuel economy.

Truck tractor can be operated with semitrailers, whose technically permissible maximum weight does not exceed the weight designated for this vehicle.

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CONTENT

1 FOR YOUR ATTENTION 1-1
2 OPERATION PARAMETERS 2-1
Vehicle technical data 2-1
Table of additional technical data 2-2
Engine technical data 2-3
Tire air pressure 2-3
Tools, accessories, spares and operational documentation supplied with vehicle 2-4
Vehicle marking 2-6
Engine marking 2-8
Scheme of sealing 2-9
3 BRIEF DESCRIPTION OF VEHICLE SYSTEMS AND MECHANISMS 3-1
Engine 3-1
Transmission 3-1
Frame and fifth-wheel coupling 3-1
Suspension 3-2
Steering control 3-2
Brake system 3-2
Cab 3-2
Hydraulic equipment 3-2
Electric equipment 3-3
Electronic control systems 3-3
4 VEHICLE OPERATION 4-1
Vehicle keys 4-1
Driver's working place 4-2

Instrument panel..... 4-3
Instrument cluster..... 4-3
Pilot lamps..... 4-5
Information display..... 4-6
Information system control..... 4-7
Check before motion initiation..... 4-8
Switch blocks..... 4-11
Instrument panel..... 4-11
Driver's/ passenger's door..... 4-13
Over the windshield..... 4-13
Bunk..... 4-14
Adjustment of headlamp inclination angle..... 4-14
Light shifter..... 4-15
Light for movement in the daytime..... 4-15
End-outline and side marker lamps..... 4-15
Low beam..... 4-15
High beam..... 4-15
Auxiliary illumination headlamps in insufficient visibility conditions and rear fog lamps..... 4-16
Train lamps..... 4-16
Spotlight of the coupler..... 4-16
Flash beacons..... 4-16
Combination switch..... 4-17
Switching of direction indicator..... 4-17
Engagement of warning light..... 4-17
Horn..... 4-17
Windscreen wipers..... 4-18

Windscreen washer…..…….... 4-19
Cab doors……..……...……... 4-20
Door lock blocking……..……...……..…….... 4-20
Lowering and raising of side windows of driver/ passenger…….……..…. 4-21
Lifting top hatch……..…..……..… 4-21
Mechanical closure of raisable top hatch……..……... 4-22
Safety screen of the hatch…..……..…….. 4-22
External rear view mirrors……..……..…….. 4-23
Position regulation of external rear view mirrors…….……..……..… 4-23
Mirror heating…….…….……..……... 4-23
Seat position adjustment…….……...……..…. 4-24
Safety belts……..……..... 4-27
The upper bunk……..……..…….. 4-28
The lower bunk…….…… 4-29
Steering wheel adjustment……..…….. 4-30
Air conditioning system control…….…… 4-31
Ventilation deflectors……..……..…… 4-31
Air conditioning system control panel……..……..…… 4-31
Examples of settings……..……..…. 4-33
Fresh air mode……..……..…. 4-33
Air recirculation mode……..……..…. 4-33
Engagement of ventilation in the cab..……..……..…. 4-33
Engagement of heating in the cab…….……..…….. 4-33
Windscreen defrosting.……..……..…. 4-34
Conditioner……..... 4-35
Independent cab air heater……..……..... 4-36

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Cab interior light…… 4-37
Electrical sockets…… 4-38
Jumper…… 4-38
Voltage converter…… 4-38
Output terminal for radio station power…… 4-38
Ash tray…… 4-39
Smoke detector…… 4-39
Digital tachograph…… 4-40
Glove compartments and boxes…… 4-40
Terminal for power of radio receiver…… 4-40
Emergency response service calling unit (ERA-GLONASS)…… 4-41
Application and control devices…… 4-41
Operation modes…… 4-42
Driving the vehicle…… 4-43
Safety requirements…… 4-43
Safety requirements during operation of vehicle with electronic systems…… 4-45
New vehicle operation (running-in)…… 4-46
Main rules of operation…… 4-46
Recommended operation modes of engine…… 4-48
Preliminaries for vehicle motion…… 4-49
Fuel tank filling (for certain configurations upon availability of two fuel tanks)…… 4-50
Engine start and shutdown procedure…… 4-51
Engine start up…… 4-51
Engine shutdown…… 4-52
Idle speed adjustment…… 4-53
«Cruise-control» mode…… 4-54
Gearbox control…… 4-55
Gearbox with automated control…… 4-57

Messages on the display…….... 4-57
Gear shifter……..…….. 4-58
Automatic gear box control…….……..……. 4-59
Gearbox manual control…….……...……. 4-60
Motion modes…….…. 4-60
Interwheel differential lock……...……...……..... 4-62
Brake system……..……...…….....…... 4-63
Service brake system……..……...…. 4-63
An emergency brake system…..…… 4-63
Parking brake system……..……..…. 4-63
Auxiliary brake system……..……..…. 4-64
Auxiliary brake system control by means of the switch……... 4-65
Electronic brake system EBS……..……. 4-66
Control of service and auxiliary brake systems with the aid of brake pedal («Brake-Management»)……..……..……..... 4-66
Antilock brake system……...……..……..…. 4-66
Antiskid system (ASR)……..……..……. 4-67
Vehicle stability control system……...……..... 4-67
Hill start assist control…….……..……..…… 4-68
Air suspension remote-control console……..……..…… 4-69
Chock……..……..... 4-70
Facing panel……..……..…… 4-71
Vehicle towing……..……...…… 4-72
Operation of bolster truck tractor being a part of a road train…… 4-73
Pumping of petroleum product during operation of hydroficated bolster traction truck with a tank semitrailer ……...……..…… 4-75

5 VEHICLE OPERATION IN COLD SEASON..... 5-1
Special features of vehicle operation during cold period of time..... 5-1
Cold weather engine starting..... 5-3
To start the engine using the efu unit..... 5-4
Pre-starting heater..... 5-5
Fuel heating..... 5-5
To heat the neutralizing liquid..... 5-5
6 MAINTENANCE..... 6-1
Daily maintenance (daily Mnt.) procedures..... 6-2
Weekly maintenance (weekly Mnt.) procedures..... 6-8
Vehicle care..... 6-14
To care the windscreen..... 6-15
Air filter replacement..... 6-16
Checking receivers for condensation..... 6-17
Tire maintenance..... 6-17
When inflating the tires..... 6-18
Checking the oil level in engine crankcase..... 6-19
Coolant level check..... 6-20
Coarse fuel filter..... 6-21
Fuel tank air filter..... 6-23
After-treatment system..... 6-24
Checking the fuel level in the independent fuel tank of pre-starting heater..... 6-26
Storage batteries..... 6-27
7 VEHICLE MECHANISMS AND SYSTEMS TROUBLESHOOTING. SELF-HELP..... 7-1
Hazard signal system engagegment..... 7-2
Diagnostics of vehicle systems..... 7-3

Sequence to read diagnostic codes…… 7-4
Mode for diagnostics of operational parameters…… 7-6
Indication and elimination of faults…… 7-8
Indication of faults in the lightning equipment…… 7-19
Engine start from external power source…… 7-24
Starting the engine from the battery of another vehicle…… 7-25
Battery emergency switch off…… 7-26
Brake linings wear-out…… 7-26
Battery emergency stop switch for vehicles carrying dangerous goods …… 7-26
Steering system faults…… 7-27
Steering play…… 7-27
Power steering unit does not provide required force…… 7-27
Parking brake release in hazard situations…… 7-28
Fuses and relays…… 7-29
Arrangement of fuses and relays…… 7-29
Checking and replacing fuses…… 7-35
Replacing the bulbs…… 7-36
Safety requirements…… 7-36
Replacing the bulbs…… 7-36
Table of lighting equipment applied in a vehicle…… 7-39
Trouble-shooting guide for electric equipment…… 7-40
Cab raising and lowering…… 7-41
Lifting jack…… 7-44
Spare wheel…… 7-46
Spare wheel horizontal installation…… 7-46
Disassembly and assembly of wheels in vehicles…… 7-47

Wheel with tubeless tire disassembly and assembly…… 7-48
Troubleshooting for bolster…… 7-51
8 VEHICLE STORAGE…… 8-1
9 VEHICLE TRANSPORTATION…… 9-1
10 MANUFACTURER'S WARRANTY…… 10-1
11 UTILIZATION …… 11-1

APPENDIX……
Appendix 2. Lubrication chart for KAMAZ 5490 vehicle…… A2-1
Appendix 3. Service materials…… A3-1

Appendix (copy) Diesel Engine Pre-heaters 14TC-10.
Appendix (copy) Liquid small-size pre-starting heater PROMOTRONIK-16ЖД-24.
Appendix (copy) Service instruction AIRTRONIC D2. Independent device for heating and maintenance of air temperature in the cab
Appendix (copy) Operating Instructions. Trucks ZF-NewEcosplit.
Appendix (copy) Operating Instructions ZF-INTARDER. The Integrated Retarder for Trucks and Buses With ZF Transmissions ECU 42 Control Unit

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1 FOR YOUR ATTENTION

1. Prior vehicle (train) operation, study this manual carefully and further observe all recommendations presented in it.

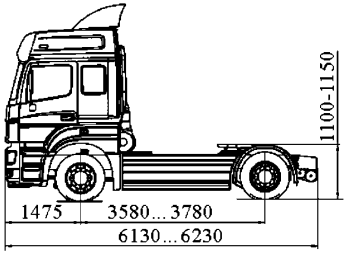
2. New vehicle is to be registered. This provides technical consultation on vehicle operation, maintenance and warranty maintenance. Each vehicle is provided with a Service book.

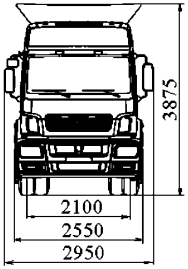
3. To ensure trouble-free operation, use only genuine spare parts. Installation of different equipment and devices on a vehicle and its chassis is to be agreed with design documentation developer and owner – Scientific & Technical Centre, KAMAZ PTC. Failure to observe this requirement will void the warranty maintenance of a truck.

4. KAMAZ PTC preserves the right for further development of vehicle construction without preliminary notification of users.

5. Drivers trained in specialized training centers are allowed to drive KAMAZ vehicles.

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VEHICLE TECHNICAL DATA

KAMAZ-5490 (M1842)

Wheel arrangement ……..……..4x2
Technically permissible maximum bolster load, daN
……..…..10550[3], 11050[4], 10625[5]
Technically permissible maximum weight of vehicle[1], kg.……....18600
Technically permissible maximum weight of semi-trailer towed, kg……....35950[3], 36450[4], 36025[5]
Technically permissible maximum weight of train[2], kg.…….……...44000
Engine….....….Mercedes-Benz OM 457LA.V/2
……..Mercedes-Benz OM 457LA.V/3
……..Mercedes-Benz OM 457LA.V/3
……..……...Mercedes-Benz OM 457 LA.EEV/3
……..…...Mercedes-Benz OM 457 LA.EEV/4
Maximum climbability, train, %., not less.……..18 (10º)
Disk wheels ……..9,00-22,5
Tires, tubeless …….…....315/60 R22,5
…….……..…315/70 R22,5 or 315/80 R22,5

[1] Including passenger's weight.
[2] When driving on public roads, take into consideration the requirements to weight loads specified in «Rules on transportation of cargoes by vehicles».
[3] Vehicle with a high roof cab.
[4] Vehicle with a low roof cab.
[5] Vehicle with a high roof cab and a wheel base 3780 mm.
[6] For vehicle configuration, designed for transportation of hazardous cargo.

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TABLE OF ADDITIONAL TECHNICAL DATA

Operational data		Model 5490
Technically permissible maximum weight of vehicle, kg, applied to:	axle 1	7100
	axle 2	11500
Maximum driving speed[1], km/h, at least:	train	90[2]
Test fuel consumption[3] per 100 km at speed 60 km/h, l, not more:	train	27,5
Fuel distance endurance[1] [4], km, at least:	train	2800
Acceleration time[1] to 80 km/h, s, not more:	train	80
Braking distance[1] at service brake system application during test «Type-0» (with engine disconnected), with initial brake speed 60 km/h, m, not more:	vehicle	36,7
The same, with a stand-by brake system applied, with initial brake speed 40 km/h, m, not more:	vehicle	33,8
Outer vehicle turning radius between walls (front buffer), m, not more:		8
Fuel tanks' capacity[5], l		400x2; 665

[1] Parameters are given for vehicle with technically permissible maximum weight.
[2] The value is limited by vehicle software.
[3] Test fuel consumption is measured in accord with GOST P 54810-2011 for vehicle with technically permissible maximum weight, travelling with constant speed along special test section, serves for determination of truck (train) technical state and is not a performance norm.
[4] fuel distance endurance at test fuel consumption is determined by calculations and depends upon fuel tanks' capacity, in the table it is indicated for fuel tanks with total capacity 800 l.
[5] Usage of fuel tanks depends upon vehicle configuration.

ENGINE TECHNICAL DATA

Engine model	Mercedes-Benz OM 457LA.V/4; Mercedes-Benz OM 457 LA.EEV/4	Mercedes-Benz OM 457LA.V/3; Mercedes-Benz OM 457 LA.EEV/3	Mercedes-Benz OM 457LA.V/2
Engine type	Four-stroke, diesel, turbocharged		
Number of cylinders	6		
Cylinder arrangement	In-line		
Displacement, l	11,97		
Net maximum capacity, kW (h.p.) at rated crankshaft speed, min^{-1}	315 (428) 1900	295 (401) 1900	265 (360) 1900
Maximum torque, net, N·m (kgf·m) at crankshaft speed, min^{-1}	2100 (214) 1100	2000 (204) 1100	1850 (189) 1100

TIRE AIR PRESSURE

Wheel position	Tire pressure of the vehicle with technically permissible maximum weight, kPa (kgf/sm^2) for tire size		
	315/60 R22,5	315/70 R22,5	315/80 R22,5
Front axle wheels	880±20 (9,0±0,2)	830±20 (8,5±0,2)	780±20 (8,0±0,2)
Rear axle wheels	780±20 (8,0±0,2)	780±20 (8,0±0,2)	730±20 (7,5±0,2)

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TOOLS, ACCESSORIES, SPARES AND OPERATIONAL DOCUMENTATION SUPPLIED WITH VEHICLE

Name	pcs./vehicle
Operation documentation	
Operation manual	1 pc.
Service book	1 pc.
List of operational documents	1 pc.
Operation manual Engine Mercedes-Benz OM 457LA	1 pc.
Service book Engine Mercedes-Benz OM 457LA	1 pc.
Vehicle passport	1 pc.
Tools, accessories, spare parts	
Cab door key, starter and instruments switch key	2 sets
In a toolbox[1)] or in a pallet for accessories[2)]: - kit for tire inflation; - tow yoke; - minimum set of tools; Hydraulic jack (for certain configurations)	 1 set 2 pcs. 1 set 1 pc.
In a cab: - fire extinguisher; - emergency stop mark; - first aid kit case	 1 pc. 1 pc. 1 pc.
Spare wheel[3)]	1 pc.
Chock[1)]	2 pcs.
EBS helical cable for output to semi-trailer	1 set
electric cable for output to semi-trailer	2 sets

[1)] Installation on the frame. [2)] In the cab under the bunk. [3)] Arrangement is determined by vehicle (chassis) configuration.

Additional equipment that can be attached under certain requirement, specified by supply agreement: a tool kit in a small bag at extra cost, a minimum tool kit at extra cost, an oil transfer pump (1 pc.).

Truck (chassis) is to be equipped with tools, accessories and appropriate operation documentation for purchased products.

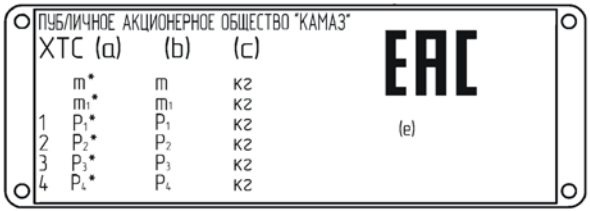
A list of additional equipment may be defined during production process.

In agreement with consumer, the vehicle may be supplied with certain accompanying automotive accessories and goods presented in a packing list.

VEHICLE MARKING

Manufacturer's plate

The manufacturer's plate is fixed in a r.h. door aperture.



Vehicle manufacturer's plate

The plate contains:

- **manufacturer's name**;
- **identification number**, including:
  - XTC - manufacturer index;
  - a - conventional vehicle model code composed of six marks;
  - b - production year code (1 mark);
  - c - vehicle ordinal manufacturing number (7 marks);
- EAC - unified market mark for products manufactured in countries - members of Customs union;
- e - number of «vehicle type approval»;
- **weight values**: technically permissible maximum weights and permitted maximum weights (not indicated on chassis).

If technically permissible maximum weight exceeds the corresponding permissible maximum weight, then, the weight values are indicated in two columns.

Technically permissible maximum weights:

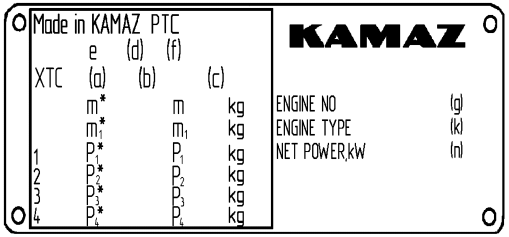
- **m*** - vehicle technically permissible maximum weight;
- **m_1*** -train technically permissible maximum weight (for tractors);
- **P_1*** - technically permissible maximum weight on the front axle;
- **P_2*** - technically permissible maximum weight on the second axle;
- **P_3*** - technically permissible maximum weight on the third axle;
- **P_4*** - technically permissible maximum weight on the fourth axle.

Permitted maximum weights:

- **m** - vehicle maximum permitted weight;
- **m_1** - train maximum permissible weight (for tractors);
- **P_1** - maximum permitted front axle load;
- **P_2** - maximum permitted second axle load;
- **P_3** - maximum permitted third axle load;
- **P_4** - maximum permitted fourth axle load.

Manufacturer's plate for export vehicle

The manufacture's plate is fixed to the cab r.h. panel in a door aperture.



Manufacturer's plate for export vehicle

Plate contains (see Fig. *Manufacturer's plate for export vehicle*):

- **manufacturer's name**;
- **e -** European approval;
- **d -** distinguishing number or letters of the country which gave the vehicle EEC type approval;
- **f** - EEC type approval number;
- **identification number**, including:
  - **XTC -** manufacturer index;
  - **a** - vehicle model conventional code pursuant to Technical specifications for vehicle, comprising six marks;
  - **b** - production year code (1 mark);
  - **c** - vehicle ordinal number (7 marks).

Permissible weights allowed for registration:

- **m*** - vehicle gross weight;
- **m_1*** - train gross weight (for tractors);
- **P_1 *** - permissible front axle load;
- **P_2 *** - permissible second axle load;
- **P_3 *** - permissible third axle load;
- **P_4 *** - permissible fourth axle load;
- **manufacturer's trade mark** .

In accord with EU Regulations 19/2011 the letter «T» is added as a suffix to the maximum load on each axle being a part of this axle group (tandem).

Technically construction-permissible weight parameters:

- **m** - vehicle gross weight permissible by construction;
- **m_1** - train gross weight (for tractors), permissible by construction;
- **P_1** - permissible by construction front axle load;
- **P_2** - permissible by construction second axle load;
- **P_3** - permissible by construction third axle load;
- **P_4** - permissible by construction fourth axle load.

Engine parameters:

- **g** - engine ordinal number;
- **k** - engine model;
- **n** - engine net power.

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VIN code

VIN code is applied onto the vertical wall of the right side member in frame front or rear part and includes:

- XTC - manufacturer's code (3 marks);
- vehicle model conventional code (6 marks);
- production year code (1 mark);
- vehicle ordinal production number (7 marks).

Vehicle component parts marking

The identification number **of frame** is punched on the upper horizontal boom of the right side member at front part of the frame and includes:

- XTC - manufacturer's code (3 marks);
- digit «0»;
- frame model designation (6 marks);
- production year code (1 mark);
- ordinal production number of the frame (7 marks).

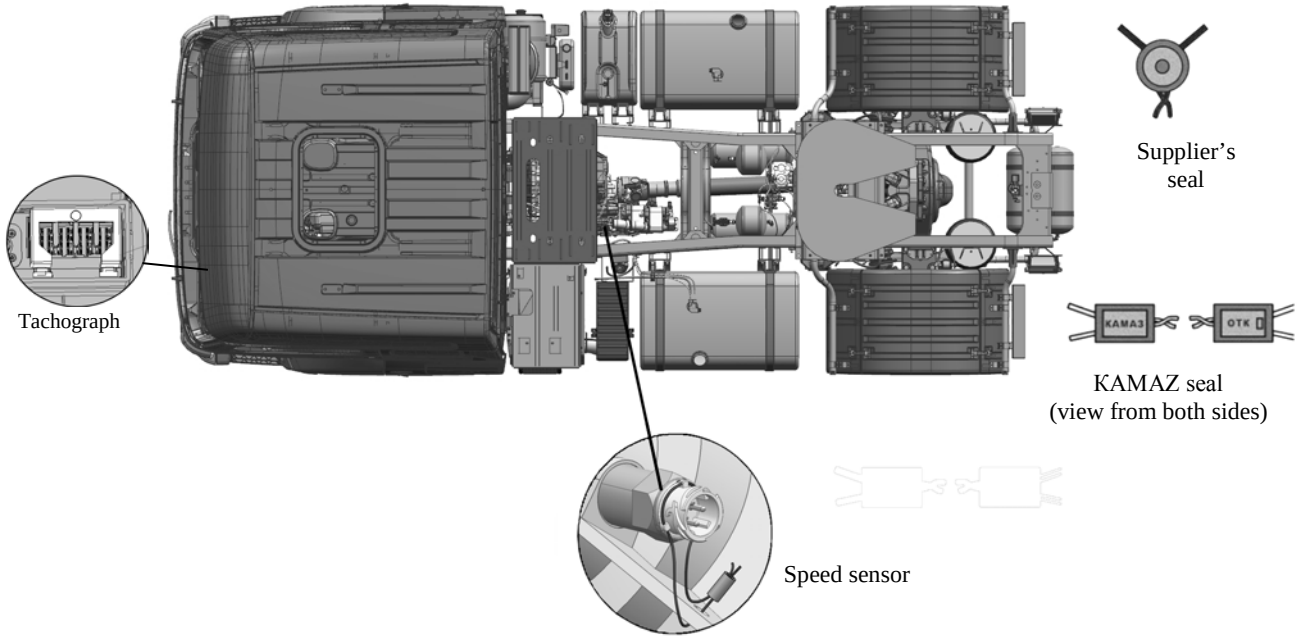
Cab **identification number** is punched on a cab front inner panel, at the left. Identification cab number comprises the following:

- cab model designation (6 marks);
- production year code (1 mark);
- cab ordinal production number (7 marks).

ENGINE MARKING

Engine has its own manufacturer's plate (see Operation and maintenance manual for Mercedes-Benz engine).

SCHEME OF SEALING



Cover of «ZF» gear box, power steering of «RBL», «ZF» companies are not sealed.
If tachograph is installed in vehicle manufacturer's plant, the tachograph is sealed temporarily.

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3 BRIEF DESCRIPTION OF VEHICLE SYSTEMS AND MECHANISMS

ENGINE

Vehicle is equipped with engine Mercedes-Benz OM457LA. Operation manual for Mercedes-Benz engine is supplied with vehicle.

TRANSMISSION

Clutch

Clutchis single-plate, diaphragm, pull-type model MFZ 430 «SACHS».

Clutch control actuator is hydraulic with air-hydraulic booster «WABCO».

Gearbox

In accord with configuration, vehicles are equipped with:

- mechanical gear boxes, models ZF 16S1820 TO, ZF 16S2220 TD, ZF 16S2221 TD (with intarder);
- mechanical gear boxes with automated control ZF 12AS 2130 TD, ZF 12AS 2131 TD (with intarder).

Operation manual for gearbox models ZF 16S1820 TO, ZF 16S2221, ZF 16S2220 see in Appendix «Operation manual. Auto trucks. ZF-NewEcosplit».

Intarder operation manual see in Appendix «Operation manual for ZF-INTARDER. Inbuilt retarder (intarder) for trucks and buses with gear box ZF».

Axles

Axle «DAIMLER» (HL6) is used on the vehicle. Provision is made on the vehicle for installation of driving axle with inter-wheel differential interlock mechanism.

FRAME AND FIFTH-WHEEL COUPLING

Frame is provided with front under-run protection device.

In frame front part there’s a towing crossbar with two threaded ports for installation of towing yokes.

The fifth-wheel coupling is installed on a vehicle frame, it provides coupling and uncoupling of tractor and semi-trailer. Installation of the fifth-wheel coupling «SAF Holland», «JOST» or «ORLANDI» is possible. Operation manual for the fifth-wheel coupling is supplied with vehicle.

Certain vehicle configurations are equipped with hydraulic equipment for hydroficated tank semitrailer, designed for transportation of dangerous cargo (oil products).

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SUSPENSION

Front suspension is a leaf spring suspension.

Rear suspension is an air spring suspension. For air suspension regulation and control an electronic control system (ECAS) of «WABCO» is used.

STEERING CONTROL

Steering control is with hydraulic booster built in steering unit. In accord with configuration, vehicles are equipped with steering mechanisms «RBL», «ZF».

The steering wheel location is on the left side.

The steering column is an adjustable one.

BRAKE SYSTEM

Service brake system actuator - pneumatic, separate. The rated pressure in pneumatic drive is from 9,0 to 10,0 kgf/cm^2.

Vehicle is equipped with electronic brake system (EBS), comprising the following functions:

- control of serice and secondary brake systems (Brake-Management);
- anti-lock braking system (ABS);
- anti-skid system (ASS);
- electronic stability programme (ESP).

Brake mechanisms, disk type, «HALDEX», «KNORR-BREMSE», «WABCO» (depending on vehicle configuration).

Front brake chambers are of diaphragm type, rear chambers are provided with spring energy accumulators.

CAB

Cab is metal, located over the engine, two seat, with a super high or low roof, with one or two bunks.

Installation of cab on the frame is possible on 4 point-contact, spring or pneumo-elastic elements. Air suspension stiffness is regulated automatically.

Vehicle is provided with a cab hydraulic tilter.

HYDRAULIC EQUIPMENT

Vehicle designed for transportation of oil tank semi-trailer is provided with double-line hydraulic system with outlet to hydraulic motor. Hydraulic motor drives oil product transfer pump.

ELECTRIC EQUIPMENT

The electric equipment comprises the following systems: power supply system, engine starting system, warning lights, outer and inner illumination means, indicating devices, heating systems, ventilation and audio signaling system, additional electric equipment and windscreen wiping system.

Flash lights are installed on a vehicle cab roof.

Flash beacons are arranged on a cab roof of the vehicle designed for transportion of dangerous cargoes.

Vehicle is supplied with electric equipment ECU.

Warnings

1. Do not connect or disconnect the plugs and the plus terminal of the alternator while the engine is running and storage batteries are energized, neither start the engine while the plus conductor of the alternator is disconnected.

2. Do not test the alternator for operability by shorting the positive terminal, the field winding lead, the phase terminal and the pilot lamp contact between themselves and to ground using the jumpers.

3. Do not test the operability of electric equipment circuit and of separate conductors using mega ohmmeter or lamp with voltage higher than 36 V while alternator is energized.

4. To prevent the rectifier block and voltage regulator malfunction while storage batteries are charged from outer source, be sure to disconnect batteries from truck mains.

5. When washing the truck, protect the alternator from water ingress.

ELECTRONIC CONTROL SYSTEMS

In accord with configuration, vehicles are equipped with electronic control systems for:

- engine;
- after-treatment system;
- air suspension;
- brake system (EBS);
- intarder;
- electric equipment;
- gearbox with automated control.

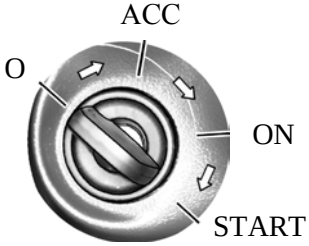
If adjustment and debugging of electronic systems is necessary it is recommended to address to specialized service centers of KAMAZ PTC.

Installation of emergency response service call device («ERA-GLONASS») on the vehicle is possible.

4. VEHICLE OPERATION

VEHICLE KEYS

Keys are designed for cab door opening and for instruments-and-starter switch. Keys have a special coding and are bound to a particular vehicle.



Positions of ignition key instruments-and-starter switch key

Key positions

0- everything is «Off». With the key removed from ignition switch the steering control is locked.

ACC - Steering control lock release/ engagement of the radio receiver, fixed position. The audio system and other auxiliary power consumers work with the key in «ACC» position

ON - Movement position, fuel supply to all vehicle systems, fixed position.

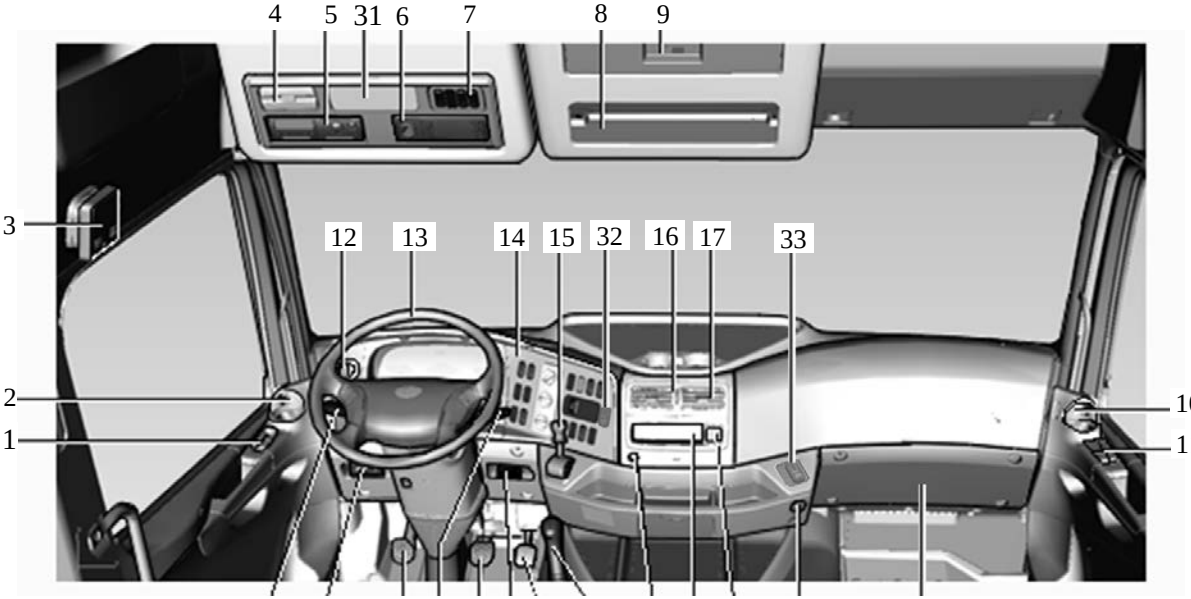
START - Start of engine, unfixed position.

Attention!

Take out the ignition key only after complete stoppage of vehicle, as vehicle driving is impossible without the key.

To prevent unauthorized persons' access to the vehicle, take out the ignition key even if you leave the vehicle for a short time.

DRIVER'S WORKING PLACE

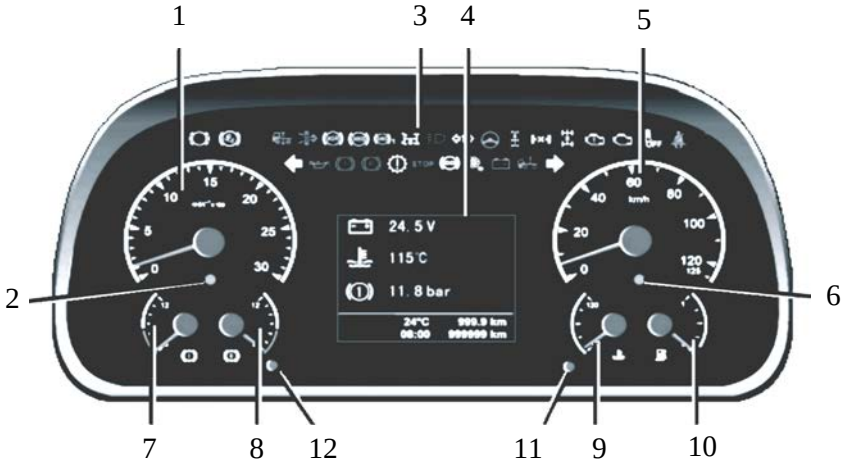


Driver´s working place

1 – switch block on driver's door; 2,10,17 – ventilation and heat deflectors; 3 – smoke detector; 4 – cab heat control console panel (if available); 5 – tachograph; 6 – terminal for radio receiver energizing ; 7 – switch block; 8, 27 – clothes compartment; 9 – glove box; 11 - switch block on passenger's door; 12 – light switch; 13 – steering wheel; 14 – instrument panel; 15 – parking brake; 16 – central part of instrument panel; 18 –combination switch; 19 – starting preheater control console panel; 20 – clutch panel; 21 – control selector switch of automated gearbox and auxiliary brake system; 22 – brake pedal; 23 – diagnostics connector; 24 – fuel supply control panel; 25 – gear shift lever; 26 – jumper cable; 28, 29 – electrical sockets; 30 – fuse box cover; 31 – terminal for radio station energizing; 32, 33 – user interface block (for emergency response service calling unit)

INSTRUMENT PANEL

INSTRUMENT CLUSTER



Instrument cluster

1 - Electronic tachometer;

2 - tachometer indicator, lightens up (color - red) when the vehicle moves at modes dangerous for engine (if admissible engine crankshaft speed is exceeded);

3 - pilot lamps;

4 - information display;

5 - electronic speedometer;

6 - speedometer indicator lights up (red color) if vehicle set maximum speed is exceeded.

Maximum speed is set by vehicle manufacturer or in service center;

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7 - pressure gauge in brake system circuit 1; the rated air pressure in pneumatic drive is from 9,0 to 10,0 kgf/cm^2 . Pilot lamp is located in the indicator zone Ⓘ, and it lights up (color - red) when pressure drops in the 1-st brake system circuit;

8 - pressure gauge in the 2-nd brake system circuit; the rated air pressure in pneumatic drive is from 9,0 to 10,0 kgf/cm^2 . Pilot lamp is located in the indicator zone Ⓘ, it lights up (color - red) when pressure drops in the 2-nd brake system circuit;

9 - liquid temperature gauge in cooling system. Over temperature pilot lamp is located in the indicator zone, it lights up (color - red) at over temperature of cooling liquid;

10 - tank fuel level indicator.

Fuel reserve pilot lamp is located in the zone of indicator, it lights up (color – orange), when fuel amount decreases in in the tank till 12 % of the tank volume;

11 - shift button of total number of kilometers travelled/ «resettable» mileage. At short pressing of the button, the mode changes. At pressing of the button more than 3-5 sec. the mileage is reset;

12 - screen scrolling button (doubler of the button on the steering wheel).

Attention!

Steady operation of instrument cluster is guaranteed at ambient air temperature to – 40 ºC.

At ambient air temperature lower than -30 ºC wrong displaying of information is possible.

Pilot lamps

	Low level of liquid in neutralization system (*color – blue*)
	Air suspension defect (*color - red*)
	Air filter clogging up (*color - red*)
	Anti-skid system engagement (*color - orange*)
	Truck tractor EBS/ ABS fault (*color - orange*)
	Fault of EBS/ АБС of trailer/ semitrailer (*color – orange*)
	Head lamp high-beam engagement (*blue color*)
	Direction indicators of trailer/ semitrailer (*color - green , intermittent*)
	Engagement of interwheel differential lock (*color – orange*)
	Engine failure (*color - orange*)
	Malfunction in exhaust gas aftertreatment system and/or engine (*color – orange*)
	Right turn indicator (*color – green, intermittent*)
	Left turn indicator (*color – green, intermittent*)
	Brake system fault (*color - red*)
	Parking brake system engagement (*color - red, intermittent*)
	Malfunction of the gear box with automated control (*color – orange*)
	Emergency situation (*color - red*)
	Incident oil pressure (*color - red*)
	Storage battery discharge (*color - red*)
	Cab lock (*color – red*)
	Engagement of low range in demultiplicator (*color - orange*)

	Wearing of brake pads (*color - orange*)
	Unfasten safety belt (*color – red)*
	Intarder engagement (*color - orange*)
	Pressure drop in the 1-st brake system circuit (*color – red*)
	Pressure drop in the 2-nd brake system circuit (*color – red*)
	Emergency coolant temperature (*color - red*)
	Reserved fuel residual (*color - yellow*)
	PTO box engagement (*color - green*)
	Recoil mechanism engagement (*color – orange*)
	Malfunction of steering control (*color – red*)

Attention!

Number of pilot lamps can change depending on vehicle configuration.

Information display



At each activation of ignition switch key into «Motion position» a screen with the logotype appears on the display of instrument cluster for 2-3 sec.

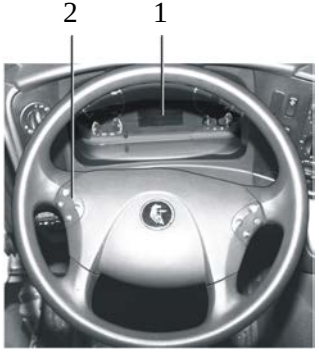
Further information about vehicle operational state, failures or warning information is displayed on the screen of instrument cluster.

When the message about failure appears, see section 7 «*Potential failures of vehicle units and systems. Self-help*».

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Information system control

Information system control is carried out by the buttons located on the steering wheel on the left side (see Fig. *Screen control on the display*).



Screen control
on the display

1 - information display;
2 - buttons of screen control on the display

Attention!

Use information system functions only on a stationary vehicle with a parking brake engaged.

**Buttons for
information screen control**

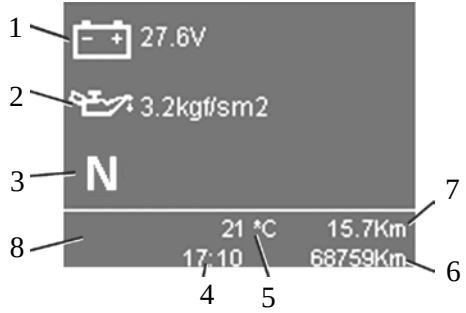
	Menu access. Confirmation of the message on display
	Scrolling forward (choice of function)
	Scrolling backwards (choice of function)
	Exit from current screen/ return to the root menu

Turn over the information screens by buttons  or  . To leave the screen press the button  .

Check before motion initiation

If messages about vehicle malfunction are absent the screens with monitored information about vehicle operational state automatically appear on the display.

Main screen



1 - Current value of onboard network voltage;

2 - current value of engine oil pressure;

3 - operation mode of the gear box with automated control:

- N – neutral is engaged;
- D – the gear for forward motion is engaged;
- R – reverse motion is engaged;

4 - current time;

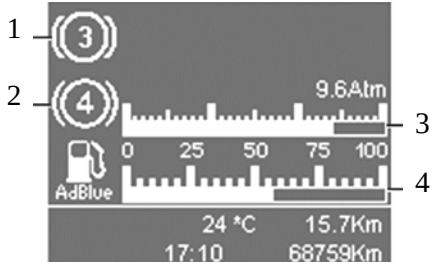
5 - current value of ambient air temperature;

6 - total distance covered by the vehicle;

7 - daily vehicle mileage (resettable);

8 - the number of the gear engaged, warning messages (for the gear box with automated control).

Pressure in circuits III and IV of pneumatic drive. Level of neutralizing lotion



1 - Indicator of air pressure in circuit III of the brake system;

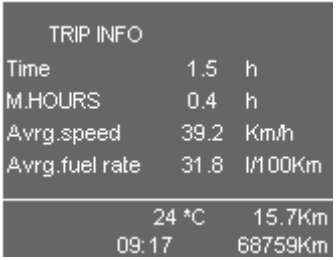
2 - indicator of air pressure in circuit IV of the brake system;

3 - scale of air pressure in circuit IV of pneumatic system (other consumers);

4 - scale of AdBlue neutralizing lotion level.

Screen «Travel»

The data on the screen «Travel» are reset simultaneously with daily mileage re-zeroing.



«Time» - current data on time for the trip covering period.

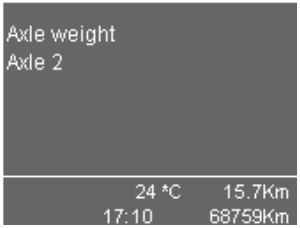
«Motor hours» - current data on motor hours for the trip covering period.

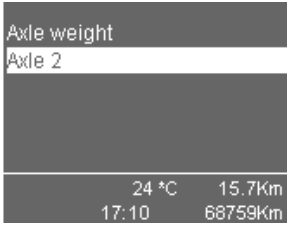
«Average speed» - current data on average speed for the trip covering period.

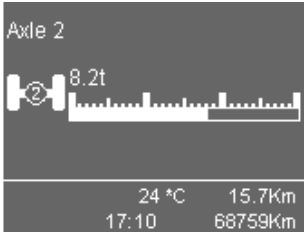
«Average consumption» - current data on average fuel consumption for the trip covering period.

Screen «Axle load»

Screen «Axle load» is displayed on the vehicle equipped with an axle load measuring system. Choosing «AXLE 2» you can determine the axle load.





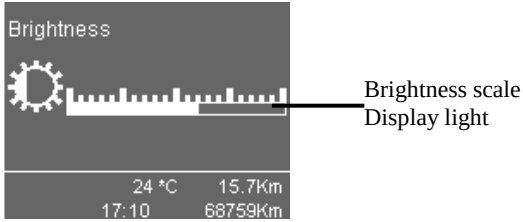


Display lighting

Press the button  . The symbol will flash on and off in front of the scale.

Adjust display light brightness by buttons  and  .

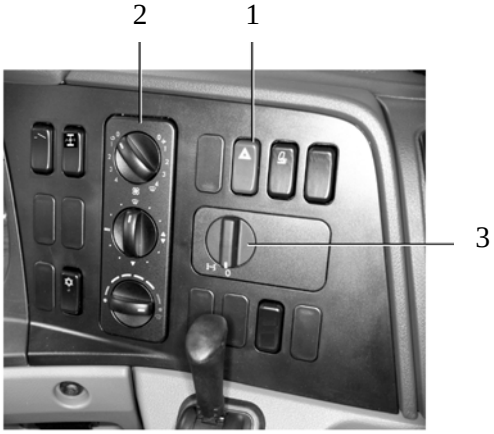
Press the button  , adjusted screen light brightness will be saved in memory.



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SWITCH BLOCKS

Instrument panel



Switches on instrument panel

1 - Switches/ shifters;

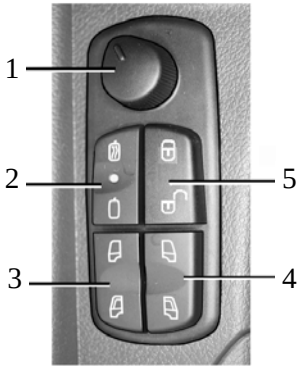
2 - control panel of heating and air conditioning system;

3 – shifter of interwheel differential lock.

Symbol	Application of switches/ shifters
	Engagement/ disengagement of strorage batteries. Button is locked when ignition key is in «ON» position
	ASR mode selection
	Engagement/ disengagement of air conditioner
	Engagement/ disengagement of warning indication (color - red)
	Engagement/ disengagement of cab tilting lock
	Engagement/ disengagement of hitch mechanism flood lighting
	Engagement/ disengagement of 12V voltage converter

Symbol	Application of switches/shifters
	Engagement/ disengagement of hydraulic motor (*for certain vehicle configurations*)
	Engagement/ disengagement of PTO box
	Engagement/ disengagement of flashing lights (*for certain vehicle configurations*)
	Emergency storage battery switch-off (color - red)
	Engagement/ disengagement of hill start assist control

Driver's/ passenger's door



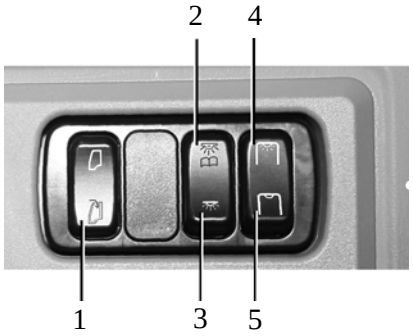
Switch block
on driver's door



Switch block
on passenger's door

Pos.	Application of shifters
1	Adjustment of external rear view mirror position
2	Rear view mirror heating
3	Window raiser on driver's door
4	Window raiser on passenger's door
5	Driver's/ passenger's door lock
6	Engagement/ disengagement of reading lamp on passenger's side

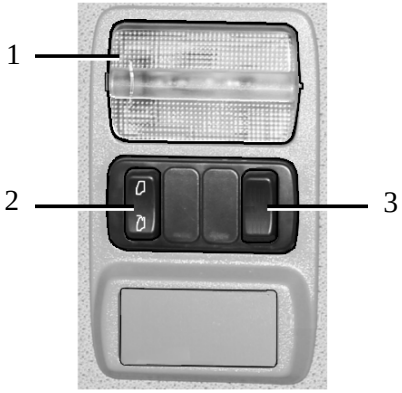
Over the windshield



Switch block over the windshield

Pos.	Application of shifters
1	Opening/ closing of the top hatch
2	Engagement/ disengagement of driver's reading lamp
3	Engagement/ disengagement of night-time lighting
4	Engagement/ disengagement of interior cab light
5	Automatic engagement/ disengagement of interior cab light. Switches on when the door is opened

Bunk



Switches
on the bunk

Pos.	Application of shifters
1	Reading lamp on the bunk
2	Opening/ closing of top hatch
3	Remote engagement/ disengagement of autonomous cab heater

ADJUSTMENT OF HEADLAMP INCLINATION ANGLE

Adjuster of headlamp inclination angle is located on instrument panel (see Fig. *Adjuster of headlamp inclination angle*).

Adjustment is carried out in accord with vehicle load.



Adjuster of headlamp inclination angle

Adjuster position

0 - Vehicle is not loaded.

1-3 - From partial vehicle load to loaded vehicle.

Headlamp inclination angle is to be adjusted in such a way when headlamp beam doesn't blind the drivers of oncoming vehicles.

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LIGHT SHIFTER

Vehicle light is switched on and off by light shifter. Prior light energizing, rotate the ignition key to position «ON» (motion position).



Light shifter

1 - light shifter; 2, 3 - light switch steps

Symbol	Application
0	Light is switched on/ off for movement during the daytime
	End-outline lamps, marker lamps, number plate light and switch illumination are engaged
	Low/ high beam (depending on combination switch location)
	Pilot LED indicating auxiliary illumination headlamps engagement in insufficient visibility conditions (*color - green*)
	Pilot LED indicating rear fog lamps engagement (*color - orange*)

LIGHT FOR MOVEMENT IN THE DAYTIME

Daytime running lights switch on automatically when ignition key is shifted to «ON» position. Light shifter is in «0» position.

Daytime running lights are switched off when low or high beams or auxiliary illumination headlamps are engaged in insufficient visibility conditions.

END-OUTLINE AND SIDE MARKER LAMPS

To engage the end-outling and side marker lamps, shift the light switch to position . With this number plate light and switch illumination are energized.

LOW BEAM

Turn the light switch to position .

HIGH BEAM

1. Turn on the low beam: turn the light switch to position .

2. Shift combination switch forward till fixation (see Section «*Combination switch*»). Pilot lamp will light on the instrument panel .

High beam switches on only after low beam engagement.

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AUXILIARY ILLUMINATION HEADLAMPS IN INSUFFICIENT VISIBILITY CONDITIONS AND REAR FOG LAMPS

Auxiliary illumination headlamps in insufficient visibility conditions

1. To switch on turn the light switch to position .

2. Pull the light switch till position 2 (see Fig. *Light shifter*).

With headlamps switched on the pilot LED lights on the light switch .

Engagement of auxiliary illumination headlamps in insufficient visibility conditions and rear fog lamps

1. To engage auxiliary illumination headlamps and rear fog lights turn the light switch to position .

2. Pull the light switch till position 2 (see Fig. *Light shifter*).

When auxiliary illumination headlamps and rear fog lamps are engaged the LEDs and light on the light switch.

At trailer/ semitrailer connection the rear fog lamps of truck tractor are not active.

TRAIN LAMPS

Train lamps are switched on automatically when trailer/ semitrailer electric equipment is connected to truck tractor.

SPOTLIGHT OF THE COUPLER



To switch on the spotlight press on the upper part of spotlight switch located on instrument panel. When the spotlight is switched on, the pilot LED, built in the switch, lights up.

To switch off the spotlight press on the lower part of spotlight switch. When the spotlight is switched off, the pilot LED, built in the switch, dies out.

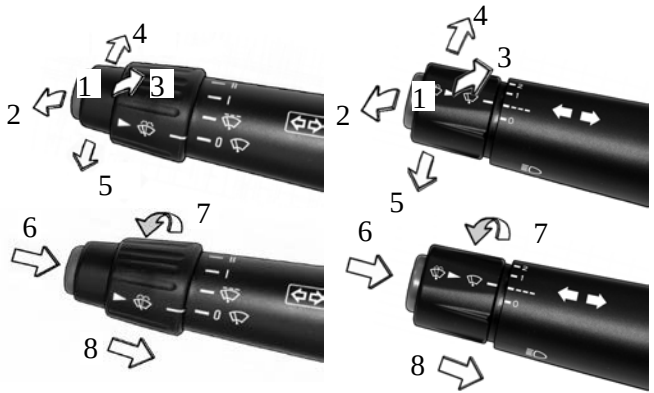
FLASH BEACONS



To switch on flash beacons press on the upper part of the switch located on instrument panel. When flash beacons are switched on, the pilot LED, built in the switch, lights up.

To switch off flash beacons press on the lower part of the switch. When flash beacons are switched off, the pilot LED, built in the switch, dies out.

COMBINATION SWITCH



Version I Version II

Combination switch

Pos.	Application
1	High beam is switched off (with low beam engaged)
2	High beam is switched on (with low beam engaged)
3	Warning light
4	Turn indicator, right
5	Turn indicator, left
6	Horn
7	Windscreen wipers
8	Windscreen washers

SWITCHING OF DIRECTION INDICATOR

Pull combination switch till fixation:

- towards «4» (away from oneself») - right turn signal;
- or «5» («toward oneself») - left turn signal.

When the steering wheel returns after long-term turn the combination switch automatically resets.

ENGAGEMENT OF WARNING LIGHT

Shortly pull the combination switch up to position «3». For a short period of time the pilot lamp on instrument panel ≡D and high beam light up.

HORN

Giving of audible warning is carried out through «6» button pressing.

WINDSCREEN WIPERS



Version I



Version II

Engagement of windscreen wipers

1 - shifter

Position of windscreen shifter
(depending on vehicle configuration)

Symbol		Application
Version I	Version II	
—0	—0	Windscreen wipers are disengaged
—	----	Intermittent operation mode
— I	— 1	Slow operation mode
— II	— 2	Accelerated operation mode

Engagement of windscreen wipers

Turn the switch 1 (see Fig. *Engagement of windscreen wipers*) into required position.

Disengagement of windscreen wipers

Turn the switch 1 to position —0 (or —0). Windscreen wiper will make one more movement and witll be disengaged.

Intermittent operation mode

Durability of the interval between two consecutive movements of windscreen wipers is 4 sec. This interval can be smoothly adjusted in a range from 2 to 20 sec. For the purpose:

1. Turn the switch 1 to position — (or ----).
2. Wait until the first movement of wipers and turn the switch 1 to position (or —0).
3. Maintain the interval required, but not more than 20 sec.
4. Turn the switch 1 to position — (or ----). Time passed between disengagement and engagement is entered to the memory as a new interval of windscreen wiper movement.

If the switch remain in position —0 (or —0) for more than 20 sec., windscreen moovement interval 4 sec. is set automatically.

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Attention!

It is necessary to check the windscreen wiper blades for the presence of dirt and damages.

Switch off the windscreen wipers before placing the vehicle in the parking area, as windscreen wiper blades can suddenly start mooving when starting.

WINDSCREEN WASHER

To switch on the windscreen washer press the shifter 1, located on combination switch, up to stop (see Fig. *Windscreen washer engagement*). When holding the shifter in depressed position, water is supplied to the windscreen from the windscreen tank.



Version I



Version II

Windscreen washer engagement

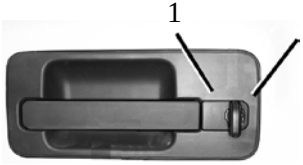
1 - shifter

CAB DOORS

DOOR LOCK BLOCKING

Door lock releasing/ locking externally, by key

When releasing the vehicle door lock only corresponding door is opened by the key.



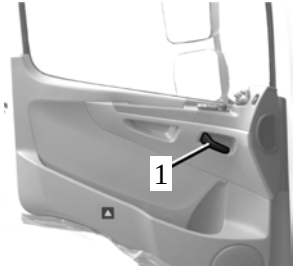
Key positions

1 - door locking;
2 - door lock releasing

Door lock releasing/ locking from inside the cab

For locking the door from onside the cab press the lever 1 (see Fig. *Cab door*).

For door lock releasing pull the lever 1.

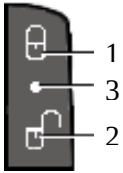


Cab door

1 – lever

Door locking/ lock releasing from inside by the shifter

Vehicle doors can be lock released and locked by means of door locking shifters, located in switch block on driver's and passenger's door (see Fig. *Door locking shifter*).



Door locking shifter

1 - lock switching on shifter;
2 - lock switching off shifter;
3 - pilot LED

To release the door lock press the shifter 2. Pilot LED 3 starts blinking.

To lock the door press the shifter 1. Pilot LED dies out.

Attention!

If during the vehicle moovement the driver's door is not closed an intermittent audible signal sounds.

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LOWERING AND RAISING OF SIDE WINDOWS OF DRIVER/ PASSENGER

Cab doors are equipped with electric window raisers.

Lowering and lifting of side windows is carried out at rotation of ignition key into position «ACC».

To open the driver's/ passenger's side windows press the shifter or , till the window occupies the necessary position.

To close the driver's/ passenger's side windows press the shifter or for approximately 1 sec.

For full raising of the window it is necessary briefly (1 sec.) to press the shifter or .

Attention!

It is necessary to be careful that nobody touches the side window during its opening. During the window movement there is a hazard of drawing-in and jamming between side window and door frame. In case of danger release the shifter or press on its upper part to close the side window again.

LIFTING TOP HATCH

Control shifters of lifting top hatch are located in switch blocks, near the lower bunk and above the windshield.

To open the lifting top hatch press the shifter , till the hatch occupies the necessary position.

To close the lifting top hatch press the shifter , till the hatch occupies the necessary position.

Attention!

Closing the lifting top hatch be careful that nobody is squeezed. In case of danger lower the shifter or again press it in the lower part to open the lifting hatch again.

Mechanical closure of lifting top hatch is possible.

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MECHANICAL CLOSURE OF RAISABLE TOP HATCH

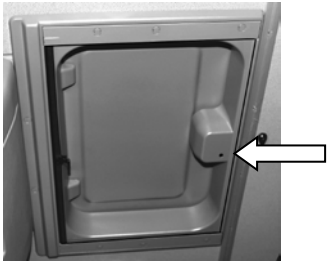
1. Prepare the flat screwdriver (the width of screwdriver working end is 4 mm).

2. Remove the plug (see Fig. *Closing down of lifting top hatch*).

3. Insert the screwdriver in the drive port.

4. Rotate the screwdriver counter clockwise till full closing of the hatch.

5. Install the plug in the port.

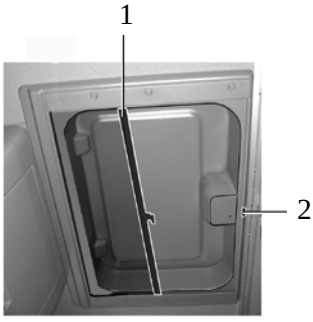


Closing down of lifting top hatch

SAFETY SCREEN OF THE HATCH

The hatch is equipped with a safety screen (see Fig. *Safety screen*).

To close the safety screen it is necessary to pull it out and fix it in the fixing device.



Safety screen

1 - safety screen;
2 - fixing device

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EXTERNAL REAR VIEW MIRRORS

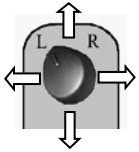
It is recommended to check the installation of external mirrors on the vehicle before each drive.

Position of the right and the left external rear view mirrors is regulated by electric drivers.

POSITION REGULATION OF EXTERNAL REAR VIEW MIRRORS

1. Turn the ignition key to «ON» position (motion position).

2. Choose by the shifter a proper rear view mirror (see Fig. *Shifter of external rear view mirror position*): for l.h. mirror - position «L», for r.h. mirror - position «R».



Shifter of external rear view mirror position

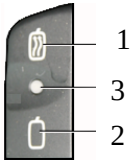
3. Press the shifter forward or backward, to the right or to the left until the time when the mirror occupies necessary position.

One must bear in mind: the reflection in external mirrors is always undersized, that is why the objects seem more away than it is in reality.

MIRROR HEATING

In wet and cold weather to prevent misting and ice coating of external rear view mirrors use mirror heating system.

The shifter of mirror heat engagement/ disengagement is located in the switch block on driver's door (see Fig. *Mirror heat shifter*).



Mirror heat shifter

1 – Shifter of mirror heat engagement;
1 – Shifter of mirror heat disengagement;
3 - pilot LED

To engage the mirror heating press the shifter 1. Pilot LED 3 lights up.

To disengage the mirror heating press the shifter 2. Pilot LED dies out.

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SEAT POSITION ADJUSTMENT

Adjustment of seat position on air suspension

The angle of armrest 3 inclination is smoothly adjusted at armrest regulator rotation.

Seat cushion depth. With lever 4 up, the cushion displaces forward-and-backward against the base. With lever released, the cushion is fixed in a stepped-like manner in selected position.

Adjustment of seat inclination angle. With lever 5 shifting up the front edge of seat cushion raises, with lever shifting down – the edge lowers down.

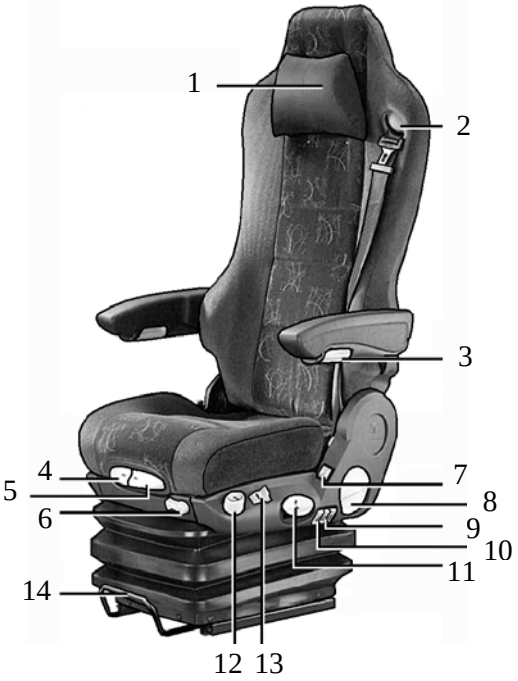
Longitudinal damper. With the level 6 in the upper position the longitudinal damper is locked, in the lower position it is unlocked.

Seat on the air suspension

1 - head restraint;
2 - safety belt;
3 - adjustable armrest;
4 - adjuster of seat cushion depth;
5 - adjuster of seat inclination angle;
6 - longitudinal damper control lever;
7 - seat heating;
8 - adjuster of seat back inclination angle;
9 - adjustment of lateral support;
10 - adjustment of lumber support;
11 - adjustment of the seat height;
12 - down rush button;
13 - rigidity adjuster;
14 - adjuster of forward-backward movement

Seat heating. Seat heating is engaged at pressing on the upper or lower part of the button 7. Heating is engaged at air temperature not more than 18 ºC.

Heating is disengaged at pressing of button into position «0».



Seat back inclination angle. With lever 8 shifting up the back is unfixed and inclines forward, with lever release, the back is fixed in selected position.

Seat lateral support is adjusted by the button 9.

Lumber support is adjusted by the button 10.

Adjustment of the seat height. With the lever 11 shifting up the seat raises, with the lever pressing the seat lowers down. With the lever released the seat is fixed in selected position. The maximum height value is 100 mm.

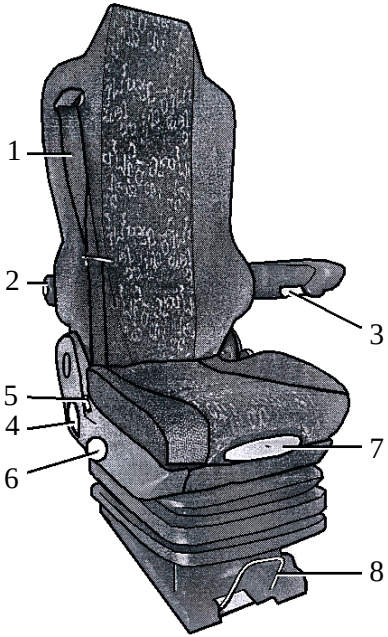
Quick drop of the seat. With the button 12 pressed the seat quickly drops into the lower position. At second pressure of the button 12 the seat raises and is automatically fixed in position set by the lever 11.

The lever 13 is used to adjust the seat suspension stiffness.

Adjustment of the seat lateral position. With the lever 14 shifted up the seat slides are unlatched. With the lever shifted down, the seat slides are fixed in a chosen position. The range of adjustment is 200 mm, with a step 10 mm.

Passenger's seat adjustment (version)

In certain vehicle configurations passenger's seat is mounted without air suspension.



Passenger's seat

1 - safety belt;

2 - lumber support adjustment handle;

3 - adjustable armrest;

4 - heat engagement button;

5 - back inclination angle adjustment lever;

6 - seat height adjustment button;

7 - cushion inclination angle adjustment button;

8 - seat longitudinal position adjusting caliper

The shape of seat back profile is selected at rotation of the handle 2 (see Fig. *Passenger's seat*). At counterclockwise rotation the back convex camber increases, clockwise - decreases.

The angle of armrest 3 inclination is smoothly adjusted at armrest regulator rotation.

Back inclination angle With lever 4 shifting up the back is unfixed and inclines forward, with lever release, the back is fixed in selected position.

Seat heating (if available) is engaged at pressing on the upper or the lower part of the button 5. Heating is engaged at temperature not more than 18 ºC.

Heating is disengaged at pressing of button into position «0».

Adjustment of the seat height. When the lever 6 is shifted up the lifting mechanism is unlocked and the seat lifts up or goes down to the necessary position. With the lever released the seat is fixed in selected position. The maximum height value is 100 mm.

Adjustment of cushion inclination angle. With the button 7 shifted up the front edge of cushion raises, with it shifted down – the edge lowers down.

With the button lowering down the seat cushion is fixed in selected position.

Adjustment of the seat lateral position. With the lever shifted up the seat slides are unlatched. With the lever shifted down, the seat slides are fixed in a chosen position. The range of adjustment is 200 mm, with a step 10 mm.

Attention!

To enter the cab and to leave it, release the driver's seat on air suspension completely down.

It is prohibited to change seat settings during the motion. *Seat should be adjusted in a steady vehicle, with a parking brake engaged.*

After adjustment of driver's and passenger's seat, check if there are any contacts of seat units and parts with cab elements while in motion, to avoid seat breakage.

Avoid upholstery soaking. *Dry the seat items, if need be.*

At engine stoppage and storage batteries disengagement, the seat heating is to be switched off.

It is prohibited to drive the vehicle with depressed quick-descent button.

Seats are maintained together with the vehicle by qualified specialists in service centers.

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SAFETY BELTS

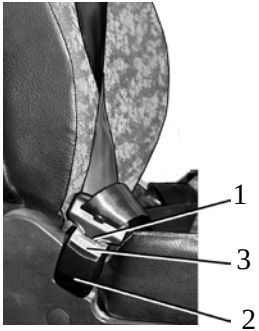
The vehicle seats are provided with safety belts. Safety belt prevents considerable displacement of driver in direction opposite to hit direction, thus, decreases danger of injure, e.g. at frontal clash.

To fasten the safety belts

1. Smoothly pull the safety belt out of mechanism and place over the shoulder (see Fig. *Safety belts*).

2. Insert the belt tongue 1 into lock 2 till the click of fixation, with this avoid strap twisting.

To unfasten the safety belts, press the knob of lock 3.



Safety belts

1 - belt tongue; 2 - lock; 3 - lock knob

Attention!

Ensure that the belt strip:

- is tight to driver's body;

- passes across the shoulder middle;

- does not pass across throat or under hand;

- is stretched in lumbar part while tightening the safety belt up in front of breast;

- if belt is unfastened for complete reeling, and also, to avoid seizure, it is suggested to hold the belt strap on.

Safety belt performs protection function if seat back is arranged almost vertically and if sitting person body is straight.

Use safety belts in all trips. Each safety belt is used by one person only.

Disassembly of safety belt parts is prohibited. In case of straps soiling, wash them with soft detergent.

In case of serious belt damages (worn straps, cuts, failure of draw-in device) as well as at critical loads in road accident, the belt should be changed by the belt of the same model.

Warning system of safety belt fasting is installed in certain vehicle configurations.

If safety belt is unfasten the pilot lamp flashes on the instrument panel . At start of vehicle motion and unfasten safety belt an intermittent sound signal activates.

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THE UPPER BUNK

Attention!

Get a move on only with a folded and belt fixed bunk.

It is forbidden to be on the upper bank of the driving vehicle.

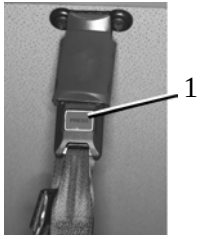
Dropping of the bunk

1. Throw forward the backs of driver's and passenger's seats.

2. Slightly lift the upper bunk and holding it press the the release button of retaining belt lock (see Fig. *Retaining belt of the upper bunk*).

3. Unhook the belts.

4. Lower the bunk down.



Retaining belt of the upper bunk

1 – release button of retaining belt lock

For installation of guard mesh hang the hooks of guard mesh in the eye ring (see Fig. *Installation of guard mesh*).



Installation of guard mesh

1 - hook of guard mesh; 2 - eye ring

Bunk lifting

1. Lift the upper bunk up and hold.

2. Insert the tongues of retaining belts into belt locks and fix them till the typical click.

THE LOWER BUNK

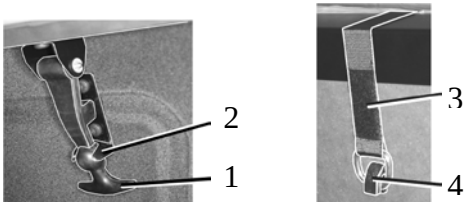
Setting of the lower bunk into operational state

1. Raise slightly the lower bunk and detach the retaining belt 3 from the hook 4 (see Fig. *Fixation of the lower bunk*).

2. Throw the lower bunk down.

3. Fixate the rubber clamp 1 on the safety clip 2, the lower bunk is fixed.

4. Fasten the retaining belt 3 to the back wall using hook-and-loop tape.



Fixation of the lower bunk

1 - rubber clamp; 2 - safety clip; 3 - retaining belt; 4 - hook

Lifting of the bunk

1. Draw the rubber clamp 1 down and detach from the safety clip 2.

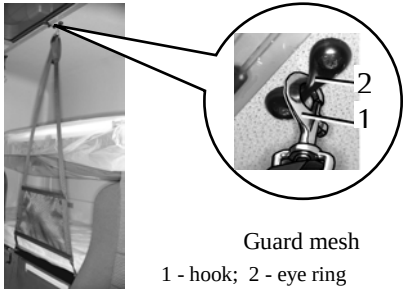
2. Detach the retaining belt 3 from the rear wall.

3. Raise up the bunk.

4. Stretch the retaining belt 3 and fix it on the hook 4 on the lower side of the bunk.

Installation of guard mesh

Before starting the trip fix the hook 1 of the guard mesh on the eye ring 2 on the cab ceiling (see Fig. *Guard mesh*).



Guard mesh

1 - hook; 2 - eye ring

The belts disassembly is prohibited. In case of straps soiling, wash them with soft detergent.

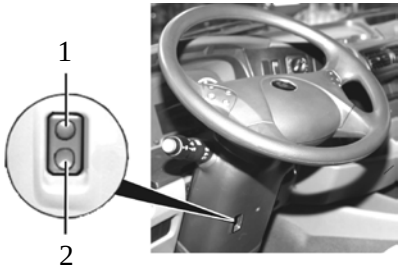
In case of serious belt damages (worn straps, cuts, failure of draw-in device) as well as at critical loads in road accident, the belt should be changed by the belt of the same model.

STEERING WHEEL ADJUSTMENT

Position of steering wheel is adjusted by height and inclination. Adjustment mechanism is provided with the system of pneumatic lock and lock release.

Adjustment of steering wheel position

1. Stop the vehicle.
2. Engage the parking brake.
3. Press on the lower part of the steering wheel lock/ unlock switch (see Fig. *Steering wheel lock/ lock release switch*). Steering column is unlocked.



Steering wheel
lock/ lock release switch

1 – steering wheel lock;
2 - steering wheel lock release

4. Adjust position of steering wheel by height and inclination.
5. Press on the upper part of steering wheel position adjustment switch. Steering column is locked.

If the steering column locking mechanism is not locked, roughly in 10 sec. after lock release the steering wheel is automatically locked.

Attention!

Do not adjust the steering wheel while in motion, otherwise you may lose control over the vehicle handling.

Adjustment is performed only in a steady vehicle, with engaged parking brake.

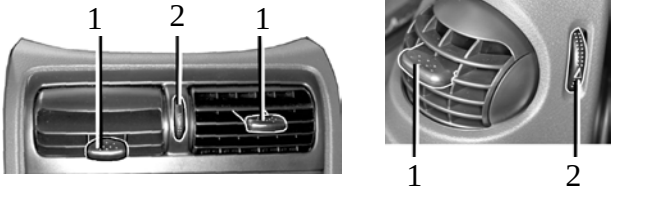
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AIR CONDITIONING SYSTEM CONTROL

VENTILATION DEFLECTORS

The airflow direction can be adjusted by means of deflectors located on cab doors and on instrument panel (see Fig. *Ventilation deflectors*):

- **opening** - turn the flywheel 2 upwards;
- **closing** - turn the flywheel 2 downwards;
- **adjustment** - turn the ventilation deflector by handle 1 to the necessary position.



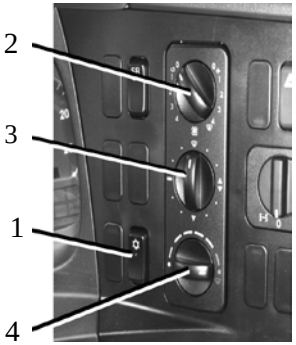
Central part of instrument panel

Driver's side cab door (passenger's door, inversed manner)

Ventilation deflectors
1 - handle; 2 - flywheel

AIR CONDITIONING SYSTEM CONTROL PANEL

Using the shifters on instrument panel of air conditioning system you can regulate: air distribution, air temperature, air flow.



Control panel of air conditioning system
1 - conditioner switch;
2 - fan switch;
3 - air distribution regulator;
4 - temperature regulator

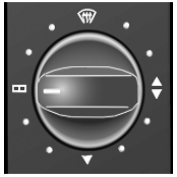
Attention!

In case of air conditioning system elements malfunction it is not recommended to switch the conditioner on.

Procedures on maintenance, repair and change of failed air conditioning system components are to be carried out by specially trained specialists of service departments!

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Air distribution in the cab



Regulator
of air distribution

Positions of air distribution regulator

Symbol	Application
	Air supply to the windscreen and to the side windows
▲ ▼	Air supply to the windscreen and to the foot room
▼	Air supply to the foot room and also to the middle and side deflectors
	direct ventilation through the central and side deflectors

Temperature setting



Temperature regulator

To increase the temperature turn the temperature regulator to the right, to decrease - to the left.

It is recommended to engage the temperature regulator not less frequently than once-twice a month to maintain its operation reliability.

Air flow regulation



Fan switch
1 - air recirculation mode;
2 - fresh air mode

Positions of fan switch in air recirculation mode

0 - air recirculation is engaged;
1-4 - Air flow rate adjustment.

Positions of fan switch in the mode of fresh air:

0 - fan is disengaged;
1-3 - heating/ ventilation/ cooling;
4 - glass defrosting/ ventilation/ cooling.

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EXAMPLES OF SETTINGS

Fresh air mode

In case of the glass misting it is necessary immediately to switch the fan to the fresh air mode.

Air recirculation mode

At low or too high ambient air temperature you can briefly engage the air recirculation mode. In this mode a closed-looped air change is provided in the cab.

Engagement of air recirculation mode

1. Fix the fan switch in position 1-4.
2. Fix the regulators as it is shown in the Figure *Air recirculation mode*.
3. Close the side windows and ventilation hatch.

Attention!

It is suggested to use the recirculation mode during short period of time, as the glass misting over can occur. It is necessary to shift to the fresh air mode as soon as it is possible.



Air recirculation mode

Engagement of ventilation in the cab

1. Install the shifter and regulators as it is shown in the Fig. *Cab ventilation*.
2. Open ventilation hatch on the roof and ventilation deflectors.



Cab ventilation

Engagement of heating in the cab

1. Set the shifter and regulators as it is shown in the Fig. *Cab heating*.
2. Open ventilation deflectors.
3. Switch, if necessary, autonomous cab heater.



Cab heating

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Windscreen defrosting

1. Set the shifter and regulators as it is shown in the Fig. *Windscreen defrosting*.

2. Close ventilation deflectors.

3. Switch on, if necessary, the autonomous cab heater.



Windscreen defrosting

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CONDITIONER

The air conditioner regulates air temperature and humidity in the vehicle cab.

Attention!

Air conditioning system works only with engine working.

For normal operation of air conditioner compressor it is necessary to switch it at least once a month for 10 min.

In cold season it is suggested to engage conditioner for 5-10 min. in a warm room. This provides greasing of inner seals by oil primed in the system, preventing their drying and corrosion.

Conditioner is to be topped up from time to time (once in 1-2 years). Topping-up is carried out in a specialized service center.

Conditioner engagement

1. Press on the upper part of conditioner switch. LED (color - red) built into switch comes ON.



2. Set the temperature regulator on a required temperature.

Conditioner switching off

Press on the lower part of conditioner switch. LED built into switch comes OFF.

Air cooling

For the short period cooling in the mode of air recirculation switch on the conditioner and set the regulators, as it is shown in the Fig. *Cooling in the mode of air recirculation*. Cooling in the mode of air recirculation results in lack of oxygen in the cab.

When constant cooling is required shift to the mode of fresh air:

- switch on the conditioner;
- close the ventilation hatch;
- open ventilation deflectors.



Cooling in the mode of air recirculation

Air drying

1. Set the shifter and regulators as it is shown in the Fig. *Air drying*.
2. Switch on the conditioner.
3. Close the ventilation hatch.
4. Close the ventilation deflectors.



Air drying

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INDEPENDENT CAB AIR HEATER

In certain vehicle configurations an independent cab air heater is installed.

An independent cab heater automatically adjusts temperature in the cab.

Engagement, disengagement, adjustment of independent heater is carried out by console panel, located over the windshield (see Fig. *Shelf over the windshield*).



Shelf over the windshield

1 - independent cab heater console panel

In a switch block, on the bunk, a remote switch of independent cab heater is located (see Fig. *Shifters on the bunk*). An independent heater is engaged and disengaged by remote switch.

Attention!

Before going to the dangerous zone (fuel filling station, petroleum processing plant and so on) the heater should be disengaged.



Switches on the bunk

1 - remote switch of independent cab heater

In a vehicle with semitrailer-tank cistern for transportation of dangerous cargo the heater is automatically disengaged:

- at vehicle engine cut off;
- at PTO box engagement.

Independent air heater operation manual «Independent device for heating and maintenance of air temperature in the cab AIRTRONIC D2» see in Appendix.

CAB INTERIOR LIGHT

Lighting types:

- cab lighting;
- lamp for reading;
- night lighting.

All types of lighting are engaged and adjusted independently of each other.

Engagement and disengagement of interior cab lighting



Switch block over the windshield

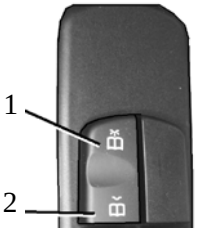
1 - engagement of night lighting;
2 - engagement of driver's reading lamp;
3 - engagement of interior lighting;
4 - engagement of automatic mode of interior lighting engagement, it is switched on when the door is opened.

With the shifters in neutral position the lighting is disengaged.

Engagement and disengagement of reading lamp on passenger's side

1 - engagement of reading lamp on passenger's side;

2 - disengagement of reading lamp on passenger's side.



Switch block on the passenger's door

Reading lamp on the bunk

(on the side wall of the cab)

Engagement - press on the upper part of the reading lamp;

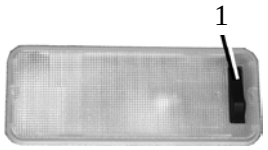
Disengagement - press on the lower part of the reading lamp.



Reading lamp on the bunk

Reading lamp

(on the back wall of the cab)



Lamp for reading on the back wall of the cab

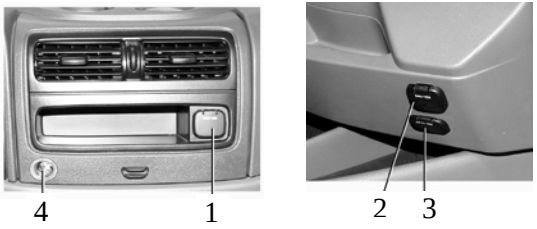
1 – engagement/ disengagement of the lamp

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ELECTRICAL SOCKETS

Electrical sockets **24 V/ 10 A** are located in the central part of instrument panel and on passenger's side (see Fig. *Electrical sockets and jumper*). Load on each such electrical socket should not be more than 240 V.

Electrical socket **12 V/ 15 A** is located on instrument panel, on passenger's side. Load on such electrical socket should not be more than 180 W. Electrical socket 12 V/ 15 A serves for power supply to electric equipment with the voltage 12 V (radio receiver, radio station).



Electrical sockets and jumper

1 - electrical socket 24 V/ 10 A on the central part of the instrument panel;
2 - electrical socket 24 V/ 10A from passenger's side;
3 - electrical socket 12 V/ 15 A; 4 – jumper

JUMPER

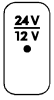
To engage the jumper turn the ignition key to position «ACC». Further press the jumper in (see Fig. *Electrical sockets and jumper*).

If the helix got hot, the jumper automatically protrudes. ***Take the hot jumper only by handle.***

VOLTAGE CONVERTER

Before switching on the electric equipment with the voltage 12 V it is necessary to switch on the voltage converter (to shift the electrical socket to 12 V).

To engage the voltage converter, depress the voltage converter switch, located on instrument panel, in its top part. LED (green color) built into switch comes ON.



To disengage the voltage converter press on the lower part of the switch. LED built into switch comes OFF.

OUTPUT TERMINAL FOR RADIO STATION POWER

To connect the radio station to the vehicle network, in the overhead console the power terminal **12 V** (red-white wire - terminal «+», grey wire - terminal «-») is provided.



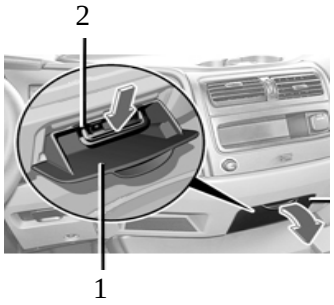
Terminal for radio station connection

Before switching of the radio station with voltage 12V it is necessary to engage the voltage converter.

ASH TRAY

Installation of ash tray is possible in the cab.

To open pull the ash tray by the handle in the direction of the arrow until stop (see Fig. *Ash tray*). Further press the lock release button 2 and, holding it down, fully pull the ash tray 1 out.

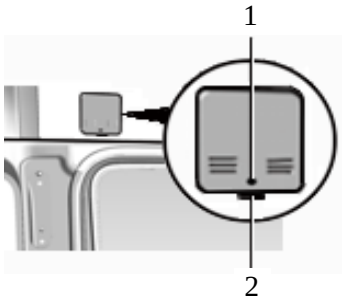


Ash tray
1 - ash tray;
2 - lock release button

SMOKE DETECTOR

Smoke detector gives alarm signal in case of the cab smoke blanketing. Detector can activate having identified the particles of cigarette smoke, dust or exhaust gases.

Smoke detector is located over the driver's door (see Fig *Smoke detector*).



Smoke detector
1 - operating button;
2 - lock release button

Warning sounds as a pulsating signal. Sound signal can be switched on by short pressing of operation button. From the moment of pressing the button the smoke alarm deactivates roughly for 20 min. When the signal is switched off roughly every 40 sec. a short audio signal sounds.

Control of smoke detector operation

It is recommended to check serviceability of the smoke detector once a week: press the operating button and hold it down for 5-10 sec. If detector is fault free the signal sounds. From the moment of pressing the button the smoke alarm deactivates roughly for 20 min.

When batteries discharge a short signal sounds roughly in every 40 sec. To provide the work of the smoke detector change the battery.

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DIGITAL TACHOGRAPH

On the shelf over the windshield a digital tachograph is installed.

Digital tachograph – technical control device, designed for registration, storage, display, printing of data about the mode of movement, labour and rest of the driver (see Operation manual of tachograph manufacturer).



Shelf over the windshield

1 - digital tachograph

Tachograph is designed to be used by one or two drivers.

Vehicle manufacturer temporarily seals tachograph during its installation.

Further, after tachograph adjustment, the workshop, carrying out activities on installation, check, maintenance and repair of tachograph, seals it.

GLOVE COMPARTMENTS AND BOXES

It is not recommended to carry over heavy things in the compartments.

Attention!

In order to prevent injury of people by things falling at hard vehicle braking, all glove boxes and additional compartments for accessories should be closed and locked during the motion.

TERMINAL FOR POWER OF RADIO RECEIVER

On the vehicles the overhead console is prepared for installation of the radio receiver with the input voltage 24 V (radio recorder, multimedia system).

For connection of the radio receiver to the vehicle network and to the loudspeakers, the terminal is provided in the overhead console, standard ISO 10487.



Terminal, standard ISO 10487

Attention!

Connection of the radio receiver with inlet voltage 12 V is forbidden, as it may cause the radio receiver failure.

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EMERGENCY RESPONSE SERVICE CALLING UNIT (ERA-GLONASS)

APPLICATION AND CONTROL DEVICES

Emergency response service calling unit is designed for:

- transfer of minimum data set with description of motor vehicle, coordinates of its location, time and movement direction;

- call of emergency service operator via loudspeaker by pressing the emergency button SOS at road traffic incidents and other emergency situations.

Connection is carried out via mobile cellular network, meeting GSM/ UMTS standards.

Coordinates of motor vehicle location are calculated by using the signals of Global Navigation Satellite System (GLONASS) or GLONASS together with GPS.

At failed attempt to transfer the data by tone modem the emergency response service calling device will execute it by means of SMS mechanism.

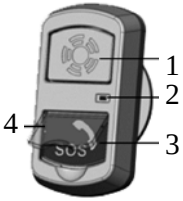
The emergency response service calling device consists of the following components:

– ERA-GLONASS BLOCK;

– two blocks of user interface, located on instrument panel (see Fig. *User's interface block*);

– loudspeaker block is located in an overhead console or over the door from driver's side;

- GLONASS/GPS antenna is located under instrument panel.



User's interface block
1 – service button;
2 - microphone;
3 - emergency button «SOS» (with lighting);
4 - protection cover

At night time when marker lights are engaged the buttons of user's interface block are illuminated by green.

Attention!

Emergency response service call unit ensure safe operation at ambient temperature from minus 45 to plus 85 ºC.

The unit is to be used solely in emergency situations.

It is forbidden to use the emergency response service call unit during the motion without extreme necessity.

Dismantling and repair of the emergency response service call unit should be carried out only in the service center.

On the vehicles equipped with the emergency response service call unit the radio receiver should be provided by «MUTE» function.

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OPERATION MODES

When the ignition key is turned to position «ON», the illumination of emergency button «SOS» (color - red) lights up for 5-6 sec. and dies out. If malfunction in emergency response service call system appears, in 20-30 sec. the emergency «SOS» button illumination lights up and is on continuously till the moment of fault elimination or when the ignition key is turned to position «0». Address the service center to eliminate the troubles.

Illumination of emergency «SOS» button can be continuously on in case when signals from satellites GPS/ GLONASS are absent. It is not a defect if the vehicle is in the places closing the direct visibility of satellites (in tunnels, under bridges and so on). After vehicle moving out to the places of direct satellite vision the illumination should die.

The emergency response service call unit is in the mode «Switched Off», if from the moment of ignition key rotation to position «0» not less than 72 hours have passed. In the mode «Switched Off» the system does not respond to emergency call SOS button pressing and there is no illumination of emergency call SOS button.

Emergency call «SOS»

Emergency call can be made under condition that ignition key is in position «ON» or that from the moment of the last disengagement not more than 72 hours have passed.

For emergency call it is necessary to take away a protection cover, press and hold down the button of emergency «SOS» call for not lessthan 2 sec. Illumination of emergency «SOS» call button (color-red):

- starts blinking while calling to the operator of emergency response cervices;

- is continuously on during the call, minimum data set transfer, voice connection with operator.

At the beginning of voice connection the sound reproduction of radio receiver (radio recorder or multimedia system with «MUTE» function) stops, if it worked before the moment of emergency call.

Cancellation of extreme manual call can be fulfilled at the moment of dialing to the operator of emergency response services (illumination of emergency «SOS» call button blinks red), for this purpose it is necessary to press and hold down the emergency «SOS» call button for not less than 2 sec. Red illumination dies out.

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DRIVING THE VEHICLE

SAFETY REQUIREMENTS

1. All defects discovered during vehicle inspection should be eliminated.

2. At starting the engine, observe the following safety precautions: first of all, make sure that the parking brake system is engaged, while the gearshift lever is in neutral position, and in the gear box with automatic control the neutral is engaged.

3. Do not warm up the engine in closed premises with poor ventilation.

4. Keep the engine and pre-starting heater clean and in good working order; oil-stained engine crankcase and fuel leak may cause fire.

5. Remember, that diesel fuel and its vapors are toxic and flammable. Observe safety measures and fire safety regulations.

Avoid diesel fuel getting onto skin and cloth, or diesel fuel vapors into respiratory passages.

6. In case of diesel fuel inflammation, flame must be covered with soil, sand; felt or canvas cloth, use the fire extinguisher. ***It is strictly forbidden to flood the firing fuel with water.***

7. Do not grease or clean the engine while it works.

8. ***It is strictly forbidden to perform any works in the zone of cooling system fan while engine works.***

9. Do not open the expansion tank cap of an overheated engine, let the engine cool down.

10. Remember, that cooling liquids used in engine cooling system and liquids used in clutch drive are toxic and should be handled with adequate care.

11. Before motion start make sure that the cab is safely locked.

12. When coasting downhill, do not disengage the gear in the gearbox and, for mechanical gear box, do not depress the clutch pedal.

13. Prevent vehicle driving if the rear suspension torque rods are loose in fastening.

14. Prevent vehicle usage if total play in steering control is more than 25º.

15. Operation with untight input path leads to premature engine fail. Regularly check rubber branch pipes and air pipes for integrity, also check reliability of connections and eliminate the path leakage.

16. Do not use the semitrailer with disconnected or faulty brake and electric systems.

17. Do not drive the vehicle with cargo unfastened.

18. Do not start motion while people are between truck and semitrailer.

19. It is forbidden to change vehicle wheels if vehicle is jacked up only, without trestles.

20. **Prior to performance of electric welding activities the following operations are necessary to be fulfilled on the vehicle**:

- the storage batteries should be disconnected by means of a remote-control switch;
- disconnect terminals from battery leads;
- remove the wires from all outlets of alternator and disconnect the connector (if any);
- disconnect all connectors from all ECUs installed on the vehicle: vehicle engine, brake system (ABS, EBS), exhaust gas aftertreatment system, air suspension, gear box, electric equipment and others (if any);
- when welding on chassis, disconnect the communicating connectors going into cab. In such a case disconnection of connectors of electronic units located in a cab is not required;
- the welder minus terminal should be connected in immediate proximity to the weld area;
- when welding on a cab, connect the "ground" wire to the cab, only, while welding on a vehicle chassis – to the chassis, only.

It is prohibited to perform welding on conditioner components (if any) or in proximity to it, since conditioner heating may cause it failure or explosion.

It is forbidden to connect "ground" conductors to any sensors, items of wiring or to engine electronic control module arranged on engine.

It is strictly forbidden to lay out a welder cable in parallel to the vehicle wiring harness.

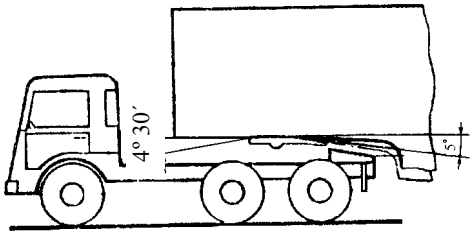
It is not suggested to perform welding operations on engine or components mounted on engine.

21. Do not disassemble brake chamber spring energy accumulators on the vehicle. It should be carried out in a workshop with the usage of special accessories.

22. During operation of bolster traction truck equipped with a low bolster (the bolster installation height is 1100 mm or less) and air suspension, being a part of the train the angles of semi-trailer longitudinal tilt in relation to traction truck are to be no more than those specified in Fig. *Angles of train flexibility*.

It is possible with the following train driving conditions fulfilled:

- while descending onto the road horizontal section and while ascending from the horizontal section, the road slope is to be no more than 8%;
- while ascending onto the road horizontal section and while descending from the horizontal section, the road slope is to be no more than 9 %.



Angles of train flexibility

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SAFETY REQUIREMENTS DURING OPERATION OF VEHICLE WITH ELECTRONIC SYSTEMS

1. Be sure to disconnect the storage battery while repairing or replacing the items of vehicle electronic systems.

2. It is strictly forbidden to connect the electric connectors to control module prior the process of system installation is over.

3. It is strictly forbidden to supply the voltage directly onto the control module terminals.

4. Voltage measurements in the system should be carried out only by appropriate measurement devices! Input impedance of measurement device is to be not less than 10 MOm.

5. The connectors of electronic control module are to be disconnected and connected only while the starter-and-instrumentation key is in position «0».

6. It is forbidden to use the vehicle while the circuit resistance between the accumulator battery «minus» and the electronic module connector is more than 3 Om.

7. During painting, the electronic components of the system may be subject to heating in a drying chamber up to 95 °C for a short period of time (up to 10 minutes), while at temperature of no more than 85 °C – up to 2 hours. With this, be sure to disconnect the storage batteries.

8. Be sure to change the fuses, pilot lamps and disconnect/ connect the cables and other commutation devices only with power (storage battery) disconnected.

To use the fuse with the same rating instead of that to be replaced, strictly.

9. The short-circuiting of electronic control module leads onto the «ground» or positive terminal of power source is inadmissible.

10. The opening – closing of control module connector while the power source is ON is intolerable.

11. It is prohibited to touch the outlets of ECU by hands to avoid deformation of outlets and damage of ECU elements by electrostatic discharge.

Warnings

1. For the period of painting in the electrostatic field the connections of storage batteries to engine control module are to be removed. Prior to vehicle painting disconnect the positive as well as the negative lead from the storage battery.

2. When disconnecting the vehicle storage battery, be sure to disconnect the positive lead at first.

3. Prior to painting, all electrically mateable connectors are to be connected. Non-connected connectors are to be masked for the period of painting.

4. For the period of painting mask the information plate on the engine control module. When painting is over remove all the masking materials.

NEW VEHICLE OPERATION (RUNNING-IN)

Vehicle reliability and economic feasibility as well as its life duration depend upon parts and aggregates running-in during new vehicle operation – the first 1000 km of the race.

The following requirements should be observed during running in:

- vehicle motion at maximum speed should be avoided. Do not exceed ¾ of crankshaft rated speed in each gear;
- in mechanical gear box: shift the gears in due time; do not gear down to brake the vehicle;
- prevent vehicle operation in hard road conditions.

MAIN RULES OF OPERATION

1. During vehicle operation, use service materials recommended by manufacturer (see Appendices 2, 3).

2. Before start of operation turn the power supply (storage batteries) ON in electrical equipment system of the vehicle, having pressed the button of remote storage battery switch. Click the button briefly, for no more than 2 sec.

3. Start vehicle driving after warming up of engine cooling liquid till temperature of not less than 40 °C.

4. Do not start driving the vehicle till the light of brake system failure pilot lamp goes out and the buzzer stops humming, demonstrating that the brake system is filled in with air.

5. During cold period of time, after engine start, before vehicle movement, it is necessary to warm up oil in steering system (see Section 5 «*Vehicle operation in cold season*»).

It is prohibited to rotate the steering wheel, before the oil in the steering system is warmed up!

6. For mechanical gear box when starting the vehicle it is always necessary to engage the first gear. Change the gears softly, with clutch surely released.

It is recommended to keep the gear shifter in the neutral position for a short period of time. Don‘t throw into the gear sharply when you feel resistance to shifter moving. Smoothly increase pressure on the lever till the synchronizer full engagement.

If you fail to engage the gear at vehicle start, once again release the clutch and then again throw into gear.

7. When in motion, the crankshaft speed is to be controlled by tachometer. Keep it in mind that the maximum torque (maximum tractive effort) of the engine is achieved at crankshaft speed lower than the rated one (see section 2 «*Operating parameters*»).

Do not exceed the maximum crankshaft speed. Choose the driving speed on the route with due consideration of the most economical engine operation mode.

8. Monitor the state of all vehicle systems using measurement instruments and messages on instrument cluster display. Observe their indications and eliminate troubles in proper time.

9. Watch out for the air cleaner clogging up signaling system: if air cleaner clogging up pilot lamp comes ON (lamp is on instrument panel), be sure to change the filter element.

10. In case of lighting of incidental oil pressure and incidental coolant temperature pilot lamps located on the instrument panel and warning about the dangerous drop of pressure in engine lubricating system and about critical over-heating of coolant, stop the engine immediately, find and remedy the trouble.

11. In case of any faults menacing the road safety, stop the truck immediately to eliminate troubles and switch ON the emergency signaling system.

12. Observe the tire pressure values in accordance with the requirements presented in this Manual in order to prevent the tire intensive wear-out.

13. The weight of the cargo to be transported should not exceed the established norms, as overloading influences the road safety and causes rapid wear of vehicle units.

14. When accelerating the vehicle it is not recommended to throw into high gear until speed of motion on this gear reaches the maximum.

15. It is not recommended to stop train on climb or descend. To prevent road train runaway at forced stop it is necessary to:

- engage the parking brake system;
- engage the lower gear in mechanical gear gox.

In the gear box with automated control the neutral position should be fitted (forcefully - if necessary). Make sure that «N» illuminates on the display;

- shut down the engine;
- put the chocks under rear wheels of vehicle and semitrailer.

16. In the attempt to drive the truck out of the rut, do not keep the steering wheel turned to extreme position longer than for 15 sec.

17. During long traveling on dirty roads (with liquid dirt), periodically, wash the radiator surface with water directed under sufficient pressure from the hose. To do this, raise the cab and direct the water jet onto the radiator from engine side. Keep the alternator from direct water hit.

18. Engage the reverse gear only in stationary vehicle, with engine idling.

19. Do not disconnect the storage batteries by the switch while engine is running.

20. When parking the vehicle for a stoppage disconnect the storage batteries from electric equipment by pressing the button of storage battery remotely controlled switch. Click the button briefly, for no more than 2 sec.

21. It is forbidden to use the side safety device as a ladder.

22. Water obstacles fording is forbidden. Maximum fordable depth is to be not more than 250 mm.

23. Maximum permissible speed of the vehicle movement without semitrailer on the roads of normal type (not an express way GOST R 52398-2005) is not more than 60 km/h.

Climbing

Short climbs on good roads should be overcome with speed reserve.

While overcoming sharp and prolonged climbs, choose the low gears taking into account the road train load, length and sharpness of climbing. If possible use the gear that provides moving without additional shifts and stops.

If for some reasons the truck cannot overcome the climb, drive down it slowly reversing and try again.

Descending

When coasting downhill, do not disengage the gear and do not depress the clutch pedal.

To slow down the vehicle (train) when descending, use the auxiliary brake system and if necessary use the service brake.

With the auxiliary brake system engaged, do not release the clutch and do not change gears.

Climbing and descending (for the vehicle equipped with automated gearbox)

Short climbs on good roads should be overcome with speed reserve. If for some reasons the truck cannot overcome the climb, drive down it slowly reversing and try again.

When climbing and descending, it is suggested to move in automatic mode. Gearbox itself selects the required gear appropriate for certain driving speed.

To slow down the truck (train) when descending, use the auxiliary brake system and if necessary use the service brake.

RECOMMENDED OPERATION MODES OF ENGINE

1. While moving on long ascending grades and in mountains, choose the corresponding engine operation mode at which rpm do not fall less than 1100 min^{-1}.

2. In order to prevent oil ingress from turbo compressors and getting it into engine cylinders and onto those parts of compressor and turbine where gas flows, AVOID prolonged idle operation of engine. Otherwise, piston rings will be coked, gas-flow part of compressor polluted and gas-flow part of turbine carbon-deposited.

In case of engine urged idle operation (heating, air pumping into brake system receivers etc.), maintain rotation frequency from 1100 to 1500 min^{-1}.

3. Prior to engine shutdown after operation under load, it is obligatory to operate 3-5 minutes in idle mode to prevent overheating of turbo-compressor bearings and rotor seal assembly coked.

Abrupt engine stop after loaded operation is STRICTLY FORBIDDEN.

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PRELIMINARIES FOR VEHICLE MOTION

Prior to the vehicle movement:

1. Perform vehicle daily maintenance (see section 6 «*Maintenance*»).

2. Check fuel reserve in fuel tank by indicator.

When the volume of fuel decreases in fuel tank to 12 % from its total volume the fuel reserve pilot lamp , located on instrument panel in the zone of tank fuel level indicator, flashes on.

If fuel level in vehicle fuel tank is low, air may ingress into fuel feed system causing unstable engine operation or its stop succeeded by hard or failed starting.

Engine operation is not recommended at reserve residual fuel indicator actuation.

If air gets into fuel feed system, be sure to prime the tank and bleed fuel system before the engine is started (see section 7 «*Possible malfunctions of vehicle units and systems. Self-help*»)

Fuel the vehicle in accordance with recommendations, presented in Appendices 2, 3.

Attention!

Before vehicle priming shut off the engine and cab independent heater.

If at fuel tank opening the air sharp output is observed (increased air pressure in the tank) or air suction (vacuum in the tank), it is necessary to change the air filter of fuel tank.

Replacement of fuel tank air filter is described in Section 6 «*Maintenance*».

3. Check availability of neutralizing fluid. If on instrument panel the pilot lamp of neutralizing fluid level in neutralization system flashed up , top up the neutralizing fluid AdBlue.

Neutralizing liquid should be used in accord with recommendations, specified in Appendices 2, 3.

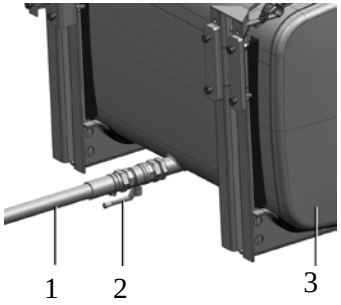
Fuel tank filling

(for certain configurations upon availability of two fuel tanks)

Fuel tanks are connected by the crossover pipeline of small section (see Fig. *Fuel tank*).

When filling in both fuel tanks it is recommended:

- to open covers on both fuel tanks;
- fill in both tanks through filler neck of one of the tanks, with crossover pipeline valve opened. Filling of the second tank is carried out through the crossover pipeline



Fuel tank

1 – crossover pipeline;
2 – valve;
3 –fuel tank

Speed of fuel overflow from tank to tank is enough in the process of vehicle motion. Sequence of filling in the tanks is free, but the left tank is considered to be the main, as a fuel suction pipe is installed in it.

If at fuel tank opening the air sharp letout is observed (increased air pressure in the tank) or air suction (vacuum in the tank), it is necessary to change the air filter of fuel tank.

Replacement of fuel tank air filter is described in Section 6 «*Maintenance*».

Attention!

In emergency situations (at breakage of crossover pipe, damage of the right side) or if necessary you can close the valve and fill in only the left tank.

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Engine start up

Parking brake system is engaged.

1. Check if gearbox control lever is in neutral.

For the gear box with automated control the rotary switch is set to position «N».

If the rotary switch is not set to position «N», engine start up is not possible.

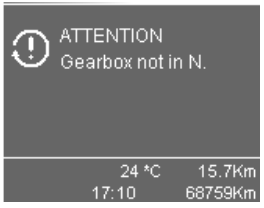
2. If need be (after long-term parking, filter element change in fuel filter) pump-through the fuel feed system with priming pump (see Section 6 «*Maintenance*»).

3. Engage the storage batteries by short-time clicking the battery switch knob.



4. Turn the ignition key to «ON» position (motion position). Approximately for 2-3 sec. all pilot lamps will flash on the instrument panel and the logotype - on the display (operability control).

If gear box control lever is not in neutral position, the screen is displayed on the instrument cluster.



5. About EFU readiness for engine start up in the cold period of time the message signals on the display of the instrument cluster (see Section 5 «*Vehicle operation in the cold period of time*»).

At ambient air temperature minus 20 °C preliminarily warm up the engine with the aid of starting preheater.

6. For the vehicle with mechanical gear box depress the clutch panel.

7. Turn the ignition key to position «START» (engine start up). With this do not press the fuel feeding pedal.

If in 20 sec. the engine fails to start, interrupt the start process. Turn the ignition key back to position «0». Repeat engine start up approximately in 1 min. If after three trials the engine fails to start, find and eliminate the trouble.

8. Just after engine work start release the ignition switch key immediately.

9. Be sure, there's certain pressure in lubricating system. After engine start up operate the engine for some time with a minimum idle speed, till enough oil pressure is fixed.

Attention!

If oil hazard pressure pilot lamp lightens on instrument panel and intermittent audio signal sounds; oil pressure in engine lubricating system is below norm-stop the engine and eliminate the trouble.

10. For the vehicle with mechanical gear box smoothly release the clutch panel.

11. Increase pressure in brake system circuits up to norm (from 9,0 to 10,0 kgf/cm^2), controlling pressure in brake system circuits I and II by indicators located on instrument cluster.

At pressure in brake system circuits below the standard, pilot lamps are ON on the instrument panel Ⓘ, Ⓘⓘ *and intermittent audio signal sounds.*

12. If coolant temperature 40 °C is reached, work under load may be started.

If storage batteries are discharged (after prolonged parking of the vehicle, not disconnected consumers), engine may be started from external power source (see section *7* «*Potential failures of vehicle units and systems. Self-help*»).

Engine shutdown

1. Stop the vehicle.
2. Install neutral in the gear box.
3. Engage the parking brake.
4. At coolant high temperature or engine operation under maximum load (for example when upgrading), before engine shut down let it work approximately for 3-5 min with minimum idle speed.
5. Rotate the instruments-and-starter switch key to position «0».
6. Switch off vehicle storage batteries having pressed the button of storage battery switch.

After storage battery switch depressing the off-delay is foreseen for 5-6,5 sec.

It is necessary for bleeding of neutralizing fluid injection system to avoid fluid crystallization in supply ducts.

Peculiarities for Mercedes-Benz engine start and stop see in Operation manual for Mercedes-Benz engine.

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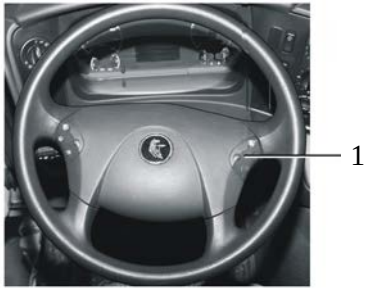
IDLE SPEED ADJUSTMENT

After engine start up the idle speed is set automatically depending on coolant temperature.

Idle speed of the engine warmed up to operation temperature is approximately 600 min^{-1}.

The engine idle speed is to be adjusted on a steady vehicle.

The idle speed adjustment may be performed with the help of fuel feed control pedal as well as with the buttons located on the steering wheel, r.h. side (see Fig. *Steering wheel*).



Steering wheel

1 – control buttons of idle speed adjustment and cruise control mode

Control buttons of idle speed adjustment and cruise control mode

	Increase of crankshaft speed/ cruise - control speed
	Decrease of crankshaft speed/ cruise - control speed
	Engagement of cruise-control mode
	Return to the preset speed/ disengagement of cruise-control mode

In contrast to pedal adjustment the button fixates the target idle speed.

To increase the crankshaft speed depress the button  to reach necessary idle speed.

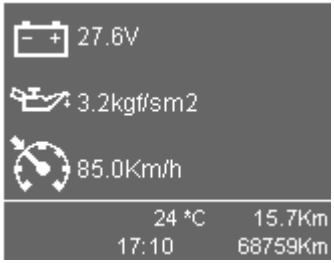
To decrease the crankshaft speed depress the button  to reach necessary idle speed.

Return to preset rotation frequency is carried out by pressing the button  , by affecting on the pedal of clutch or brake pedal, or by engaging the secondary brake system.

«CRUISE-CONTROL» MODE

In cruise-control mode, the vehicle traveling speed is maintained on a level set. The mode may be activated at vehicle speed at least 38 km/h. When «Cruise-control» is engaged but not active, speed digits are flashing on the display.

When necessary drive speed is reached (cruise-control speed) engage cruise-control mode, having pressed the button . In this case the symbol flashes on the display and speed indicating digits light on unwinkingly.



The speed set in such a way will be maintained by vehicle irrespective of the affection on the fuel feed pedal. If it is necessary to overtake, the set speed may be increased with accelerator pedal depressed.

After the pedal is released, the system keeps running in the mode of speed maintaining, while the speed value restores till that prior to pedal depression.

To increase the speed of cruise-control press the button .

To decrease the speed of cruise-control press the button .

To disengage cruise-control mode repetitively press the button . The symbol on information display dies out.

Reduction of cruise-control speed is carried out by pressing the button , affecting on clutch or brake pedal or the button of secondary brake system.

After rotation of ignition key to «0» position, the set value of cruise-control speed is erased.

Attention!

To prevent possible vehicle failures and for personal safety it is not recommended to use cruise-control mode in *the following cases*:

- on twisty roads, in hard traveling conditions, while traveling with various speeds etc., when it is impossible to maintain the constant vehicle speed;

- on slippery roads.

GEARBOX CONTROL

Gear change in gearbox is performed with the help of gearshift lever located to the right of driver's seat. Shift the lever with the clutch released. Depress the clutch pedal against stop.

The gear engagement and change should be performed at minimum idle speed.

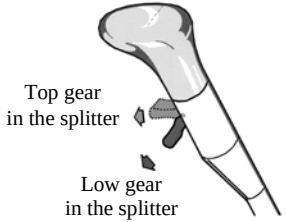
Start motion only on the first gear (to prevent premature clutch fail).

It is recommended to keep the gear shifter in the neutral position for a short period of time. Don't throw into the gear sharply when you feel resistance to shifter moving. Smoothly increase pressure on the lever till the synchronizer full engagement. If the gear fails to engage at vehicle speeding up, once again release the clutch and then again throw into gear.

To provide quick vehicle acceleration on a proper road and in hard conditions, it is suggested to engage all gears successively pursuant to gearshift scheme.

Operation manual for gearbox see in Appendix «Operation manual. Auto trucks. ZF-NewEcosplit».

Upon the availability of splitter in gearbox, the splitter control selector is built into gearshift lever handle (see Fig. *Gearshift lever*). Selector may be shifted to high «S» or low «L» splitter gear position. It is suggested to use the whole range of low and high gears.



In order to shift from high gear to low one and vice versa (without lever shifting), it is necessary to shift the splitter control shifter to the required position, then depress and in a short time (1 sec.) delay release the clutch pedal – the gear will be engaged automatically.

For simultaneous lever shifting and high or low gear engagement, shift the splitter selector to position «S» or «L», depress the clutch pedal and shift the lever.

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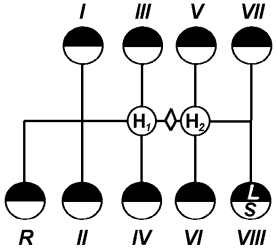
For gearbox models ZF 16S1820 TO, ZF 16S2220 TD, ZF 16S2221 TD gear shifting is fulfilled according to the scheme (see Fig. *Gear change scheme for gearbox models ZF 16S1820 TO, ZF 16S2220 TD, ZF 16S2221 TD*):

– 1-2-3-4 - low gears (the lower range of splitter);

– 5-6-7-8 - high gears (the high range of splitter).

When slowing down shift the gears only successively: 8-7-6-5-4-3-2-1.

In motion, always keep the gear engaged.



Gear change scheme for gearbox models ZF 16S1820 TO, ZF 16S2220 TD, ZF 16S2221 TD

H1 – neutral of splitter low gear range;
H1 – neutral of splitter high gear range;
L – decelerating (low) gear in splitter;
S – accelerating (high) gear in splitter

Attention!

For gearboxes, it is strictly forbidden:

- to change from high range of the splitter onto the lower one at speed more than 30 km/h;

- to drive with gearshift lever in neutral;

- to engage the reverse gear if the vehicle have not stopped completely and while the clutch driven plate is rotating.

The gears shift automatically in the splitter: high gear engagement – with lever shifting from the forth gear position to the fifth gear position, low gear engagement – when shifting from the fifth to the forth gear.

After the low range is engaged in a splitter, the pilot lamp lightens on the instrument panel .

After the lever is shifted through position «◇» the valve comes to operation which provides automatic shifting in a splitter.

While shifting the splitter, the rod of main gearbox shift lever is locked, whereby the effort is felt on the lever. It is recommended to wait for 1-1,5 sec. after that to provide gear shifting in the splitter.

GEARBOX WITH AUTOMATED CONTROL

Depending upon vehicle configuration, the vehicle may be equipped with gearboxes of models ZF 12AS 2130 TD, ZF 12AS 2131 TD with automated control for clutch linkage and gear shift mechanism.

Gear shifting can be carried out in automatic mode (gear box control unit chooses the necessary gear itself) as well as in manual mode (the gear choice is made by the driver).

Gear box and clutch are managed by electronic control system. Clutch pedal is absent.

Gearbox automatic control is carried out depending on the engine crankshaft speed, fuel feed pedal position, vehicle load, service brake operational state, road conditions.

Manual gear shifting and gear shift point are defined by the driver.

Messages on the display

The display on the instrument panel shows operational information, warning messages for the gear box with automated control.



Indication on the display

1 - operational information;
2 – number of the gear engaged from 1 to 12, warning messages

Operational information

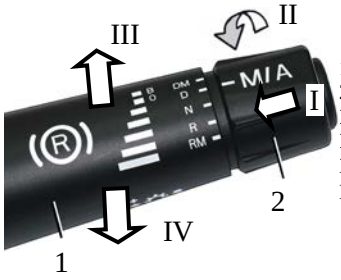
Display	Description
IM	Forward maneuvering
I	Forward movement
N	Gearbox in neutral position
R	Reverse gear;
RM	Backward maneuvering
PN	PTO box is engaged
4	Number of the gear engaged. In this case the 4th gear is engaged in manual mode.

Warning messages

Display	Description
CH	Self checking of the system (after ignition key rotation to «ON» position)
AL	Insufficient pressure in circuit IV of pneumatic system. Gear shifting is impossible
CC	Clutch position can not be identified. Vehicle driving is prohibited till fault correction
CL	Clutch overload. Choose the low gear
CW	Clutch wear limit
EE	Connection of the display and electronics is broken. Gear boxes System error
FP	Take the foot away from the fuel feed pedal. If error is still ON, so the system error has occurred. Further movement is impossible
HT	Emergency temperature of oil in the gear box

Gear shifter

Gear box control is carried out by the gear shifter, located on the steering column, on the right hand (see Fig. *Gear shifter*).



Gear shifter

1 – shifter lever;
2 – rotary switch;
I – choice of control;
II – choice of motion mode;
III – upshifting in manual mode;
IV - downshifting in manual mode

Attention!

Use the rotary switch only on a stationary vehicle and with engine idle speed.

Simultaneous usage of rotary switch and fuel feed pedal is prohibited.

Before leaving the vehicle engage the neutral in the gear box.

If with the driver's door open the rotary switch is not set in neutral position «N», with this an intermittent audible signal sounds.

I – To choose an automatic or manual gear box control shift the rotary switch towards the steering column against stop.

With automatic mode engaged the motion mode, corresponding to rotary switch position, is displayed.

At manual control engagement the number of the gear engaged is displayed.

Change of automatic and manual gearbox modes is possible in any time including the time of vehicle motion. After engine start an automatic mode of gear box control is always engaged.

II - To choose the motion mode turn the rotary switch to necessary position:

DM – forward maneuvering;

D – forward motion (in automatic or manual mode);

N – Neutral position of the gearbox;

R - reverse gear;

RM – reverse maneuvering

III – For upshifting press on the handle upwards.

IV- For downshifting press on the handle downwards.

Automatic gear box control

Start of the vehicle motion

1. Start the engine. Automatic engine mode is engaged. The system automatically chooses the gear for starting from standstill.

2. Shift the rotary switch from «N» position to «D» position (see Fig. *Gear shifter*).

3. Depress the fuel feed pedal and release the parking brake. With fuel feed pedal depressed the clutch is automatically engaged, and the vehicle starts moving.

For starting from standstill from neutral position of the gearbox the 1st-4th gear engagement is possible.

All upshifts and downshifts are carried out automatically depending on the vehicle load.

When moving in automatic mode the other gear can be chosen by pressing on the gear shifter handle upwards (III) or downwards (IV). Automatic mode in such a case is not disengaged.

Upshifting can be carried out by changing of fuel feed pedal position:

- light pedal depression causes the earlier upshifting;
- strong pedal depression causes the later upshifting.

To drive-up depress the fuel feed pedal. When the maximum, for these conditions, engine crankshaft speed in the gear engaged is achieved, electronic control system automatically upshifts the next gear.

Gearbox manual control

In difficult road conditions (for example, during the off-road movement) it is recommended to shift to the manual control mode to preserve an opportunity of self gear shifting in accordance with the road situation.

To choose the manual control, shift the rotary switch towards the steering column against stop (see I on Fig. *Gear shifter*). If the figure indicating the number of the gear engaged appeared on the display, then the gearbox switched to the manual control mode.

In this case the gear in the gearbox remains engaged.

Further change the gears by means of the gear shifter. Upshifting is managed by pressing the shifter handle upwards (III), reversion shifting – by pressing the handle downwards (IV). With this the gear engaged is shown on the display.

For reversion gearbox shifting to automatic control mode it is necessary tho shift the rotary switch towards the steering column, against stop. If operation mode is displayed corresponding to the rotary switch position, so the shifting is executed.

Motion modes

Direct maneuvering DM and reverse maneuvering RM modes are meant for very slow motion.

It is recommended to use maneuvering mode as more rarely as it is possible and for a short period of time to exclude the high load on the clutch.

Engagement of the maneuvering mode

1. Shift the rotary switch to position N, symbol «N» will flash on the display.

2. In two sec. shift the rotary switch to position of direct maneuvering DM or reverse maneuvering RM. The symbol of chosen maneuvering mode «DM» or «RM» flashes up on the display.

3. In two more seconds depress the fuel feed pedal and simultaneously release the parking brake. Vehicle moves from a standstill.

To slow the motion down release the fuel feed pedal and smoothly depress the pedal of the service brake system. Electronic control system automatically shifts the gearbox down.

Attention!

When engine crankshaft speed drops to more than 550 min^{-1} the electronic system automatically disengages the clutch, for example, when climbing. Escape the engine crankshaft speed drop more than 550 min^{-1}.

To decrease the motion speed use secondary brake system. When engaging secondary brake system the electronic control system automatically shifts the gearbox down.

To stop the vehicle apply the brakes and stop it. At short stoppage, for example before the traffic light, the chosen motion mode can remain engaged. In such a case it is always recommended to hold the service brake on.

During the long term stop (more than 2 minutes) set the neutral gear in the gear box. For this shift the rotary switch to position N (symbol «N» will flashes on the display) and engage the parking brake.

Attention!

When the vehicle is stopped, shortly before the engine crankshaft idle speed is reached, the electronic system engages the clutch automatically. With the engine operating and stationary vehicle the gearbox automatically engages the gear convenient for starting from standstill. The vehicle can start moving.

Stopping the vehicle always set the service or parking brake.

Engagement of reverse gear

Reverse gear is engaged only on a stationary vehicle with the neutral engaged in the gearbox.

1. Depress the service brake pedal or engage the parking brake.

2. By the rotary switch choose the mode R. The symbol «R» will flash on the display.

3. Release the service brake or disengage the parking brake and smoothly depress the fuel feed pedal.

Attention!

When coasting downhill, do not disengage the gear.

When shifting the gear do not change position of fuel feed pedal.

After the gearbox failure pilot lamp lighting on the instrument panel , vehicle movement is limited.

If simultaneously the pilot lamp of automated gearbox failure and the emergency pilot lamp STOP light on - vehicle movement is prohibited till fault elimination.

Suggestions on fault elimination see in Section 7 «*Potential failures of vehicle units and systems. Self-help*».

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INTERWHEEL DIFFERENTIAL LOCK

Differential is to be locked when there is a difference in values of wheel adhesive forces between which it is set.

The lock is to be engaged directly before overcoming of hard track sections (sticky ground, hindrances, slippery dirty road).

Attention!

Lock engagement and disengagement are to be done with the coupling disengaged and only after full vehicle stop.

For vehicles equipped with automatic gearbox the lock engagement and disengagement are to be carried out only when the vehicle is stopped and with «Neutral» position chosen in the gearbox.

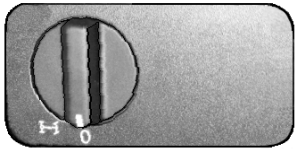
At the moment of one of the wheels skidding the lock engagement is forbidden. In this case lock engagement is to be done only after vehicle stop.

With differential locked it is necessary to move linearly, with speed not exceeding 10 km/h, without stops, preventing the wheel skidding.

The lock should be disengaged immediately after reaching the hard dry road, as a motion with the lock engaged can cause failure of the main gear parts.

Movement on a hard road with the lock engaged is strongly prohibited!

Interwheel differential lock control is electropneumatic and is fulfilled by the shifter located on the instrument panel (see Fig. *Switch of interwheel differential lock*).



Switch of interwheel differential lock

Engagement of interwheel lock

Turn the switch to position ⊥–⊥. Pilot lamp of interwheel lock engagement lights up ⊢×⊣ in instrument cluster, an intermittent audible signal sounds.

Engagement of interwheel lock

Turn the switch to position **0**. Pilot lamp of interwheel lock engagement ⊢×⊣ dies out, sound signal is switched on.

BRAKE SYSTEM

Service brake system is intended to reduce the vehicle traveling speed and to bring it to total halt; it is controlled by the brake pedal.

An emergency brake system is designed to provide the brake application in case the service brake system partially gets out of order. Functions of emergency brake system are fulfilled by service brake system circuits. In case of front service brakes failure, braking is executed by rear service brakes, and vice versa.

Parking brake system is designed to prevent spontaneous rolling away of stationary vehicle.



Handle of parking brake control valve

Handle of parking brake system control valve has two fixed positions:

- in the upper position 1 the parking brake is disengaged (position «Movement»);

- in the lower position 2 the parking brake is engaged (position «Stop»).

With the parking brake system engagement the pilot lamp comes ON (P).

In intermediate positions the truck tractor and semitrailer slowing down is fulfilled.

At shifting the valve handle further than the lower fixed position 2, against stop, the semitrailer brake releasing takes place; at the same time keep the vehicle parking brake system engaged. This allows to control the possibility of the road-train managing on the slope only by means of vehicle parking brake system. To shift further than the lower fixed position it is necessary to sink the parking brake control valve handle in.

Auxiliary brake system

Use the auxiliary brake system in all cases to reduce the traveling speed and compulsorily when driving on protracted downgrades in order to prevent over-heating of braking mechanisms.

On continuous grades up and down the optimum utilization of the engine braking capacity is possible by means of:

- auxiliary brake engagement;
- timely downshifting.

Auxiliary brake system works only with the gas pedal not engaged.

Auxiliary brake system of vehicle includes:

- decompression brake. An auxiliary valve in the head of cylinder block, connecting combustion chamber and outlet passage, opens in engine operating stroke, causing compression release. The result is that engine «braking» is executed;

- engine brake. When the engine brake is engaged the reverse pressure is created in exhaust system by means of throttle valve.

The work of engine brake depends upon the engine crankshaft speed. With increase of revolutions the braking power and efficiency increase.

Maximum engine crankshaft speed for engine brake operation:

- for a short period of time 2500 min^{-1};
- for a long period of time 2300 min^{-1}.

Optimum engine brake range of operation is from 1500 to 2300 min^{-1}.

At low rotation frequency it is necessary in advance to shift down or to apply the service brake.

- retarder (intarder). The intarder allows to execute a long time and gradual braking. Intarder operation manual see in Appendix «Operation manual for ZF-INTARDER. Inbuilt retarder (intarder) for trucks and buses with gearbox ZF».

Auxiliary brake system control is carried out by the brake pedal or the under steering switch, located to the right of the steering wheel.

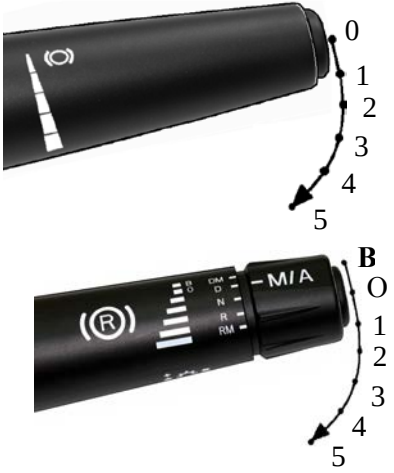
Attention!

When ABS system comes into action the auxiliary brake system is disengaged.

With the auxiliary brake system engaged, do not release the clutch and do not change the gears.

Do not engage the auxiliary brake on a slippery road to avoid the lock of wheels, it spells the vehicle sidewise skidding.

Auxiliary brake system control by means of the switch



Positions of auxiliary brake system control switch (depending on vehicle configuration)

With the switch in position «B» the mode of downhill operation constant speed is engaged, it doesn't allow the vehicle to pick up speed.

Vehicles without retarder have two brake steps 1 and 2.

Auxiliary braking by retarder brake is executed when the switch is sequentially shifted to positions 3-5.

Switch positions

B	The mode of downhill constant speed maintenance is engaged
0	Auxiliary brake is disengaged
1	Decompression brake is engaged
2	Engine brake is engaged
3-5	Retarder brake is engaged. The indicator lights up on the display .

Braking torque executed by auxiliary brake system stepwise increase from 1 to 5 lever position.

If necessary, an additional braking is possible by means of service brake system pedal.

In non-depressed position of the switch the auxiliary brake system is controlled by function «Brake-Management».

Attention!

If pilot lamps and STOPlight up on the instrument panel along with indication of the brake system circuit on the display, and if audible signal sounds, it means that failure occurred in brake system (see Section 7 «*Potential failures of vehicle units and systems. Self-help*»).

ELECTRONIC BRAKE SYSTEM EBS

Vehicle is equipped with electronic brake system (EBS), comprising the following functions:

- control of service and auxiliary brake systems (Brake-Management);
- anti-lock braking system (ABS);
- anti-skid system (ASR);
- electronic stability programme (ESP).

Vehicle brake control is carried out via two pneumatic and one electronic circuits. In case of brake electronic control failure the management is carried out via two pneumatic circuits. In such a case the brake system EBS operates as a standard pneumatic system.

Attention!

If brake system failure occurs the pilot lamp of electronic control system EBS/ ABS failure comes on.

Trouble shooting of electronic brake system see in Section *7* «*Potential failures of vehicle units and systems. Self-help*».

After failure elimination the pilot lamp of truck tractor EBS/ ABS dies out at motion start when the vehicle achieves the speed 5-7 km/h.

Similarly the lamp of trailer EBS/ABS goes out if the vehicle is connected with the trailer, equipped with electronic brake system.

Control of service and auxiliary brake systems with the aid of brake pedal («Brake-Management»)

Function of Brake-Management - control of service and auxiliary brake systems by means of brake pedal.

When pedal is depressed (under condition that auxiliary brake switch is released) braking by means of auxiliary systems happens, further if slowing-down is not enough braking is carried out by service brake system.

Antilock brake system

Main purpose of the system is automatic support of optimum truck brake application without wheels locking (skidding) irrespective of the type of road where brakes are applied - greasy or dry.

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Antiskid system (ASR)

Antiskid system prevents slippage of driving wheels, irrespective of road conditions.

With driving wheels skidding on one or both sides, automatically, ASR working mode is activated, with this, pilot lamp of anti-skid system activation arranged on instrument panel lightens on (ASR). With skidding over, pilot lamp dies out.

If driving wheels rotate on one side, ASR retards them automatically.

With driving wheels skidding on both sides, ASR decreases the engine traction force automatically.

When crossing the sections with loose soil (on sand or gravel roads), be sure to shift ASR to «Poor road» mode.



Switch on the mode «Poor road» by short-time pressing on ASR mode switch located on the instrument panel. With this, pilot lamp of ASR system engagement lights up on the instrument panel .

With the following pressing an automatic mode of ASR system is engaged, pilot lamp goes out.

Vehicle stability control system

Electronic stability program (ESP) is a combination of two systems stabilizing the vehicle movement:

- systems controlling vehicle stability, defining the steering wheel turning degree, compensate control loss by means of selective partial braking of the necessary wheel;
- anti roll-over systems, decreasing the speed and preventing the vehicle roll-over in different road situations.

Vehicle stability control system is disengaged at vehicle speed less than 7,2 km/h.

Anti-roll over system is switched off at vehicle speed less than 18 km/h.

Attention!

ESP system opportunities can not overcome all critical situations occurring during motion of the vehicle.

ESP system doesn't dispense the driver with the necessity of consideration of meteorological conditions and traffic situation.

Critical even for the vehicles equipped with ESP is the following:

- big and/ or sharp turn of the steering wheel on a high speed;
- load conditions with very high gravity center;
- load conditions with light load and simultaneously with a high gravity center;
- load conditions with high and floating gravity center;
- vehicle control situation when the wheels are in contact with the side surface (pavement).

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HILL START ASSIST CONTROL

Hill start assist control is a part of ESP brake system. Hill start assist control helps the driver to keep the vehicle from rolling down at starting from standstill on the upgrade.

Operation of hill start assist control

1. Start the engine.

2. Engage the hill start assist control pressing on the the upper part of the hill start assist control switch. With this, the pilot lamp lights up on the instrument panel  .



3. Engage the gear in the gearbox.

4. Release the vehicle parking brake and start the motion.

When starting from standstill the vehicle is automatically taken off from the hill start assist control, pilot lamp dies out.

During the motion or when depressing the parking brake the hill start assist control device is disengaged but is in operational status.

To switch off the hill start assist control device press on the bottom of the hill start assist control device switch, pilot lamp goes out.

Attention!

Do not use the hill start assist control device when it is an ice covered ground to exclude the vehicle rolling down.

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AIR SUSPENSION REMOTE-CONTROL CONSOLE

Air suspension electronic control system fulfills the following functions:

1. If there is sufficient pressure in receiver and hand brake is released, the system automatically settles the suspension into position in which it was at the moment of previous power OFF.

2. The system allows to adjust the height of platform and to record any two heights and to set any of them, if needed, using the remote-control console;

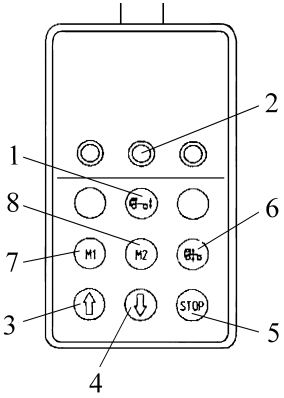
3. The system maintains the earlier settled height automatically and locks the suspension during retardation. At speed more than 30 km/h, the system sets the «transport» position of height automatically, at speed more than 60 km/h – the second «transport» position (to decrease the height of gravity center and to increase the truck stability).

4. It provides built-in self-diagnostics in process of traveling. If any fault is detected, the pilot lamp of air suspension fault lightens on the instrument panel .

Air suspension electronic control system does not require special maintenance except control inspection of operability (in the service center).

Air suspension control

The air suspension control is carried out by means of remote-control console arranged to the left of driver's seat.



Air suspension
remote-control console

1 – console engagement button;
2 – light indicator of console engaged state;
3 - platform lifting;
4 - platform lowering;
5 – lifting/ lowering stop (STOP);
6 – arrangement of transport position;
7, 8 – buttons of memory switches with recorded platform positions

Remote-control console is engaged by depressing the button 1, with this the lamp 2 comes on (see Fig. *Air suspension remote-control console*). The console is OFF if you depress the button 1 again, the lamp dies out.

To raise/ lower – depress, the buttons 3, 4 of platform raising/ lowering switches, correspondingly.

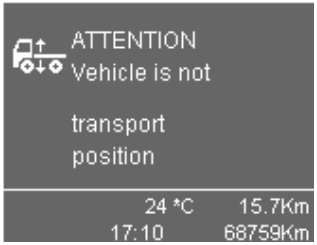
To set the platform height in «transport» position – depress the switch 6 button.

To record the settled height of platform – depress the switch 5 button (STOP) and, holding it on, depress the buttons of switches 7 (M1) or 8 (M2).

To set the earlier recorded height – depress the buttons of switches 7 (M1) or 8 (M2).

To interrupt the process of height variation – depress the switch 5 button (STOP).

The suspension «transport» position state is declared by the message on the instrument cluster display:



The vehicle air suspension, not in a transport position

CHOCK

The chocks are intended to assure under-run protection for the vehicle (road train) when it is parked or the rear or the front part of vehicle is jacked for repair (for example, when removing and installing tires).

The chocks are also intended to prevent vehicle runaway in case of emergency stop (See section «*Main operation rules*»):

- for road train when driving on uneven ground or on the asphalt road with incline up to 18 % (10°);
- for single unit truck when driving on the uneven ground or on the asphalt road with incline up to 25 % (14°).

To remove chock

1. Unscrew the butterfly nut (see Fig. *Chock removal*).
2. Turn the clamping plate.
3. Get out the chock upwards.



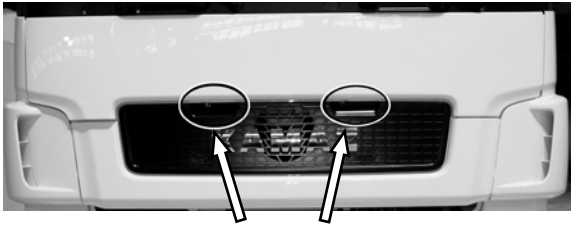
Chock removal

FACING PANEL

Facing panel is opened and closed by both hands applying uniform force to both sides, observing maximum distance from center of the panel (see Fig. *Opening of the upper facing panel*).

Attention!

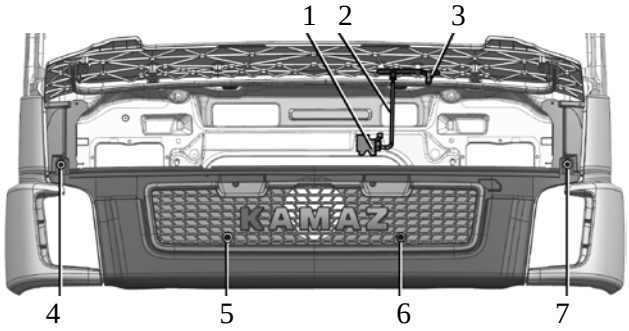
It is strictly forbidden to open and to close the facing panel pulling it only by one edge.



Opening of the upper facing panel

For fixation of the upper facing panel in the upper position pull the thrust from the holder and install it into the bracket slot.

To remove the lower facing panel it is necessary to screw out fastening screws and dismantle the panel.



The upper and the lower facing panel

1 – bracket; 2 – thrust; 3 – holder; 4, 5, 6, 7 – screw

VEHICLE TOWING

Vehicle is towed by other vehicles of the same type by means of a rigid towing.

For vehicle towing remove the plugs in buffer facing, install the tow yokes (see Fig. *Installation of tow yokes*). Install the tow device.



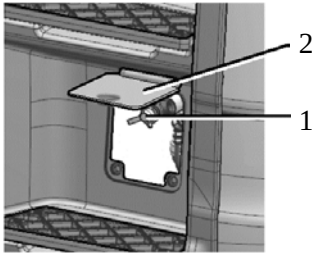
Installation of tow yokes

When towing the vehicle with a non-operated engine, use the tire inflation hose for charging the pneumatic brake actuator with compressed air.

Connect one end of the inflation hose to the extra brake release valve or to the check output valve of the parking brake system of the towing vehicle. The second end of the hose is to be connected on the towing vehicle to the inflation valve located on the right side of the vehicle, under the cover of the cab instep hatch (see Fig. *Access to the inflation valve*).

It is forbidden to open the hatch of the foot step shield for more than 90° to make the tire inflation valve accessible.

Tighten the tire inflation valve till the rest clockwise and unscrew for two revolutions counterclockwise to open the valve. Taking into account the pressure indicators make sure that pneumatic drive is filled in.



Access to tire inflation valve
1 - tire inflation valve;
2 - foot step shield hatch

Attention!

Tow yokes are provided for towing the vehicle.

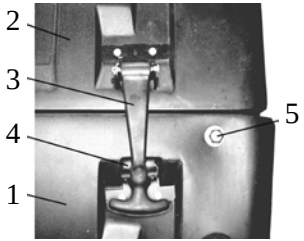
It is strictly forbidden to tow KAMAZ vehicle with an inoperative engine , irrespective of distance, with driving axles' propeller shafts being connected. The propeller shaft of rear axle drive in vehicles with wheel arrangement 4x2 should be removed.

OPERATION OF BOLSTER TRUCK TRACTOR BEING A PART OF A ROAD TRAIN

When bolster tractor is a part of a train with installed three-component wings of rear bogie, the upper part of wings should be dismantled.

For dismantling it is necessary to (see Fig. *Dismantling of the upper part of rear three-component wings*):

- unfasten the clamps 3;
- slacken the nuts 5;
- remove the upper part of rear wings;
- tighten the nuts 5.



Dismantling of the upper part of rear three-component wings

1 – rear wing;
2 – rear upper wing;
3 - clamp;
4 – fastener hook;
5 - nut

Place the dismantled upper parts of wings into the semi-trailer.

To install the upper part of the rear wings:

- slacken the nuts 5;
- install the upper part of rear wings;
- tighten the nuts5, fasten the clamps 3.

Coupling of tractor with semi-trailer

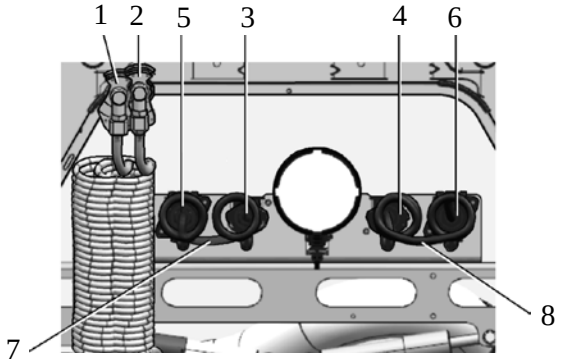
1. Place the vehicle on a level and hard surface.
2. Place chocks (Block stops) under wheels of semi-trailer.
3. Apply the parking brake system to stop the semi-trailer.
4. Couple the tractor with trailer pursuant to requirements of Operation manual of the fifth wheel manufacturer.
5. *During operation of hydroficated tractor with hydroficated semi-trailer:*

- remove plugs from locking means of oil ducts and connect the locking means of tractor and trailer with each other with a cap nut;

- then connect the tractor plug with the plug of semi-trailer.

6. Connect automatic heads of semi-trailer brake system pneumatic drive hoses with corresponding heads of truck pneumatic system 1, 2 (see Fig. *Coupling heads and sockets for connection of the tractor with the semi-trailer*).
7. Using the spiral cable, connect the socket 3 with corresponding socket of semi-trailer. Electric cable for connection to semi-trailer is supplied with truck.
8. Connect the EBS system (terminal 4). EBS electric cable for connection to trailer is supplied with truck.
9. Release the semi-trailer parking brake system.
10. Remove the chocks (block stops).

At trailer/ semitrailer connection the rear fog lamps of truck tractor are not active.



Coupling heads and sockets
for coupling bolster tractor and semi-trailer

1 - connecting head of managing main line (color -yellow);
2 – connecting head of feeding main line (color - red);
3 – socket for connection of lighting engineering;
4 - EBS system terminal; 5, 6 – parking socket;
7 - spiral cable for lighting engineering connection;
8 - spiral EBS cable

Attention!

Thin layer of grease is applied onto bolster support plate.

Do not start motion until you are sure that lock is reliably closed.

When maintaining coupling heads and sockets for semi-trailer the load on frame boarding is to be not more than 200 kg.

Uncoupling of tractor and semi-trailer

1. Place the vehicle on a level and hard surface.

2. Place chocks (block stops) under wheels of semi-trailer.

3. Apply the parking brake system to stop the semi-trailer.

4. Lower the semi-trailer support device till thrust into road surface, until coupling device is practically unloaded.

5. *During operation of hydroficated tractor with hydroficated semi-trailer:*

- unscrew the nut and disconnect hydraulic locking devices of tractor and trailer;

- disconnect the plugs and close locking devices by them.

6. Disconnect all cables between tractor and semi-trailer.

7. Uncouple the tractor and trailer pursuant to requirements of Operation manual of the fifth wheel manufacturer.

8. Drive with low speed till complete uncoupling of semi-trailer.

PUMPING OF PETROLEUM PRODUCT DURING OPERATION OF HYDROFICATED BOLSTER TRACTION TRUCK WITH A TANK SEMITRAILER

1. Place the vehicle on a level and hard surface.

2. Apply the parking brake system to stop the semi-trailer.

3. Use the chocks (block stops) to stop the vehicle.

4. Be sure the air system pressure is not lower than 490 kPa (5 kgf/cm^2).

5. Switch on the power take-off (PTO) box.

For this purpose:

- depress the clutch pedal against stop;
- shift the gearshift lever to neutral;
- engage PTO box by means of the switch located on the instrument panel. With this, PTO engagement pilot lamp lights up on the instrument panel;



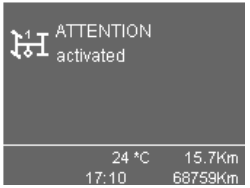
- release the clutch pedal smoothly.

The symbol «PTO1» is displayed in the first line (in appearance the same as LED indicator of PTO engagement) and symbol «PTO2», if the vehicle is equipped with two PTOs.

6. To pump over the petroleum product press on the upper part of hydraulic motor switch located on the instrument panel. LED built into switch comes ON.



The message appears on the display (see Fig. *The hydraulic distribution valve is engaged*).



The hydraulic distribution valve is engaged

7. After the petroleum products transfer is over, press on the lower part of hydraulic motor shifter. LED built into switch comes OFF.

8. Disengage the PTO box. For the purpose:

- depress the clutch pedal;
- disengage PTO box by means of the switch located on the instrument panel. With this, PTO engagement pilot lamp comes Off on the instrument panel;
- release the clutch pedal smoothly.

Attention!

In cold months it is recommended to switch the PTO about 8-10 min before petroleum product transfer, it allows to warm the oil up in hydraulic system.

With PTO box working, gear shifting is not admissible.

On vehicles equipped with ZF gear boxes the locking device is installed and the vehicle movement with operating PTO box is impossible.

For the gearbox with automated control the PTO continuous operation is not more than 60 min.

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5 VEHICLE OPERATION IN COLD SEASON

SPECIAL FEATURES OF VEHICLE OPERATION DURING COLD PERIOD OF TIME

In cold season, observe the following requirements:

-use service materials recommended by manufacturer (see Appendices 2, 3 of this Manual);

- prime the washer tank with ready-made cooling liquid with low freezing temperature.

During work at sub-zero temperatures, stop the engine only after pressure regulator has come to work to discharge condensate accumulated to prevent its freezing.

If regulator or supply pipes have frozen or if regulator did not come to work at system pressure (10±0,2) kgf/cm^2, or if air drive is not filled with compressed air and compressor noise is excessive, be sure to shut down the engine and heat the pressure regulator with warm water or warm air.

To avoid freezing in a tire hose, inflate the tires in two steps:

- connect the hose to check outlet valve in parking brake receiver, inflate tires till maximum possible pressure recorded by pressure regulator;

- connect hose to tire inflation cock, top up tire pressure to norm.

To prevent the brake shoes freezing on to the diskprior to vehicle parking, do not fail to dry up the brake gears with several successive applications of brake.

If the truck is parked for a long time (for instance, for a night), do not use the parking brake system.

To apply brakes in vehicle with manual gearbox

1. Apply the vehicle parking brake.
2. Engage the low gear.
3. Place chocks under wheels.
4. Release the vehicle parking brake.
5. Shut down the engine.

To apply brakes in vehicle with automated gearbox

1. Place vehicle on a level horizontal surface to prevent vehicle rolling off.
2. Apply the vehicle parking brake.
3. Check if «N» lightens on display. If no, engage «N» by force.
4. Place chocks under wheels.
5. Release the vehicle parking brake.
6. Shut down the engine.

Attention!

Make sure in safety of the vehicle parking.

Oil heating in the steering system

It is necessary to heat the oil in the steering system after engine cranking, prior to vehicle motion start, to exclude the damage and excessive wear of parts of steering mechanism and hydraulic power steering pump.

Engine operating time necessary for heating of oil in the steering system versus the temperature of ambient air is indicated in Table «*Engine operating time necessary for oil heating in the steering system versus ambient air temperature*».

Engine operating time necessary for oil heating in the steering system versus ambient air temperature

Ambient air temperature	Lower than minus 25 °C	Lower than minus 35 °C	Lower than minus 50 °C
Engine is in operation	Not less than 5 minutes	Not less than 10 minutes	Not less than 15 minutes

Attention!

It is PROHIBITED to rotate the steering wheel, before the oil in the steering system is warmed up!

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COLD WEATHER ENGINE STARTING

In cold period, start the engine with the help of EFU (Electric Flame Unit). Prestarting heater may be also used for engine starting.

Extreme temperatures for a reliable cold engine start and the engine preparation-for-loading time are specified in a Table «*Extreme temperatures for a reliable cold engine start*».

Attention!

Avoid the open plug flame and torch usage for air heating at engine start.

If the ambient air temperature is below 30 ºC an unstable operation of display is possible and the temperature of 40 ºC can cause an erratic instrument cluster operation.

Extreme temperatures for a reliable cold engine start

Parameters	W/o starting aids	With EFU	With pre-starting heater
1. Extreme temperatures for reliable start, °C, at least	minus 10	minus 22	minus 45
2. Time needed to prepare engine for loading, min, not more	8	10	36 (30 - with EFU)
3. Motor oil viscosity (grade)	In accord with suggestions specified in Appendix 3		
4. Fuel	In accord with suggestions specified in Appendices 2, 3		

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TO START THE ENGINE USING THE EFU UNIT

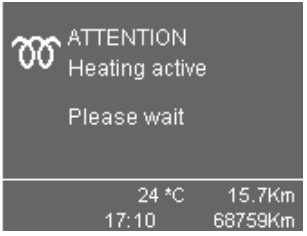
EFU is a device for heating the intake air and facilitating engine starting at the ambient temperature of minus 5 °C and below.

The EFU reduces emission of harmful substances into the atmosphere. Furthermore, it results in lower wear rates of starter and storage batteries as well as the reduced engine starting time.

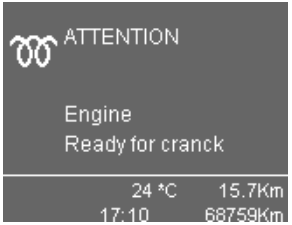
The EFU operation cycle is automatically controlled be the ECU.

To activate EFU, switch on the instruments by rotating the instruments-and-starter switch key to the ON position (position of motion).

In ambient temperatures below minus 5 °C the preheating of EFU plugs switches on automatically, whereby the following information is displayed in instrument cluster:



After the glow plugs are completely warmed up, the following information is displayed:



Start the engine within 15 seconds.

EFU switches off automatically, if:

- the engine does not start within 30 seconds, after the light has gone out ;
- the engine is started when the indicator light is ON ;
- the engine is running with coolant temperature of approximately 0 ºC

Peculiarities for Mercedes-Benz engine start and stop are described in Operation manual for Mercedes-Benz engine.

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PRE-STARTING HEATER

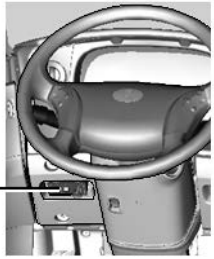
Pre-starting heater is for heating the engine before starting it up at the ambient temperature of up to minus 45 °C.

The vehicles are equipped with preheaters of model 14ТС-10 or 16ЖД-24, according to the vehicle configuration.

The operating instructions manuals for prestarting heaters you will find in Appendices «Pre-starting diesel heater 14ТС-10-GP» or «Liquid small-size heater PRAMOTRONIC-16ЖД24».

Engagement/ disengagement of heater, the indication of its functional state is performed with the help of control panel.(see Fig. *Position of pre-starting heater control panel in a cab*).

The vehicle is equipped with an independent fuel tank for preheater 14ТС. Observe the fuel level in a tank as independent tank is not included into engine fuel system (see Section 6 «*Maintenance*»).

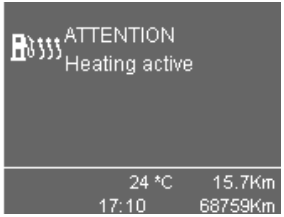


Position of pre-starting heater control panel in a cab

1 - heater control panel

FUEL HEATING

The fuel is heated automatically in a coarse fuel filter and a fuel suction pipe. The information about the fuel heating is displayed on instrument panel.



Fuel heating in a fuel suction pipe is activated

Fuel heating in a coarse fuel filter (UFI filter) is activated at temperatures of (2±3) °C, where it is deactivated at temperatures of (8±3) °C.

TO HEAT THE NEUTRALIZING LIQUID

Neutralizing liquid freezes at the temperature of minus 10 ºC.

The AdBlue tank is heated by the engine coolant temperature. With working temperatures achieved, the liquid injection starts

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6 MAINTENANCE

The main purpose of daily and weekly maintenance is general monitoring over state of units and systems to ensure safe driving as well as maintaining proper external appearance.

Daily maintenance is performed once a day prior to departure or in stations after prolonged work.

Weekly maintenance is performed once a week by a driver. It is tolerable to perform weekly maintenance in a service center by demand of vehicel owner.

Attention!

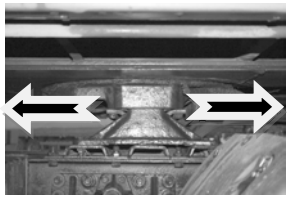
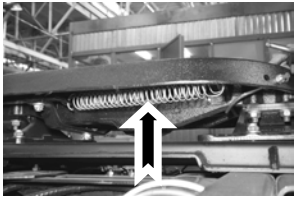
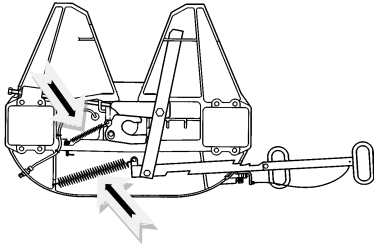
Be sure to address the service center if any faults discovered during daily and weekly mnt.

During maintenance, avoid ingress of greases into sewerage, surface water, ground water or soil.

Greases are used in accord with suggestions of Appendices 2, 3.

DAILY MAINTENANCE (DAILY MNT.) PROCEDURES

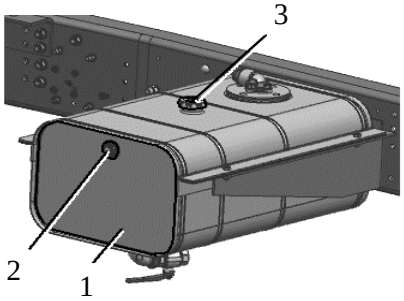
№	Description of procedure	Technical requirements and instructions
	For information about maintenance interval and requirements for Mercedes-Benz engines refer to the service book «Service Book. Mercedes-Benz OM457LA Engine».	
1	Wash the vehicle (if necessary)	See subsection «*The vehicle care*».
2	Check the vehicle systems for faults according to the information from indicator lights on instrument panel and the messages displayed on the LCD-screen.	To reveal and eliminate troubles – see section *7* «*Possible faults in vehicle systems and units. Self-help*».
3	Check condition and leak-proof of items and pipes of fuel supply system, of lubricating system, of cooling system, of clutch hydraulic drive, gearbox, transfer case, driving axles, of power steering booster, of cab platform hydraulic tilter, after-treatment system.	Fuel, oil and special liquids leakage is not admissible. Eliminate leakage by tightening the pipes' fixtures.
4	Check the state of air cleaner filter by indications of air filter clogging lamp.	If pilot lamp of air filter clogging in instrument panel comes to operation, be sure to change the main filter element (see subsection «*Air filter change*»).

№	Description of procedure	Technical requirements and instructions
5	Check visually the state of bolster device, coiled hoses of semi-trailer brake system, the state of semi-trailer connection cables.	Inspect the bolster visually at the beginning of motion and during vehicle stop. There must be no perceptible clearance between semi-trailer kingpin and bolster lock. Damage of hoses is not admissible (inspect visually). Connection cables must be secured reliably.  Check the state of coiled hoses, the state of connection cables  Inspect the bolster state
6	Check the state and secure of lock cam spring and bolster latch spring.	Breakage and disconnection of springs is not tolerable. The springs should be securely fastened and ensure proper functioning (see Fig. ***Bolster***).   Bolster

№	Description of procedure	Technical requirements and instructions
7	Check the state of semi-trailer sides' latches.	Locking means must keep the sides of semi-trailer platform closed reliably.
8	Inspect condition of tires. Check (if any control systems) tire pressure according to the information from indicator on instrument panel.	See subsection «*Tire maintenance*».
9	Check brake system for proper operation. Test the brake system air drive for leakage.	Inspect the state of brake chambers, hoses and pipes. Brake chambers must be secured reliably. Hoses must be free of wear traces, damages and cracks. Avoid brake pipes deformation. By ear, test the air drive for leakage. Air leakage is not permissible. The air drive should be tested for leakage at a nominal pressure, with activated compressed air consumers and with engine switched off using 2 positions of the brake system controls: - with brake valve free pedal and engaged parking brake (position - «Stop»); - with depressed brake valve pedal and disengaged parking brake (position - «In motion»).
10	Check visually the state of steering linkage.	For this, front wheels should be arranged on horizontal site. Test free play of steering wheel, with engine idling, rotating the steering wheel to the right and to the left till steerable wheels begin rotating (free angle must not exceed 25°). Axial displacement of steering wheel is not tolerable.

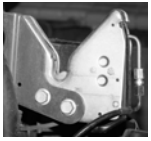
№	Description of procedure	Technical requirements and instructions
11	Check the operability of light emitting devices (LED's), light and audio alarm. Eliminate faults.	Switch on the instruments by rotating the ignition key to the first fixed position. Check all LED's and light alarm devices for proper operation using the different positions of light and combination light switch. Check the operability of hazard system switch. Test the pilot lamps and horn for normal operation. Replace faulty lamps *Check the operability of front headlamps and lights*: - direction indicators (left, right); - marker and end-outline lamps; - low beam; - high beam; - train lamps; - additional illumination for poor visibility conditions (if any). *Check the condition of rear lamps*: - direction indicators (left, right); - stop signal lamp; - marker and end-outline lamps; - reverse lamps.
12	Check the wipers and washer operation.	See subsection «*Windscreen maintenance*».
13	Inspect if any condensate in one of brake receivers.	See subsection «*Condensate drain from receivers*».
14	Check the condition of fuel tank air filter. If necessary, replace it.	See subsection «*Fuel tank air filter*».

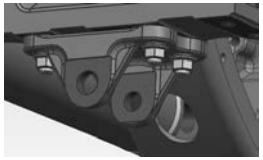
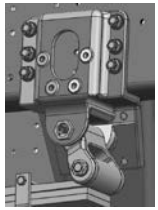
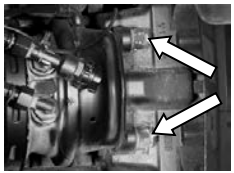
№	Description of procedure	Technical requirements and instructions
15	Check the coolant level in the cooling system.	See subsection «*Coolant level inspection*».
16	Check the operation of oil separator and dryer.	When the compressor is running in a filling mode, the air leakage through air outputs in the dryer and oil separator is not permitted. When the maximum pressure in the system is reached, the air should be dropped through the air outputs in the dryer and oil separator, while the premature actuation of oil separator is not permitted.
17	Check the tightness of rear suspension.	Check visually the state of rear suspension. Not permissible: - cuts on rubber-cord casings of air springs; - loosening of bolted connections; - unevenly pumped air springs; - leakage in the shock-absorber; - failed shock absorber rubber bushings.
18	Check the state of the rear fender brackets.	Check visually the condition and fastening of the rear fender brackets. No loose bolted joints, damages or cracks are permitted.
19	Drain sediment from the coarse fuel filter.	Drain sediment from coarse fuel filter (see section *6* «*Maintenance*» subsection «*Coarse fuel filter*»). Drain fuel till pure diesel fuel without water traces flows out. After drain, pump-through the fuel system.

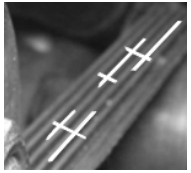
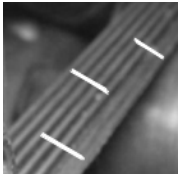
№	Description of procedure	Technical requirements and instructions
20	Top up to norm the oil level in the vehicle hydraulic system (for hydraulically operated vehicle).	The oil level should be in the inspection hole middle (see. Fig. *Hydraulic oil tank*). If necessary, add oil through the filling neck. Greases are used in accord with suggestions of Appendices 2, 3.  Hydraulic oil tank of the vehicle 1 - hydraulic oil tank; 2 - inspection hole; 3 - filling neck
21	Check the state and cottering of pins of auxiliary brake air cylinder.	Cylinder and rod must be secured and cottered. It is not permissible to use parts without cotters and with excessive play. 

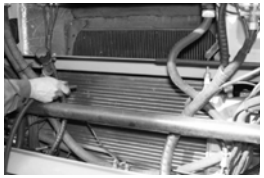
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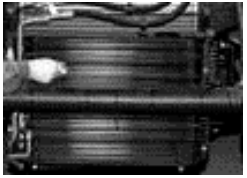
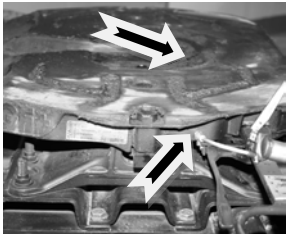
WEEKLY MAINTENANCE (WEEKLY MNT.) PROCEDURES

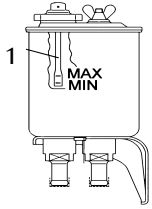
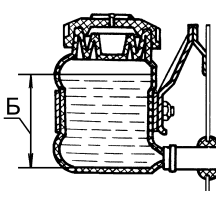
№	Description of procedure	Technical requirements and instructions
1	Check the cotter-pinning of nuts of steering rod ball pins (visually), the fastening of pitman arm.	The pitman arm should not have any damages. The nut to fasten the pitman arm should be secured and locked with a plate. The nuts of steering rod ball pins should tightened and cottered. If there are no cotters put them on their place.   Check the cotter-pinning of nuts of steering rod ball pins
2	Inspect condition and operation of hydraulic locks and hydraulic cylinder for raising and lowering the cab.	The locking mechanism must retain the cab securely from spontaneous raising. Check the spring for integrity Check visually the locking device - worn rods and hook mouth are not permitted. The hydraulic cylinder for raising and lowering the cab should be securely fastened. It is not permissible to use parts without cotters.  Hydraulic   Cottering of hydraulic cylinder for raising and lowering the cab

№	Description of procedure	Technical requirements and instructions
3	Check visually the state of and fastening of front spring brackets.	Cracks in brackets and loose rivets are not tolerable.  Front bracket of front spring  Rear bracket of front spring
4	Check the state and attachment of wheel disks.	See subsection «*Tire maintenance*».
5	Check the fastening of brake chambers.	Check the fastening ofbrake chambers. The tightening torque for fastening brake chambers 180 - 220 N·m (18 to 22 kgf·m).  Securing of the front axle brake chambers  Securing of the drive axle brake chambers
6	Inspect visually the state and fastening of torque rod.	Inspect visually the state and fastening of upper torque rod brackets. ***Vehicle driving is prohibited till fault correction***.

№	Description of procedure	Technical requirements and instructions
7	Check tire pressure using the test pressure gauge.	See subsection «*Tire maintenance*». 
8	Check the condition of compressor drive belt in the air condtioning system.	Prior to inspection shut down the engine. Visually check the condition of belt Cracks are tolerable. Crossing of transverse and longitudinal cracks is not permissible. Be sure to change belt if any pitting.  Non tolerable cracks  Tolerable cracks
9	Inspect the integrity of electric contacts in the air conditioning system.	Check visually the integrity of electric contacts in the air conditioning system.
10	Check the integrity of refrigerant hoses in the conditioning system.	Inspect visually. Damages on refrigerant hoses are not permitted. Connection cables must be secured reliably and have no damages.

№	Description of procedure	Technical requirements and instructions
11	Clean the outer surface of the radiator frame in the air conditioning system of dirt, wash it and blow-through. Clean the corrugated plates of charge-air cooler heat-exchanger using blowing with compressed air.	Perform air-blast cleaning bleeding the compressed air from on-board or autonomous network.  
12	Clean the gearbox and drive axle breathers.	The breathers must be clean. Remove breathers prior to blowing, to prevent the ingress of contamination into the hole. It should be possible to turn breather head by hand.  Drive axle breather  Gearbox breather
13	Clean the electromagnetic compressor clutch using air blowing	Perform air-blast cleaning bleeding the compressed air from on-board or autonomous network.  Engine Mercedes-Benz

№	Description of procedure	Technical requirements and instructions
14	Clean the conditioning condenser using air blowing.	Perform air-blast cleaning bleeding the compressed air from on-board or autonomous network. 
15	Grease the bolster, the saddle support surface, the mouth, the locking gear of bolster and the bolster kingpin.	Grease the bolster through grease cups. Apply an even layer of grease to the bolster support plate and mouth by brushing. (see Fig. *To grease bolster*). Greases are used in accord with suggestions of Appendices 2, 3.  To grease bolster
16	Top up to norm the oil level in engine crankcase.	See subsection «*Oil level inspection in crankcase*».
17	Top up to norm the electrolyte level in storage batteries. If necessary, clean the storage batteries' covers of dirt and dust.	See subsection «*Storage batteries*».

№	Description of procedure	Technical requirements and instructions
18	Top up to norm the oil level in the tank of the power steering booster pump.	Undo the cover-dipstick and test oil level in a tank. The oil level must be between upper and bottom marks on dipstick. Check and top up oil while engine is idling, vehicle front wheel being straight. Greases are used in accord with suggestions of Appendices 2, 3.  Tank of the power steering pump 1 – cover-dipstick
19	Top up to norm the fluid level in tank of clutch master cylinder.	Inspect visually the liquid level in a tank of clutch master cylinder (see Fig. *Tank of the clutch master cylinder*). The clutch master cylinder is located under the front facing panel. The normal liquid level «Б» in a tank corresponds to 40 mm, the permissible level is 10 mm (see Fig. *Level of liquid in tank of clutch master cylinder*). Greases are used in accord with suggestions of Appendices 2, 3.  Tank of clutch master cylinder 1 - cover; 2 – tank  The level of liquid in a tank of clutch master cylinder

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VEHICLE CARE

Wash: headlamps, parking, marker and tail lamps, windows and number plates. Eliminate dirt, snow and ice from wings' bottom parts, step boards, springs, axles, mud flaps, cover of storage battery box. Wipe instruments and windows in a cab.

Blow-through (in cold season) locks of doors and tool box with compressed air.

For washing, use neutral detergents, water jet application pressure is to be not more 118 kPa (1,2 kgf/cm^2).

To preserve paint coating, avoid prolonged effect of salts, acids, solvents and other aggressive substances.

To preserve paint coating resulting in corrosion spots, eliminate dirt in time, particularly: insects' discharges, birds' excrements, oils and greases.

Be sure to eliminate paint coating faults in time caused by stone impacts and other mechanical effects.

TO CARE THE WINDSCREEN

Wiper brushes should bear against glass surface along the whole length of edge, they must shift uniformly, without seizure.

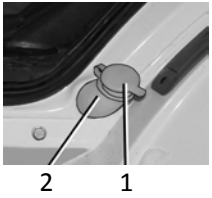
Test the washer operability and, if necessary, adjust the direction of water by cleaning and adjusting the jet. Direction of water jet is adjusted with the help of needle arranged in jet orifice.

Attention!

Avoid wiper sliding along dry windscreen.

At ambient air temperature below zero the work of windshield wiper with brushes frozen to the window is prohibited.

If the information about the low liquid level in a washer tank is displayed, prime the tank with ready-made washing liquid.



Washer tank

1 - tank filler cover;
2 - filling neck

The washer tank is placed under the cab from the driver side, the filling neck is inserted into the door opening (see Fig. *Washer tank*).

In cold season, prime system with glass-washing liquid with low freezing temperature.

Attention!

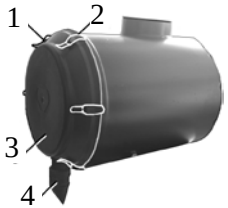
Do not use concentrated glass detergent, it should be diluted with water to avoid paint coating void.

AIR FILTER REPLACEMENT

The cab should be raised to provide access to the latches in the air filter cover when performing maintenance and replacing filter elements.

To replace the main filter element

1. Undo the latch of air filter cover, remove the cover (see Fig. *Air filter*).



Air filter

1, 2 - latch; 3 -cover;
4 - nipple valve

A nipple valve is arranged in bottom part of cover for dust and water discharge, dust and water may ingress with air coming. Valve should be secured by clip to air filter cover. Inspect the valve for integrity, visually.

2. Take the main filter element 2 out of filter body (see Fig. *To replace the main filter element*).

3. Insert the new main filter element as far as it can go.

4. Place cover on air filter body. The nipple valve, in this case, should be mounted vertically downwards.

5. Fasten the latches on air filter cover.

To change safety element

After triple change of main filter element, or, if air filter clogging pilot lamp comes ON in spite of small mileage after main filter element change, be sure to change the safety element.

When replacing safety element, avoid ingress of contaminated air into engine intake path, e.g. if adverse weather conditions (wind blowing).

Be sure to use filter elements from manufactures possessing official approval of KAMAZ PTC for delivery.



To replace the main filter element

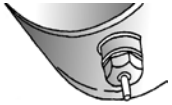
1 - filter body;
2 - main filter element;
3 - safety element

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CHECKING RECEIVERS FOR CONDENSATION

To maintain the required compressed air (from compressor) pressure and to cool and extract the condensate, a truck brake system is provided with adsorbent air dryer united with pressure regulator.

Check for condensate in receivers daily, at the end of the shift. Open the condensate drain cocks having shifted the pusher aside (see Fig. *The pusher*).



The pusher

Attention!

Do not pull the rod down and do not push it upwards.

If any condensate in receivers:

- check the pressure regulator for normal operation (ON/ OFF). Compressed air pressure in the pneumatic drive is to be nominal (9,0-10,0 kgf/cm^2);

- check the adsorbent air dryer, the oil separator and the connection hoses for tightness. ***Even the slightest leak is not permissible***;

- if no deviations in pressure regulator, change the filter element.

Be sure to use filter elements from manufactures possessing official approval of KAMAZ PTC for delivery.

If you are not able to eliminate the fault yourself, be sure to address the service center.

Maintenance of a dryer supposes a regular change of a filter element as soon as it becomes dirty (approximately once a year).

If any oil emissions by compressor causing the filter element contamination with oil and considerable its service life reduction, be sure to repair the compressor.

TIRE MAINTENANCE

Avoid cracks, dents on wheel disks. Disks should be secured properly, avoid studs breakage, all nuts to secure wheels should be in their places.

Adhere to the specified tightening torque and sequence (see Section 7 «*Vehicle mechanisms and systems troubleshooting. Self-help*»).

The tires are inspected for technical condition visually, starting from l.h. front wheel and proceeding clockwise. Remove stones, nails and other foreign objects which stuck in tread, tire sides and between the dual tires. If there are fuel, oil and other petroleum products on the tires, wipe them with dry cloth. Protect the tires from fuel, oil and other petroleum products, as this results in premature failure of tires.

Test the air pressure in tires using a pressure gauge.

Tire pressure should correspond to the rated value given in the technical data (see section 2 «*Operation parameters*»).

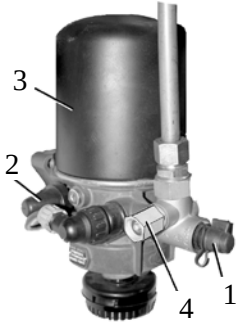
WHEN INFLATING THE TIRES

Decrease of air pressure onto 25 % of the rated value cuts their service life onto 35-40 %. Also mind that reduction of air pressure in tires onto 98 kPa (1,0 kgf/cm^2) results in increase of fuel consumption onto 1 – 1,5 l/100 km.

You may inflate the tire without demounting it if air pressure has dropped not more than onto 40 % from normal one and if you are sure that pressure decrease didn't violate the proper tire mounting.

For inflating the tires, you should use the special hose supplied with the service kit, or any other suitable hose fitted with a cap nut threaded to M16 x 1,5. The hose is to be connected to the pressure regulator.

For tire inflation, the air delivery valve is on pressure regulator, valve is closed by cap 1 (see Fig. *Air dryer with pressure regulator*).



Air dryer
with pressure regulator

1 - cap;
2 - pressure regulator;
3 - airdryer;
4 - tire inflation safety valve (comes to operation at a pressure of 12,5 to 14,5 kgf/cm^2)

To deliver air using a tire inflation hose (from tools set), connect it instead of a cap, for this, tighten the butterfly nut until it stops and decrease the compressed air pressure in air drive to 608-637 kPa (6,2-6,5 kgf/cm^2). To decrease pressure, be sure to open the condensate drain cock in any receiver and apply the brake valve several times. The regulator comes to operation and compressor starts compressed air delivery.

Attention!

Constantly watch the pressure level in a tire when inflating tires. Excess of rated tire pressure is not admissible!

During tire inflation, leave the zone of work.

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CHECKING THE OIL LEVEL IN ENGINE CRANKCASE

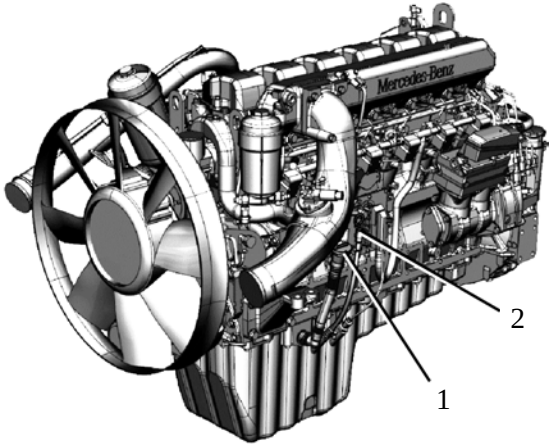
1. Place the vehicle on level horizontal surface. Engage the parking brake.

2. The level of oil is tested in 10 min. after engine stop. During that time, oil flows into crankcase sump.

3. Check the oil level with the help of dipstick (with the cab raised). The oil level should be between the lower and upper dipstick marks.

4. If necessary, add oil through a filling neck (see Fig. *Checking the oil level in the Mercedes-Benz engine crankcase*). Greases are used in accord with suggestions of Appendices 2, 3.

If oil level is above the set mark, the engine can be damaged.



Checking the oil level in the Mercedes-Benz engine crankcase

1 - filling neck for oil; 2 - dipstick

COOLANT LEVEL CHECK

1. Place the vehicle on level horizontal surface. Stop the engine.

2. Raise the front facing panel.

3. Check the coolant level on cold engine (temperature should not exceed 50 °C). An optimum position of a liquid level is when it reaches the lower edge of the filling neck.

4. If necessary, add coolant of the same grade through a filling neck after removing expansion tank cover (see Fig. *Expansion tank cover*). Use the coolant in accord with suggestions of Appendix 3.

5. Tighten the cover till stop and let engine rotate with variable speed for some time.

6. Stop the engine and inspect the coolant level once more.

7. Lower the front facing panel.

Attention!

Do not open the tank plug on hot engine, strictly!

Coolant is poisonous! Avoid liquid spilling onto soil, skin and mucous!

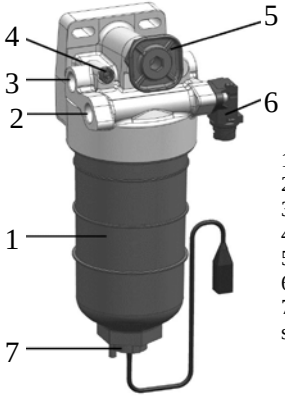


Expansion tank cover

COARSE FUEL FILTER

UFI coarse fuel filter (see Fig. *UFI coarse fuel filter*) is installed between fuel tank and low-pressure feed pump.

The filter is installed with the body-built-in fuel priming pump in the vehicle.



UFI coarse fuel filter

1 - filter cover;
2 - fuel inlet;
3 - fuel outlet;
4 - screw for air release;
5 – hand fuel priming pump;
6 - electric heater;
7 - water bleeder screw with water sensor

Fuel system priming

Prime the fuel feed system (release air) using a priming pump when starting the engine or when changing the replaceable filter. For this:

1. Open the expansion tank cover.

2. Place reservoir under the coarse fuel filter. We recommend putting clear tubing on the vent plug so as to avoid uncontrolled fuel spill.

3. Unscrew the vent plug on 2-3 turns.

4. Counterclockwise, undo the handle of manual priming pump and bleed air from the system by moving the handle back and forth. Stop bleeding after the fuel without bubbles comes out of the opening.

5. Press the pump handle until it stops and fix this position by turning it clockwise.

6. Tighten the vent plug with the torque of 1,0 to 2,0 N·m.

7. Close the expansion tank cover.

8. Start the engine. The air will be released from the fuel feed system automatically.

Attention!

Do not use the manual priming pump after the engine is started to prevent damage to the coarse fuel filter components as well as leakage.

The manual priming pump may be used only for filling the coarse fuel filter.

It is prohibited to use any external filling devices to fill a coarse fuel filter.

When filling the coarse fuel filter with the help of external filling devices or when filling the whole low pressure circuit with the help of manual priming pump, which is mounted into the coarse fuel filter, the permissible fuel pressure is exceeded. This may result in feed system components failure and uncontrolled fuel leaks.

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To drain water from coarse fuel filter

When the information about the triggering of water sensor is displayed, you need to drain sediment from the coarse fuel filter: remove the water drain plug from the filter cap and drain sediment until clean fuel appears.

Prior to draining the water-fuel mixture from water collection vessel or prior to air release with the help of priming pump, place the vessel to collect water-fuel mixture under the coarse fuel filter.

Avoid fuel getting onto vehicle aggregates and soil.

To replace filter element

1. Disconnect the water sensor plug.
2. Undo the water drain screw to let fuel drain from the filter.
3. Tighten the water drain screw witch a torque of 1,5 to 2,0 N·m.
4. Remove the filter cap and take out the filter element.
5. Replace the filter cap sealing ring.
6. Grease sealing rings of the filter cap and of the new filter element using motor oil.
7. Put the new filter element into the cap and screw cap into the filter body with a torque of 20-25 N·m.
8. Insert the water sensor plug into the socket.
9. Bleed air from the system using the priming pump.
10. Start the engine, make sure that the fuel system is leak-proof.

Prevent the ingress of contaminations into the fuel feed system when replacing filter elements.

Be sure to use filter elements from manufactures possessing official approval of KAMAZ PTC for delivery.

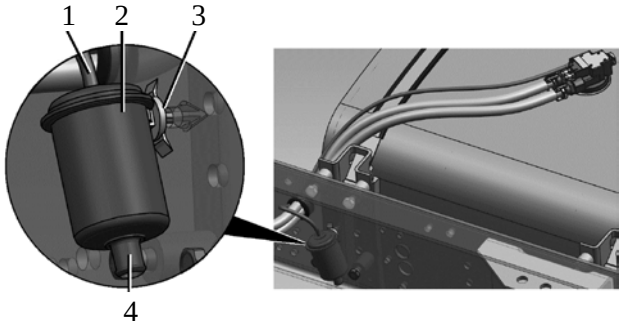
Attention!

While installing the filter, be sure to stop the engine.

Do not dismantle the pre-starting priming pump.

FUEL TANK AIR FILTER

The fuel tank air filter is located near the fuel tank on a frame side member (see Fig. *Fuel tank air filter*).



Fuel tank air filter

1 – pipe; 2 - air filter; 3 – worm clamp; 4 - air outlet

In case of abrupt air release during fuel tank opening (excessive air pressure in tank) or air suction (vacuum inside tank), you need to check the condition of fuel tank air filter.

The air filter should be placed vertically, the maximum permissible inclination shall not exceed 25°. Check the condition of air outlet. If necessary, clean it of dirt to allow free flow of air.

If the fault is not eliminated or by excessive contamination, the fuel tank air filter should be replaced.

To replace fuel tank air filter

1. Stop the vehicle, shut off the engine, engage the parking brake, the gearshift lever should be in neutral position, place the chocks under wheels.

2. Slacken the worn clamp.

3. Take the air filter out of polyamide pipe.

4. Check the condition of pipe inner surface - it should be free of dirt. If any contaminations or fuel, blow and clean it using the compressed air.

5. Install the new worn clamp in the new filter.

6. Install new air filter in a polyamide pipe.

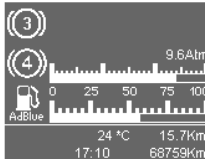
7. Secure the worm clamp on the frame side member by placing the air filter int a vertical position (the maximum permissible inclination shall not exceed 25°).

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AFTER-TREATMENT SYSTEM

After-treatment system is designed to decrease the emissions of nitride oxides as result of injection of neutralizing liquid into engine exhaust system.

With ignition key rotated to the «ON» position in instrument (position of motion) cluster, the information about the vehicle is displayed. One of displays shows the neutralizing liquid level in a tank, by default.



← The AdBlue liquid level

Be sure to prime the system with neutralizing liquid as required.

If liquid level in a tank is low, the pilot lamp indicating the low level in after-treatment system on instrument panel is ON .

The after-treatment system is primed with AdBlue agent only in accord with suggestions of Appendices 2, 3.

Appr. consumption of liquid is 4-8 % of fuel consumption.

Filling neck of tank with neutralizing liquid is closed by **blue cover**.

Pour the AdBlue liquid through filling neck in the tank 10-12 cm from the edge.

The filling neck in the tank is equipped with magnet valve, which allow the fuel nozzle to switch off automatically after the maximum Adblue level has been reached.

Attention!

Do not over-pour AdBlue above the max level!

Any illegal interference or dismantling of any items of after-treatment system is prohibited.

Do not use the system without AdBlue agent.

Ensure the engine is switched off, before refilling the Adblue tank.

For practical hints, handling, transport and storage requirements for Adblue agent see GOST ISO 22241-3-2013.

If any faults in after-treatment system, corresponding pilot lamp in instrument panel comes ON. To reveal and eliminate troubles in the aftertreatment system – see section 7 «*Possible faults in vehicle systems and units. Self-help*».

Attention!

Any additives to AdBlue agent are prohibited.

Do not dissolve the AdBlue agent with tap water, otherwise the after-treatment system will be failed.

Be sure to provide the agent purity. Pollutions in agent cause increase of emissions and after-treatment system failure.

Avoid liquid getting into eyes. If any, rinse with pure water immediately.

Avoid AdBlue getting onto vehicle aggregates and soil.

In case of AdBlue ingress onto varnished or aluminum surfaces during system priming, be sure to rinse the surface immediately.

It is prohibited to re-use liquid drained during repair.

Be sure to use only plastic or stainless steel cans for AdBlue storage.

If agent is stored in cans produced from copper, copper alloys, plain or zincing steel, the particles of those metals may be introduced into AdBlue agent to cause the after-treatment system failure.

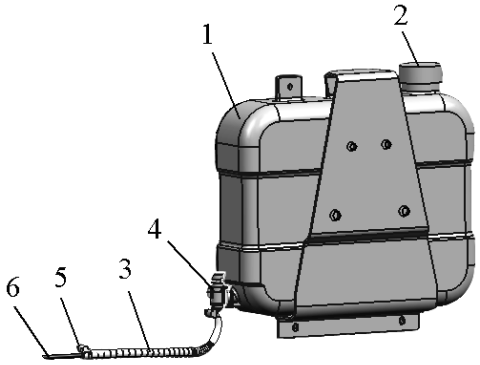
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CHECKING THE FUEL LEVEL IN THE INDEPENDENT FUEL TANK OF PRE-STARTING HEATER

The pre-starting heater is equipped with an independent fuel tank which is mounted behind the cab on the right side of a vehicle.

Observe the fuel level in a tank as independent tank is not included into engine fuel system. Average tank filling interval (with heater constant work) is appr. 8 hours.

Use fuel in accord with suggestions of Appendix 3.



Pre-starting heater fuel tank

1 – fuel tank, 2 – filling neck; 3 – hose; 4 – drain cock; 5 – clip; 6 – polyamide pipe

In summer, we suggest to drain fuel from independent fuel tank. After fuel is drained and the hose is placed back, the heater should work until all fuel burns.

Fuel is drained as follows:

1. Close the fuel cock 4.
2. Slacken the clip of hose 5.
3. Remove hose 3 with polyamide pipe 6.
4. Direct the hose into drain vessel, open the cock.

To eliminate air from the system, perform at least 4 heater starting cycles.

Season maintenance of pre-starting is in accord with Operation manual for pre-starting heater (see Appendix «Diesel pre-starting heater» or «Small-sized liquid engine pre-heater PRAMOTRONIC-16ЖД24»).

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STORAGE BATTERIES

During operation

Storage batteries are intended to start engine with starter and supply electric consumers. Storage batteries are filled with aqueous solution of electrolytic sulfuric acid as electrolyte.

Electrolyte density in fully charged battery should be (1,28 ± 0,01) g/cm^3 at 25 ºC, open circuit voltage is to be not below 12,6 V.

Battery operation is prohibited if electrolyte density is below 75 % of full charge (less 1,24 g/cm^3) and voltage of closed circuit of storage battery is less than 12,0V.

Storage batteries should be applied according to B type external dimensions применяются с габаритами типа B (GOST R MEK 60095-4).

If vehicle won't work for more than 3 days, be sure to disconnect constant power supply wire (wire with yellow mark) from storage battery to avoid discharge. The storage battery, in this case, should be disconnected with the help of storage battery switch.

Battery body should be intact, without chips and cracks. The body surface should be clean, without leakage traces, dirt or dust, otherwise, excessive self-discharge may take place. For maitenance, wipe the upper battery cover to clean it from dirt and dust.

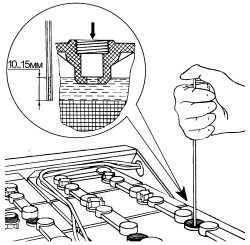
Prevent vent holes of storage batteries from clogging and clean them on a regular basis. Vent holes on covers should be free to provide gas escape. Otherwise the cover can be damaged resulting in the storage battery failure.

If any clogging in the cover holes a damage in the form of explosion destruction of battery may occur.

Battery terminals should be clean and dry. Apply thin layer of acid-resistant protective grease. Tighten wires on terminals with a torque of 8-12 N·m. Loose attachment may cause sparking and explosion with release of explosive gas, battery may fail.

To test the electrolyte level

Electrolyte level should touch the bottom edge of filling neck tube which corresponds to distance from electrolyte surface till separator of 10-15 mm (see Fig. *To test the electrolyte level in storage batteries*). Electrolyte level is topped to norm with distilled water.



Checking the electrolyte level in storage batteries

In order to bring electrolyte into homogeneous constitution the topping-up should be carried out on the vehicle with running engine and switch-on parking brake system.

Attention!

Use rubber acid-resistant gloves and glass tube to test the electrolyte level.

To connect/ disconnect storage batteries

Attention!

Do not loose and do not take away terminals of batteries while engine is working.

Avoid contact of wires from plus terminal with parts of vehicle frame, otherwise short circuit is possible.

Disconnecting the battery, start with plus terminals, then, disconnect negative ones.

Connecting the battery, start with plus terminals, then, with minus ones.

Do not confuse polarity of power wires of electric equipment connected to storage batteries.

Batteries storage

Be sure to connect and disconnect the power supply wire with consumers disengaged.

For storage, remove the batteries from the truck (if the truck is going to be out of use for more than 1 month), charge them and keep, if possible, in a dry cool room at temperature not higher than 0 °C.

The minimum storage temperature should not be lower than minus 30 °C. Check the electrolyte density monthly; if decrease by 0,03 g/cm^3, be sure to charge the battery.

The maximum suggested storage period for storage batteries w/o additional charging should not exceed three months.

Do not store batteries discharged, since this leads to sulfatation of the plates and complete deterioration of the batteries.

Attention!

Charge the batteries only when they are removed from the vehicle.

C***harge batteries in rooms with operable ventilation as explosive detonating gas emits during charging.***

Do not smoke or allow an open spark or flame in the vicinity of the battery.

Do not place metal items or tools on batteries.

Exhausted and faulty batteries should be transported to specialized receiving points.

During maintenance, observe safety rules (see symbols on body of storage battery).

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7 VEHICLE MECHANISMS AND SYSTEMS TROUBLESHOOTING. SELF-HELP

Be sure to eliminate all faults in proper time to avoid worsening of ecological and operation parameters of vehicle (such as: fuel consumption increase, engine power decrease, increased emission of pollutions) and provide save operation of vehicle.

Monitor the state of all vehicle systems using instruments and display messages.

With ignition key rotated to the first fixed position, all pilot lamps and indicators on instrument panel come ON for 2-3 seconds.

If lamps stay ON or lighten during vehicle driving, it is a proof of fault (see subsection *Indication and fault elimination*). The pilot lamps go out after the fault has been eliminated.

After a fault has been eliminated, the tractor ABS lamp goes out at the beginning of motion, when truck reaches the speed of 5-7 km/h.

If any critical faults, **STOP** pilot lamp comes ON in addition to message. At that moment the buzzer sounds.

If the hazard signal system or direction indicators are ON, the sound signals are not emitted.

If necessary, perform diagnostics of vehicle systems. The diagnostic mode helps to control the operation of vehicle electronic systems and generation of fault codes.

For code cracking and failure elimination, please contact the Service center.

The repair of Daimler components as well as cracking of fault codes in Mersedes-Benz engines should be performed in Mercedes-Benz service centers or in the authorized (to perform maintenance of Daimler components) KAMAZ PTC service centers.

Attention!

During repair and troubleshooting, be sure to stop the engine and disconnect power supply. System power is de-energized with starter-and-instruments key rotated to position «0».

Possible faults of vehicle units and systems, methods of their elimination are described in Construction, maintenance and repair manual for KAMAZ 5490 vehicle.

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HAZARD SIGNAL SYSTEM ENGAGEGMENT

If any faults critical to traffic safety, be sure to stop vehicle immediately, engage parking brake and hazard signal system.



To engage hazard signal system, press the corresponding switch in the upper part of instrument panel. With this, all direction indicators lighten and the signal lamp (LED), built into the button, flashes.

To disengage hazard signal system, depress the corresponding button again. With this, all direction indicators as well as the signal lamp (LED), built into the button, go out.

If both stop lights (brake lights) of tractor truck or trailer/semitrailer are faulty, once the brake pedal is depressed, the hazard warning lights become active.

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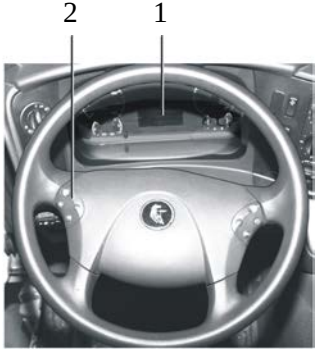
DIAGNOSTICS OF VEHICLE SYSTEMS

If the pilot lamp of electronic system fault lightens in the instrument panel (e.g., fault in the engine control system) it means, there is a fault in the system, which controls this system.

You need to perform diagnostics of vehicle electronic system and eliminate trouble.

After the fault has been corrected, the pilot lamp dies out.

The displays are controlled by using the buttons located on the left steering wheel side (see Fig. *Display screen control*).



Display screen control

1 - information display;
2 - display screen control buttons

Display screen control buttons

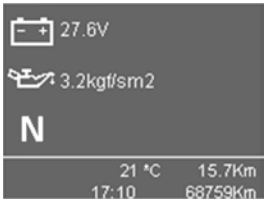
	Menu key. Confirmation of display message.
	Page down (function selection)
	Page up (function selection)
	To exit the menu screen/to return to the main menu

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SEQUENCE TO READ DIAGNOSTIC CODES

1. Rotate the instruments-and-starter switch key to position «ON» (position of motion).

The home screen appears.



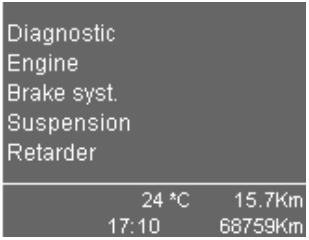
Main screen

2. Engage the parking brake.

Attention!

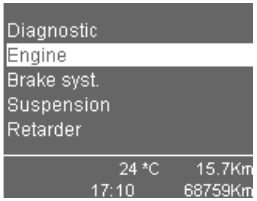
Diagnostic mode for all systems is possible only in stationary vehicle (with parking brake engaged).

3. Depress the button until the screen «Diagnostics» appears. Depress the «Menu key» button. The menu bar of diagnostics system selection becomes highlighted.



4. With buttons or pressed, select the vehicle system (if available) for diagnostics:

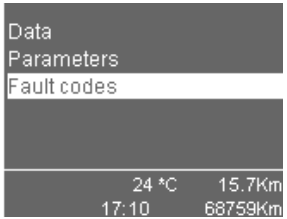
- engine;
- brake system;
- after-treatment system;
- air suspension;
- ZF ASTronic gearbox;
- retarder;
- electric equipment.

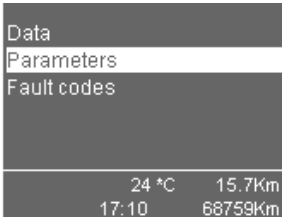


5. Depress the «Menu key» button.

6. Depress the button to select the «Fault codes» menu bar.

When you select the «Parameters» line, the screen with the parameters of the selected electronic control system received via the CAN data bus opens.



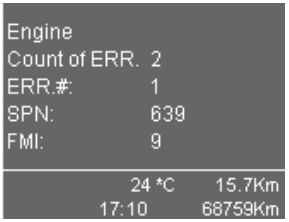


7. Depress the «Menu key» button  .

If any faults are available, the following is emitted to display:

- system name;
- the total number of faults in a unit;
- SPN (number of device connected to a certain electronic (local) system (sensors, actuators, messages in CAN data bus);
- FMI - malfunction type code.

Then by pressing  and  buttons you can scroll up to 10 active errors in a unit. If there are more than 10 errors, the further errors can be viewed only after elimination of those that are already displayed.

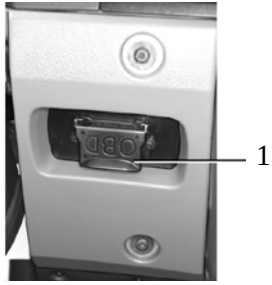


8. After viewing the errors, you can return to the main screen by keeping the  button pressed for a long time.

The diagnostics of the other electronic systems in a vehicle is performed in the same way.

For code cracking and failure elimination, please contact the Service center.

For troubleshooting performed in the service centers use the OBD connecter, which is located to the left side of steering column (see Fig. *OBD connecter arrangement*).



OBD connecter arrangement

1 - diagnostics connector

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MODE FOR DIAGNOSTICS OF OPERATIONAL PARAMETERS

The diagnostics of operational parameters can be used in case of remote malfunction diagnostics performed by KAMAZ PTC specialists or by experts of service centers.

To determine the type of malfunction when performing diagnostics of operational parameters in vehicle systems the display shows eight additional screens. Parameters of various vehicle elements and systems are shown on the display.

Attention!

The diagnostics of operational parameters is more informative while driving. Thus, this mode should be used only on the even ground without obstacles and other road users.

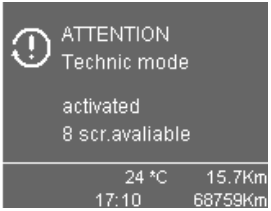
Never use the mode for diagnostics of operational parameters on public roads, because reading and evaluating information from the screens will cause the driver to pay less attention to the situation on the road. The mode for diagnostics of operational parameters can be activated only when alarm is on.

To view the display screens in the operational parameters diagnostics mode:

1. Turn on the alarm.

2. Rotate the instruments-and-starter switch key to position «ON».

3. Within 15 seconds, press the accelerator or the brake pedal five times, or turn on the high beam ten times. The message 1 appears on the display.



Message 1

Then the message 2 appears on the display.

4. To view the next eight screens use the buttons  or  .



Message 2

To exit the mode for diagnostics of operational parameters, turn off the alarm.

Screens of mode for diagnostics of operational parameters.

Screen 1.

The version of software for CBCU unit and the LCD display firmware language.

Screen 2. Engine:

- crankshaft speed;
- instant fuel consumption;
- pressure in the intake manifold;
- the actuating force applied to accelerator pedal (per cent).

Screen 3. Engine (continuation):

- output torque (as a percentage of the maximum torque);
- air temperature in the inlet manifold;
- oil pressure in the engine lubricating system;
- oil level in the lubrication system (10 % - the «MIN» mark on the dipstick, 90 % - the «MAX» mark on dipstick).

Screen 4. Temperature of:

- ambient air;
- fuel injection;
- coolant;
- oil.

Screen 5. Controls:

- the actuating force applied to accelerator pedal (per cent);
- the actuating force applied to brake pedal (per cent);
- clutch pedal effort (pressed/ not pressed);
- parking brake actuation.

Screen 6:

- front axle speed, as an arithmetic mean of the speeds of the left and right wheels of the front axle;
- relative speed of the front left wheel;
- relative speed of the front right wheel;
- the relative speed of the rear left wheel;
- the relative speed of the rear right wheel.

Screen 7. Stability Control System:

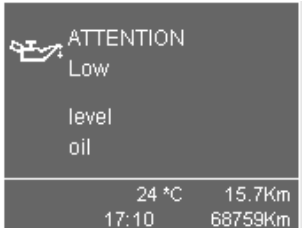
- yaw rate;
- lateral acceleration rate;
- longitudinal acceleration rate;
- vehicle speed at the wheels.

Screen 8. Gearbox:

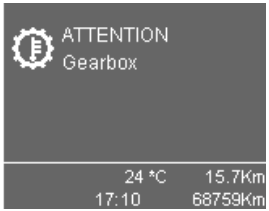
- speed of the input shaft of the gearbox with automatic control;
- speed of the output shaft of the gearbox with automatic control;
-clutch slipping, per cent;
- selected gear;
- engaged gear.

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INDICATION AND ELIMINATION OF FAULTS

Fault indication	Cause of trouble	Suggestion on correction
 (color - red) Intermittent horn	Oil pressure in the engine lubricating system is below norm.	***Vehicle driving is prohibited till fault correction.*** • Stop the vehicle taking into account the traffic situation; • stop the engine; • engage the parking brake; • check the level of oil in crankcase (see section *6* «*Maintenance*»). If oil level in crankcase is OK, but pilot lamp of hazard oil pressure fails to die out, be sure to address the service center. Inspect engine for leakage. In case of any leakage of oil***, vehicle driving is prohibited till fault elimination***. Address the service center.
 Intermittent horn	Oil level in the engine crankcase is below the norm.	
 (color - red)	Air filter clogging.	Replace the air filter.

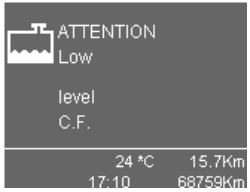
Fault indication	Cause of trouble	Suggestion on correction
 Reserve fuel indicator in the area of fuel level indicator in the tanks (color - yellow)	Fuel level is less than 12 % of the fuel tank volume. Air may enter the engine fuel system.	***Engine operation is not recommended if Reserve fuel indicator comes ON.*** If any air in fuel injection system, be sure to prime fuel tank and eliminate air prior to engine start.
 (color - red)	Alternator charging current is absent.	Vehicle motion is permitted with special care. Check the alternator drive belt tensioning, adjust it, if necessary. (see. Operation manual for «Mercedes-Benz» engine maintenance). If tensioning is OK, check the electric equipment in service center.
 (color - orange)	Fault in automated gearbox.	Vehicle motion is permitted with special care. Address the service center.

Fault indication	Cause of trouble	Suggestion on correction
 (color-orange) **STOP** Buzzer sounds	Critical malfunction in theautomated gearbox.	***Vehicle driving is prohibited till fault correction.*** • Stop the vehicle taking into account the traffic situation; • stop the engine; • engage the parking brake; • perform the system diagnostics. If fault indicated by codes persists, address the service center to eliminate trouble.
 HT On the display 	Overheated oil in the a utomate d gearbox.	***Vehicle driving is prohibited till fault correction.*** • Immidiately stop the vehicle paying attention to the road situation; • engage the parking brake; • let the engine running at an increased crankshaft speed, let the gearbox cool down. If the oil temperature in the gear-box has reduced and the message has gone out, stop the engine and let it cool down until it reaches the ambient air temperature; • check the level of coolant in expansion tank, the leakage-proof of cooling system joints. If need be, top up the coolant. In case of any coolant leakage, eliminate fault in place as possible; • check the level of oil in gearbox. If coolant level and oil level in gearbox is normal but pilot lamp fails to die out, be sure to address the service center.

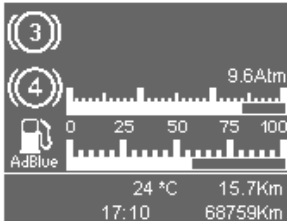
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Fault indication	Cause of trouble	Suggestion on correction
 on the display	The pressure in the 4-th circuit of air system is insufficient.	Gear shifting is not possible. Check the 4-th circuit of the air system for leaks, check the function of 4-circuit safety valve, adsorption dehumidifier, compressor. In all circuits, the pressure must be at least 10 kgf/cm ^{2}. If the fault persists, contact the service center.
 on the display	Clutch position can not be determined.	**Vehicle driving is prohibited till fault correction**. Address the service center.
 on the display	Clutch is overloaded.	Select the lowest gear or stop the vehicle.
 on the display	limit clutch wear.	The estimated clutch wear limit is reached. Contact the service center for clutch replacement.
 on the display	Faulty communication between display and gearbox electronics.	**Vehicle driving is prohibited till fault correction**. Address the service center.
 on the display	Malfunction, system error.	Take your foot off the gas pedal. If the error does not go off, then a system error occurred. Further movement is impossible. Address the service center.

Fault indication	Cause of trouble	Suggestion on correction
 (color-orange)	Fault in engine control system.	Vehicle motion is permitted with special care. Address the service center. Perform engine diagnostics. • Stop the vehicle paying attention to road situation; • stop the engine; • engage the parking brake; • perform engine diagnostics. If fault indicated by codes persists, address the service center to eliminate trouble.
 (color-orange) **STOP** Buzzer sounds	Engine hazard state.	***Vehicle driving is prohibited till fault correction.*** Address the service center.
 color-orange	Trouble after-treat ment system and/ or in engine.	Vehicle motion is permitted with special care. Perform engine diagnostics. For code cracking and failure elimination, please contact the Service center.
 (color - blue)	Low level Blue level in the after treatment system.	***Do not use the system without AdBlue agent.*** Check the AdBlue level (see Section 6 «*Maintenance*»), add, if necessary. If the Adblue level is normal, but the pilot lamp does notgo out, contact the service center.

Fault indication	Cause of trouble	Suggestion on correction
 (color-red)  (color-orange) Intermittent horn	Increased coolant t temperature. Disengagement of automatic operation mode of engine fan drive coupling.	Vehicle motion is permitted with special care. • Stop the vehicle taking into account the traffic situation; • stop the engine; • engage the parking brake; • check the coolant level in expansion tank (see section «6. *Maintenance*»). If coolant level is OK, but pilot lamp and indicator persist, be sure to contact the service center.
 (color-orange)	The wear of brake shoe linings is higher than permissible.	Contact the service center to replace brake linings.
 Intermittent horn	Low level of coolant.	Add coolant into expansion tank (see Section 6 «*Maintenance*»).

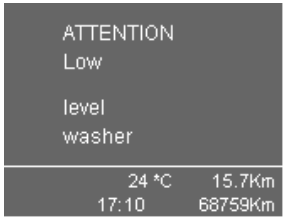
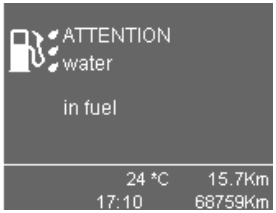
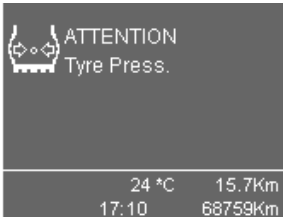
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Fault indication	Cause of trouble	Suggestion on correction
 (color-red) Intermittent horn	If the indicator of 3-d or 4-th circuit is blinking on the screen, there is a fault occured in the 3-d or 4-th circuit of the brake system, respectively.	***Vehicle driving is prohibited till fault correction.*** • Stop the vehicle taking into account the traffic situation; • engage the parking brake; • inspect for compressed air leakage in pneumatic drive caused by leakage of pipelines' and elastic hoses' connections. Check the brake system devices for operability; • eliminate trouble; • after faults correction, with vehicle being stationary, let engine working to restore the compressed air reserve; • continue driving only after the control lamps go out (at a pressure of 5,0 to 5,5 kgf/cm^2) and the pressure in the circuits of the brake system reaches the norm (9,0 to 10,0 kgf/cm^2). If fault persists, pilot lamps do not die out, be sure to address the service center**.**
(color-red) (color-red) Intermittent horn	Pressure drop in the 1-st circuit of the brake system.	***Vehicle movement is limited*** Adjust the pressure to the normal level.

Fault indication	Cause of trouble	Suggestion on correction
 (color-red)  (color-red) Intermittent horn	Pressure drop in the 2-d brake system circuit.	***Vehicle movement is limited*** Adjust the pressure to the normal level.
 (color - orange)	Trouble in the brake system of the vehicle.	Vehicle motion is permitted with special care. • Stop the vehicle; • engage the parking brake; • perform the system diagnostics. Be sure to address the service center to eliminate troubles. After system troubleshooting has been completed, be sure to erase passive errors from the memory of EBS electronic unit to avoid their accumulation (not more than 50) and further system operation blockage. To erase passive errors, address the service center.

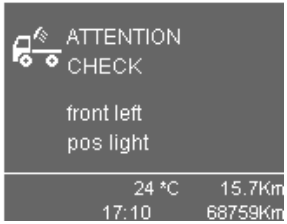
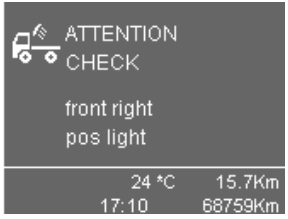
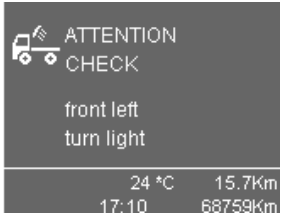
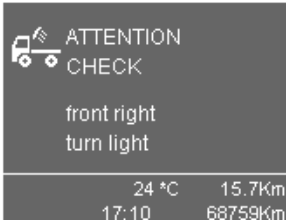
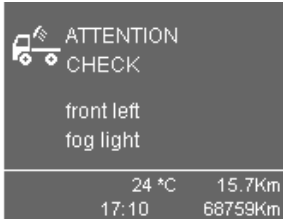
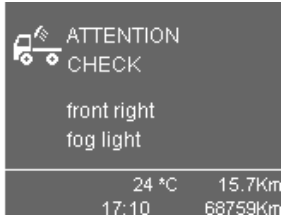
Fault indication	Cause of trouble	Suggestion on correction
 (color - orange) **STOP** Buzzer sounds	Failure of EBS in the vehicle.	Vehicle motion is permitted with special care. • Stop the vehicle; • engage the parking brake; • carry out diagnostics of the vehicle brake system. Be sure to address the service center to eliminate troubles. After system troubleshooting has been completed, be sure to erase passive errors from the memory of EBS electronic unit to avoid their accumulation (not more than 50) and further system operation blockage. To erase passive errors, address the service center.
 (color - orange)	Failure of EBS semi-trailer.	Vehicle motion is permitted paying attention to road situation. Address the service center.
 (color-red)	Hydraulick locks are failed to lock.	***Vehicle driving is prohibited until the fault is corrected.*** Check the locks closure. If at least one of locks fails to close, raise and lower the cab (see subsection «*Cab raising and lowering*»). Hydraulic locks should close automatically. If necessary, bring the pressure in air drive to nominal. If pilot lamps fail to die, be sure to address the service center.

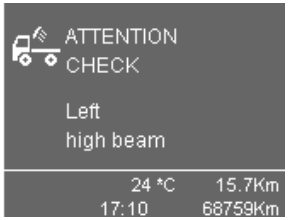
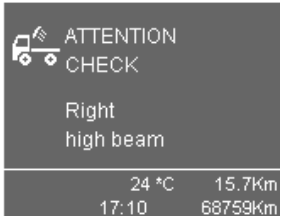
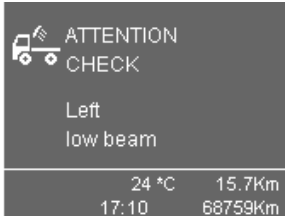
Fault indication	Cause of trouble	Suggestion on correction
 (color-red) **STOP** Buzzer sounds	Faults in the control system of air suspension.	Carry out the diagnostics of air suspension (See subsection «*Diagnostics of vehicle systems*»). After the fault has been corrected, the pilot lamp dies out. If the lamp does not go out after the fault has been rectified, as determined by the flashing light code, or if the fault is not resolved by yourself, contact the service center.
 (color - red) Intermittent horn	Safety belt is not fastened.	Fasten the safety belt.
 (color - red) Buzzer sounds	Malfunction of hydraulic system in the power steering pump.	Be sure to do the following: - check oil level in tank of power steering pump; - test the pump operability and inspect the filters; - inspect the steering system for leakage visually. Vehicle motion is permitted with special care. Address the service center. If any leakage of oil, vehicle driving is prohibited till fault elimination.

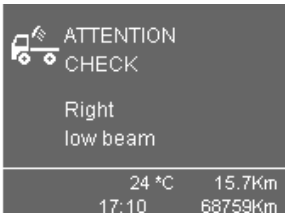
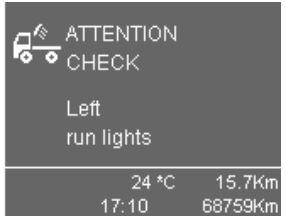
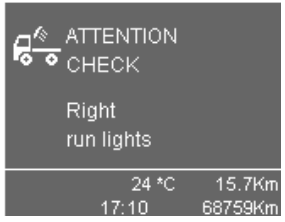
Fault indication	Cause of trouble	Suggestion on correction
	Low level of liquid in the windshield washer reservoir. The pump motor cannot be activated.	Prime the washer tank with ready-made washing liquid.
	The water detection sensor has tripped in the coarse fuel filter.	Drain sediment from coarse fuel filter (see section *6* «*Maintenance*»).
	Pressure in the tire (s) is below or above the critical level. The screen is active, when the tire-pressure monitoring system is installed and connected in a vehicle.	Adjust the pressure in the tire (s) up to norm.

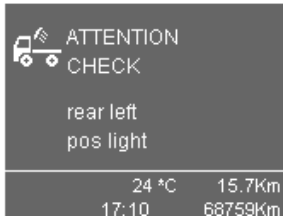
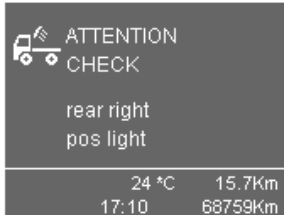
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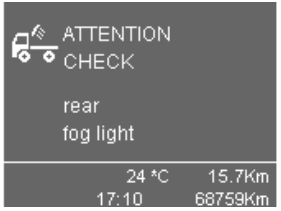
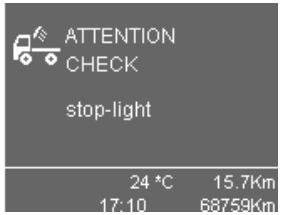
INDICATION OF FAULTS IN THE LIGHTNING EQUIPMENT

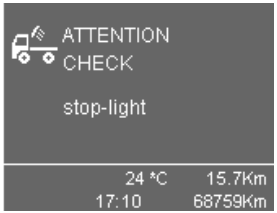
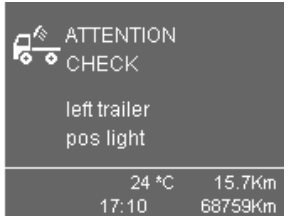
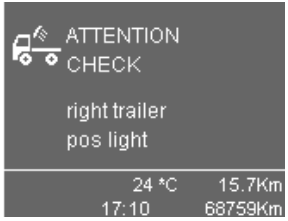
	Trouble of all front left side marker lights
	Trouble of all front right side marker lights
	Trouble of the front left direction indicator
	Trouble of the front right direction indicators
	Trouble of the front left bulb of the additional lighting for poor visibility conditions
	Trouble of the front right light bulb of the additional lighting for poor visibility conditions

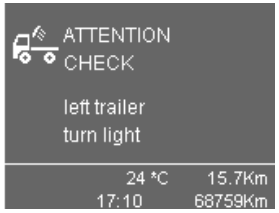
	Trouble of the left high beam headlamp
	Trouble of the right high beam headlamp
	Trouble of the left low beam headlamp

	Trouble of the right low beam headlamp
	Trouble of the left daytime running lamp
	Trouble of the right daytime running lamp

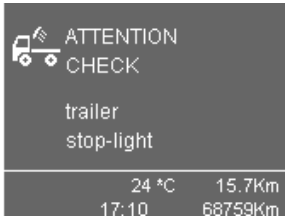
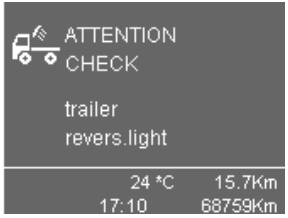
	Trouble of all rear left marker lights
	Trouble of all rear right marker lights
	Trouble of the rear left direction indicator

	Trouble of the rear right direction indicator
	Trouble of tail fog lamps, located on both sides of the vehicle
	Trouble of brake lights of the rear lamps located on both sides of the vehicle

	Trouble of the reverse lamps located on both sides of the vehicle
	Trouble of all left marker lights of the trailer/ semi-trailer
	Trouble of all right marker lights of the trailer/ semi-trailer

	Trouble of the left direction indicator of the trailer/ semi-trailer
	Trouble of the right direction indicator of the trailer/ semi-trailer
	Trouble of fog lights located on both sides of the trailer/ semi-trailer

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	Trouble of stop-lights (brake lights) located on both sides of the trailer/ semi-trailer
	Trouble of reverse lights located on both sides of the trailer semi-trailer

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ENGINE START FROM EXTERNAL POWER SOURCE

You may use external power sources to start engine in vehicle with partially or completely discharged storage batteries.

The following devices may be used as external power source:

- charged storage batteries with voltage 24 V and suggested capacity 190 A·h;
- moving charging station (batteries with network unit).

Prior charging the storage batteries, check if station has been disconnected from mains, otherwise, excessive charging voltage may damage vehicle electronic control systems.

External power sources should possess the following characteristics:

- rated voltage from 24 to 30 V;
- the recommended starting current is more than 1000 A. If power source has weaker starting current, then, prior to starting, wait for some 10-15 minutes to charge regular storage batteries.

If engine start from external power source has failed, be sure to charge the batteries completely or replace them by new ones.

Attention!

Start engine from external power source with installed and connected regular storage batteries in a vehicle.

Use starting connection cables protected from twisting, with cross section 35 mm^2, at least, and with isolated pole terminals.

At ambient temperature below minus 10 ºC, the discharged storage battery can freeze, so, before starting the engine, the frozen storage batteries must be thawed out.

STARTING THE ENGINE FROM THE BATTERY OF ANOTHER VEHICLE

1. Place the vehicle with charged storage battery next to the vehicle with discharged storage battery, preventing their contact with each other.

2. Apply parking brakes of both vehicles.

3. Check if gearshift levers in both vehicles are in neutral.

4. Switch off the engine of the vehicle with charged storage batteries.

5. Connect positive, then, negative poles of batteries using starting cables:

- connect the cable plus clip to «plus» terminal of the discharged storage battery. Connect the second clip of plus cable to «plus» terminal of the charged storage battery;

- connect the clip of minus connection cable to «minus» terminal of charged storage battery. Connect the second minus clip of cable to «minus» terminal of the discharged storage battery.

Avoid contact of positive clips of positive and negative connection cables.

6. On the vehicle **with discharged** batteries - turn the ignition switch key to the position «**O** - everything is off».

7. In vehicle **with charged** storage batteries, start the engine and let it run for 10-15 minutes with speed higher than rpm at idle to charge storage battery.

8. In vehicle **with charged** ***storage battery, shut down engine to prevent failure of electric and electronic items.***

Rotate the ignition switch key to position «0 - all is OFF».

9. In vehicle **with charged storage battery**, start the engine and let it run until the idle speed is stable.

10. Disconnect the starting cables. First, disconnect negative, then, positive poles.

Attention!

Observe the polarity of electric supply wires connected to storage batteries:

- positive pole terminal should be connected to positive pole of charge current source,

- negative pole terminal should be connected to negative pole of charge current source.

WRONG CONNECTION OF WIRES CAUSES FAILURE OF ALTERNATOR AND ENGINE CONTROL UNIT!

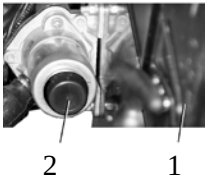
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BATTERY EMERGENCY SWITCH OFF

Attention!

In the event of emergency situation in a vehicle (short circuit, fire) disconnect the storage batteries urgently with the help of switch button arranged on side of batteries box (see Fig. *Emergency battery switch off*).

In all other situations, the urged disconnection is prohibited!



Emergency battery switch off
1 - storage battery;
2 - switch button

BRAKE LININGS WEAR-OUT

In disk brake gears, the degree of wear-out should be checked daily, visually, but at least, once in 3 months.

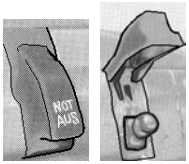
Be sure to change brake linings if thickness at least in one section is less 2 mm.

With worn brake linings, the pilot lamp lightens on instrument panel .

Address the service center to change brake linings.

BATTERY EMERGENCY STOP SWITCH FOR VEHICLES CARRYING DANGEROUS GOODS

The vehicle for carrying dangerous goods is equipped with an emergency stop switch **installed on its instrument panel** (see Fig. *Emergency stop switch*) which intention is to switch the battery off in the event of emergency situation.



EMERGENCY STOP switch

For emergency shutdown of the battery, tilt the switch cover, pull up the switch (the switch may not be kept extended for more than two seconds). Then immediately close the switch cover as far as it will go.

Attention!

Use the emergency stop switch only in case of danger and when the vehicle is stationary. Do not use the emergency stop switch while driving.

When the emergency stop switch is ON, energy supply to all power consumers is interrupted automatically, the engine is automatically switched off, the power steering does not work. There is a danger that an accident may occur.

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STEERING SYSTEM FAULTS

STEERING PLAY

It is difficult to keep hold the lane with increased steering play.

If an increase is detected in steering play compared to previous tests, you need to check steering gear swivel joints for play.

Play at the swivel joints of steering mechanism is not allowed.

To check swivel joints of steering mechanism for play and to repair it, contact the service center.

POWER STEERING UNIT DOES NOT PROVIDE REQUIRED FORCE

If power steering unit does not ensure sufficient effort or operates irregularly, with increased noise, there's fault in power steering system.

Possible causes:

- oil level in power steering pump tank is too low;
- leakage in hydraulic system of power steering pump;
- air in hydraulic system;
- filter is clogged.

Vehicle driving is prohibited till fault correction.

If fault is not eliminated, be sure to address the service center.

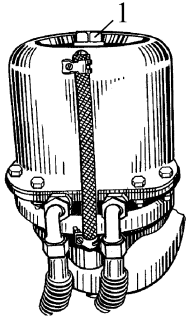
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PARKING BRAKE RELEASE IN HAZARD SITUATIONS

Means of parking brake release in hazard situations:

1. If there is no available means to fill the receivers with compressed air, the truck brake may be released mechanically. To do this, rotate the mechanical brake release screws (approximately for 30 turns) out to the stop (see Fig. *Spring brakes of the brake chambers*).

After the trouble in pneumatic drive is eliminated, screw-in the screws into their place.



Spring brake of the brake chambers.

1 - mechanical brake release screw

Attention!

If there is no sufficient air pressure in brake system pneumatic drive, then after the mechanical release of parking brake, the truck will have no brakes at all.

Prior to parking spring brake release, place the chocks under wheels.

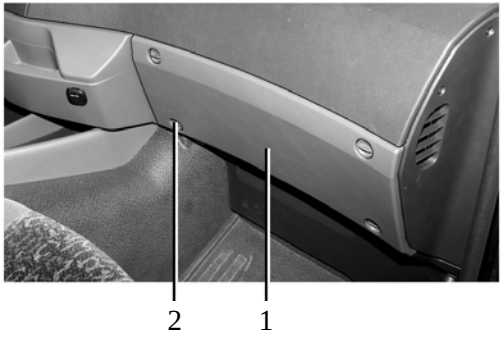
2. Besides, with no compressed air in the pneumatic system, you may release the truck brakes having supplied the compressed air from the outer source into the tire inflation valve arranged on the right side of vehicle, under the hatch cover of cabin footstep.

To do this, you need to turn the tire inflation valve clockwise and then turn it on 2 turns counterclockwise, to open the valve. According to information of pressure indicators, make sure that the pneumatic actuator is filling.

FUSES AND RELAYS

ARRANGEMENT OF FUSES AND RELAYS

Fuse and relay box is installed on the instrument panel, on the passenger side (see Fig. *Access to the fuse box*).



Access to the fuse box

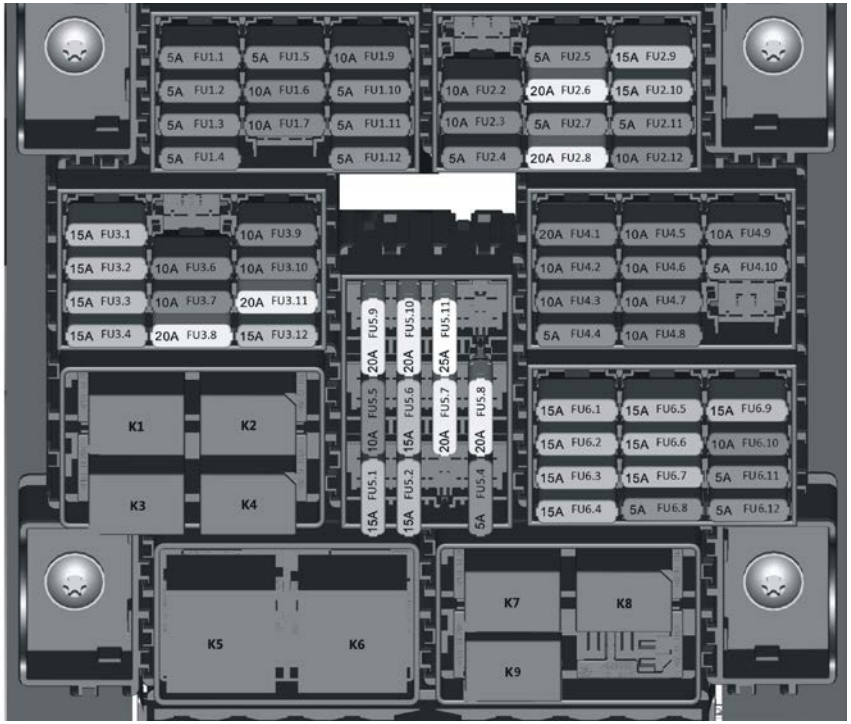
1 - fuse box cover; 2 - cover fastening

To provide access to the fuse box remove fasteners and take off the fuse box cover (see Fig. *Fuse and relay box*).



Fuse and relay box

Fuse and relay box



Relay

Symbol	Consumer
K1	Wiper operation modes relay
K2	Wiper stop relay wipers
K3	Towing hitch light relay
K4	Horn relay
K5	Fuel heating relay
K6	Cab tilting lock relay*
K7	Relay for locking storage battery switch off
K8	Conditioner relay
K9	Emergency switch off relay of the storage batteries*
K10	
* For certain configurations	

Fuses

Symbol	Rating	Consumer	State of the main supply switch/ ignition switch key
FU1.1	5A	EFU control unit	ON
FU1.2	5A	Air suspension control module	ON
FU1.3	5A	Control module for electric equipment (CBCU)	ON
FU1.4	5A	EBS control unit	ON
FU1.5	5A	ADM3 engine control unit	ON
FU1.6	10A	Control unit for after-treatment system	ON
FU1.7	10A	Control unit for MR2 engine	ON
FU1.8	10 A	Control unit for gearbox	ON
FU1.9	10A	Retarder control unit*	ON
FU1.10	5A	OBD-diagnostics connector	ON
FU1.11	5A	Tachograph / instrument cluster	ON
FU1.12	5A	Connector for special add-ons	ON
FU2.1	5A	Electronic control unit gVCU	ON
FU2.2	10A	Driver's side control panel	ON
FU2.3	10A	Dehumidifier	ON
FU2.4	5A	Alternator exciting coil	ON
FU2.5	5A	Control module for central lock	ON
FU2.6	20A	Voltage converter 24/ 12V	ON

* For certain configurations

Symbol	Nominal value	Consumer	State of the main supply switch/ ignition switch key
FU2.7	5A	Hatch control actuator*	ON/ACC
FU2.8	20A	Conditioner	ON/ACC
FU2.9	15A	Driver's side control panel	ON/ACC
FU2.10	15A	Passengers's side door control panel	ON/ACC
FU2.11	5A	Audio system	ON/ACC
FU2.12	10A	Cigar lighter	ON/ACC
FU3.1	15A	EBS control unit	ON/0
FU3.2	15A	Trailer EBS	ON/0
FU3.3	15A	Air suspension control module	ON/0
FU3.4	15A	Flash beacons*	ON/0
FU3.5	10A	Control unit for gearbox	ON/0
FU3.6	10A	Retarder control unit*	ON/0
FU3.7	10A	Instrument cluster	ON/0
FU3.8	20A	EFU control unit	ON/0
FU3.9	10A	OBD-diagnostics connector	ON/0
FU3.10	10A	Control module for electric equipment (CBCU) gr.3	ON/0
FU3.11	20A	Control module for electric equipment (CBCU) gr.4	ON/0
FU3.12	15A	EBS control unit	ON/0

* For certain configurations

Symbol	Rating	Consumer	State of the main supply switch/ ignition switch key
FU4.1	20A	Electric pump for cab raising/lowering *	ON/0
FU4.2	10A	Interior lighting	ON/0
FU4.3	10A	Connector for special add-ons	ON/0
FU4.4	5A	Power supply for buttons and sensors	ON/0
FU4.5	10A	Audio system	ON/0
FU4.6	10A	Window heating	ON/0
FU4.7	10A	Towing hitch light	ON/0
FU4.8	10A	24V Socket	ON/0
FU4.9	10A	Buzzer sound	ON/0
FU4.10	5A	Remote switch off relay of storage batteries	ON/0
FU4.11			ON/0
FU4.12	5A	Steering-wheel-mounted paddle shifters	ON/0
FU5.1	15A	Fuel heating in the fuel suction pipe	Is not dependent/0
FU5.2	15A	Fuel heating in coarse fuel filter	Is not dependent/0
FU5.3	10A	Electronic control unit gVCU	ON/0
FU5.4	5A	Tachograph	Is not dependent/0
FU5.5	10A	ADM3 engine control unit	Is not dependent/0
FU5.6	15A	Control unit for after-treatment system	Is not dependent/0

* For certain configurations

Symbol	Rating	Consumer	State of the main supply switch/ ignition switch key
FU5.7	20A	Control module for electric equipment (CBCU) gr.1	Is not dependent/0
FU5.8	20A	Control module for electric equipment (CBCU) gr.2	Is not dependent/0
FU5.9	20A	Control module for electric equipment (CBCU) gr.5	Is not dependent/0
FU5.10	20A	Control module for electric equipment (CBCU) gr.6	Is not dependent/0
FU5.11	25A	engine liquid heater	Is not dependent/0
FU5.12			Is not dependent/0
FU6.1	15A	Control module for electric equipment (MUX4-P)	Is not dependent/0
FU6.2	15A	Control module for electric equipment (MUX4-P)	Is not dependent/0
FU6.3	15A	Control module for electric equipment (MUX4-P)	Is not dependent/0
FU6.4	15A	Control module for electric equipment (MUX4-P)	Is not dependent/0
FU6.5	15A	Control module for electric equipment (MUX4-P)	Is not depend ent/0
FU6.6	15A	Control module for electric equipment (MUX4-P)	Is not dependent/0
FU6.7	15A	Seat heater	ON
FU6.8	5A	Monitoring system/ ERA-GLONASS	ON
FU6.9	15A	Control module for central lock	ON/0
FU6.10	10A	Air heater (boi ler)*	ON/0
FU6.11	5A	Air heater (timer)*	ON/0
FU6.12	5A	Monitoring system/ ERA-GLONASS	ON/0

* For certain configurations

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CHECKING AND REPLACING FUSES

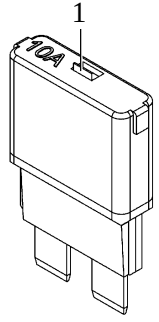
The electric circuits are protected by fusible links or by means of automatic fuses.

If any power consumer stopped working, switch it off and check, if the fuse is functioning correctly. Change the faulty fuse.

If an automatic fuse is triggered (see Fig. *Automatic fuse*), eliminate the cause of trip, then switch on the automatic fuse again.

Check the circuit leading from the fuse to the consumer. Replace fuses(circuit breakers) after the short-circuit is eliminated.

Breaks in the circuit are also possible. Address the service center to eliminate the breakage.



Automatic fuse

1 - fuse is OFF

Attention!

Do not use fuses rated for higher current (A) as compared to specified. Otherwise, electric equipment may damage or cables burn.

Do not shunt contacts and do not repair fuses.

Change fuse only after fault.

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SAFETY REQUIREMENTS

1. Prior to replacing the bulbs, de-energize the harness having rotated instruments-and-starter key to position «0 - all is OFF» or disconnect from storage battery.

2. ***When replacing the bulb, do not touch the bulb barehanded***. Hold it by plug or bulb socket, or, if needed, you may hold by glass bulb using clean dry cloth or clean dry gloves.

3. Avoid water getting onto bulb and spotting the bulb.

4. If any spots, wipe the cold bulb using spirit and dry cloth.

5. Inspect for corrosion on contacts, eliminate if discovered.

6. When installing new lamps, take care of correct arrangement of sealing gaskets.

When replacing blown bulbs, their type and power must be considered.

Replacement of lighting products with LEDs should be carried out at the service center.

REPLACING THE BULBS

Replacing the additional lighting bulbs for poor visibility conditions

1. Take apart the locking lug cover, placed under the bumper, and remove it (see Fig. *Additional lighting bulb for poor visibility conditions*).

2. Remove the cable cap on the lamp.

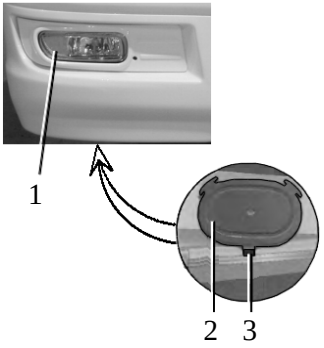
3. Remove the clamping spring.

4. Pull out the bulb.

5. Insert the new bulb into the socket, so that the lamp cap enters the slot.

6. Secure the clamping spring, connect the plug with the bulb contact.

7. Close the cover.



Additional lighting bulb for poor visibility conditions

1 - additional lighting bulb for poor visibility conditions;
2 - cover;
3 - locking lug

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Replacing the bulb of side repeater lights

1. Loosen the fastening screw, remove the diffuser (see figure *Side repeater light*).

2. Change the bulb.

3. Install the diffuser, tighten fastening screws.



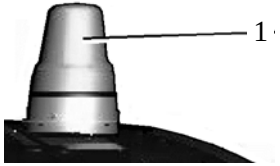
Side repeater light
1 - fastening screw;
2 - diffusor

Replacing the flashing light bulb

1. Unscrew fastening screws, remove the diffuser (see Fig. *Flashing light lamp*).

2. Change the bulb.

3. Install the diffuser, tighten fastening screws.



Flashing light lamp
1 - diffusor

Replacing the searchlight bulb of the hitch lighting

1. Loosen the fastening screw 1, remove the bulb in upward direction (see Fig. *Searchlight bulb of the hitch lighting*).

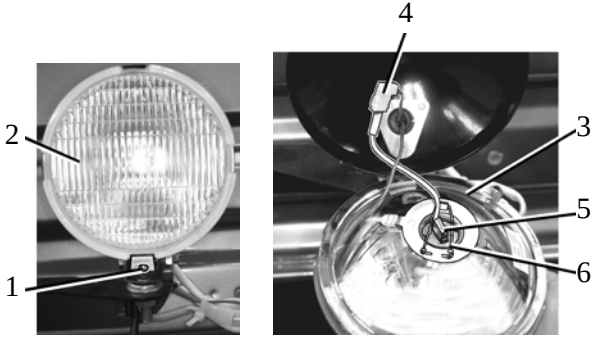
2. Take out the plug 4.

3. Disconnect the clamping spring 6, take out the halogen lamp holding it by the socket 5.

4. Install the new halogen lamp so that the socket plate matches the recess in a holder.

5. Secure the clamping spring, connect the plug with bulb contact.

6. Install the lamp to its place, tighten the screw 1.



Searchlight bulb of the hitch lighting
1 - screw; 2 - diffusor; 3 - deflector; 4 - plug;
5 - halogen lamp socket; 6 - clamping spring

Changing the bulb in headlamp cluster

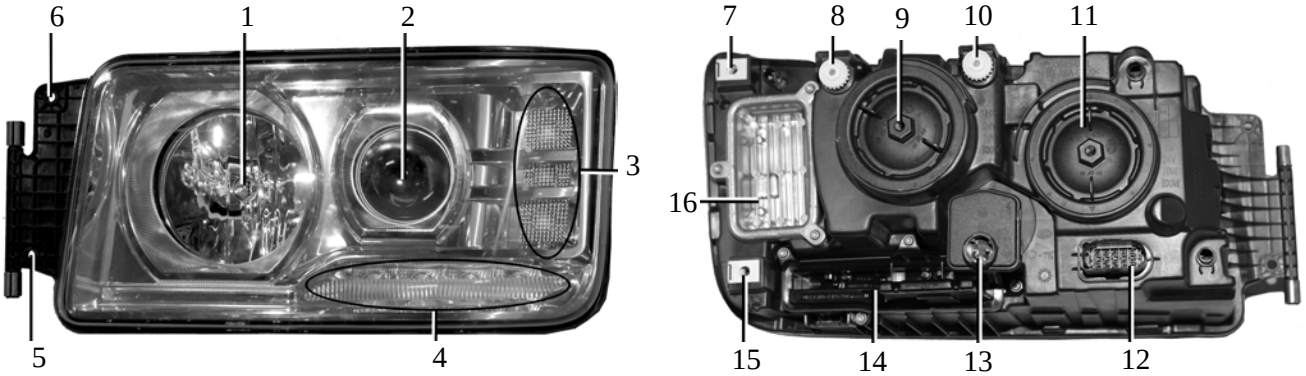
1. Remove the fastening cover plate of the headlamp cluster, unscrew two bolts securing the bulb (holes 6 and 7) and two fastening bolts on the headlamp cluster reverse side (holes 7 and 15) (see Fig. *Headlamp cluster*).

2. Pull out the headlamp cluster.

3. Open the covers 9 and 11.

4. Disconnect the plug from the lamp contact, remove the clamping spring, take out the halogen lamp holding it by the socket, install the new halogen lamp, secure the clamping spring, connect the plug with the bulb contact, close the cover.

5. Install the headlamp cluster, secure it with bolts.



Headlamp cluster

1 - high beam light; 2 - low beam light; 3 - direction indicator; 4 - daytime running lights/marker lights; 5, 6, 7, 15 - bolt holes to secure headlamp cluster; 8 - vertical/ horizontal light adjustment for low beam; 9, 11 - cover; vertical light adjustment for low beam; 10 – adjustment of the low beam vertically; 12 - headlamp cluster bulb socket; 13 - beam adjuster socket; 14 - radiator for cooling the LED cluster of daytime running light (DRL) bulbs; 16 - radiator for cooling the LED cluster of direction indicator bulbs

TABLE OF LIGHTING EQUIPMENT APPLIED IN A VEHICLE

Application	Bulb type	Power, W
Additional lighting bulb for poor visibility conditions	АКГ24-70	70
Headlamp cluster:		
low beam light	(H7)	70
high beam light	АКГ24-70-1(H1)	70
marker lamps	Light diode	1
direction indicators	Light diode	4
daytime running light	Light diode	4
Tail lamps:		
direction indicator	Light diode	3,5
tail fog lamp	Light diode	7,9
rear light	Light diode	3,9
rear marker and end-outline lamps	Light diode	0,3
stop signal lamp	Light diode	3,5
License plate light bulb	Light diode	0,8
Train lamps	24V 10W	10
Cab dome lamp	24V 21W	21
Side step light bulb	24V 5W	5
Roof marker lights	24V 10W	10
Side flashers of direction indicators	A24-21-3	21
Tail marker lamp	Light diode	0,8
Side marker lamp	Light diode	1,6
Running lamp (searchlight lamp for coupling(hitch) device)	АКГ24-70	70

We suggest have several spare filament bulbs for the case of their failure.

TROUBLE-SHOOTING GUIDE FOR ELECTRIC EQUIPMENT

Trouble	Probable cause	Remedy
Storage batteries are discharged.	Alternator drive belts are slackened.	Adjust the belt tension. Address the service center.
Alternator operates with increased noise.	Pulley fastening is loosened.	Tighten up the pulley.
Starter fails to operate (headlamps are not dimmed with starter engagement).	Break or absence of contact in starter power supply circuit. Storage battery is discharged.	Restore the contact. Charge/ replace the battery. Address the service center.
Crankshaft is not rotated by starter (traction relay comes to operation).	Poor contact between starter body and truck frame.	Ensure good contact. Address the service center.
	Motor oil used does not correspond to season in cold.	Change the motor oil.
Bulb does not glow.	Shaking (braking of filament as a result of external influence) or filament failure.	Change the bulb.
	Break in power supply circuit: - fuse has come into action; - no contact in plug-and-socket connections.	To eliminate short-circuit: - change the fuses; - restore the contact. Address the service center.
When turned on, horn emits no sound.	Break of conductor. No contact in power circuit. Fuses are blown or circuit breakers come into action due to short-circuit in power supply.	Eliminate the break. Restore the contact. Eliminate the short-circuit. Address the service center.

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CAB RAISING AND LOWERING

For raising and lowering the cab use (see Fig. *To control cab raising and lowering*):

- cab hydraulic lift pump, placed on the right side behind the cab.

- electric pump of the cab tilt mechanism (depending on vehicle configuration).

Position of knobs for cab raising and lowering is shown in a plate on a pump body (see Fig. *Pump plate*).

During operation, control the oil level in a hydraulic drive system. The oil level should be between marks on a dipstick built into pump tank body.



Pump plate

Prior to raising the cab

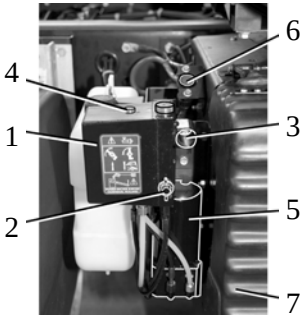
1. Zone of cab tilting must be free.
2. Apply the vehicle parking brake.
3. Shift the gearshift lever to neutral.
4. Rotate the ignition switch key to position «0» - all is OFF.
5. Move the steering column to the lower position.
6. Disengage the additional heating (cab air heater) or conditioner.
7. If you need to start engine after cab tilting, rotate the ignition switch key to the «Position of Motion».
8. Secure or take all non-secured items out of cab. Close all doors, boxes and sections in a cab. Close the cab doors.
9. Place the chocks, prevent the vehicle rolling-off.
10. Check if all tow yokes are removed.
11. Raise the front facing panel.

To tilt the cab



1. To disable cab tilt lock: press the cab tilt lock switch located at the top of the instrument panel. The pilot LED, which is mounted into the switch, will light up.

2. Set the control handle of pump 2 to the position Arrow Upwards, by rotating it clockwise until it stops (see Fig. *To control cab raising and lowering*).



To control cab raising and lowering

1 - pump;
2 - control handle;
3 - pump handle;
4 - dipstick;
5 - electric pump;
6 - electric pump control button;
7 - storage batteries

3. For raising the cab:

- place the tire iron into the pump handle 3, and raise the cab by swinging it;

- when installing electric pump: press the button 6, the cab will raise with it. *Do not use the electric pump of cab tilt mechanism at the ambient temperature below minus 30 °C.*

The hydraulic locks are opened automatically when the pump is in operation.

Accidental cab lowering is prevented by the hydraulic cylinder design.

To lower the cab

1. Place the control handle 2 of the pump 1 to the position Arrow downwards bo rotating it counterclockwise until it stops.

To lower the cab:

- swing the pump handle 3 using tire iron;

- when installing electric pump, press the electric pump control button 6.

2. Lower the cab until the hydraulic locks of the cab rear suspension are active.

In vehicles with gearbox **with telescopic drive** (except for the automated gearboxes), the locking means of telescopic items should close with a snap just after the cab being lowered to provide the rigid connection between lever and rod. If locking means fails to close with snap, depress the gearshift lever abruptly to shift it forward until the telescopic lock snaps.

After lowering the cab switch on the cab tilt lock: press the cab tilt lock switch, located at the bottom (to prevent accidental cab lowering). The pilot LED, which is mounted into the switch, will go out.

If the cab is not locked, the cab lock indicator  lights up on the driver's instrument panel.

The unblocked cabin creates a danger for the operational reliability and safety of the vehicle.

At the end of hydraulic cylinder travel (100 mm till complete cab stop), cab lowers with acceleration under its own weight).

Attention!

During cab accelerated lowering, there's danger of injure – do not keep the cab by hands.

You can stay under the cab only after it is entirely set into a tilted position.

With engine working and cab tilted, the cooling system fan may engage automatically.

It is strictly forbidden to work in zone of fan with engine working.

Do not touch the hot parts of engine (e.g. intake manifold) when the cab is tilted and the engine is running.

Start motion only with locked driver cab, the pilot lamp ***in this case must go out.***

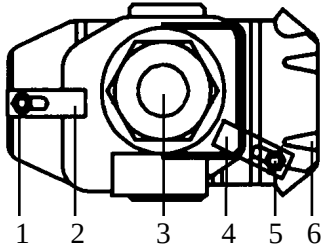
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LIFTING JACK

The jack is designed for short-time lifting the vehicle, only, e.g., when changing wheel. It is not for vehicle lifting in order to perform any operation under jacked up vehicle.

Instruction plate with technical data, instructions on jack raising-lowering, service materials data are arranged on a jack body. Jacks from various manufacturers may be used.

The lifting jack is located in the tool box (see Fig. *Jack transport position*).



Jack transport position (top view)

1, 5 - nut;
2, 4 - clamping spring;
3 - hydraulic jack;
6 – bracket

To remove the jack, proceed as follows:

- undo the nuts 1 and 5;
- rotate the clamping plates 2 and 4;
- take the hydraulic jack 3 out of bracket 6.

With work over, shift the jack to transport position. For this:

- place the jack 3 in bracket 6;
- secure the jack with clamping plates 2 and 4, and drive in the nuts 1 and 2.

In storage, the screw head should be driven in, working plungers lowered and lock needle should be driven out.

No leakage of working fluid out of the jack is permitted.

Prior to lift vehicle using a jack:

1. Apply the vehicle parking brake.
2. Engage the low gear in manual gearbox.

In automatic gearbox, be sure to shift gear to neutral position.

3. Rotate the ignition switch key to position «0» - all is OFF.
4. Place the chocks, prevent the vehicle rolling-off.
5. Place the jack perpendicularly on horizontal hard and level surface. Radial load applied to jack is not tolerable. If weak soil, preliminarily, place firm board or any flat pad under base of jack.

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Vehicle lifting by a jack

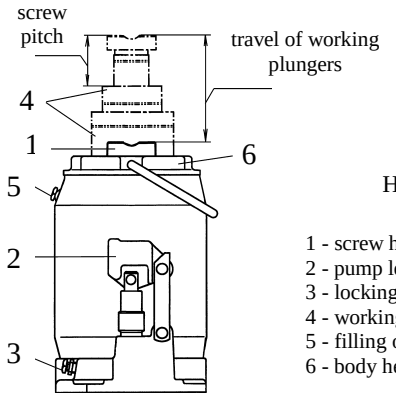
1. Undo the screw head 1 as required (see Fig. *Hydraulic jack (version)*).

2. Undo the locking needle 3 and the filling hole plug 5 rotating them counterclockwise, and make several quick swings of pump 2 lever using a tire iron.

3. Drive in the locking needle 3 till stop clockwise.

4. Raise the working plungers 4 as required, operating the pump 2 lever by tire iron.

5. As force applied to pump lever increases at the end of raising, stop raising.



Hydraulic jack (version)

1 - screw head;
2 - pump lever;
3 - locking needle;
4 - working plungers;
5 - filling orifice plug;
6 - body head part

To lower the vehicle

1. Slowly, screw out the locking needle 3.

2. Screw out the filling orifice plug 5 to release air and screw it in with cargo lowering over.

Attention!

Never release the parking brake of jacked up vehicle, strictly.

Do not change wheels while in uphill or downhill. Vehicle may slide off the jack.

Never start engine in jacked up vehicle. Vehicle may slide off the jack.

Do not work under jacked up vehicle.

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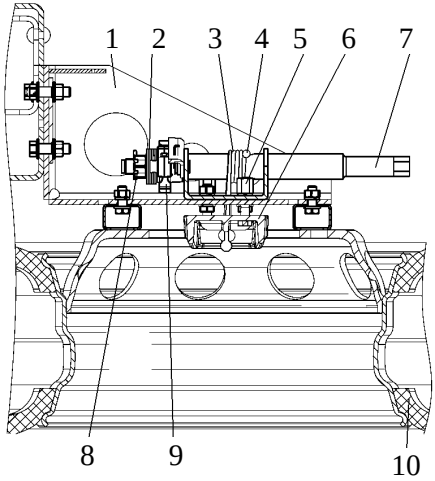
SPARE WHEEL

Depending on vehicle model and configuration, spare wheel is mounted:

- horizontally on a bracket;
- technological installation.

SPARE WHEEL HORIZONTAL INSTALLATION

The spare wheel is mounted horizontally on a bracket which is secured on a frame l.h. side member (see Fig. *Spare wheel carrier*).



Spare wheel carrier

1 – bracket;
2 - winch plate spring;
3 - winch rope;
4 - insert for the rope;
5 - nut;
6 - spare wheel support;
7 - winch shaft;
8 - nut to adjust the shaft rotation;
9 - ratchet;
10 - spare wheel

To raise the spare wheel

1. Place the wheel upside down.
2. Insert the spare wheel support inside the rim.
3. Rotating the shaft with wrench for wheel nuts tightening, raise the spare wheel support and ensure that the wheel and support surfaces coincide. With further rotation of the shaft the rope is reeled up and the support is rising along with the wheel.
4. Secure the wheel with two nuts with washers in raised position.

To lower the spare wheel

1. Undo two nuts which fasten the spare wheel to bracket.
2. Depress onto the wheel. If force for wheel lowering is excessive or if wheel drops spontaneously, adjust the pressing force of plate springs (after adjustment, the nut should be secured with a cotter pin).
3. Lower the wheel and remove it, for this, shift the support out of spare wheel rim.

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DISASSEMBLY AND ASSEMBLY OF WHEELS IN VEHICLES

Wheel dismantle

1. Apply the parking brake.
2. Place the chocks under the wheels.
3. When disassembling the tire, release air from the tire completely.
4. Undo the disk attachment nuts, remove disk (if any).
5. Slacken the wheel nuts.
6. To install the jack:

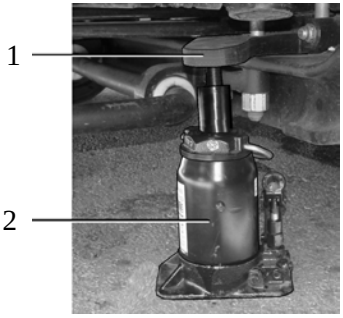
- for the front shaft of the thrust journal (see Fig. *Lifting the front wheel*);
- for the rear shaft of the thrust journal (see Fig. *Lifting the rear wheel*).

7. Lift the wheel using a jack. Place trestles.
8. Undo ten nuts attaching wheels to hubs. Take down the outer and the inner wheel.

Attention!

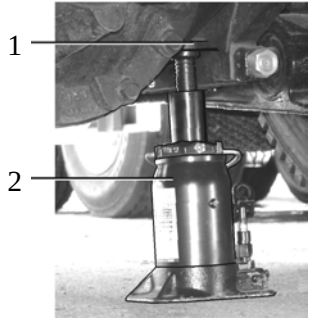
It is forbidden to change vehicle wheels if vehicle is jacked up only, without trestles.

Be sure to remove jack immediately after work.



Lifting the front wheel

1 - thrust journal for installing the jack;
2 - lifting jack



Lifting the rear wheel

1 - thrust journal for installing the jack; 2 - lifting jack

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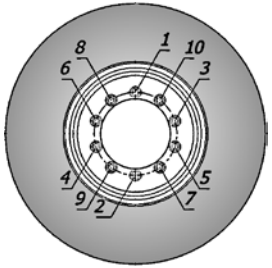
Wheels mounting

Mount wheels in reverse order.

Prior to the disk wheels setting, clean the setting surface on a hub and a wheel. Grease the setting diameter on a hub, thread on wheel fastening bolts. Drip a drop of oil between a nut and a lock washer.

The wheels fastening nuts should be evenly tightened in two-three steps according to Fig. *Sequence of wheel nuts* tightening. Tightening torque is 54-67 kgf·m.

After dismantling and reassembling the disk wheels on a truck, check the tightening torque of nuts after short travel (100-150 km). If necessary, tighten up to the torque specified.



Sequence of wheel nuts tightening

WHEEL WITH TUBELESS TIRE DISASSEMBLY AND ASSEMBLY

Assemble and disassemble wheels in a special site of enterprise equipped with required tools and appliances.

When assembling and disassembling wheels field, use special tire irons from kit of tools and accessories.

Attention!

Do not remove the faulty wheel from the hub until air is evacuated from the tire.

Mount or dismantle the wheels with the tires using the tire irons available in the driver's kit, do not use the sledge hammers, crow-bars and similar heavy tools capable of deforming the wheel parts.

Do not use the tires with the mounting flanges scored or damaged, since these hinder the mounting.

Do not mount the tire on a rim which is of different size than the given tire.

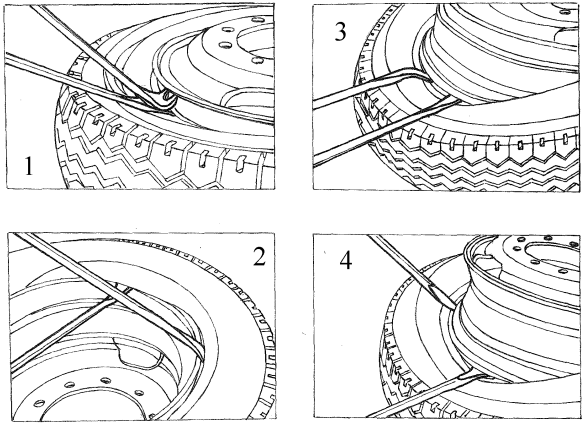
To disassemble the tubeless tire off the wheel rim

1. Completely let air out of the tire;

2. Make marks on the tire and wheel rim (to assure balancing after re-assembling).

3. Place the wheel assembled with tire horizontally, with disk up.

4. By means of fork and flat straight iron ends, remove completely the tire bead from a rim tapered seat (see Fig. *Sequence of wheel with tubeless tire disassembling, 1*).



Sequence of wheel with tubeless tire disassembling

5. Turn the wheel with tire over, with disk down, in the same way, remove the second tire bead from a rim seat.

6. Force the tire bead down till level of mounting groove. Simultaneously, from the diametrically opposite side, insert the curved flat iron ends between the wheel rim and tire bead, withdraw the bead outside the rim end face in that very place and further, working around the wheel circumference, sink the rim end face inside the tire (see Fig. *Sequence of wheel with tubeless tire disassembling, 2*).

7. Turn the wheel with tire over, with disk up.

8. By means of curved and straight iron ends, attach to the bottom rim flange and withdraw it from the tire space, with this, the tire bead from the opposite side should be in a rim mounting groove (see. Fig. *Sequence of wheel with tubeless tire disassembling, 3*).

9. Keeping the rim in certain position shown in Fig. *Sequence of wheel with tire disassembling, 4*) with the help of a fork end of one of the tire irons, remove the rim out of tire using the curved flat end of the second iron, inserted successively around the circumference between the tire bead and rim flange.

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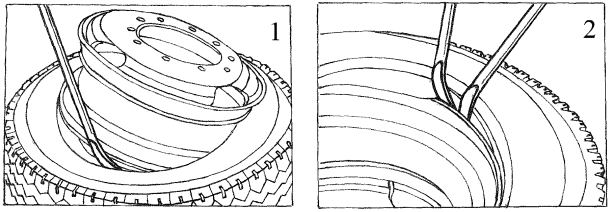
10. If need be, remove gate from the rim.

To facilitate the assembly and disassembly and to avoid the tire sealed ply breakage, wipe the tire bead and the rim flange with cloth soaked in soap or simple water.

Prior to mounting, inspect the technical state of wheel and tire: there should be no traces of corrosion, dirt, metal scoring, especially on tapered surfaces contacting with tire, there should be no bead damages, deep cuts, holes on sides or tire tread. The operations should be performed with the serviceable tools.

To mount a tubeless tire on a wheel rim

1. Place the gate onto a wheel rim.
2. Place the tire horizontally.
3. The wheel is disposed with disk up, insert the bottom flange of wheel rim completely into the tire space (see Fig. *Tubeless tire mounting procedure 1*).
4. Turn the wheel with tire over and, keeping the upper tire bead on the level of a rim mounting groove, by means of flat ends of one then both tire irons, force it completely behind the bead flange of a rim (see. Fig. *Tubeless tire mounting procedure, 2*).
5. Inflate the tire to working pressure.
6. Test the tire-rim setting for leakage.



Sequence of tubeless tire mounting

TROUBLESHOOTING FOR BOLSTER

Cause	Remedy
Bolster fails to close	
Coupling pivot of semi-trailer is disposed too high	Install the support plate on one level or 50 mm below
Bolster fails to open	
Train is on rough ground or bolster is under action of stretching forces	Release the bolster locking means
Bolster is not ready for coupling	
Poor maintenance of bolster	Eliminate dirt from the locking means, grease it again

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8 VEHICLE STORAGE

The vehicles (chassis) prepared for sale but not delivered to consumers may be stored in storehouses* without preservation within three months after production date. If, after storage period expired, the truck (chassis) is not put into operation, the regular preservation procedures should be performed by a storehouse in process of storage, in correspondence with requirements of norms and instructions available in «KAMAZ» PTC.

The trucks (chassis) purchased but not introduced into operation may be stored in storehouses** without preservation for not more than three months from the date of sale. If, after storage period expired, the truck (chassis) is not put into operation, the regular preservation procedures should be performed by a storehouse in process of storage in accord with requirements of operation documentation in «KAMAZ» PTC.

Note:

* - enterprises (organization, department, «KAMAZ» PTC division or juridical person), involved in truck (chassis) storage;

** - enterprises (organization, department or private person), involved in storage of vehicle (chassis) purchased.

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9 VEHICLE TRANSPORTATION

The trucks may be transported to any point of destination by railway, sea or by its own power. The type of transport is to be stipulated in agreement for delivery.

While preparing the trucks for transportation, depending on transport type, be sure to adhere to the requirements in the following documents:

1. «Rules for railroad transportation of goods in an open rolling stock» (approved by the order of Ministry of Communications, Russia, dd. 16.06.2003 N 19).

2. «Rules for highway transportation of goods» (approved by RF Government Regulation, dd.15.04.2011 N 272).

3. «Guideline for goods transportation on domestic airlines of USSR» (approved by the order of USSR Ministry of Civil Aviation, dd. 20.08.1984).

4. GOST 26653 «Preparation of general cargoes for transportation».

The rules of transportation, methods of loading and carriage should correspond to requirements presented in regulating- technical documentation in «KAMAZ» PTC.

When transporting, shipping and haulage by any kind of vehicles, be sure to use appliances able to exclude any probability of truck (chassis) damage and its paint coat deterioration.

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10 MANUFACTURER'S WARRANTY

The guarantee terms are agreed upon in a purchase-sale agreement.

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11 UTILIZATION

The purchased units and component parts of a truck are to be utilized pursuant to service documentation.

The rest equipment of a truck, prior to utilization, is to be dismantled and sorted out onto nonferrous metals (by metal trade marks) and ferrous ones.

Prior to waste disposal, be sure to clean the items of oil and grease.

When working with greases and cleaning agents, be sure to observe the manufacturer’s prescriptions.

When using cleaning agents, oils, greases in the process of product operation or washing, do not pollute the ambient and provide proper utilization of used materials (greases, oils, coolants, sealing gaskets, etc.). Do not mix empty packs of these materials with household wastes, they should be sent to corresponding utilization. Collect the used oil into vessels of appropriate dimensions. Greases and cleaning agents should not get into soil, sub-soil water or sewerage.

Appendix 2. LUBRICATION CHART FOR KAMAZ 5490 vehicle

The Lubrication chart determines the range and usage of fuels, greases and special liquids for operation of KAMAZ 5490-vehicles (4x2 type) with EURO 5 engine.

Maintenance interval is specified for vehicles of A maintenance group. Maintenance interval of the other groups is set in accordance with "Service book".

Table 1 Values for maintenance intervals

Types of maintenance	Vehicle maintenance intervals
Daily Maintenance (Daily mnt)	daily
Weekly maintenance (Weekly mnt)	weekly
Maintenance - 2500-Mnt.*	In interval from 1000 till 5000 kilometers of haulage
Maintenance Mnt	80000 km travelled
Additional Mnt	Once a year, in autumn
* Maintenance procedures Mnt -2500 are to be performed during the initial operation period, once for the entire vehicle lifetime.	

The lubrication chart is given in table 2 of this Appendix.

Table 2 Lubrication chart for KAMAZ 5490 vehicle

Lubrication points	Name & Designation of Fuel, Oil and Grease		Grease, qnt. (per item)	Maintenance	Name of works
	main	specifications			
1	2	3	4	5	6
Vehicle power supply system Daimler OM457	Diesel fuel EURO GOST P 52368-2005 (EH 590:2009) *grade III*; Diesel fuel EURO complant with the standards of the environmental class K5 according to GOST 32511-2013 (EH 590:2009)	EN 590:2009			
Pre-starting heater power supply system (independent)	Diesel fuel EURO GOST P 52368-2005 (EH 590:2004) grade III; Diesel fuel EURO complant with the standards of the environmental class K5 according to GOST 32511-2013 (EH 590:2009)	EN 590:2009	7 l		
Lubrication system of Daimler OM457 engine	Motor oils in accordance with the sheets No.228.5 «Of the «Mercedes-Benz» prescriptions for operating materials»	MB Sheet No.228.5	37÷39 l*	W.Mnt. Mnt.	Check the oil level Change oil

*The oil level should be between the lower and upper dipstick marks.

Table 2 cont.

1	2	3	4	5	6
Gear box case: - ZF 16S2220TD; - ZF 16S2221TD; - ZF 12AS2130TD; - ZF 12AS2131TD; - ZF 16S1820TO	See the Appendix 3 (section «Transmission oils»)	TE-ML 02	10,0 l 18,5 l 11,0 l 15,5 l 8,0 l	In accordance with the ZF gearbox operation manual	
Rear hypoid axle case Daimler HL6	See Appendix 3 (section «Transmission oils»)	MB Sheet No.235.8	11,0 l	3 maintenance (1 time in 3 years)	Change oil
Plate support surface and bolster mouth	Grease: BP Energrease L21-M; BP Energrease BP LS2; Shell Retinax HDX 2; Chevron Moly Grease EP2	Grease with addition of desulphyde molybdenum or graphite	-	W.Mnt.	Apply uniform layer onto support plate

Table 2 cont.

1	2	3	4	5	6
Locking mechanism and truck bolster kingpin	Grease: BP Energrease L21-M; BP Energrease BP LS2; Shell Retinax HDX 2; Chevron Moly Grease EP2	Grease with addition of desulphyde molybdenum or graphite	_	W.Mnt.	Lubricate through grease cups
Pins of: front springs	Grease Litol-24 GOST 21150-87	KP2N-20 on DIN 51502 (lithium basis)	0, 036 kg	Mnt.	Lubricate through grease cups
Front spring sh ackle	Grease Litol-24 GOST 21150-87	KP2N-20 on DIN 51502 (lithium basis)	0, 070 kg	Mnt.	Lubricate through grease cups
Kingpins of the front axle steering knuckles	Grease Litol-24 GOST 21150-87	KP2N-20 on DIN 51502 (lithium basis)	0, 070 kg	Mnt.	Lubricate through grease cups until fresh grease appears from under the sealing edges
Bearings of the front axle wheel hubs	Grease Litol-24 GOST 21150-87; Grease MC-1000 ТУ 0254-003-45540231-99	NLGI 2 KP2K-20 по DIN 51825	0, 070 kg	Mnt. - 2500 Mnt. (once a year)	Lubricate, if necessary. Pack the grease between rollers and cage uniformly. The rest of grease is to be packed into the hub cavity between bearings

Table 2 cont.

1	2	3	4	5	6
Terminals of storage batteries	Grease Litol-24 GOST 21150-87	KP2N-20 on DIN 51502 (lithium basis)	0, 020 kg	once a year	Apply thin layer to grease
Connections of electric equipment	Grease Litol-24 GOST 21150-87	KP2N-20 on DIN 51502 (lithium basis)	0, 008 kg	once a year	Grease connections on a frame
Power Packer hydraulic cab tilter (including cab hydraulic lock)	Exxon Mobil UNIVIS HVI 26	-	1,2 l	_	In case of depressurization, change the oil.
Steering control equipped with ZF pump or ZF steering gear	See Appendix 3 section «Steering oil»	ZF TE-ML 09	4,2 l	W.Mnt. once every 3 years	Check the oil level Check the oil level Change oil
Clutch release hydraulic drive	Brake liquid: ROSDOT TU 2451-004-36732629-2006	DOT4	0,48 l	W.Mnt. Once a year, in autumn	Check the oil level Change the liquid

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Table 2 cont.

1	2	3	4	5	6
Hydraulic drive of the road train: KAMAZ 5490 vehicle and tank semi-trailer	See tables 1, 2 of the Appendix 3		88,0 l*	D.Mnt. once a year	Check the level, top up to norm Change oil
Daimler OM457 engine cooling system including the intarder cooling	The coolants are according to the (specification) sheets No. 326.0/325.0/326.3/ 325.5 «Of the «Mercedes-Benz» prescriptions for operating materials»	MB Sheet No.325.0/2 MB Sheet No.325.3 MB Sheet No.326.0/2 MB Sheet No.326.3	50,0 l	In accordance with Mercedes-Benz OM457 engines operation manual	
After-treatment system (for vehicles equipped with SCR system)	Neutralizing agent: - AdBlue (DIN 70070); - ExtraBlue TU 2181-001-68718743-2011; - TopBlue TU 2181-001-90549586-2013	–	90,0 l**	–	–

_____

*Oil level in the middle point of the inspection hole
**Tank volume

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Appendix 3. **SERVICE MATERIALS**

To ensure reliable operation of the vehicle, use fuels, oils and special liquids recommended by the manufacturer.

The list of motor oils permitted for application in Daimler units and assemblies is presented in "Mercedes-Benz" Specifications for Service Products ". The information about these prescriptions is available from any Mersedes Benz service center or on the following web page: htpp://bevo.mercedes-benz.com/.

DIESEL FUEL

Apply fuel compliant with EURO EN 590 standard, where the sulfur content is no more than 10 million^{-1}.

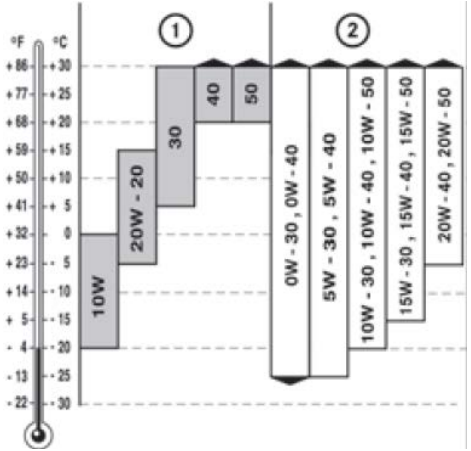
MOTOR OILS

For complete information about motor oils see section «*Service materials*» Operating manuals for OM 457LA engines.

For Daimler engines use motor oils given in specification No.228.5 «of «Mercedes-Benz» Specifications for Service Products».

The applicable temperature range for motor oils is shown in Fig.1.

Oil change intervals depend on vehicle operating conditions; quality of the applied oil; fuel qualiy (sulfur content).



1 - seasonal motor oils
2 - MG engine oils

Fig.1

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TRANSMISSION OILS

Attention! For ZF gearboxes, use oils approved by ZF, strictly. The complete information on oils (list, usage conditions and change intervals) for ZF units may be found in any ZF service center and on site www.zf.com. The site information is updated every 3 months. Each further revision substitutes all previous ones.

*For gearboxes**ZF 16S2220TD** and **ZF 16S2221TD** use oils of class: **02E, 02H, 02L.***

*For **ZF gearbox 12AS2130TD**and ZF 12AS2131TD oils of the following classes are recommended for service priming: **02E, 02L.***

*For gearboxes**ZF 16S1820TO** use oils of class: **02B, 02E, 02H, 02L.***

Attention! If the service priming at gearbox plant is carried out with oil grade 02E, the oil change is not permitted during the first two operation years. It is allowed to top up the oil level only with lubricant class 02E during this period. If the vehicle mileage during this period exceeds the limit values for operation according to the list of lubricants TE-ML 02, it is neccessary to change the oil.

Attention! Note - it is allowed to mix different lubricant classes only within one class in the list of lubricants TE-ML 02.

For Daimler HL6 hypoid gear axles use motor oils given in Specification sheet No.235.8 of No.228.5 «of «Mercedes-Benz» Specifications for Service Products» (Specification sheet No. 235.8 - MG gear oils on a synthetic basis). Oil change interval in Daimler axles is specified in service book.

OILS FOR STEERING SYSTEM

For steering systems with ZF pump and (or) steering gear use liquids for automatic transmissions (ATF).

Recommendations on use and permitted types of liquid are given on the site:

http://www.bosch-automotive-steering.com

It is recommended to use mineral-based ATF liquids without specific grades pointed, that correspond to requirements Dextron II D, III F, III G, III H, VI of General Motors specifications.

Attention! Note: Mixing oils of different grades is not permitted!

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COOLANT

Coolant is a balanced aqueous solution of antifreeze. Presence of antifreeze permits to expand the operation temperature range by decreasing the freezing temperature and by increasing the coolant boiling point. Additives in antifreeze protect the engine cooling system from cavitation corrosion.

The usage of coolants is obligatory in all climate zones.

For complete information about coolants see section «*Service materials*» Operating manuals for OM 457LA engines.

For Daimler engines use coolants given in the sheets No.325.3/326.3/325.0/2/326.0/2 «of «Mercedes-Benz» Specifications for Service Products».

Antifreeze agent grades compliant with sheets 325.3 and 326.3 may not be mixed with antifreeze agent grades listed in sheets 325.0/2 and 326.0/2.

NEUTRALIZING AGENT

Adblue liquid provides neutralization of nitric oxide emissions (NOx) in diesel trucks equipped with Selective Catalytic Reduction system (SCR).

Adblue liquid is an aqueous solution of urea with solidification temperature of minus 11,5 ºC.

The tank heating system prevents the liquid freezing.

At ambient temperature below minus 5 ºC, we recommend to prime the tank not more than 90 %.

Attention! Vehicle operation with SCR system being not primed with neutralizing liquid is prohibited.

HYDRAULIC OIL

Suggestions on oils and their application in hydraulic fuel-transfer systems and platform tilt gears are presented in Table 1 of this Appendix.

For hydraulic systems with slightly increasing temperature, choose oils which viscosity is at least 100mm²/sec. at the lowest start temperature. This eliminates slow operation, cavitation and adverse events.

For extremely cold climate conditions with temperatures below minus 30°C use hydraulic fluids with high viscosity index(aircraft fluids with the viscosity index > 250). If the the operating temperature is not reached, you need to heat the oil before use.

List of oils applied for operation of HYVA platform tilt gear is presented in Table 2 of this Appendix.

Table 1 - Application conditions for hydraulic oils applied in vehicle hydraulic systems

Viscosity grade VG according ISO at 40 °C	Viscosity index	The lowest temperature of the short start with a viscosity value of 750 mm²/c	Oil temperature with minimum viscosity value of 100 mm²/c	Oil temperature with maximum operating viscosity value of 12 mm²/c
15	100	minus 23 °C	0 °C	+ 45 °C
22	100	minus 17 °C	+ 9 °C	+ 55 °C
32	100	minus 10 °C	+ 17 °C	+ 65 °C
46	100	minus 4 °C	+ 24 °C	+ 65 °C*
* It is highly recommended to use oil cooler when operating at temperatures above 65 °C.				
Note - the specified temperature ranges refer to the oil temperature, and not to the ambient air temperature.				
Note - For hydraulic systems with slightly increasing temperature, choose oils which viscosity is at least 100 mm²/sec. at the lowest start temperature. This eliminates slow operation, cavitation and adverse events. For extremely cold climate conditions with temperatures below minus 30°C use hydraulic fluids with high viscosity index(aircraft fluids with the viscosity index > 250). If the the operating temperature is not reached, you need to heat the oil before use.				

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Table 2 – List of oils for operation of vehicle hydraulic system

Firm	Oil grade	ISO viscosity grade	Viscosity index	Viscosity mm²/sek, at a temperature of		Limit short start temperature °, C	Oil temperature with minimum viscosity value, ˚C	Temperature of: oil with maximum operating viscosity value, °C
				40 °C	100 °C			
BP	Energol SKF-LT1	14	>300	14	5,40	>minus 45	minus 30	47
	Energol SHF 22	22	166	22	5,04	minus 27	4	60
	Energol SHF 32	32	163	32	6,51	minus 20	13	(72) 65*
	Energol SHF45	46	163	46	8,47	minus 20	7	(82) 65*
CAIITEX-CHEVRON-TEXACO	AW32	32	100	32	5,60	minus 13	16	65
	AW46	46	100	46	6,90	minus 4	25	(77) 65*
	Cygnus 32	32	115	32	5,40	minus 10	17	(68) 65*
	Cygnus 46	46	109	46	6,90	minus 4	25	(77) 65*
	LT5606G	14	372	14	5,13	>minus 45	minus 25	48
ESSO	Univis Extra	32	213	32	7,60	minus 27	11	(77) 65*
	Nuto HP32	32		32	5,30	minus 9	17	(67) 65*
	Nuto HP46	46		46	6,70	minus 3	25	(73) 65*
	Essolube 10W	38	107	38	6,10	minus 8	20	(73) 65*
GULF	Harmony 15	15	150	15	3,90	minus 38	minus 4	47
	Harmony 22	22	150	22	4,20	minus 18	9	57
	Harmony 32	32	150	32	5,30	minus 10	17	(67) 65*
	Harmony 46	46	144	46	6,90	minus 9	23	(83) 65*
MOBIL	DTE 21	10		10	2,30	>minus 55	minus 7	minus 10
	DTE 22	22		22	4,20	minus 18	8	57
	DIE 24	32		32	5,30	minus 10	17	(67) 65*
	DIE 25	46		46	6,60	minus 3	25	(77) 65*
	Aero HF	13	370	13	5,80	>minus 55	minus 45	45

Table 2 Cont.

Firm	Oil grade	ISO viscosity grade	Viscosity index	Viscosity mm^2/sek, at a temperature of		Limit short start temperature, °C	Oil temperature with minimum viscosity value, ˚C	Temperature of: oil with maximum operating viscosity value, °C
				40 °C	100 °C			
SHELL	Tellus 10	10	34	10	2,40	>minus 55	minus 35	33
	Tellus 22	22	99	22	4,23	minus 17	5	58
	Tellus 32	32	108	32	5,52	minus 18	18	(69) 65*
	Tellus 46	46	98	46	6,70	минус 6	25	(75) 65*
	Tellus Artic	34	>300	34	9,89	minus 38	7	(87) 65*
	Tellus TX	32	162	32	6,50	minus 18	13	(73) 65*
TOTAL-ELF	Eguivis ZS 15	15	151	15	3,70	minus 33	minus 5	47
	Eguivis ZS 22	22	164	22	5,10	minus 30	6	62
	Eguivis ZS 32	32	160	32	6,50	minus 17	17	(74) 65*
	Eguivis ZS 46	46	161	46	8,40	minus 11	27	(84) 65*
* It is highly recommended to use oil cooler when operating at temperatures above 65 °C.								
Note - the specified temperature ranges refer to the oil temperature, and not to the ambient air temperature.								

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Diesel Engine Pre-heaters
14TC-10

User Manual
14TC.451.00.00.00.000-10 РЭ
Table of Contents

Table of Contents

1 Introduction 3
2 Key features and characteristics 4
3 Safety measures 5
4 Description of pre-heater set-up and operation 6
5 Pre-heater control unit 11
6 Control panel 11
7 Faults 13
8 Pre-heater control system faults 13
9 Maintenance 16
10 Recommendations 18
11 Transportation and storage 18
12 Warranty 18

1. Introduction

The present User Manual gives information on set-up, operation and servicing of 14TC-10 diesel engine pre-heater (further on – pre-heater), which is used for start heating and warming – up of diesel engines of any trucks with liquid-cooling system at ambient temperature as low as minus 45 °C.

The functions of the pre-heater are the following:

1. Fail-safe starting engine operation under low ambient temperature conditions.

2. Additional heating of engine and passenger compartment with the engine running under hard frost conditions.

3. Warming up passenger's compartment and windscreen (to remove icing) with engine running idle.

4. Possibility to start the pre-heater manually for 3 or 8 hours with simultaneous selection of «economic» or «standard» operating mode.

Pre-heaters are manufactured in different assemblies.

Minor structural modifications, introduced by the Manufacturer into the design after publication of the Manual, may be missing in the User Manual.

2. Key features and characteristics

Main technical characteristics of the heater are shown with a tolerance of ± 10 %, obtained at a nominal voltage of 24 V and a temperature of 20 °C.

2.1 Nominal supply voltage, V	24
2.2 Heat productivity, kW	
- full duty	15,5
- medium duty	9
- low duty	4
2.3 Fuel	diesel fuel
meeting requirements of GOST305 Standard (depending on ambient air temperature)	
2.4 Fuel consumption, l/h	
- full duty	2
- medium duty	1,2
- low duty	0,54
2.5 Heat carrier	ntifreeze agent
2.6 Power consumption, W	
- full duty	132
- medium duty	101
- low duty	77
- cooling down	47
at start-up during 90 sec	156
2.7 Start up and switch off mode	manual
2.8 The duration of one working cycle,	
the hours, not less	3 or 8
2.9 Pre-heater mass in full configuration, kg	10

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3. Safety measures

3.1 The pre-heater and its components shall be installed only by authorized companies, by reason of its complicated structure: there's a combustion chamber where fuel burns, a heat exchanger which provides heat transfer to the cooling liquid, fuel pump, air pump, control unit, which controls and operates the work of the heater according to the program, heat indicators, etc.

3.2 The pre-heater shall be used only for purposes described in the present User Manual.

3.3 It is prohibited to use the pre-heater on special trucks used for transportation of dangerous cargo.

3.4 It is prohibited to lay the fuel pipe inside the passenger compartment or driver's cab.

3.5 Truck with the pre-heater shall be equipped with a fire extinguisher.

3.6 It is prohibited to use the pre-heater in areas, where highly inflammable vapors or ample quantity of dust may be generated or accumulated.

3.7 It is prohibited to use the pre-heater in enclosed spaces having no ventilation.

3.8 While fuelling the truck the pre-heater shall be switched off.

3.9 In case of malfunctioning, the pre-heater shall be repaired in service centers, authorized by the manufacturer.

3.10 The pre-heater shall be disconnected from the accumulator battery when being repaired or welding is performed with the truck.

3.11 It is prohibited to use the pre-heater with cooling liquid frozen.

3.12 During installation and dismantling of the pre-heater, there shall be observed safety measures applicable for activities with wiring harness, fuelling system and liquid system of the truck.

3.13 It is prohibited to connect the pre-heater to the electric circuit of the truck with the engine running and accumulator battery missing.

3.14 It is prohibited to switch off pre-heater power before ending of the purging cycle.

3.15 The pre-heater is powered from the accumulator battery regardless of the availability of the truck frame connection.

3.16 It is prohibited to connect and disconnect the pre-heater plug when the pre-heater power is on.

3.17 It is recommended to restart the pre-heater after its switching off not earlier than in 5-10 sec.

3.18 In case of violation of the above-mentioned rules, the User is deprived of warranty service right.

3.19 To ensure the pre-heater operating safety, in case of three successive failures to start it, it is recommended to contact with the service center for trouble-shooting and fault handling.

4. Description of pre-heater set-up and operation

The pre-heater runs independently of the truck engine.

The pre-heater is fueled and powered from the truck. The pre-heater electric circuit is given in Figure 1.

The pre-heater is an autonomous heater (main components are given in Figure 2), consisting of:

- Heater (main components are given in Figure 3);
- Fuel pump for fuel supply to the combustion chamber;
- Circulation pump for forced circulation of liquid in cooling system through the heat-exchanging system of the pre-heater;
- Control unit to coordinate operation of the above-mentioned systems;
- Control panel;
- Wiring harness for connection of the pre-heater components to the truck systems.

The pre-heater principle of operation is based on warming-up of liquid in the engine cooling system with its further forced pumping through the heat-exchanging system of the heater.

Gases generated because of the fuel blend combustion in the combustion chamber warm up the liquid. The heat is transmitted through the walls of the heat exchanger to the coolant fluid, which in its turn is pumped through the cooling system of the truck engine.

When the pre-heater is switched on, first of all there is performed functional test of its components, such as: flame detector, heat and overheating sensors, pump, air pump motor, glow plugs, fuel pump and corresponding electric circuits. In case of nonfailed status, there starts ignition. Simultaneously the circulation pump is also activated.

The pre-heater may work in two modes (programs): «economic» and «nominal». The «economic» mode is characterized by less power consumption.

In conformity with the preset program there is performed purging of the combustion chamber and glow plug warming-up to the desired temperature (the glow plug is on for 90 sec). Then, there starts fuel and air supply and combustion process is initiated in the combustion chamber. The flame detector controls combustion of the fuel blend in the combustion chamber. Operation of the pre-heater is controlled by the control unit.

The control unit controls temperature of the coolant fluid and depending on this parameter, there is chosen full, medium or low duty mode of the pre-heater. The full duty mode means that the coolant fluid is heated up to 70 °C in «nominal» program, and up to 55 °C in «economic» program; in case of overheating more than 70 °C or 55 °C the pre-heater is switched to the medium duty mode. The medium duty mode means that in both programs the coolant fluid is heated up to 75 °C; in case of overheating more than 75 °C the pre-heater is switched to the low duty mode. The low duty mode

means that in both programs the coolant fluid is heated up to 80 °C; in case of overheating more than 80 °C the pre-heater is switched to the cooling-down mode. At the same time combustion stops, the pump continues its operation and the passenger compartment heating is continued as well. When the temperature of the coolant fluid gets below 55 °C the pre-heater automatically starts either the full duty mode if the «nominal» program is selected, or medium duty mode, if the «economic» program is selected.

Duration of the total cycle is 3h («nominal» program) or 8h («economic» program) and depends on the position of the trigger on the control panel (refer to Section 6). Moreover, there is a possibility to switch of the pre-heater any time during the cycle.

When the pre-heater is switched off manually or automatically, as preset time expires, the fuel supply stops and the combustion chamber is purged with air.

Peculiarities of the pre-heater automatic control under emergency conditions and in contingencies:

1) If the pre-heater has not started for some reason, the starting process will be repeated automatically. After two successive failed starts the pre-heater is switched off;

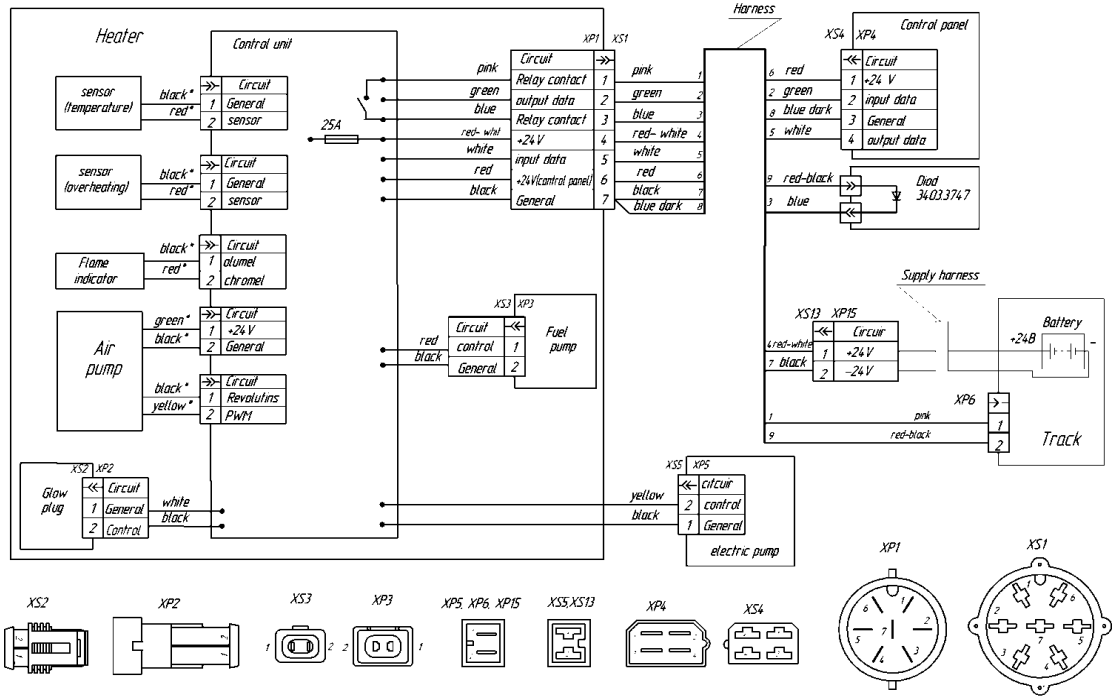
2) If combustion stops when the pre-heater operates, the pre-heater stops its operation;

3) in case of the pre-heater over-heating (for example, abnormal coolant fluid circulation, air bloc, etc.) it automatically switches off;

4) in case of voltage drop lower than 20 V or voltage surge higher than 30 V, the pre-heater switches off;

5) in case of the pre-heater emergency shut-down, a corresponding LED starts blinking on the control panel. Certain blinking indicates type of malfunction. Refer to User Manual Section 8 for interpretation of malfunctions.

Note. Heating of the passenger compartment is possible only with the passenger compartment heater cock in open position and frame connection available.



1. view of the connectors from contactors.
2. * - color labels on the wiers of sensors,flame indicator air pump.

Figure 1- Pre-heater electric circuit

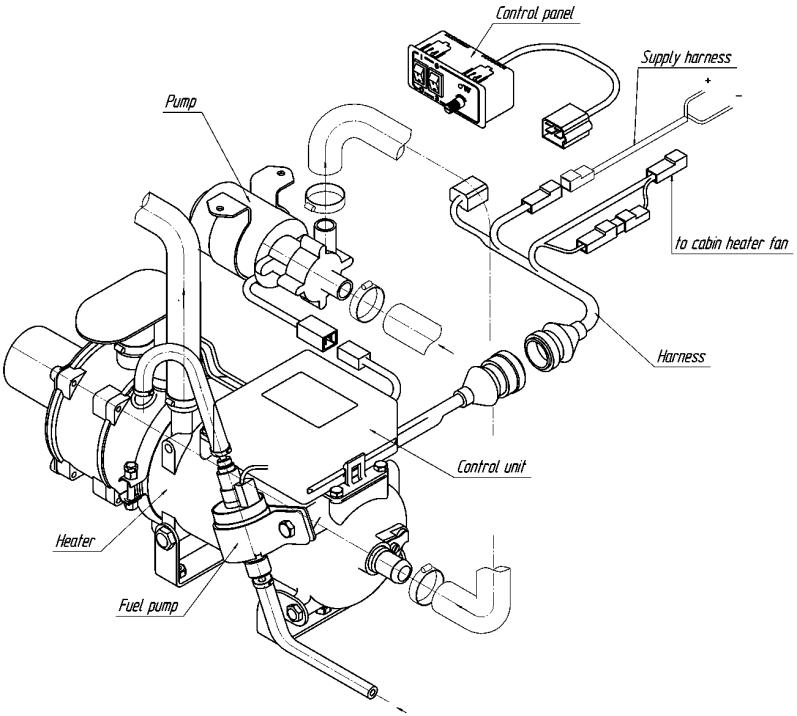


Figure 2 – Pre-heater main components

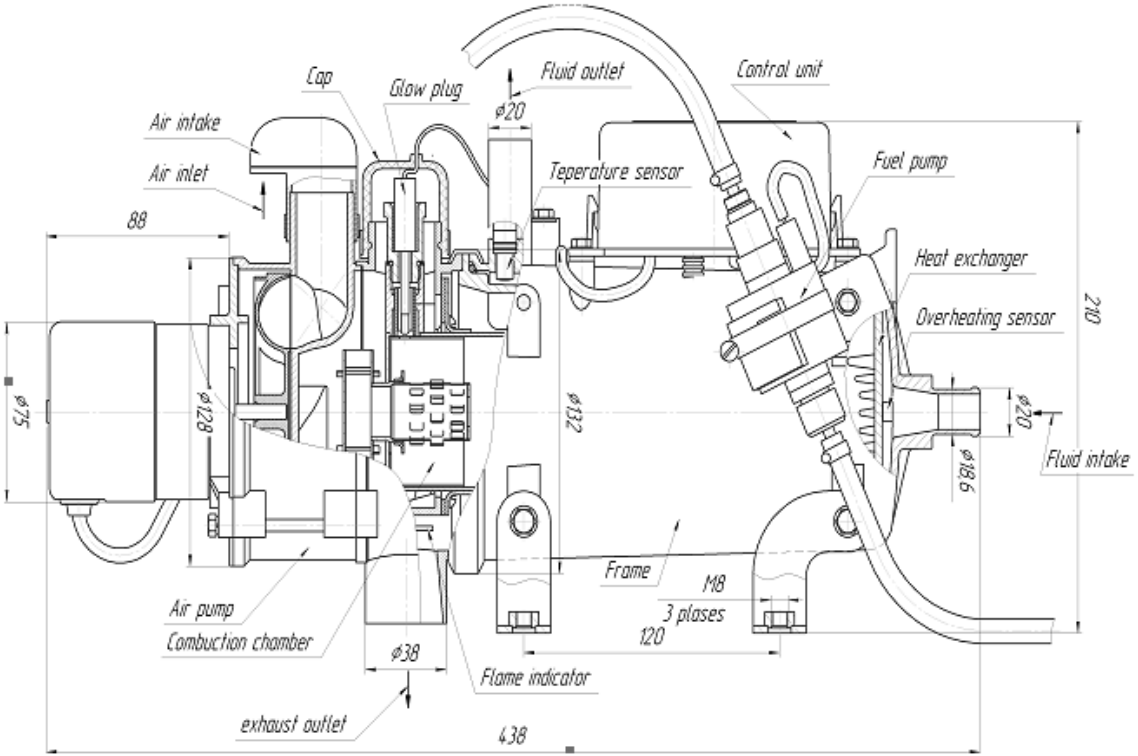


Figure 3 – Pre-heater basic components

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5. Pre-heater control unit

Jointly with the control panel, the control unit is used to control the pre-heater operation

The control functions of the pre-heater are the following:

a) initial health check of the pre-heater units at start;

b) health check of the pre-heater units during operation;

c) «normal» and «economic» programs selection and support of their automatic operation (switching over to different modes depending on temperature of the coolant fluid);

d) pre-heater switch off:

- when the preset cycle finishes (3h or 8h cycle);
- when one of the controlled units fails;
- when the preset parameters (temperature, voltage, blowout) are out of the limits;
- when flameout in the combustion chamber is arise.

6. Control panel

Control panel (further on – panel) is a part of the pre-heater meant for manual control of the device.

The panel functions are the following:

- pre-heater manual starting and switching off;
- selection of a program and duration of operation;
- control of the cab heater fan;
- indication of the pre-heater status (ON, OFF, Failure).

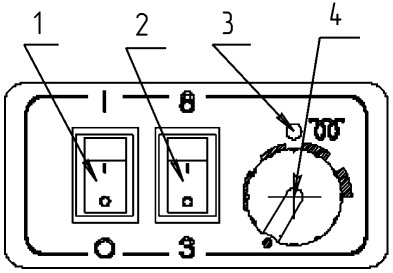


Figure 4 – Control panel faceplate

6.1 «ПУ-4МР» control panel set-up and how-to-use principle.

The faceplate of the panel has two key switches (1 and 2), LED (3), heat controller knob (4) – refer to Figure 4.

6.1.1 The key switches are used for the following:

- key switch 1 is used to start (position «I») and stop (position «O») the pre-heater;
- key switch 2 is used to select the operating mode:

The pre-starting mode is used to warm up and keep the engine warm for 3 hours.

The economic mode is used to keep the engine and the driver's cab warm when the engine is idle for 8 hours maximum.

The positions of the key switch are marked with figures 3 and 8 correspondingly.

6.1.2 Heat controller knob 4 is used to control the cab heater fan (provided that the coolant fluid temperature is more than 55 °C, key switch of the cab heater on the dash is OFF, frame connection available) the following way:

а) with the knob in the utmost left position the cab heater fan is OFF;

б) with the knob in the utmost right position the cab heater fan is continuously ON;

в) with the knob in the middle position the fan will runin cycles. Cycle duration is 10min.

Example: if the knob is in a position when the heater fan is ON for 4min, then it will be ON again only in 6min for 4min. Thus, it will continue cycling unless the knob is turned or the heater is switched off. After each turn of the knob (between two extreme positions), the cab heater fan is activated within 2 min – 8 min interval.

6.1.3 LED 3 indicates the pre-heater status:

- LED glows - pre-heater ON;
- LED blinks – malfunction (failure). The number of blinks and pauses corresponds to a certain malfunction code (refer to Table 2).
- LED OFF – pre-heater OFF.

Attention!

To restart the pre-heater when it automatically stopped, the key switch 1 shall be in position «O» and then, not earlier than in 5-10 sec back in position «I»

Heat controller knob poses. 4 for KAMAZ vehicles of «Euro 3» and «4» is not used (Car maker does not connect the relay of cabin heater fan to the harness of pre-heater on these cars).

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7. Faults

7.1 Faults that the User can eliminate on his own. If after being switched on the pre-heater won't start, it is necessary to do the following:

1) Check the presence of fuel in the tank;

2) Check the safety device (if the 25 A safety fuses in the control unit is burnet out or not installed, the pre-heater doesn't start and corresponding LED doesn't glow).

7.2 All the other faults of the pre-heater are indicated by panel LED blinking.

7.3 Refer to Section 8 for typical faults of the pre-heater and trouble-shooting procedures.

7.4 If malfunctions occur during the operation, which is required the partial disassembly of the heater, please contact the dealer.

8. Pre-heater control system faults

8.1 Trouble-shooting shall be started with checking the connector terminals and corresponding circuits (refer to Table 1 and Electric circuit in Figure 1).

Table 1

Circuit	Heater	Pump	Panel
Pump	1,2 – XS5	1,2-XP5	-
Fuel pump	1,2- XS3	-	-
+ 24 V	4,6 –XP1	-	1-XP4
- General	7-XP1	1-XP5	3-XP4

8.2 Other faults are listed in Table 2.

Table 2

Number of LED blinks	Fault	***Notes/ Troubleshooting***
1	Overheating The risk of overheating. Temperature difference between the readings of the overheating sensor and heat sensor is too big.	Heat/ overheating sensor indicates temperature higher 102 °C. Thoroughly check the complete liquid circuit and circulation pump operation. Difference between temperature measured by the heat sensor and overheating sensor is more than 20 °C (i.e. reading of the overheating sensor or heat sensor is above 70 °C). Check the overheating sensor or heat sensor and replace with a new one, if necessary. Check circulation pump for correct operation.
2	No more tries to start the pre-heater left	In case there is no more tries to start the pre-heater left, check fuel supply and amount of fuel supplied. Check the air supply system to the combustion and exhaust gas-escape channel.
3	Interruption of combustion	Check fuel supply and amount of fuel supplied. Check the air supply system to the combustion and exhaust gas-escape channel. If the pre-heater starts, check the combustion detector and replace, if necessary. Check the fine fuel filter for clogging up.
4	Glow plug malfunction Air pump motor malfunction	Check the glow plug, replace if necessary. Check the electric wiring of the air pump motor; replace the air pump, if necessary.

5	Combustion detector malfunction	Check the leads. Check the ohmic resistance between the detector plug pins. In case of rupture the ohmic resistance is more than 1 Ohm, and the combustion detector shall be replaced.
6	Overheating sensor malfunction Heat sensor malfunction	Check the leads. Output signal and voltage are in linear dependence from the temperature (0 °C corresponds to 2.73 V and with temperature increase for 1 °C output signal increases for 10 mV correspondingly). Check the sensor and replace, if necessary.
7	Circulation pump malfunction Fuel pump malfunction	Check the electric wiring of the circulation pump for the short circuit; check the circulation pump itself and replace, if necessary. Check the electric wiring of the fuel pump for the short circuit, check the pumping capacity and replace the pump, if necessary**.**
9	Inadvertent switching off, overvoltage Inadvertent switching off, undervoltage	Check the battery, voltage regulator and entrance wiring. Voltage between pins 4 and 7 contacts of XS1 connector shall not be more than 30 V. Check the battery, voltage regulator and entrance wiring. Voltage between pins 4 and 7 of XS1 connector shall not be less than 20 V.
10	Excessive ventilation time	The pre-heater is not cooled enough during purging. Check the air supply system to the combustion and exhaust gas-escape channel. Check the combustion detector and replace, if necessary.

9. Maintenance

The pre-heater maintenance includes the following:

- Daily maintenance;
- Seasonal maintenance (preparation for winter-time operation).

Daily maintenance of the pre-heater shall be regularly done during the heating season. The list of activities to be done is given in Table 3.

Seasonal maintenance of the pre-heater is done before the heating season.

Within the frames of the seasonal maintenance its health shall be checked in conformity with Table 3.

Table 3

Service object, description of activities and maintenance technique	Requirement specification	Instruments, materials, tools	Type of maintenance	
			daily	Seasonal
Electrical equipment Check of security of attachment of the pre-heater electrical contacts. In case of dirt or oil deposit on the contacts, remove with suede moistened in benzene. In case of carbon deposit on the operating interface of contacts, smooth it out with fine glasspaper № 150 GOST 6456-82 and wipe with petrol.	Visual inspection	petrol, white spirit	As necessary	+
Air intake Dismantle the air intake, rinse with benzene and clean out the net by blowing with compressed air.	Visual inspection	petrol (acetone)	As necessary	

Glow plug - Dismantle the air intake, rubber cap protecting the glow plug, disconnect the leads, unscrew the ignition plug and remove carbon deposit from it. - check the glow plug rubber cap for mechanical damage, and in case of detection, replace the glow plug.	Visual inspection	Special purpose wrench, clean rags, benzene (acetone), screwdriver.		Every 500h
Combustion chamber Clean up the ∅ 1.5 mm hole for air supply to the ignition plug	Visual inspection	KO-13 wrench, screwdriver		Every 500h
Fuel system Check the fuel pipe for leakage; tighten up clamp connections, if necessary.	Visual inspection	screwdriver		+
Fluid system Clean up the heat exchanger	Visual inspection	KO-13 wrench, screwdriver, brush, tank for cooling liquid		Every 500h
Check the fluid system for leakage; tighten up clamp connections, if necessary.	Visual inspection	KO-13 wrench, screwdriver	+	+

10. Recommendations

10.1 In case the device is not used, to guarantee safe performance of the pre-heater it is recommended to switch it on once per month for 5-10 min (even during the warm period of the year). This procedure is necessary to remove sticky film deposited on moving parts of the fuel pump and other units (the mentioned deposit may occur due to low-quality fuel and moving parts and units contacting with it for a long time). Ignoring this operation may cause the pre-heater failure.

10.2 The safe performance of the pre-heater depends on the type of fuel. The fuel shall correspond to the ambient temperature. Regularly monitor the level of battery charge.

10.3 While long storage of the vehicle it is recommended to switch off the heater from the vehicle battery to avoid its discharging (current consumption in non operation mode 30-40 mA)

11. Transportation and storage

11.1 The pre-heaters are safe for transportation and may be transported with any vehicles, including air and rail transport, provided that the packaged products are protected from atmospheric precipitation and climatic factors in conformity with requirements 5 GOST 15150-69, and from mechanical effects in conformity with category C requirements GOST 23216 -78.

11.2 As concerns the climatic factors, transportation and storage conditions of the pre-heaters shall correspond to those specified in 5 GOST 15150-69.

12. Warranty

12.1 The pre-heater warranty life is 18 months from the date of sale, i.e. 500 h or 50000 km mileage, provided that the User followed the operating rules, transportation rules and storage rules, foreseen by the present Manual.

12.2 In case the vendor stamp and date of sale is missing, the warranty life starts from the pre-heater date of manufacture.

12.3 Production malfunctions that may occur during the warranty life are handled by authorized specialists, spare parts are provided by the manufacturer at his expense.

12.4 The manufacturer acts on no complaints regarding incompleteness or mechanical damage of the pre-heater.

12.5 The present warranty does not cover defects occurred as a result of:

- force majeure – lightning stroke, fire, flood, inadmissible voltage oscillation, traffic accident;
- violation of installation, operational, transportation and storage rules foreseen by the present Manual;
- installation, repair or setup of the pre-heater performed by personne or company, not authorized by the manufacturer;
- pre-heater non-dedicated usage.

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ПРАМОТРОНИК
производственная компания

ЭТРА термо ОАО «ЭЛТРА-ТЕРМО»

Pramotronic **Production Company**
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ELTRA
TERMO OPEN JOINT STOCK COMPANY
«ELTRA TERMO»

1 Introduction

This instruction manual (IM) is assigned for study of the structure, operation, assembly and regular maintenance of the heater «PRAMOTRONIC 16WD24» (further referred to as the heater).

The diesel heater of 16WD24.8106.000 model with the nominal voltage 24V is designated for pre-starting heat and automatic keeping of thermal conditions of a liquid cooling diesel motor for all makes of trucks, as well as for heating and automatic keeping of temperature in a cabin (a passenger compartment) of motor vehicles, buses and stationary premises at ambient air temperature up to -45 °C.

The reliable operation of the heater and a long term of its maintenance can be guaranteed only by following all the rules and instructions stated in this instruction manual.

2 Technical characteristics of the heater

The characteristics in Chart 1 are given under the ambient air temperature +20 °C and the nominal voltage. Admissible fluctuations are ±10 %.

Chart 1

Items of characteristics	Heater PRAMOTRONIC-16WD24
Nominal Voltage, V	24
Fuel	Diesel oil under State Standard Specification 305 (GOST 305)
Admissible voltage, V	20…30
Heating efficiency in operating mode: Full mode , kilowatt Medium mode, kilowatt Low mode, kilowatt	 16±1,6 10 5
Consume power (without electric pump), watt: At start up (not more than) In full operating mode In medium operating mode In low operating mode	 95 130 75 36
Fuel consumption in operating mode: Full mode , litre per hour Medium mode, litre per hour Low mode, litre per hour	Kbnh 2,25 1,25 0,625
Heat carrier	Tosol, antifreeze
Admissible maximum heat carrier pressure, kg/cm	2,5
Temprerature range set on the control panel for keeping automatically in the cabin, C	От 15 до 30
The exhaust temperature,ºC (not more than)	500
Start up and stop action conditions	Manual
The heater operation time	Not limited (is limited only by the condition of the electric power storage)
Weight (of the set) kg (not more than)	9

3 Safety requirements and warnings

3.1 Assembling and maintenance of the heater must be carried out by organizations and individuals having the producer's license.

3.2 The plug-in of the heater must be carried out by the two-wired scheme directly to the accumulator battery regardless the motor vehicle "weight".

3.3 It's not allowed to connect the heater to the electric circuit of a vehicle lacking the accumulator battery.

3.4 The safety measures provided by the regulations of work with electric circuit and a motor vehicle fuel system must be taken when assembling and disassembling the heater.

3.5 The heater must be disconnected from the accumulator battery when electric welding works on the motor vehicle or repair work on the heater are carried out.

3.6 It's not allowed to lay a fuel tube inside the cabin of a motor vehicle.

3.7 The heater can be used only for the purposes stated in this instruction manual.

3.8 A motor vehicle outfitted with the heater must be supplied with a fire-extinguisher.

3.9 It's not allowed to use the heater in the places where highly inflammable fumes or great amount of dust can be formed and accumulated.

3.10 It's not allowed to install the heater without a spark extinguisher on motor vehicles transporting explosive and highly inflammable liquids.

3.11 It's not allowed to use the heater when the vehicle is parked in enclosed spaces (in a garage, in a workshop, etc.) to prevent poisoning by the exhaust.

3.12 When fuelling the motor vehicle the heater must be turned off.

3.13 To prevent the deformation of plastic parts, boiling of the heat carrier inside the heater and the emergency of the heat sensors it's not allowed to disconnect the sockets and cut off the heater from the electric power supply until the end of the blow-off cycle.

3.14 The heater can be restarted not earlier than in 5-10 seconds after its turning off.

4 The structure and operation of the heater

4.1 The heater works independently from the motor vehicle engine.

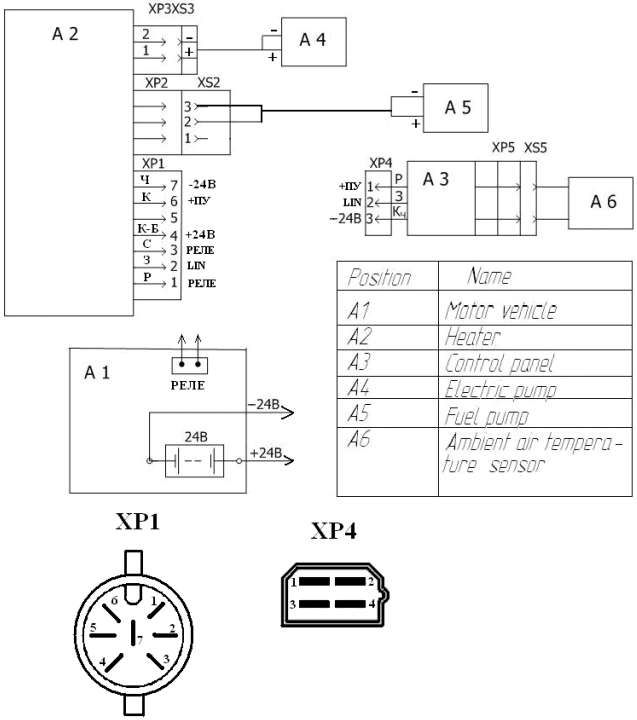
It is the main element in the heating system of engine cooling liquid of a motor vehicle.

4.2 The heater is incorporated into the engine liquid cooling (heating) system together with the spare pump, which generates the circulation of the cooling liquid through the heater, the engine and the cabin heater.

4.3 The fuel is supplied to the heater by a special piston pump through the system of intake and feeding hydraulic hookups.

4.4 Starting and switching of the heater are carried out «manually» with the help of the control panel.

Power is supplied from the accumulator battery of the motor vehicle and is connected with the control panel, electric pump and fuel pump by connecting cords. The electric circuit diagram is shown in figure 1.



Position	Name
A1	Motor vehicle
A2	Heater
A3	Control panel
A4	Electric pump
A5	Fuel pump
A6	Ambient air temperature sensor

Fig. 1. The electric circuit diagram
of «PRAMOTRONIC 16WD-24» heater

4.5 The heater is a self-contained heating device and consists of the following main parts (figure 2):

- Frame (position 1);
- Heat exchanger (position 2);
- Air pump (position 3);
- Control unit (position 4);
- Glow plug (position 5);
- Flame indicator (position 6);
- Heat sensor of incoming liquid (overheating sensor) (position 7);
- Heat sensor of outgoing liquid (position 8).

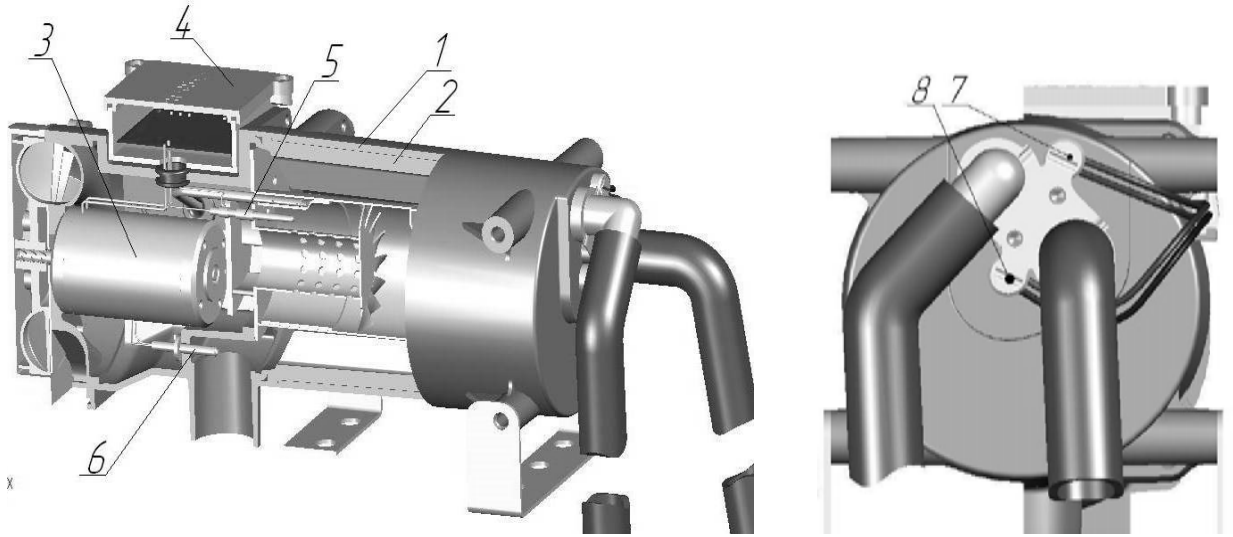


Fig. 2.The main parts of the liquid heater
«PRAMOTRONIC 16WD-24»

4.6 The source of heat is gases got from burning of air-fuel mixture in the combustion chamber. Hot gases moving through the blades inside the heat exchanger warm it and the cooling liquid that washes the heat exchanger from outside is heated and sends this heat into the cooling system.

4.7 The operation of the heater is carried out by the control panel which must be located on the dash panel of a motor vehicle. On the front board of the panel a handhold position 1 (figure 3) of potentiometer is inserted for controlling the air temperature inside the vehicle cabin. The temperature can be set from +15 °C till +30 °C.

A button position 2 and a button position 3 are also located on the front board of the panel. Each of them is assigned for starting and switching the heater.

Two light-emitting diodes are also output on the front board of the panel (see figure 3). They show the condition of the heater:

- it doesn't glow , the heater doesn't work;
- it glows green, the heater works;
- it flickers with intervals and beeps (the malfunction code), the heater is out of order.

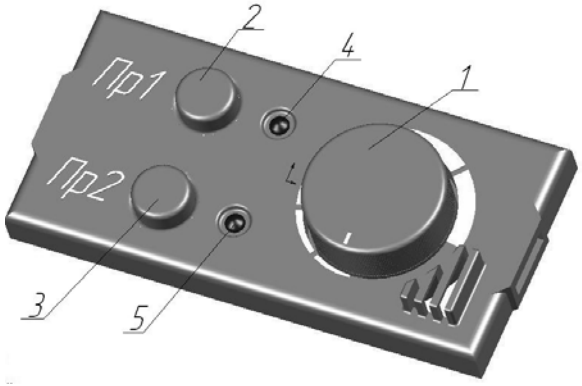


Fig. 3. The Control panel board

4.8 After pushing the startup button of the heater the control panel diagnoses all the operation system elements and their electric circuits. If all the elements are operable the control panel begins the work of the heater under the set program. When button position 2 is pushed the heater starts working under program № 1 and when button position 3 is pushed – under program № 2.

Startups under programs № 2 and № 1 don't differ from each other until the heater reaches the medium operating mode.

In the beginning the control unit gradually boosts the voltage in the glow plug; the cellular structure in the combustion chamber is heated. Then fuel and air are supplied, which begins the process of burning that is

controlled by the control unit with the help of the flame indicator. When steady burning and the sufficient signal from the flame indicator are reached the control unit turns off the glow plug and the further process of burning is supported by permanent fuel and air supply into the combustion chamber.

Working under program № 1 the control unit puts the operation of the heater into «FULL» mode and under program № 2 – into «MEDIUM» mode.

4.8.1 If for any reason the startup of the heater doesn't occur the process of the starting up the heater is automatically repeated. After two feeble attempts to start up the heater it is automatically switched off. On the control panel the red light emitting diode starts flickering with intervals and the signal sounds, which shows that the startup attempts are exhausted «code № 2».

At this time the control unit carries out blowing of the combustion chamber for five minutes. Such blowing is carried out when any malfunction of the heater occurs. After the blowing is finished the electric pump switches off. The malfunction code flickers and beeps for ten minutes.

The malfunction code can be stopped with the button of the respective program by pushing it and holding it in that position for five seconds.

4.9 When the button position 2 is pressed the heater will work under program № 1 which provides a quick preparation (heating) of the motor for starting up, that is, the heater reaches the «FULL» mode and in this mode heats the liquid up to the temperature +70 °C. Then it goes to the «MEDIUM» mode and brings the temperature of the cooling liquid up to +75 °C, after that it goes to the «LOW» mode and continues heating the liquid to the temperature +80 °C. After the temperature +80 °C is reached the heater goes to the waiting mode, that is, the combustion chamber switches off and the electric pump continues working.

The «waiting» mode extends until the temperature of the cooling liquid drops up the level +55 °C. At this temperature the control unit starts up the heater and works out program № 1 again.

The heater can be switched off at any moment of its operation by a repeat pushing of the button position 2. The work of the heater can be moved to program № 2 by pushing the button position 3.

Working under program № 2 the control unit measures the temperature of the heater's incoming liquid. When the temperature +40 °C is reached it turns on the cabin heater fan, which starts heating the cabin air and keeping the air temperature set on the control panel.

The control unit together with the control panel automatically keep the set temperature in the cabin. The temperature in the motor vehicle cabin is measured by a remote heat sensor that must be located in the place where the set temperature is to be kept. In the process the heat sensor must be well blown by air. The temperature adjustment is carried out by switching on and off the cabin heater fan.

Working in the «MEDIUM» mode the heater warms the cooling liquid up to +60 °C and goes to the «LOW» operating mode. After it heats the liquid up to +70 °C it goes to the waiting mode, the combustion chamber switches off, only the electric pump works. At this mode the temperature of the cooling liquid drops until +40 °C.

After the temperature +40 °C is reached the control unit starts the heater and program № 2 is worked out again.

4.10 The operation of the heater in item 4.9 can differ from which is described above.

This difference can occur at very low minus temperatures (-40 °C), when the engine and the cabin are highly blown by the wind at temperatures -30 °C – -40 °C or when the heater warms the premises of large sizes. In those cases a great amount of heat will be withdrawn into the ambient space.

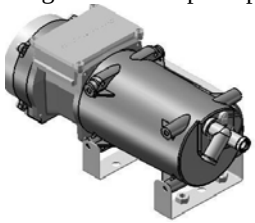
The heater can work under program № 1 in the «FULL» mode without reaching the set temperature of the cooling liquid +70 °C. The heater will work in this mode until the moment when the incoming heat exceeds the outgoing heat. In this condition the rising of the temperature of the cooling liquid starts and when the temperature reaches +70 °C the heater will go to the «MEDIUM» operating mode, in this case the temperature of the cooling liquid can drop up to the level +65 °C. At this temperature the control unit will put the heater in the «FUUL» operating mode. If the temperature of the cooling liquid keeps rising and the heater warms the cooling liquid up to +75 °C the heater will go to the «LOW» operating mode. If the temperature of the cooling liquid keeps falling and reaches the level +70 °C the control unit will put the heater into the «MEDIUM» operating mode.

While working under program №2 the situation different from the one described in item 4.9 may occur, that is, the heater can work in the «MEDIUM» mode without reaching the temperature +60 °C or after reaching the temperature +60 °C and going to the «LOW» mode the temperature of the cooling liquid will keep falling until +55 °C. At this temperature the control unit will put the work of the heater into the «MEDIUM» mode.

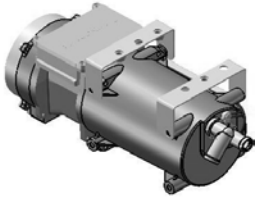
5 Requirements to the assembly of the details and units of the heater

5.1 The heater is assembled depending on its working position.

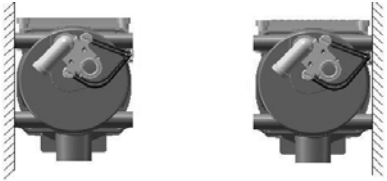
5.2 The heater must be assembled outside the saloon (the cabin) of the motor vehicle in a horizontal position with the control unit on top. Admissible horizontal and vertical misalignments are +10°. The heater can be fastened to the attachment points from two sides with the help of two M8 bolts or to the floor or the ceiling with the help of special brackets. (see figure 4)



The floor fastening of the heater



The ceiling fastening of the heater



Fastening of the heater to the side walls

Fig. 4. Admissible assembling positions of the liquid heater «PRAMOTRONIC 16WD-24»

5.3 **The heater must be installed in the way that prevents dirt from getting into the intake hole of the air filter.**

5.4 The construction of the heater allows it to be installed above the head level of the radiator. The main condition is the admissible level of the heights between the electric pump and the heater that mustn't exceed 1 meter.

5.5 The electric pump must be placed below the minimal admissible level of the cooling liquid.

5.6 The connecting hydraulic hookups (hose pipes) must be laid with pitches and without excessive bends in which air locks can occur.

5.7 The assembly of the exhaust pipe must be carried out considering its high temperature in the time of the heater operation. The exhaust must be withdrawn outside the motor vehicle which eliminates its getting into the cabin.

Besides, the outlet of the exhaust pipe mustn't be directed towards the oncoming flow of the air when the motor vehicle is moving.

5.8 Assembly of the fuel system of the heater

While assembling the fuel system it's necessary to keep the following prompts which are preferable:

- the fuel pump must be located near the fuel tank;
- it's preferable to place the axle of the fuel pump closer to the vertical (see figure 5);
- it's preferable to locate the heater above the maximal level of fuel in the fuel tank (see figure 6, figure 7);

- for connecting the fuel tank and the fuel pump it's preferable to use hose pipes with the inside diameter about 2 millimeters, as in that case it takes the working fuel pump a short time to fill the inner volume of the hose pipe with the fuel.

In assembling the fuel system short radius bends of sleeves and hose pipes are not allowed, as a bite (fracture) of the flow passage occurs.

The diagrams of a comparative position of the fuel tank, the fuel pump and the heater are shown in figures 6 and 7.

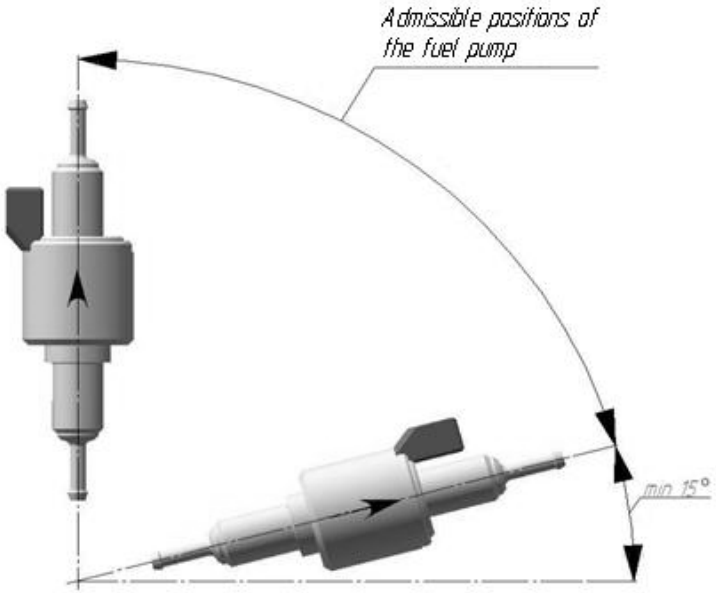


Fig. 5. Admissible assembling positions of the fuel pump

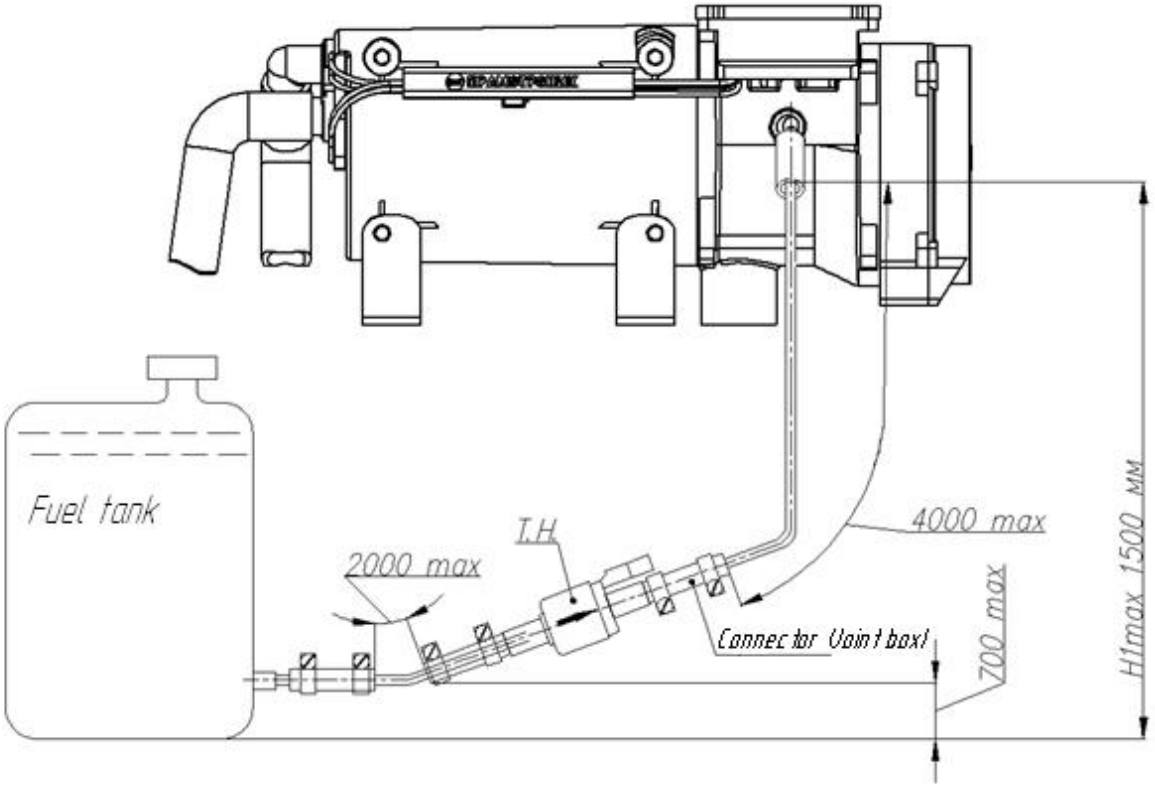


Fig. 6. The diagram of the assembly of the fuel system of the heater with an individual fuel tank

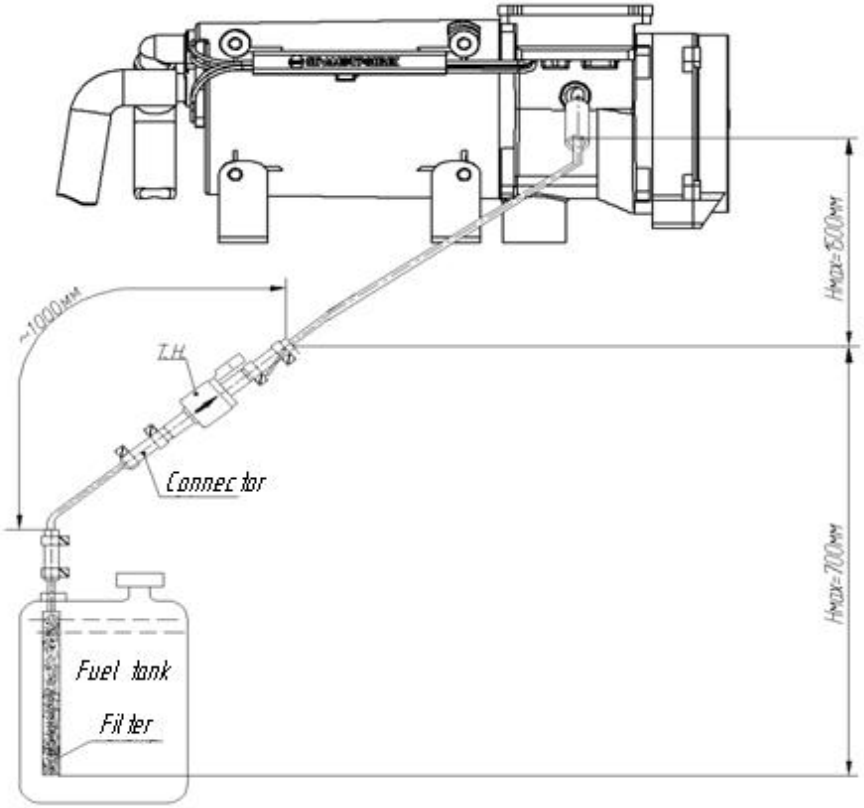


Fig. 7. The diagram of the assembly of the fuel system of the heater with the fuel intake from the motor vehicle fuel tank.

While assembling is carried out the hose pipes must be cut off only with a sharp knife as in figure 8. The restriction of the flow passage of the heater, as well as hollows and barbs are not allowed.

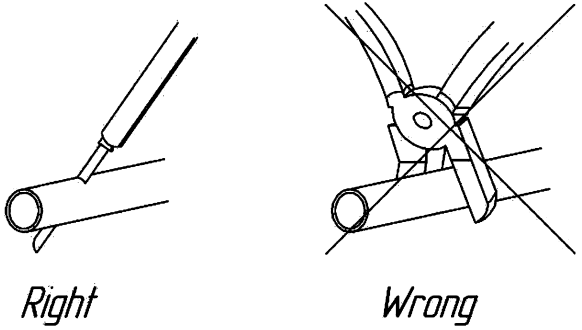


Fig. 8

Attention : The hose pipe and the fuel pump should be protected from heating. They mustn't be installed next to the exhaust pipe or on the engine

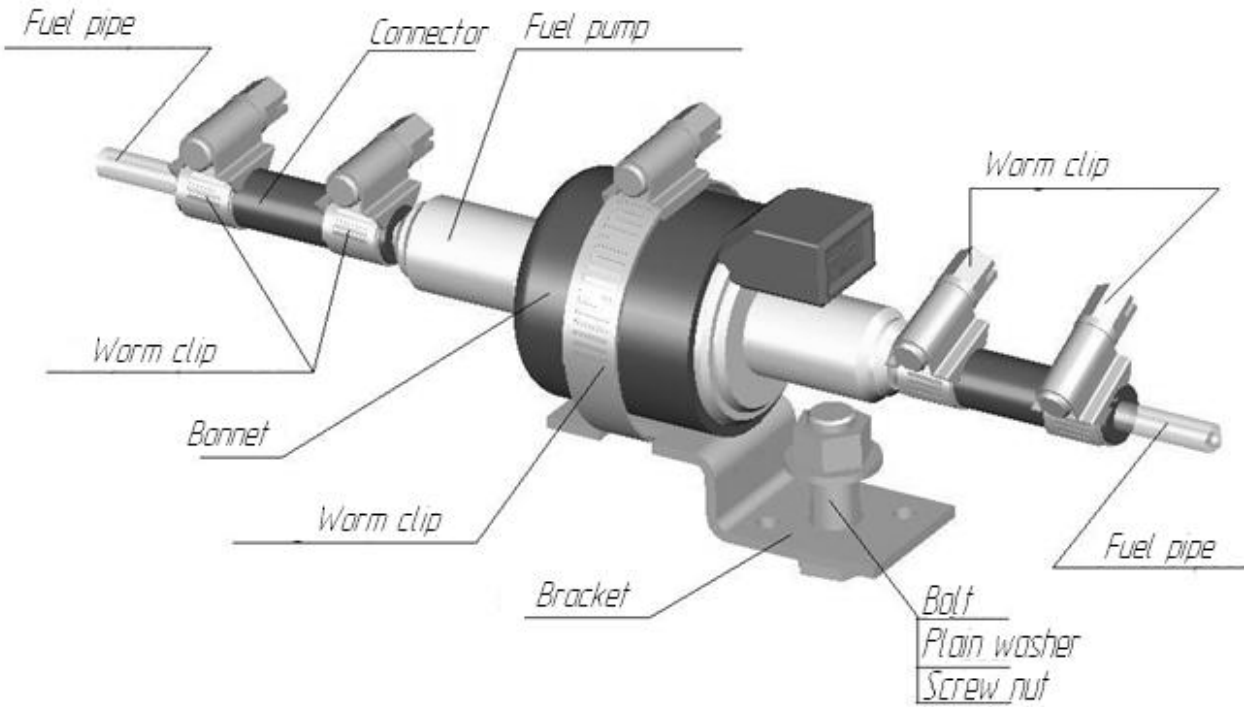


Fig. 9 The diagram of the fuel pump assembly

It's allowed to install the fuel pump on the frame of the heater.

5.9 The control panel assembly

The control panel is installed in the cabin or saloon of the motor vehicle on the dash panel in the place specified by the manufacturing plant, or this place is specified by the specialized organizations carrying out the assembly. The dimensions of the hole for the control panel locating are shown in figure 10.

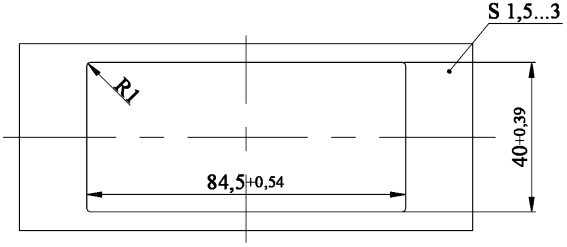


Fig. 10 The control panel matching site

5.10 Assembly of the electric system of the heater

The assembly of the wire harnesses of the heater is to be carried out according to the electric diagram (see figure 1). While assembling the harnesses the opportunity of their heating, deformation and shifting during the motor vehicle operation must be excluded. Harnesses are to be fastened to the parts of the motor vehicle with plastic clips.

Attention: When assembly is carried out the safety device must be dismantled

6 Checkup of the heater after the assembly

6.1 When assembling the following must be secured:

- air tightness of the fuel system and tightening of the clips;
- reliability of electrical connection.

6.2 Mount the protective device, buttons 2 and 3 on the control panel will glow.

6.3 Firmly turn the potentiometer for setting the temperature on the control panel clockwise.

Attention!

1 At the first startup of the heater the fuel system must be filled with fuel up to the incoming connecting pipe of the heater. If the booster pump is missing the startup of the heater must be repeated several times until the fuel system is filled.

2 It's necessary to remember that each time the heater is turned on and doesn't start working at the first attempt the control unit automatically turns on the heater for the repeated startup attempt with the following blowing for five minutes.

6.4 After the combustion chamber of the heater comes to the maximal mode (about 5 minutes after the startup), the potentiometer for setting the temperature in the cabin on the control panel must be slowly turned counterclockwise and the necessary temperature must be set. The further work of the heater is described in chapter 4 of this instruction manual.

7 Guidelines

7.1 For securing continuous working capacity of the heater it's recommended to turn on the heater briefly for about five minutes once a month during the whole year (including a warm season of the year). The turning on must be carried out at the ambient air temperature near the control panel and the heat sensor below +30 °C. Thus, the sticking of the movable parts of the fuel pump can be eliminated (it can arise because of the low-quality fuel).

7.2 Reliable work of the heater depends on the fuel used in relation with the ambient air temperature. Recommended types of fuel are given in chart 2.

Chart 2

The ambient air temperature, ^{0}C	Fuel or mixture type
Up to 0	Diesel fuel L-0,2-40 or L-02-62 State Standard Specification 305-82
From 0 till minus 5	Diesel fuel 3-0,2 minus 45 State Standard Specification 305-82
From minus 5 till minus 20	Mixture of diesel fuel 3-0,2 minus 45 State Standard Specification 305-82 (70 %) and kerosene KO-25 or KO-20 Technical Specifications 38.401-58-10-90 (30 %)
Below minus 20	Diesel fuel A-0,4 State Standard Specification 305-82 or mixture of diesel fuel 3-0,2 minus 45 State Standard Specification 305-82(50 %) and kerosene KO-25 or KO-20 Technical Specifications 38.401-58-10-90 (50 %)

7.3 In the case of untimely change for winter fuel the heater may not start or may turn off during the operation.

The reason of such failures is the blocking of the fuel pump and possibly the hose pipes by paraffin that is generated in the diesel fuel that doesn't fit the arisen minus temperature of the surrounding environment.

To eliminate the appeared failure it's necessary:

- to change the fuel in the fuel tank in accordance with the guidelines given in chart 2;
- to disconnect the hose pipe from the heater and put its end into a transparent container (a jar);
- to turn on the heater and try to pump through the fuel system. If the positive results are obtained, to connect the hose pipe to the heater and turn it on again;
- if it's not possible to pump through the fuel system, it's necessary to dismantle it, put it into a warm place and keep it there (warm it) and then pump it through with the changed fuel. Then to mount the fuel system on the motor vehicle and start the heater.

9 Possible malfunctions, their reasons and ways of their elimination

9.1 Some malfunctions that can be eliminated in-house:

- the buttons on the control panel don't glow

To determine the reasons it's necessary to check (replace) the protecting device, check the supply circuit and sockets of the harnesses connecting the panel and the heater;

- the heater doesn't start.

If this malfunction occurs code № 2 "Two attempts of startup are exhausted" glows. Check the presence of the fuel in the fuel tank and the work of the fuel pump.

9.2 All possible malfunctions that may occur during the heater operation are displayed as malfunction codes on the control panel. Each malfunction code is displayed on the control panel as repeated flickers and intervals of the light emitting diode (red) and is accompanied by a sound signal.

Attention: At this time the sound signal can be switched off by pressing and holding the button of the corresponding program for 2-3 seconds.

The decryption of the number of flickers at the malfunction of the corresponding program (malfunction codes) are shown in chart 3.

Chart 3

The number of flickers before the interval	Malfunction	Guidelines on malfunctions elimination
1	The voltage in the accumulator battery is not normal	Check the voltage in the connector. The voltage must be from 20-30 Watt. If voltage is less than 20 Watt, charge or replace the accumulator battery; if it's more than 30 Watt, check the voltage regulator.
2	Two startup attempts have been wasted	Check the presence of fuel in the fuel tank, disconnect the hose pipe from the heater and check the fuel supply. At the lack of fuel check the work of the fuel pump and replace it if necessary. Check if the air-take filter and the exhaust pipe are blocked.
3	Flame breaking in the combustion chamber	Check the amount of supplied fuel. Check if the air-take filter and the exhaust pipe are blocked. If the heater turns on and off check the flame indicator and replace it if necessary.
4	The electric pump failure	Check if the engine circuit with the harness is broken or failed. Resistance between the terminals must be ~1ohm.
5	The fuel pump failure	Not connecting the fuel pump harness from the pump check if it is broken or failed. Resistance between the terminals must be ~20ohm.
6	Failure of the circuit of the environment temperature sensor	Check the socket connecting the panel and the environment temperature sensor, check if the harness is broken.
7	The air pump circuit failure	Check the circuit of the electric motor, change the air pump if necessary.
8	The glow plug failure	Check the circuit of the plug. Resistance must be ~2 ohm.
9	There is no connection with the control panel	Check the socket connecting the control panel with the control unit of the heater.
10	Failure of the circuit of the incoming liquid heat sensor	Check the socket connecting the sensor with the control unit, check if the harness is broken.
11	Failure of the circuit of the outgoing liquid heat sensor	Check the socket connecting the sensor with the control unit, check if the harness is broken.
13	The heat exchanger is overheated	Check the electric pump, the presence (the level) of the cooling liquid, the absence of the air blocks in the liquid system.

APPENDIX.

SERVICE INSTRUCTION

AIRTRONIC D2 Eberspächer



INDEPENDENT DEVICE FOR HEATING AND MAINTENANCE OF AIR TEMPERATURE IN THE CAB

CONTENT

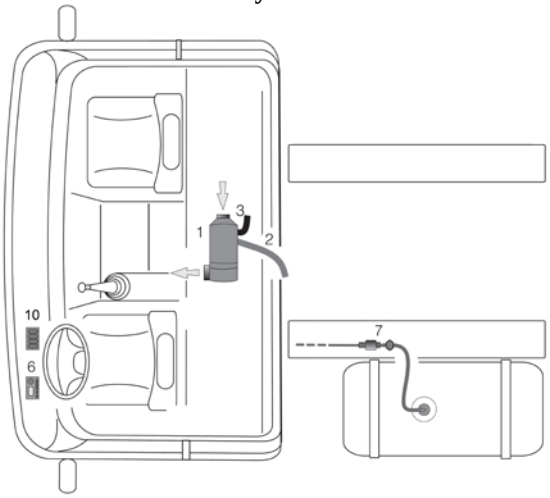
1. Self-contained hot-air heating system plan in the cab …… 4
2. Intent of the heater …… 5
3. Safety directions …… 5
4. Fuel delivery…… 7
4.1 Accidents prevention guidelines concerning fuel supply system…… 7
4.2 Fuel quality …… 7
4.3 Operation using bio fuel (fatty-acid methyl esters)…… 7
5. Operation guidelines…… 7
6. Maintenance advice…… 7
6.1 Reliability control before starting…… 7
6.2 Heating operation on high ground…… 8
7. Technical details and functional description…… 8
7.1 Actuation…… 8
7.2 Start…… 8
7.3 Temperature setting using a control panel…… 8
7.4 Temperature control in heating mode…… 9
7.5 Mode of ventilation…… 9
7.6 Switching…… 9
8. Malfunction/ Maintenance…… 10
8.1 Malfunction response actions…… 10
8.2 Malfunction repair…… 10
8.3 Maintenance instructions…… 10
9. Control panel (timing device)…… 11

https://truckmanualshub.com/

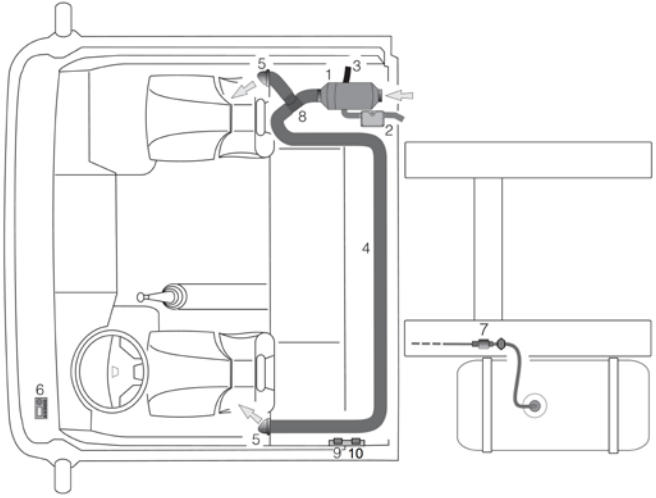
9.1 Main functions of push buttons …… 11
9.2 Menu bar…… 11
9.3 Data entry field…….. 11
9.4 HEATING…….. 12
9.5 VENTILATION…….. 12
9.6 PROGRAM…… 12
9.7 SETTINGS…….. 14
9.8 Factory setting…… 14
9.9 Error codes, their description and remedial procedure…….. 15

1. SELF-CONTAINED HOT-AIR HEATING SYSTEM PLAN IN THE CAB

Day cab



Night cab



1 - Self-contained device for heating air;
2 - exhaust system;
3 - air supply tube in combustion chamber;
4 – air conduct;
5 - rotating outlet vent;
6 - control panel (timing device);
7 - metering pump assembly with fuel filter;
8 – T-connector;
9 - supplementary switch;
10 - temperature detector.

2. INTENT OF THE HEATER

• Heating and maintaining the temperature in the driver's cab.

• Glasses heating to defreeze them and to remove condensate.

Do not use the heater in the following case:

• Heating and drying of:
  - people or animals by direct hot air blowing;
  - objects;
• Hot air supply in any containers.

 **Attention!**

Safety instructions in regards of sphere of application and correct use!

• The heater must only be used for the purposes specified by the manufacturer.

3. SAFETY DIRECTIONS

 **Danger!**

Safety hazard, burn hazard and toxic hazard!

• The heater must only be switched on when inspection cover is closed and outlet pipes are installed.

• Do not open the inspection cover while the appliance is operating.

• Before starting all diagnostic works and remedial maintenance of the heater, turn it off, disconnect the battery from the circuit, and wait until all hot parts have got cold.

• Do not operate the heater in closed spaces, for example in garages or in closed parking area.

• Adjustable blower nozzles should always be directed in such a way as to avoid direct hot air blow-off of people and animals, as well as thermally sensitive objects (fixed and loose).

Attention!

• When refueling the car, the heater must be switched off.

• The heat exchanger of air heating device, which is a thermally sensitive structural member, must be replaced 10 years after the first introduction into service of the heater. The «original spare part» label attached to the heat exchanger must show the date of installation.

• Repairs (including warranty) of the heater can only be carried out by a service center authorized by the manufacturer.

• Repairs by unauthorized services and/ or using non-original spare parts constitute a danger, and therefore are unacceptable. The consequence of such actions is the termination of type-approval license for operation of the heater and, therefore, the withdrawal of the vehicle's operation permit.

Do not do the following:

- redesign of parts subjected to thermal exposure;
- use of third-party parts not approved by the company Eberspächer ;
- deviation from legal requirements, safety requirements and/ or operating specifications contained in this documentation. In particular, this applies to electrical wiring, fuel supply system, air supply system to combustion chamber and exhaust system.

• When repairing it is allowed to use only original accessories or original spare parts.

• When performing electric welding operations on the vehicle in order to protect the control unit, it is necessary to remove the terminal from positive terminal of the battery and close it to weight.

• Operation of the heater is strictly forbidden when flammable materials (dried grass, leaves, paper, etc.) are located near exhaust gas outlet or when flammable vapors and dust are located, for example, near the following objects:

- fuel store;
- coal storage;
- wood yard;
- grain storage etc.

• The installation compartment for the heater, with the exception of its installation in a protective cover, etc., is not intended for storage of any objects, and should be free. Do not store or transport reserve fuel canisters, containers with oil, aerosol and gas cylinders, rags, clothes, paper, etc. near the heater or on it.

• Fuses which are broken down should only be replaced with fuses of the same rating.

• If there is a fuel leak from the fuel system of the heater (depressurization), contact the authorized service center for repair.

• It is forbidden to stop heater coastdown prematurely by using a battery disconnect switch, except for emergency switch-off.

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4. FUEL DELIVERY

4.1 ACCIDENTS PREVENTION GUIDELINES CONCERNING FUEL SUPPLY SYSTEM

Attention!

Do not operate the heater using unacceptable fuel/ fuel blends, or add used oil to fuel.

Disregard of this instruction may cause injury of people, or cause malfunctions or damage to the heater. It is only allowed to use fuel approved by the manufacturer of the heater or of the vehicle.

4.2 FUEL QUALITY

Independent device for heating and maintenance of air temperature in the cab operates on diesel fuel.

It is necessary to use fuel corresponding to European standard EN 590, with sulfur content of not more than 10 million^{-1}.

Suggestions on season usage of diesel fuels in regions of Russian Federation are presented in standard GOST P 52368-2005 (EH 590:2004).

• «Diesel fuel EURO». If fuel is supplied to the heater from a separate fuel tank, the following rules must be observed:

- at a temperature above 0 °C: use diesel fuel in accordance with DIN EN 590.

- at a temperature from 0 °C to -20 °C: use winter diesel fuel in accordance with DIN 590.

- at a temperature from - 20 °C to - 40 °C: use arctic or polar diesel fuel.

Please note!

After refueling with winter diesel fuel, fuel lines and metering pump must be filled with new fuel by turning on the heater for 15 minutes!

4.3 OPERATION USING BIO FUEL (FATTY-ACID METHYL ESTERS)

Operation and maintenance of the heater on biofuel (FAME) is not allowed.

It is allowed to add no more than 10 % of biodiesel.

5. OPERATION GUIDELINES

The heater is controlled via control panel. There is a detailed instruction for use control panel (see section 9. CONTROL PANEL (TIMIMG DEVICE)).

6. MAINTENANCE ADVICE

6.1 RELIABILITY CONTROL BEFORE STARTING

After long periods of idle time (summer time), check the fastening of all components (tighten screws if necessary).

Check leakproofness of fuel supply system by visual check.

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6.2 HEATNG OPERATION IN HIGH GROUND

• Heating operation is possible at a height up to 1500 m above sea level. Otherwise, adjustment of device is necessary.

Heating operation at a height of 1500-3000 m above sea level without adjustment of the heater is possible for a short time (for example, during a pass crossing or a stop).

If you stay for a long time at these altitudes above the sea level, you need to adjust the heater by altitude by installing air pressure sensor that is included with the kit for use at high altitudes. Installation of the kit should be done by an authorized service center.

7. TECHNICAL DETAILS AND FUNCTIONAL DESCRIPTION

7.1 ACTUATION

After actuation of the heater, display of control panel shows «On» for 2 seconds, then it shows remaining time of operation or symbol ∞ in continuous mode.

Pin electrode is switched on, and fan works at low speed.

Please note!

If temperature after previous heating cycle is still too high, only fan (cold blowing) is switched on.

After removing excess heat, the heater starts up.

7.2 START

In 65 seconds the fuel is supplied and air-fuel mixture ignites in combustion chamber.

60 seconds after detection by combined sensor (combustion sensor) of presence of flame, pin electrode is disconnected.

After that, the heater is in normal operating mode.

7.3 TEMPERATURE SETTING USING A CONTROL PANEL

You can set a temperature in the vehicle using a control panel.

The temperature can range from 8 °C above zero to 36 °C above zero; it depends on the model of installed heater, on the size of heated area in the vehicle and on the outside temperature.

Mountable position of regulator is an observation value.

For more information on temperature setting, see section 9.4 HEATING.

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7.4 TEMPERATURE CONTROL IN HEATING MODE

In heating mode, the temperature in the vehicle or the temperature of intake air are constantly measured. If the temperature is higher than the value set on the control panel, adjustment process begins.

There are four control steps, which ensure the exact dosage of heat energy flow supplied by heater in accordance with the needs. Fan rotary speed and supplied fuel quantity correspond to selected control step.

If temperature rise of instrument is recorded even at the lowest control step, the heater goes to "OFF" control stage with fan coastdown for about 4 minutes for cooling.

Then, fan works until the next start at minimum speed (recirculate mode) or turns off (fresh air mode).

7.5 MODE OF VENTILATION

To activate the mode of ventilation select the function «Ventilation» on display screen of control panel, and then switch on the heater. For more information on function selection, see below, in section 9.5 VENTILATION.

7.6 SWITCHING

When the heater is turned off, «Off» is displayed for 2 seconds on control panel display, then current time clock and actual temperature in the vehicle are switched off, fuel supply is turned off.

Inertial run-out of the fan is provided for cooling for about 4 minutes.

To clean combustion chamber during inertial run-out of the fan, pin electrode is switched on for about 40 seconds.

Exception:

If there was no fuel supply before switch-off, or if the heater was in step «OFF», the heater goes into standby mode after inertial run-out.

8. MALFUNCTION/ MAINTENANCE

8.1 MALFUNCTION RESPONSE ACTIONS

- The heater does not start after switching on:
  - switch the heater off and on.
- If after this the heater does not start again, check:
  - Is there fuel in fuel tank?
  - Are fuses in good order?
  - Are connection wires, disconnect points in good order?
  - Is there any interference in hot air supply ducts, air supply ducts to combustion chamber or exhaust gas outlet ducts?

8.2 Malfunction repair

If the heater does not start and after checking according to point 8.1 or if another fault is identified, contact your warranty service center.

Please note!

You have to take into account that warranty maintenance is not provided, if changes in design of the heater have been made by an unauthorized party or if parts of third-party manufacturers are built in the device.

8.3 Maintenance instructions

- Switch on the heater also in warm season approximately once a month for 10 minutes.
- Before starting continuous operation in cold season, perform trial start. If strong smoke persists over a protracted period or if burning is accompanied by unusual noise or distinct smell of fuel or overheated electrical / electronic parts, switch off the heater and stop operation by removing the fuse.

  Re-commissioning is permitted only after inspection by specially trained heater technicians from Eberspächer.
- Hot air ducts, air supply ducts to combustion chamber and exhaust gas outlet ducts should be checked, and if necessary cleaned after a long period of inactivity.

9. CONTROL PANEL (TIMIMG DEVICE)

EasyStart Timer



9.1 MAIN FUNCTIONS OF PUSH BUTTONS

By using the button the heater is switched on and acknowledged.

By using the buttton the heater is switched off and operations are completed.

Use buttons to select menu items and to make settings.

9.2 MENU BAR

Symbol	Function
	Heating On / Off
	Ventilation On / Off
P	Program
	Settings

9.3 DATA ENTRY FIELD

Symbol	Function
	Time setting
12 24	Time display format
Mo	Weekday setting
	Battery

Please note!

LONGPRESS – straight way

At temperatures of 20 °C below zero in the vehicle, the information on the screen is displayed with delay and contrast decay. In these cases, the heater can be switched on/ off by applying the function of LONGPRESS.

After pressing and holding LONGPRESS for more than 2 seconds heating mode starts immediately.

After pressing and holding LONGPRESS for more than 2 seconds all functions are completed.

9.4 HEATING

Immediate heating/ LONGPRESS.

Press and hold the button for more than 2 seconds.

Heating On/ SHORTPRESS.

Press and hold the button for less than 2 seconds, confirm set temperature and operating time with the button or set them using the buttons .

Confirm the setting using the button .

Heating Off/ LONGPRESS.

Press and hold the button for more than 2 seconds, all activated functions are completed.

Heating Off/ SHORTPRESS.

Press and hold the button for less than 2 seconds the function Heating On will be completed.

9.5 VENTILATION

Ventilation On

On the menu bar use the buttons to select the symbol and confirm with the button , confirm duration of the operation using the button or set using the buttons . Confirm the setting using the button .

Ventilation On/ LONGPRESS.

Press and hold the button for more than 2 seconds, all activated functions are completed.

Ventilation Off/ LONGPRESS.

Press and hold the button for less than 2 seconds, the function Ventilation On will be completed.

9.6 P PROGRAM

Programming of setting time.

Please note!

If the symbol «P» is not displayed in the menu bar, the heater is in ADR mode (transportation of dangerous goods), pre-set heating mode is not possible in this case.

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Selection of software memory device.

On the menu bar use the buttons ◄ ► to select the symbol «P» and confirm with the button ▣, using buttons ◄ ► select the memory to store programs P1, P2 or P3 and confirm using the button ▣.

Activation of selected memory for program storage.

Using buttons ◄ ► select setting «On» and confirm using the button ▣.

Deactivation of selected memory for program storage.

Using buttons ◄ ► select setting «Off» and confirm using the button ▣.

Selected memory processing for program storage.

On the menu bar using buttons ◄ ► select the symbol 🔧 and confirm using the button ▣.

- **Selection of group of days of the week/ day of the week.**

Using buttons ◄ ► select a group of days of the week Monday - Friday (Mo – Fr), Saturday - Sunday (Sa – So), Monday – Sunday (Mo – So) or a day of the week Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday (Mo, Di, Mi, Do, Fr, Sa, So) and confirm using the button ▣.

- **Setting of beginning of trip/ start time (Factory setting: beginning of trip).**

Using buttons ◄ ► set the number of hours and confirm with the button ▣. Set the number of minutes with the buttons ◄ ► and confirm with the button ▣.

- **Performance mode selection.**

Using buttons ◄ ► select the symbol ✿ or symbols ≋ and confirm using the button ▣.

- **Adjustment of given value of temperature.**

Using buttons ◄ ► set given value of temperature and confirm with the button ▣.

- **Setting of operation time.**

Using buttons ◄ ► set operation time and confirm using the button ▣.

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9.7 SETTINGS

On the menu bar using buttons select the symbol and confirm using the button .

Time setting.

- Confirm the symbol using the button .
- Using buttons set the number of hours and confirm with the button .
- Using buttons set the number of minutes and confirm with the button .

Weekday setting.

- Using buttons select the symbol and confirm using the button .
- Using buttons set the current day of the week and confirm using the button .

Setting of time display format.

- Using buttons select the symbol and confirm using the button .
- Using buttons select time display format and confirm using the button .

9.8 FACTORY SETTING

Program/ presetting:

- Group of days of the week Monday - Friday (Mo – Fr).
- Time of beginning of trip, 7:00.
- Language DE.
- Time display format: 24 h.
- Operation time with a preset: 30 minutes.
- Operation time in continuous service of heating.
- Given value of temperature 21 °C above zero.
- Programming of setting time, time of beginning of trip.

Please note!

Standard configuration is described in this operation manual. Information concerning the extended configuration of control panel EasyStart Timer and special functions can be found in installation manual «Special functions and diagnostics» and downloaded on the website: www.eberspaecher-standheizung.com/ download.

9.9 ERROR CODES, THEIR DESCRIPTION AND REMEDIAL PROCEDURE

Error code	Description	Remedial procedure/ customer
INIT	Function of machine recognition is switched on. Timing device EasyStart was switched off, and then it was switched on again.	Wait until the machine recognition finishes, then set the exact time and day of the week.
 **NO SIGNAL**	The device does not respond to commands.	Check the heater fuse, replace if necessary. Contact the service center.
 **Error**	Heater 1 failure.	Contact the service center.
	Reduced voltage supply.	Charge the battery, if necessary, contact the service center.
 **- °C**	Temperature sensor is defective.	Contact the service center.

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Operating Instructions

Trucks
ZF-NewEcosplit

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NOTE
As a result of type variety, images shown in these operating instructions are not always identical with your transmission. Consequently, only one variant is displayed on an exemplary basis.

Your vehicle is equipped with a mechanical synchromesh transmission of the **ZF-Ecosplit model range**.

The more familiar you are with the ZF transmission, the more economically you will be able to drive with it. In these operating instructions, you will learn how to derive maximum benefit from the technical advantages of the ZF transmission. Therefore, we kindly ask the driver to carefully read these operating instructions and the special information provided by the vehicle manufacturer before driving the vehicle for the first time.

In order to ensure safe and reliable operation, please note the specifications governing maintenance. The ZF Customer Service specialists are available to assist you in carrying out maintenance work on the transmission or to help if any other problems arise.

Subject to technical changes.
First edition: 2006

Motoring pleasure with the ZF transmission is brought to you by
ZF Friedrichshafen AG

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The following safety instructions are used in the present operating instructions:

NOTE
Reference is made to **special** procedures, methods, information, etc.

CAUTION
This is used when deviating and unprofessional operation can damage the product.

⚠ **DANGER!**
This is used when lack of care could lead to personal injury and material damage.

⚠ **THREATS FOR THE ENVIRONMENT!**
Lubricants, consumables, and cleaning agents must not be allowed to enter the soil, ground water, or sewage system.

- **Ask your local environmental protection agency for material safety data sheets on the relevant products and adhere to their requirements.**
- **Collect used oil in a sufficiently large container.**
- **Dispose of used oil, dirty filters, and cleaning agents in accordance with environmental protection regulations.**
- **When working with lubricants and cleaningagents always refer to the manufacturer's instructions.**

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		Page
1	**Technical Data**	6
2	**Description**	7
2.1	Setup	7
2.2	Version	7
2.3	Shift actuation	9
2.4	Auxiliary power units	11
3	**Operation**	12
3.1	Starting the engine and setting off	12
3.2	Actuating the clutch	12
3.3	Shifting the transmission	13
3.3.1	Transmission shift pattern	13
3.3.2	Changing gears	15
3.4	Engaging the PTOs	19
3.4.1	Clutch-dependent PTOs	19
3.4.2	Engine-dependent PTOs	20
3.5	Parking	20
3.6	Tow starting	20
3.7	Towing	21
3.8	Limp home operation	22
3.8.1	Servoshift	22
3.9	Initial startup of vehicle at low temperatures	23
3.9.1	Parking the vehicle at low temperatures	23

		Page
4	**Maintenance**	24
4.1	Transmission fluid	24
4.1.1	Oil grade	24
4.1.2	Oil fill quantity	24
4.1.3	Oil change interval	24
4.2	Oil change	25
4.2.1	Oil drain	25
4.2.2	Oil fill	26
4.3	Oil level check	26
4.4	Transmission maintenance for versions with heat exchanger	27
4.5	Transmission maintenance for versions with clutch-dependent PTOs	28
4.6	Checking the clutch	28
4.6.1	Checking release valve of clutch pedal	29
4.7	Venting the transmission	30
4.7.1	Hose breather	30
4.7.2	Breather	31
4.8	Compressed-air system maintenance	31
4.9	Type plate	32

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		for standard drive				
Transmission type	Direct drive	16 S 1620 TD	16 S 1920 TD	16 S 2220 TD	16 S 2320 TD	–
	Overdrive	16 S 1820 TO	16 S 2220 TO	16 S 2520 TO	–	16 S 2723 TO
Input torque max. Nm [1]		1600 / 1850	1900 / 2200	2200 / 2500	2300	2700
Ratios of	Forward gears	TD = 16.41 - 1.00			TO = 13.80 - 0.84	
	Reverse gears	TD = 15.36 - 12.92			TO = 12.92 - 10.80	
Speedometer	electronic	z = 6				
Installation [2]		horizontal with integrated clutch housing to the left				
Shift system	4-speed section	forward gears synchronized; reverse gear with constant-mesh				
	Range change and splitter group	synchronized				
Shift actuation	4-speed section	via horizontal turning-shaft shift control [3] with superimposed H shift patternor double H shift pattern [4]				
	Range change group [5]	Superimposed H: changeover effected by means of the preselector switch at the shift lever. Double H [4]: changeover effected independently, triggered by the respective selector motion				
	Splitter group [5]	pilot valve at shift lever				
Weight (without additional equipment) approx. kg		289	315	319 334		
Oil quantity for standard install. [6] approx. l		11	13	13		13.5
for oil change approx. l		8	10	10		11
Oil grade		according to applicable ZF List of Lubricants TE-ML 01 or TE-ML 02				

1) Reference value (depends on vehicle type and vehicle data as well as the prevailing operating conditions).
2) To this end, also observe the ZF guidelines for installing manual transmissions (1203 765 110).
3) To a large extent, the connection for the turning-shaft shift control can be adapted to the vehicle's installation conditions.
4) Option
5) For the required air pressure, observe the ZF guidelines for installing manual transmissions (1203 765 110).
6) Transmission inclination: 0 to 3°.

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2 Description

2.1 Setup

The ZF-New Ecosplit transmission consists of a 4-speed section, a range change and a splitter group.

2.2 Version

4-speed section:
- Synchronized, reverse gear with constant-mesh
- Mechanical operation (turning-shaft shift control)
- Superimposed H shift pattern or double H shift pattern
- Servoshift

Range change group, downstream:
- Synchronized
- Changeover via preselection switch at the shift lever with superimposed H shift pattern (Fig. 1)
- Automatic changeover when switching between shift gates 3/4 and 5/6 with double H shift pattern (Fig. 1a)

Splitter group, upstream:
- Synchronized
- Changeover via preselection switch of splitter group at the shift lever (Fig. 2 and 2a) and completely depressing the clutch pedal.

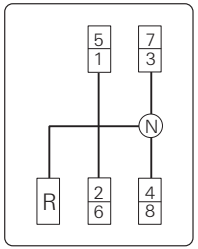


Fig. 1, Example
Superimposed H shift pattern

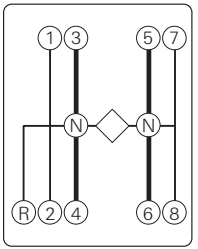
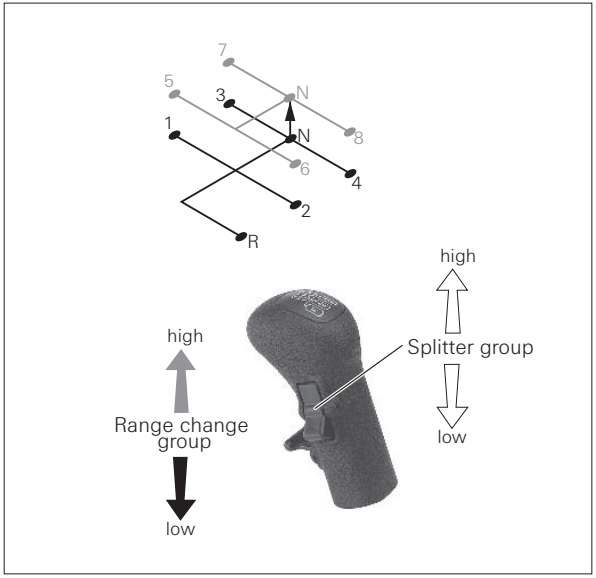


Fig. 1a, Example
Double H shift pattern

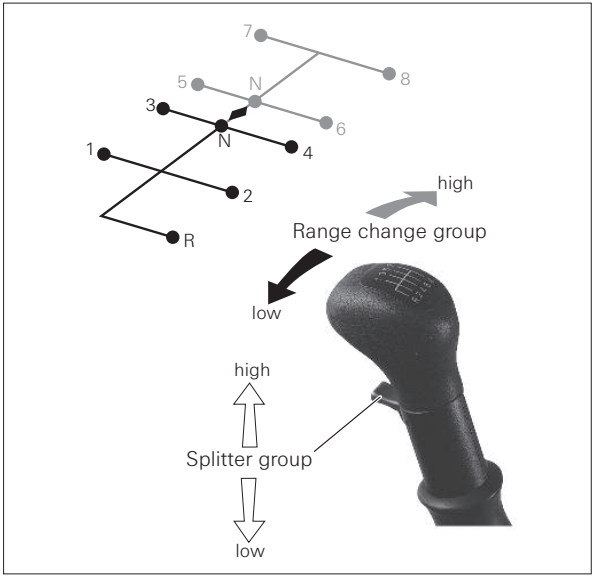
N	Neutral position
R	Reverse gear
1 - 4	Low range change group
5 - 8	High range change group
◇	Automatic changeover (double H)

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Fig. 2
Shift lever* superimposed H



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Fig. 2a
Shift lever* double H

* Depending on the vehicle manufacturer, different shift levers and shift patterns are possible. As example, the standard design is shown. Also note the details provided by the vehicle manufacturer.

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2.3 Shift actuation

Range change group, superimposed H shift pattern

The shift system is divided into 3 parallel shift gates. Shift gates 3/4 and 7/8 have a spring-mounted neutral position. Pneumatically changing the range change group from shift gate 3/4 to shift gate 5/6 and back is done via a preselection switch at the shift lever (Fig. 2).

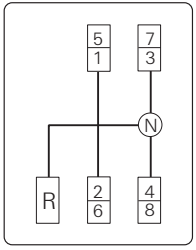


Fig. 3
Shift pattern of the ZF superimposed H shift pattern

Range change group of double H shift pattern

The shift system is divided into 5 parallel shift gates. Shift gates 3/4 and 5/6 have each a spring-mounted neutral position. Spring locking mechanisms with different strengths enable a good orientation in the transmission shift pattern. When changing from shift gate 3/4 to shift gate 5/6 and back, the range change group is changed automatically via the pneumatic changeover.

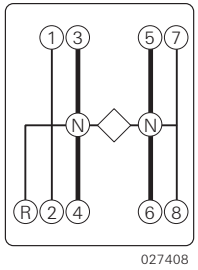
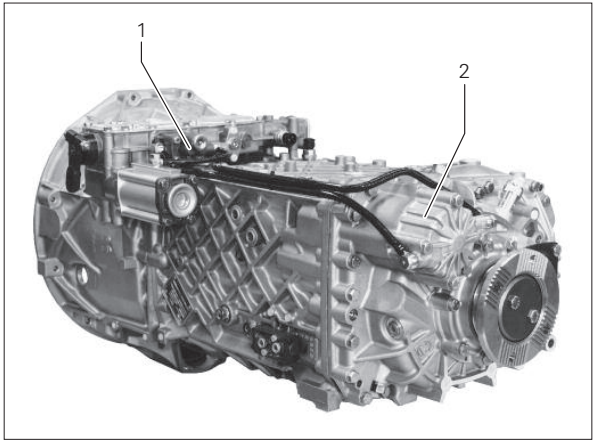


Fig. 3a
Shift pattern of ZF double H shift system

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The control unit of the range change group changeover system consists of the shift valve **(1)** and the pneumatic cylinder with a double effect in the transmission **(2)**.



017853_1

Fig. 4
1 Shift valve
2 Pneumatic cylinder

Splitter group

The splitter group is actuated via a preselection switch at the shift lever (Fig. 2 and 2a). The driver uses this preselection switch to preselect the low or high splitter group which is then triggered by depressing the clutch pedal.

NOTE
- Changeover is triggered when completely depressing the clutch pedal.
- Keep the clutch pedal pressed until the splitter group has changed.

Depending on the vehicle operating conditions, it is possible to split every gear.
Please also note the details provided by the vehicle manufacturer.

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2.4 Auxiliary power units

Depending on the vehicle version, Ecosplit transmissions can be equipped with the following auxiliary power units (Fig. 5):

- Separate heat exchanger for cooling the transmission oil
- **Voith and Telma retarder** can be built in upon request

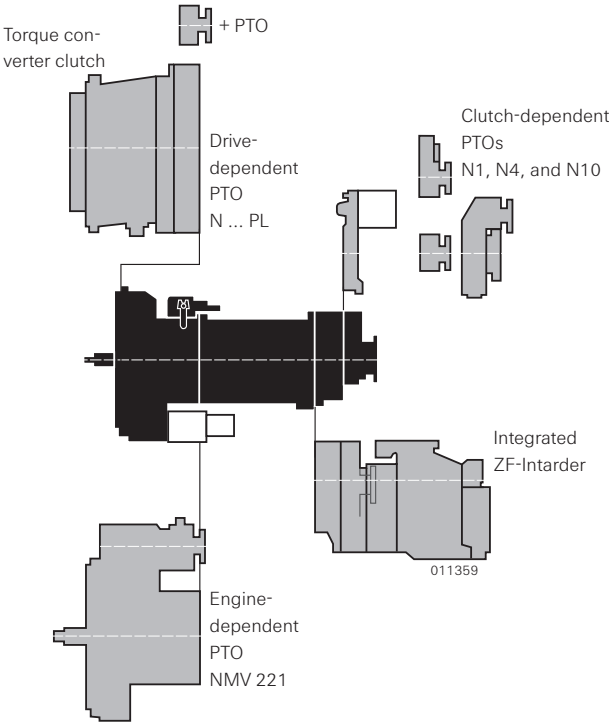


Fig. 5

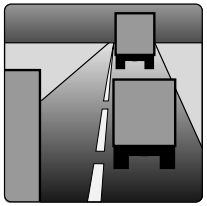
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3 Operation

Cost-effective driving with good fuel economy is assured when the following operating instructions are observed:



- Driving in medium speed range.
- Use the highest gear possible.



- Anticipate traffic conditions ahead.
- Avoid unnecessary braking or acceleration.

3.1 Starting engine and setting off

- Close the parking brake (this prevents the vehicle from starting to roll unintentionally).
- Shift transmission to neutral position.
- Start engine.
- Fully depress clutch pedal.
- Engage gear (preferably 1st gear to protect the clutch).
- Release parking brake and carefully engage the clutch. Note vehicle manufacturer's instructions.

⚠ **DANGER**
When leaving the vehicle when the engine is running, the vehicle might start rolling unintentionally. Engage parking brake!

3.2 Actuating the clutch

- Always fully depress the clutch pedal.

CAUTION
Changing gears when clutch is not completely separated causes wear on the transmission synchronizers.

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3.3 Shifting the transmission

ZF-Ecosplit transmissions are synchronized transmissions. A synchronizer is the synchronizing device for the gears. This makes shifting more comfortable.

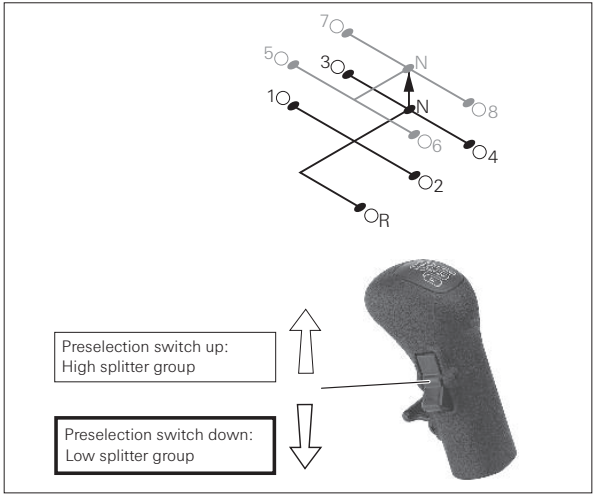
CAUTION
- **Do not operate clutch twice when upshifting.**
- **No intermediate throttle application and no double-clutch whendownshifting, even for downhill and other difficult situations.**

3.3.1 Transmission shift pattern

Superimposed H

The superimposed H shift pattern (Fig. 6) has a spring-mounted neutral position (idle position) in shift gates 3/4 (low range change group) and 7/8 (high range change group).
In order to select shift gates 1/2 and 5/6, move the shift lever in the desired direction pressing against the spring force and hold against this spring force.
The shift lever jumps back to neutral when it is released from the central position of the shift gate.

The shift gate for the reverse gear is protected by a pawl stop and requires more force to be applied.



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Fig. 6
Shift lever with superimposed H shift pattern, preselection-switch of splitter group, and preselection switch of range change group

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Double H shift pattern

The double H shift pattern (Fig. 6a) has a spring-mounted neutral position (idle position) in shift gates 3/4 (low range change group) and 5/6 (high range change group).

In order to select shift gates 1/2 and 7/8, move the shift lever in the desired direction pressing against the spring force and hold against this spring force. The shift lever jumps back to neutral when it is released from the central position of the shift gate.

The low range change group is separated from the high range change group by a stronger spring locking mechanism ("RC hump").

The shift gate for the reverse gear is protected by a pawl stop and requires more force to be applied.

The different levels of spring force provide good orientation within the shift pattern and the gates can be located with reliable certainty.

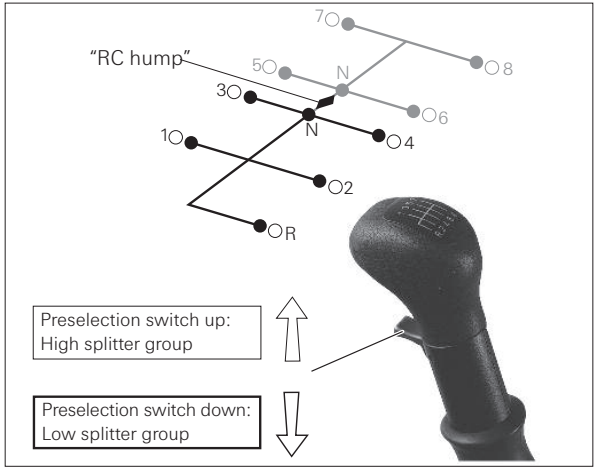


Fig. 6a
Shift lever with double H shift pattern and preselection switch of splitter group

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3.3.2 Changing gears

CAUTION

- **Keep the clutch pedal always completely depressed during the gear shifting in order to avoid damages to the transmission synchronizers.**
- **When shifting up or down, do not shift more than max. two full gear steps (e.g. from 4L to 6L). Shifting gears by more than two gear steps leads to wear of the transmission synchronizers.**
- **To prevent transmission and engine damage, do not shift to the next lower gear before you have decelerated and reached the maximum speed of the intended gear.**
- **When operating the clutch-dependent PTO, the gears shall not be changed (this applies also to a splitter group change) since this leads to wear of the transmission synchronizers. If you have to change gears to adapt the vehicle speed, switch off the PTO.**

- Move shift lever smoothly and without force. This is particularly important when the transmission oil is still cold.

- Move the shift lever with your hand open, as recommended in Fig. 7a.

- When selecting a gear, hold the shift lever against the pressure point until the synchronizing process is completed and the gear has actually engaged.

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Superimposed H

The range change group can be preselected via the preselection switch at the shift lever (Fig. 7).

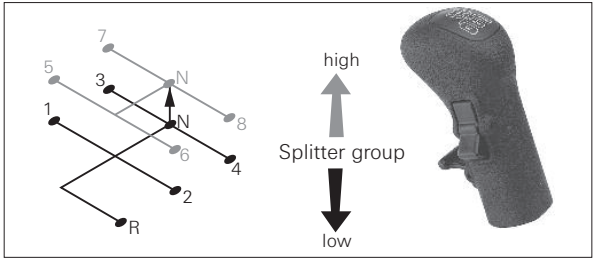


Fig. 7 027412

Upshifting from shift gate 3/4 to 5/6:

- Preselect the high range at the preselection switch.
- Fully depress clutch pedal.
- Shift the transmission into neutral – in doing so, the range change group starts changing over.
- Select shift gate 5/6.
- Engage the 5th gear of the basic transmission – in the mean time, the range change group has changed over to high range.
- Engage the clutch.
- Leave the preselection switch in the selected range.

NOTE

Only operate preselector switch when you want to engage the range change group directly afterwards.

CAUTION

- **Constant shifting with high manual shifting force can cause increased wear on the synchronizer parts.**
- **In order to avoid transmission synchronizer damage, changeover to the low range change group must only be effected when the speed is lower than approx. 28 km/h. During normal driving, the respectively other range change group must be preselected only directly before the actual gearshift. If the range change group is preselected too early, there can be unintended gearshifts during the next gear change due to e.g. quickly changing traffic conditions; this will lead to transmission synchronizer wear.**

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Double H shift pattern

- Changing from shift gates 3/4 into 5/6 or vice versa by quickly hitting the shift lever with the hand. Move shift lever smoothly and without force (Fig. 7a).

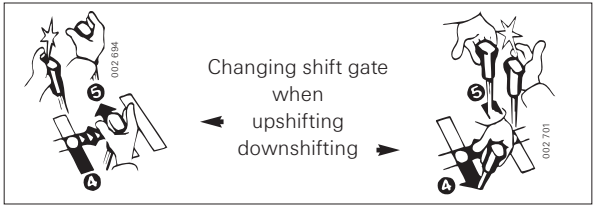


Fig. 7a

NOTE
If the range change group does not change over and a gear cannot be engaged, shift back into the previous shift gate and repeat the gear shifting again at a lower speed.

CAUTION
It is not permitted to change between shift gates 5/6 and 3/4 when the driving speed is higher than approx. 28 km/h. Changing shift gates leads to a changeover in the rear-mounted group synchronizer which will cause early wear when the driving speed is higher than approx. 28 km/h.

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Reverse gear

CAUTION
Only engage reverse gear when the vehicle is standing still.

- Only activate and deactivate the reverse gear with the vehicle standing still.
- Fully depress the clutch pedal at engine idle speed.
- In order to select the R gear shift gate, the R gear locking mechanism has to be overcome.
- Engage reverse gear smoothly and without force.
- Engage clutch slowly.

NOTE
- Grating noise when activating the reverse gear is not permissible.
- Only engage reverse gear once the countershaft is standing still. If the countershaft is not standing still, there will be grating noises when engaging the reverse gear.
- Runout times differ depending on the operating mode and may be reduced by short, initial synchronization of 1st gear. If required, wait longer before actuation.

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3.4 Engaging the PTOs

3.4.1 Clutch-dependent PTOs

The PTOs can be operated with the vehicle standing or driving.

- Only switch the PTO on and off with the vehicle standing still.
- Fully depress the clutch pedal at engine idle speed.
- Switch on PTO.
- Engage clutch slowly and move to operating speed.

NOTE
- Grating noises when activating the PTO are not permissible.
- Only engage PTO once the countershaft has come to a complete stop. If the countershaft is not standing still, there will be grating noises when engaging the PTO.
- Runout times differ depending on the operating mode and may be reduced by short, initial synchronization of 1st gear. If required, wait longer before actuation.

CAUTION
- **Gear changes are not permissible when operating the PTO.**
- **Always switch off the PTO when you park the vehicle for a longer time (e.g. overnight).**

Gear interlock (option)

A gear interlock is required:

- when the vehicle must not be moved in any case while the PTO is activated.
- when the PTO must not be activated while driving. For this reason, a pneumatic ZF gear interlock system is available for all clutch-dependent PTOs which protects the vehicle against operating mistakes. The system is activated automatically.

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3.4.2 Engine-dependent PTOs

Engagement takes place independently of the vehicle clutch.

- Activation and deactivation only when engine is running:
  minimum engine speed 600 rpm
  maximum engine speed 2000 rpm

- Engine-dependent PTO can be operated with the vehicle standing or driving.

NOTE
- When activating the PTO, the following engine speeds shall not be exceeded:
  2000 rpm
  for engine-dependent PTO transmission ratio of 0.98
  1300 rpm
  for engine-dependent PTO transmission ratio of 1.55
- The engine speeds depend on the inertia and drag torques to be shifted.

NOTES
Please refer to operation instructions **1315 758 150**.

3.5 Parking

- Change transmission to the low range change group (1st - 4th gear).

- Apply parking brake.
  Engage gear as **additional** parking interlock:

  – Vehicle **parked** uphill: **Forward gear!**

  – Vehicle **parked** downhill: **Reverse gear!**

- Secure loaded vehicles**additionally** with chocks.

3.6 Tow-Starting

Start engine by tow-starting in high range change group.

CAUTION
To avoid damages to the transmission, the vehicle shall only be tow-started in the high range change group (gears 5 to 8).

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3.7 Towing

It is only possible to tow the vehicle under the following conditions:

- Emergency steering pump installed.
- High range change group selected, shift lever in neutral position.
- Towing distance of max. 100 km.
- The max. permitted towing speed is to be determined depending on the axle ratio and tire size as depicted in the chart (Fig. 8).

NOTE
Vehicle manufacturer specifications must absolutely be observed.

CAUTION
If one of the above-mentioned conditions is not met, the propshaft must be disconnected from the rear axle flange or the axle half shafts must be removed in order to avoid transmission damage.
If you suspect transmission damage, the propshaft must also be disconnected from the rear axle flange or the axle half shafts must be removed.

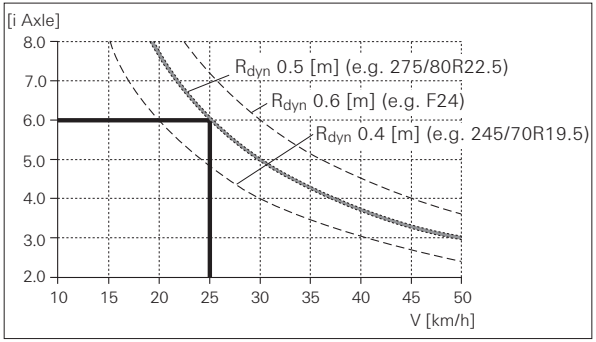


Fig. 8
Reading example: i_{axle} = 6, R_{dyn} = 0.5 m
Towing speed from diagram: V_{max} = 25 km/h

NOTE
Observe the maximum towing speed defined by national legislation.

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3.8 Limp home operation

Trouble when changing range change group (e.g. from shift gate 3/4 to 5/6 or vice versa) can be caused by the following:

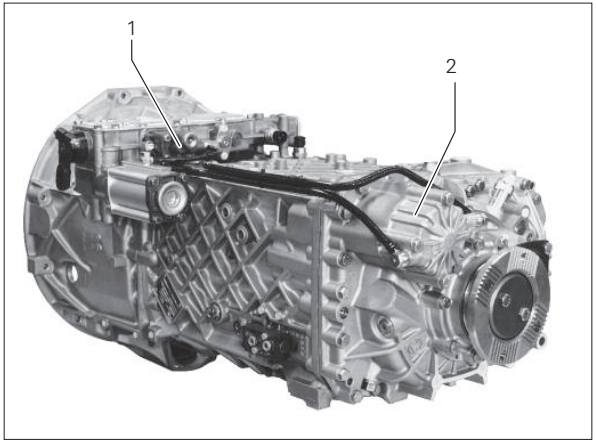
- Line damage in pneumatic system.

- Shift valve **(1)** or shift cylinder **(2)** for the range change group is defective (condensate or contamination).

NOTE
- Continuation of journey is only possible when the low range change group (1st - 4th gear) is selected.
- The vehicle must be towed if the high range change group remains engaged.

3.8.1 Servoshift

When the Servoshift fails, it is still possible to shift the transmission by applying a considerably higher manual force.



017853_1

Fig. 9
1 Shift valve for range change group
2 Shift cylinder for range change group

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3.9 Initial startup of vehicle at low temperatures

The transmission is filled with oil according to ZF List of Lubricants TE-ML 01 or TE-ML 02. At outside temperatures of less than -15 °C, suitability of the oil grade must be checked according to List of Lubricants TE-ML 01 or TE-ML 02. It may be necessary to change the oil in the transmission.
Alternatively, the oil can be preheated before starting the engine. This can be done using hot air which must not exceed a temperature of 130°C on the transmission.

⚠ **DANGER**
When leaving the vehicle when the engine is running, the vehicle might start rolling unintentionally. Engage parking brake.

NOTE
- Starting the engine and setting off, refer to Chapter 3.1.
- Vehicle manufacturer specifications must always be observed.

3.9.1 Parking the vehicle at low temperatures

At outside temperatures below 0 °C, it is to be ensured that the low range change group is selected when the vehicle is parked (shift lever in 1st gear or neutral position of shift gate 3/4).
Vehicle manufacturer specifications must be observed.

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4 Maintenance

Regular maintenance increases the service life of the transmission. It is therefore of particular importance that maintenance intervals are observed.

NOTES
- Please make sure that no plugs, switches, tubes, and pipes are damaged during maintenance.
- The switching system has an essential influence on the transmission's functionality and service life. Avoid damages.
- Only do maintenance works when the vehicle is standing still.
- During maintenance work, also check the transmission for seal tightness.
- Observe the maintenance information provided by the vehicle manufacturer.

4.1 Transmission fluid

4.1.1 Oil grade

NOTE
- When filling transmissions, only the oils specified in the latest applicable version of the ZF List of Lubricants TE-ML 01 or TE-ML 02 are authorized.
- The List of Lubricants can be obtained from all ZF Service Centers or downloaded at www.zf.com.
- We recommend that you use ZF-Ecofluid M.

4.1.2 Oil fill quantity

The key requirement for the precise oil quantity is that the oil fill is performed correctly (see Chapter 4.2.2). The oil quantity is shown on the type plate (attached to the side of the transmission) and in the Technical Data (refer to Chapter 1).

For oil level check, refer to Chapter 4.3.

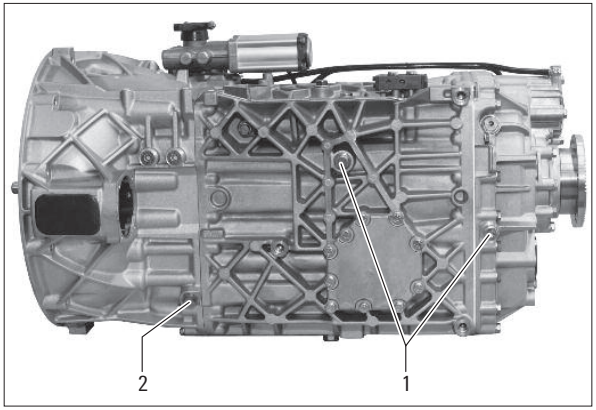
4.1.3 Oil change interval

For oil change intervals, refer to the ZF List of Lubricants TE-ML 01 or TE-ML 02.

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4.2 Oil change

4.2.1 Oil drain



017850

Fig. 10
View from below,
1 Drain plug (tightening torque: **60 Nm**)
2 Oil drain plug with magnetic plug (tightening torque: **60 Nm**)

CAUTION
Oil must not be allowed to enter the soil, ground water, or sewage system. Collect overflowing oil in a suitable container and dispose of in accordance with environmental guidelines.

NOTE
Generally: Change oil after a longer journey while the transmission oil is still at operating temperature and of low viscosity.

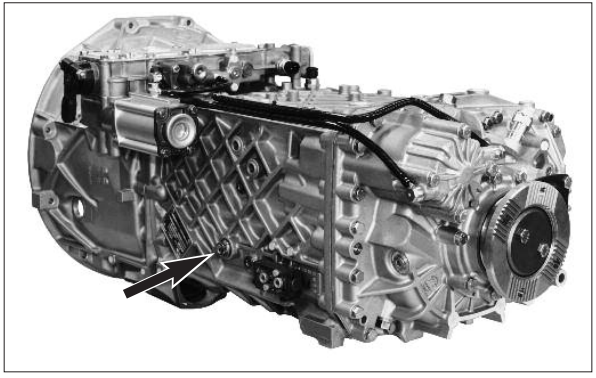
⚠ **DANGER**
Touching the hot transmission and transmission fluid may result in burns!

- Unscrew oil drain plugs on the transmission **(Fig. 10, pos. 1** and **2)** and collect the old oil in a suitable container and dispose it in an environmentally friendly way.
- Clean oil drain plugs **(1)**, replace sealing ring, and tighten it to **60 Nm**.
- Clean oil drain plug and magnetic plug **(2)**, replace sealing ring, and tighten to **60 Nm**.

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4.2.2 Oil fill

- Unscrew oil filler plug.
- Top up oil through oil filler hole (Fig. 11).
- The oil level is correct when it has reached the bottom edge of the filler hole and/or when oil is already escaping out of the filler hole.
- Tighten oil filler plug to **60 Nm**.



017853

Fig. 11
Position of oil filler plug(tightening torque: **60 Nm**)

4.3 Oil level check

CAUTION
Too less oil in the manual transmission leads to transmission damages.

Check the transmission oil level at regular intervals:

- Check oil level when vehicle is on level ground.
- Do not perform oil level check right after travel (this will produce an incorrect measurement). Only check once the transmission oil has cooled down (<40 °C).
- Unscrew oil filler plug (Chapter 4.2.2).
- If the oil level has fallen below the oil filler hole, oil must be topped up (Chapter 4.2.2).
- Tighten oil filler plug to **60 Nm**.

NOTE
During every check, the transmission is also to be checked for leakage.

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4.4 Transmission maintenance for versions with heat exchanger

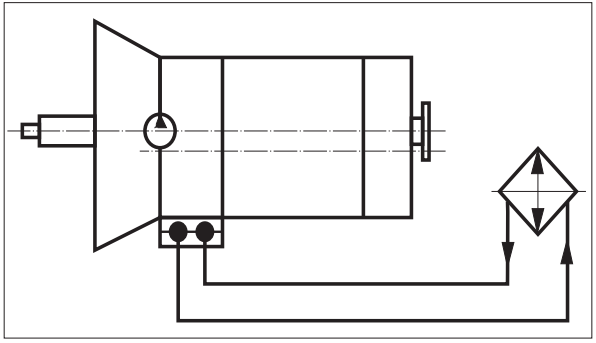
NOTE
Perform maintenance works as described in Chapters 4.1 to 4.3.

Also note the following points:

- **Draining the oil:**
  - Unscrew oil drain plug on heat exchanger (if available).

- **Filling the oil:**
  - After the oil overflow check (Chapter 4.2.2), screw in oil filler plug.
    Tightening torque: 60 Nm.
  - Shift transmission to neutral position.
  - Let the engine run for approx. 2-3 minutes at around 1200 rpm. This is necessary for the heat exchanger and the connecting lines to be fully filled with oil.
  - Switch off the engine.
  - Refill with oil again until it overflows.

- **Check:**
  - Let engine run at idle speed for approx. 3 minutes.
  - Shift transmission to neutral position.
  - Switch off the engine.
  - Check oil level, refer to Chapter 4.3.



000508

Fig. 12
Scheme: Ecosplit transmission with heat exchanger

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4.5 Transmission maintenance for versions with clutch-dependent PTOs

The clutch-dependent PTOs do not influence the oil filling and oil level check of the manual transmission. Depending on the PTO, the required oil quantity increases by up to 0.5 dm^3.

4.6 Checking the clutch

To guarantee the function and service life of the synchronizers, it is absolutely required that the clutch separates completely. This is also true for the clutch-dependent PTOs.

The correct separation of the clutch is checked as follows:

- Engine at operating temperature in idle position.
- Fully depress clutch pedal.
- Engage the R gear slowly after maximum 20 seconds*.

If “grating” of the meshing gears occurs (brushing noise of override clutch), resetting or checking the clutch is required.

* dependent on the flywheel mass and the temperature

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4.6.1 Checking release valve of clutch pedal

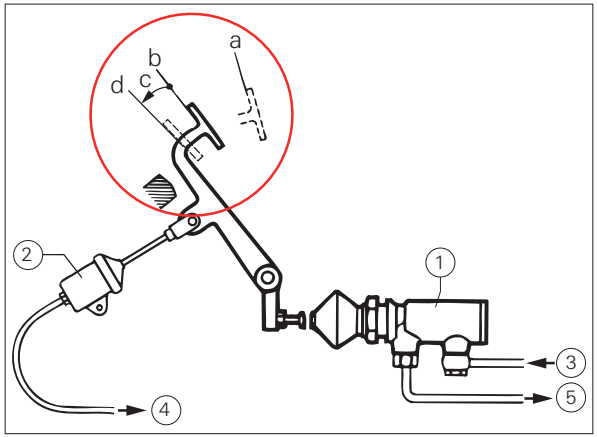
Before the splitter group can be activated via the release valve **(1)**, the clutch must be fully separated. The complete separation of the clutch must take place before reaching 70% of the pedal travel.

CAUTION

- **At the earliest, servo air release may be effected after another 10% of the pedal travel, in relation to the clutch separation point.**
- **If the release valve is incorrectly set, the synchronizers could be destroyed when activating the splitter group.**

Inspection

- Clutch must be set according to the provisions of the vehicle manufacturer.
- Adjusting screw on the clutch pedal must be set in such a way as to prevent the release valve **(1)** from responding until it enters the excessive travel range **(c)**.
- In position **(b)**, the clutch is fully separated (for check, see Chapter 4.6).



027413_1

Fig. 13
a Position “Clutch closed”
b Position “Clutch completely separated”
c Excessive travel range of the clutch
d End stop
1 Release valve for splitter group
2 Master cylinder for hydraulic clutch actuation
3 from the pneumatic tank
4 to the clutch slave cylinder
5 to the relay valve of the splitter group

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4.7 Venting the transmission

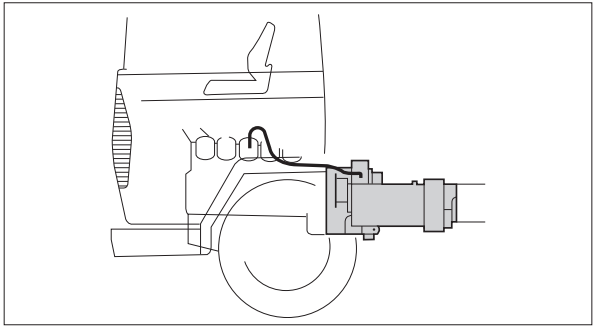
The transmission oil heats up during driving. This results in the formation of excess pressure which is continuously reduced via a bleed valve.

NOTE
Check venting system during each vehicle inspection.

4.7.1 Hose breather

Vehicles like, for instance, milk tankers, concrete mixers, etc. have to be cleaned frequently due to their application. For this reason, these vehicles should be equipped with a hose breather.

- The hose must be routed without any kinks or loops.
- The end of the hose must terminate in a dry area, e.g. in the engine compartment or in a chassis cavity.
- Do not direct pressurized water directly at the end of the hose.



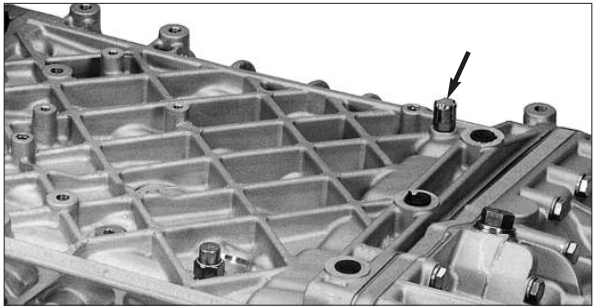
023684

Fig. 14
Hose bleeding

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4.7.2 Breather

Make sure that the breather is cleaned and not clogged. The breather must be clean and shall not be covered. Do not direct pressurized water at it (water in the transmission: risk of corrosion).



017083

Fig. 15
Breather

4.8 Compressed-air system maintenance

Condensate accumulates in every compressed-air system. To prevent any condensate, rust, water, and other impurities of the compressed-air reservoirs from entering the valves or shift cylinders, **regular maintenance** of the compressed-air system is required.
The compressed-air reservoirs must be drained once a week (or daily in winter).

NOTE
Together with the pneumatic tanks, also the compressed-air cleaner is to be drained by means of a water separator, unless the latter operates automatically.

Please also note the details provided by the vehicle manufacturer.

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4.9 Type plate

The type plate contains the key data. It is fitted on the left of the transmission when viewed in the direction of travel.

The following information must always be stated when making inquiries, placing orders, or carrying out repairs:

1. Transmission parts list number
2. Transmission type
3. Transmission serial no.

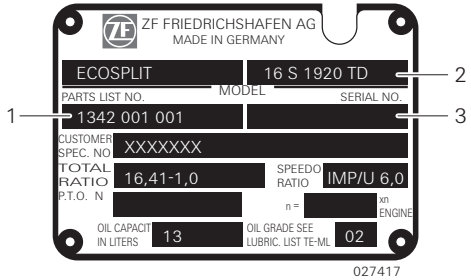


Fig. 16 Type plate (example)

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Driveline and Chassis Technology

EN 1341 758 101b - 2012-05

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Betriebsanleitung
Operating Instructions
Manuel d'Utilisation
Manual de Servicio
Istruzioni per l'Uso

ZF-INTARDER

The **In**tegrated Re**tarder** for Trucks and Buses With ZF Transmissions

ECU 42 Control Unit

6085 758 102c

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Subject to technical changes

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Edition: 2009-10

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Trucks:

ZF-Ecosplit

16 S 151 IT
16 S 181 IT
16 S 221 IT
16 S 251 IT
16 S 1621 TD
16 S 1821 TO
16 S 1921 TD
16 S 2221 TD/TO
16 S 2521 TO
16 S 2721 TO

ZF-Ecomid

9 S 109 IT
16 S 109 IT
9 S 1111 TD/TO
9 S 1311 TO

ZF-AS Tronic

12 AS 2301 IT
16 AS 2601 IT
12 AS 1631 TD
12 AS 1931 TD/TO
12 AS 2131 TD/TO
12 AS 2331 TD/TO
12 AS 2341 TD
12 AS 2541 TD/TO
12 AS 2741 TO
16 AS 2231 TD
16 AS 2631 TO

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BUS:

8 S 180 IT	8 S 2101 BD
	8 S 2101 BO
6 S 1600 IT	6 S 1601 BD
horizontal (to the right) and	6 S 1701 BO
heat exchanger at bottom	6 S 1901 BO
6 S 1600 IT	6 S 1601 BD
vertical	6 S 1701 BO
heat exchanger on the right	6 S 1901 BO
6 S 1600 IT	6 S 1601 BD
horizontal (to the right) and	6 S 1701 BO
heat exchanger on the right	6 S 1901 BO
10 AS 2010 B IT	10 AS 2001 BD
10 AS 2310 B IT	10 AS 2001 BO
	10 AS 2301 BD
	10 AS 2301 BO
	10 AS 2701 BO
12 AS 2000 B IT	12 AS 2001 BO
12 AS 2300 B IT	12 AS 2301 BO
	12 AS 2701 BO

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Before first operating the ZF-Intarder, we kindly ask the driver:

- **To thoroughly read the operating instructions in the present manual in order to properly use the Intarder in an efficient manner.**
- **To pay attention to the maintenance instructions in order to warrant smooth Intarder operation.**
- **To note the special instructions provided by the vehicle manufacturer. These details are binding in all cases.**

The ZF Customer Service specialists are available to assist you in carrying out maintenance work or to help if any other problems arise with the transmission and the ZF-Intarder. The individual addresses are listed in the "ZF Company Directory" (order number: 0000 762 703) which on request we would be only to pleased to send you.

NOTE
These Operating Instructions describe the standard version. Customer-specific deviations are possible.

Motoring pleasure with the ZF-Intarder is brought to you by

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Commercial Vehicle and Special Driveline Technology
D-88038 Friedrichshafen
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Fax: +49 (0) 75 41 / 77-908000
Internet: www.zf.com

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The following safety instructions appear in the present operating instructions:

NOTE
Refers to special processes, techniques, information, etc.

CAUTION
This is used when incorrect, unprofessional working practices could damage the product.

⚠ **DANGER!**
This is used when lack of care could lead to personal injury or material damage.

⚠ **THREATS TO THE ENVIRONMENT!**
Lubricants, consumables, and cleaning agents must not be allowed to enter the soil, ground water, or sewage system.

- **Ask your local environment agency for safety information on the relevant products and adhere to their requirements.**
- **Collect used oil in a suitably large container.**
- **Dispose of used oil, dirty filters, lubricants, and cleaning agents in accordance with environmental protection guidelines.**
- **When working with lubricants and cleaning agents always refer to the manufacturer's instructions.**

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Preface 5

Safety Instructions 6

1 General Safety Instructions Intarder 9

2 Description 11

3 Use 13

3.1 Operation at Low Temperatures 13

3.2 Intarder Master Switch 14

3.3 Intarder Check Display 14

3.4 Constant Braking Step Operations 16

3.5 BREMSOMAT Function 18

3.5.1 ZF Braking Step Lever (Standard) 19

3.6 Bremsomatic Function (Bremsomatic operation depends upon the vehicle) 20

3.6.1 ZF Braking Step Lever (Bremsomatic) 21

3.7 Deleting the Flash Code Output and the Error Memory 22

3.8 Flash Code Error List 24

4 Maintenance 27

4.1 Oil Level Check 27

4.2 Type Plate 28

4.3 Oil Drain 29

4.4 Trucks: Oil Drain, Oil Overflow, and Oil Filler Plugs 30

4.5 Bus: Oil Drain, Oil Filler, and Oil Overflow Plugs 33

4.6 Oil Filter Replacement 39

4.7 Oil Fill 40

4.8 Engine Coolant 41

4.8.1 Drain Residual Coolant at the Alu Heat Exchanger 42

4.8.2 Drain Residual Coolant at the Stainless Steel Heat Exchanger 43

4.9 Bleeding the Intarder 44

Truck Maintenance 45

Bus Maintenance 46

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1 General Safety Instructions Intarder

⚠ **DANGER !**
Make cautious use of the Intarder:
Icy roads, rainy road surfaces, unladen vehicle, tractor operation only.



RISK OF ACCIDENT!

Your vehicle may start skidding.

In the case of vehicles without ABS equipment, increased skidding danger arises which may be caused by incorrect Intarder operation. In order to avoid such uncontrolled behavior, please switch off the Intarder main switch.

- If your vehicle is equipped **with** an **ABS or EBS brake system**, then, the Intarder braking process is interrupted as long as the ABS/EBS system is active. Subsequently, the operating mode last engaged with the Intarder becomes active again.

- Intarder use does **not** impact the operation of the manual transmission.
  Intarder brake power remains unaltered with **depressed clutch pedal** (for gear change).

- If your vehicle is equipped with an **engine brake**, then these can be activated in addition to the Intarder.

CAUTION
Prior to and during downhill travel, you have to ensure that the engine speed does not fall below n = 1 600 rpm. Depress the clutch pedal only briefly for a gear change. Avoid coasting downhill or driving downhill with depressed clutch pedal because adequate cooling of the engine cooling water is then not ensured.

- **Please shift down one gear, if needed, in order to increase the speed and thus the water pump and fan performance.**

If, nevertheless, the max. cooling water temperature is attained, then the Intarder electronics are managing the Intarder automatically and reduce the brake torque to the highest still admissible level (Intarder re-setting).

- **The reduced braking performance must be considered by means of the corresponding driving style (selection of gear, engine brake, or service brake).**

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2 Description

The ZF-Intarder is a wear-free operating, hydrodynamic additional brake which is integrated into the transmission.

It reduces the wear of the wheel brakes,

- during braking down from higher speeds.
- when riding along downhill tracks.

The ZF-Intarder contributes to a smoother and more economic driving style.

The advantages of the ZF-Intarder are:

- High level of braking performance;
- Short response times;
- Joint oil circuit with the manual transmission and thus, joint oil change intervals;
- Low weight;
- Low constant operating temperatures of the transmission thanks to integrated, consistent cooling.

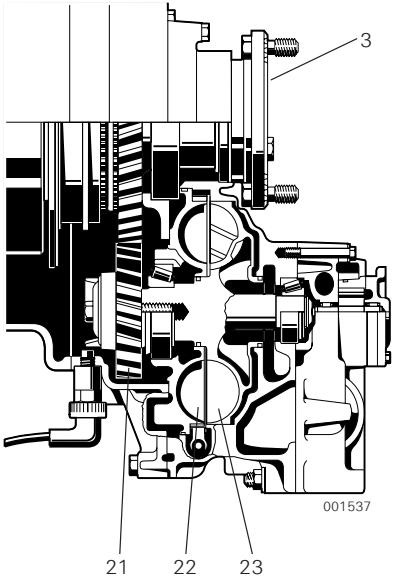


Fig. 1
Setup of the ZF-Intarder; example on the basis of the ZF-Ecosplit transmission: **3** = Transmission output flange
21 = Spur gear stage
22 = Stator
23 = Rotor

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3 Use

3.1 Operation at Low Temperatures

Vehicle manufacturer specifications MUST be observed.

Outside temperature	Down to −20 °C	−20 °C to −30 °C	−30 °C to −40 °C
Oil grade	In accordance with ZF-List of Lubricants TE-ML 02	In accordance with ZF-List of Lubricants TE-ML 02	In accordance with ZF-List of Lubricants TE-ML 02
Engine start	Permitted	Permitted	Transmission must be preheated before the engine is started.
When starting, note	–	Warm-up phase of at least 10 minutes, with increased idling speed of approx. 1 500 rpm.	This can be done e.g. with warm air which must not exceed 130 °C on the transmission. **CAUTION** **Do not heat on the transmission and clutch actuator.**
Limitations	None	At transmission temperatures in excess of −20 °C, the transmission is operable and all functions are provided. Longer shift times should be expected.	At transmission temperatures in excess of −20 °C, the transmission is operable and all functions are provided. Longer shift times should be expected.

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3.2 Intarder Master Switch

The Intarder is switched on or off with the main switch (98). This applies also for actuation during travel. The main switch is installed in the dashboard.

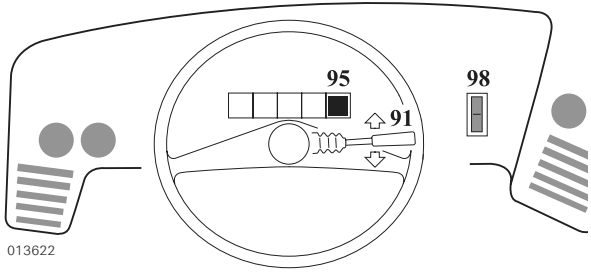


Fig. 2 Dashboard (example)
95 = Intarder check display
91 = Braking step lever
98 = Intarder main switch

3.3 Intarder Check Display

The Intarder check display lights up during Bremsomat operation i.e. when the Intarder is active as well as during the consistent braking steps.

NOTE
Please check whether the Intarder functions correspond with the subsequently described illuminated displays.

Upon engagement of the ignition and the Intarder main switch position “ON”, the Intarder system automatically checks the functioning of the check display.



The check display lights up for 3 seconds.



In the case of a defect of the electric facility, **the check display flashes with the Intarder engaged.**

Please take your vehicle to the next ZF service workshop.

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Error code output via the flash code, also refer to 3.7.

In addition to the normal functions, the Intarder check display outputs the flash code (error number), also refer to Chapter 3.7, flash code output.

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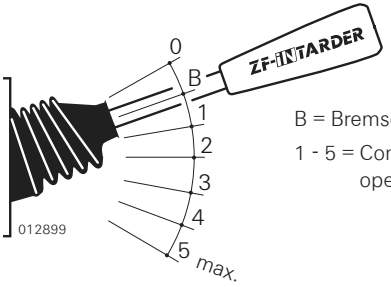
3.4 Constant Braking Step Operations

The Intarder's braking effect increases consistently from the first to the last braking step, in line with the lever's position.

The Constant Braking Step function leads to unintended vehicle deceleration (relieving the service brake system).

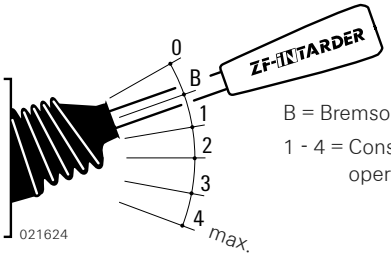
- **Activation of the constant braking step operation.**
  Set the braking step lever in the position from 1 to max. In line with the preselected position, the vehicle is consistently decelerated.

  In Position **1** = slight deceleration up to
  position **max.** = strong deceleration.



B = Bremsomat

1 - 5 = Constant braking step operations



B = Bremsomatic

1 - 4 = Constant braking step operations

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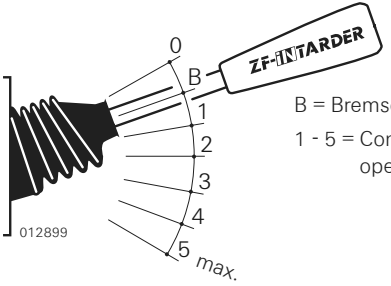
- **Deactivation of the constant braking step operations**

  The braking step lever is either

  - in the position **0** or
  - in the position **B** = BREMSOMAT function and/or BREMSOMATIC function (applications depend upon the vehicle manufacturer).

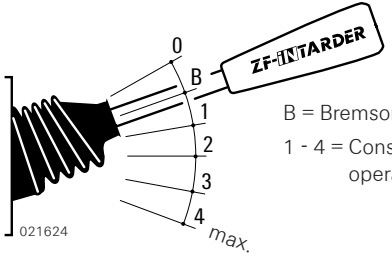
NOTES

- If the **required braking performance is greater than the maximum braking performance of the Intarder**, then, additionally, the engine or service brakes must be actuated.
- Please consider Chapter **1, General Safety Instructions Intarder.**



B = Bremsomat

1 - 5 = Constant braking step operations



B = Bremsomatic

1 - 4 = Constant braking step operations

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3.5 BREMSOMAT Function

(Bremsomat operation depends upon the vehicle)

By means of this functions, you can keep the velocity of your vehicle during downhill travel at the requested constant value.
The Intarder electronics automatically set the required level of braking torque.
Upon actuation of the accelerator pedal, the Bremsomat function is automatically interrupted and after releasing the accelerator pedal, the current speed is set.

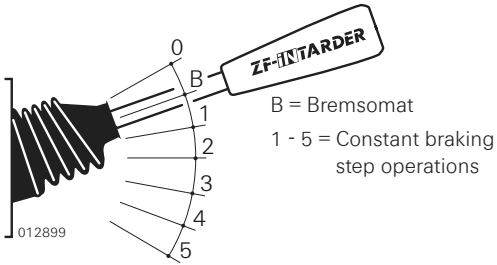
NOTES

- If, in the case of downhill travel, the **required braking performance is greater than the maximum braking performance of the Intarder**, then, additionally, the engine or service brakes must be actuated.
- If the **current driving speed is smaller than the set velocity**, then the Intarder remains functionless. Once the velocityagain attains the saved value, the Intarder becomes active again.

CAUTION
When programming cruise control and Bremsomat at the same time, ensure that the speed set for the cruise control is lower than that selected in Bremsomat operation.
Otherwise, the two functions will work again one another!

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3.5.1 ZF Braking Step Lever (Standard)



BREMSOMAT = constant speed during downhill travel

- ***Set and maintain the velocity:***
  Engagement of step **B** = Bremsomat activated.

The current traveling speed is now saved to the electronics and maintained during downhill travel.
During Bremsomat operation, the required brake torque is automatically set in a continuously variable manner.

Check display continuously lit:
- if the Intarder is active.

The Bremsomat function is only working in step **B**.

NOTE
If the braking step lever is set back into position **B** after engaging constant braking step operation and the automatic speed control becomes effective with the **current** speed.

- ***Deleting the Bremsomat function:***
  Set the braking step lever either

  - to position **0** or

  - to position **1 - 5** (= **constant braking step operation**).

  - in position **B and accelerator pedal actuated**
    (as soon as the accelerator pedal is **no** longer actuated, renewed Bremsomat activation with **new current** speed).

Check display OFF:
- in position **0**;
- always if the Intarder is **not** active.

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3.6 Bremsomatic Function

(Bremsomatic operation depends upon the vehicle)

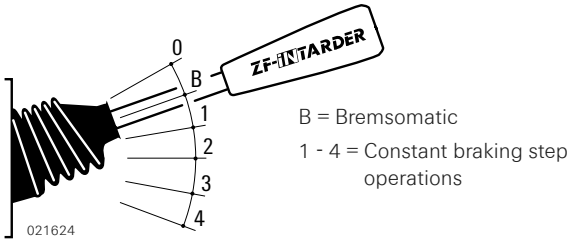
Function as with Bremsomat in position **B**, however, the respectively current speed is set after releasing the accelerator pedal, the brake pedal, or the engine brake.

Advantages Bremsomatic:

- Cruise control and Bremsomatic may **not** operate against one another.
- The braking step lever remains in position **B**. Continuous, manual intervention via the braking step lever is **not** required.

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3.6.1 ZF Braking Step Lever (Bremsomatic)



BREMSOMATIC = constant speed during downhill travel

- **Set and maintain the velocity:**
  Engagement of step **B** = Bremsomatic activated.

The current travel speed is now saved to the electronics and maintained during downhill travel.
During Bremsomatic operation, the required brake torque is set automatically in a continuously variable manner.

The Bremsomatic function is only working in step **B**.

NOTE
If the braking step lever is, after engagement of the constant braking step operation, set back into position **B**, then the automatic speed control becomes effective with the **current** speed.

- **Deleting the Bremsomatic function:**
  Set braking step lever either

  - to position **0** or

  - to position **1-4** (= constant braking step operation).

- **Change the velocity and save the new value:**
  Change the speed by actuating

  - the accelerator pedal, or
  - the brake pedal, or
  - the engine brake,

  and the **new** speed will be automatically saved.

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3.7 Deleting the Flash Code Output and the Error Memory

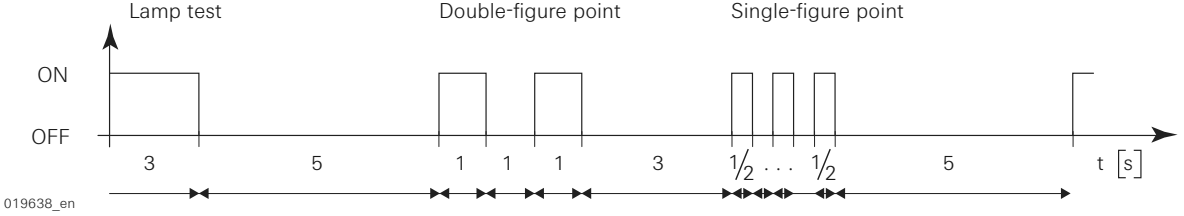
The flash code output (error number) and error memory deletion can be triggered via the brake step lever. The flash code is output by the Intarder check display.

Prompting of flash code output
Example for 5-stage braking step lever.

1. Switch ignition off.
2. Set braking step lever to **a stage below the max, braking step**, here position 4.
3. Switch on ignition and wait for continuous light (3 seconds) or flashing (5 seconds) of the Intarder check display.
4. Within 5 seconds time, the braking step lever is set to **two stages below the max. braking step** (here, position 3) and subsequently again to the position **of one stage below the max. braking step** (here, position 4).
5. Wait for flash code output (also refer to: “Intarder check display functions”).

In addition to the normal functions, the Intarder check display outputs the flash code (error number).
If the flash code output is triggered via the braking step lever, then, upon completion of the lamp tests and/or after conclusion of the 5-second-term flashing (in case of error), the error numbers saved to the error memory are output in the respective order.

Example error number 23



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Clearing error memory

1. Switch ignition off.
2. Braking step lever in position 4 (max. position -1).
3. Switch on ignition and wait for continuous light (3 seconds) or flashing (5 seconds) of the Intarder check display.
4. Within the 5 seconds, the braking step lever is set to position 3 (max. position -2), again to position 4 (max. position -1), and then back to position 0.
5. All errors displayed via the flash code output are deleted for the flash code output.

With the flash code output, only error which do not impede functions, can be read out of the control unit. Errors which do not impact the function of the control unit can only be read out by means of an external diagnosis device.
Deleting the error memory by means of the braking step lever leads to the fact that the errors entered into the error memory become invisible for the flash code output. For the external diagnosis device, all errors are still visible until they are deleted by means of the diagnosis device.

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3.8 Flash Code Error List

NOTE
This error list represents a “compressed summary“ of all possible individual errors. Error types such as interruptions and/or short circuit, may be read out from the error memory of the ZF control unit (ECU) for optimal diagnosis. Please feel free to turn to your ZF Service Center at your location.

Error code	Importance
11	El. defect - accumulator charge valve
12	El. defect - control engine brake
13	El. defect - control Intarder check display
14	El. defect - control “performance reduction” warning light
15	El. defect - control brake lights
16	El. defect - control error light
17	El. defect - switch off cruise control at constant braking step
18	El. defect - supply braking step lever
19	El. defect - control proportional solenoid (AIP)
21	El. defect - reset proportional solenoid (ADM1)
23	Error proportional solenoid (control unit / ECU internal)
24	Control LED lamp (braking step lever defective)
25	El. defect - control Bremsomat, switch off at Bremsomat active

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Error code:	Importance
26	Control flash code lamp defective
31	El. defect - speed sensor
32	El. defect - temperature sensor
33	Braking stage selector lever inputs not plausible
34	El. defect - engine speed sensor
41	CAN message EEC2 defective
42	CAN message TSC1 defective
43	Sending error of CAN messages
44	CAN BUS off
45	CAN message EBC1 defective
46	Communication error CAN messages
47	CAN message EEC1 defective
48	CAN message TCO1
49	CAN message CCVS defective
51	Engine brake CAN message ERC1 defective
52	CAN message ETC1 defective
53	CAN message ETP defective
54	Vehicle computer CAN message ERC1 defective

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Error code	Importance
55	Vehicle computer CAN message TSC1 defective
56	CAN message TIME/DATE defective
57	CAN message HRVD
58	CAN message ABS defective (IES-ID 512)
59	CAN message FMR1 defective (IES-ID 592)
61	CAN message FMR2 defective (IES-ID 593)
62	CAN message EPS1 defective (IES-ID 556)
63	CAN message BC_DR
64	ExtensionBox CAN message TSC1
65	Adaptive Cruise Control (ACC) CAN message TSC1
66	Transmission 2 CAN message ETC1 defective
67	CAN message EPS2 defective (IES-ID 557)
71	Interruption Term. 30
72	Undervoltage/Overvoltage Term. 15
81	Faulty parameterization
82	Hour meter loss
83	Error memory loss
84	Defect Intarder control unit (ECU)

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4 Maintenance

CAUTION
The present maintenance section SUPERSEDES the corresponding sections of the maintenance instructions for your manual transmission!

4.1 Oil Level Check

⚠ **DANGER !**
Too little oil in the transmission will result in transmission damage: Risk of accident!

CAUTION
To check the oil level, the Intarder must not be activated straight after the vehicle is shut down.
This ensures that the correct oil volume is measured in the transmission.

NOTES
- In order to avoid incorrect measurements, the oil level checks for the transmission with ZF-Intarder is to be effected with:
  - Vehicle in stationary position,
  - Engine turned off, and
  - Transmission oil cooled down (< 40 °C).
- Check the transmission's oil level at regular intervals.
- Please, pay particular attention to possible leakages:
  - Transmission,
  - Intarder,
  - Oil/Water heat exchanger,
  - The corresponding cooling water pipes.

CHECK:
- Leave your vehicle in stationary position without actuating the Intarder.
- In the case of the oil level checks, the oil overflow plug position 4 is to be opened.
- If the oil level has dropped below the margin of the oil overflow orifice, then the oil must be refilled via the oil overflow orifice until it overflows.
  Screw in oil overflow plug (**4**) together with new sealing ring (tightening torque, also see pages 45 and 46).

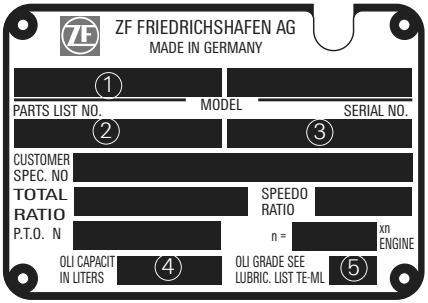
https://truckmanualshub.com/

4.2 Type Plate

The type plate contains the important key data. It is located on the side of the Intarder housing.

The following pieces of information must always be given when making inquires, placing orders, or undertaking repairs:

1. Transmission type:
2. Parts list no. of the Intarder
3. Volume production no. of the Intarder
4. Oil volume
5. List of Lubricants



Type plate (example)

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4.3 Oil Drain

CAUTION
The Intarder may NOT be actuated directly after switching off the vehicle's engine for oil change purposes.
This ensures that the correct oil volume is measured in the transmission.

NOTES
In the case of an oil change, the oil must be drained into a suitable container and must be disposed of in an environmentally-friendly manner.
Basics: Change the oil after a long journey while the transmission oil is still hot and thin.

- Park vehicle on horizontal ground and turn off engine.
- For draining the oil, the oil drain plug is to be unscrewed at the transmission (position 1) and the drain plug from the oil filter housing (position 2).

⚠ **DANGER !**
When transmission oil is hot:
RISK OF BURNS!

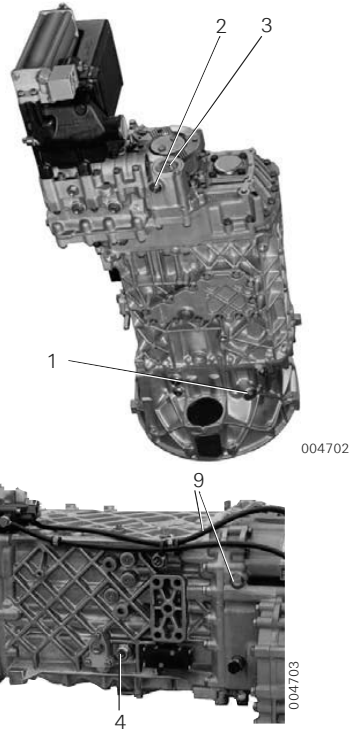
- After draining the oil, the drain plugs (magnets) must be cleaned and the sealing rings must be renewed.
- Fit new filter.
- Subsequently screw in drain plugs again.

CAUTION
Pay attention to the predetermined tightening torque in table on pages 45 and 46 (T_A) for the drain plugs; otherwise, transmission damage may occur!

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4.4 Trucks: Oil Drain, Oil Overflow, and Oil Filler Plugs

Fig. 1
e.g.
Ecosplit transmission



Alternatively, the heat exchanger can be mounted at the bottom-end, horizontally, to the truck transmission.
Oil maintenance items in line with the transmission type.

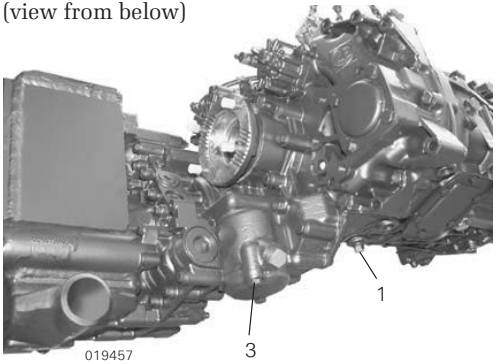


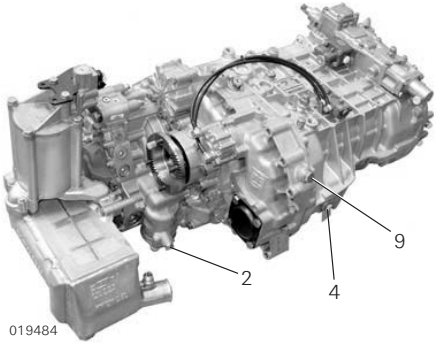
1 = Oil drain location transmission
2 = Oil drain location Intarder housing
3 = Oil filter cover Intarder housing
4 = Oil overflow and oil fill after oil change
9 = Oil filler plug after repair

Tightening torques refer to table on page 45.

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Fig. 2 e.g.
Ecomid transmission 9/16 S 109 with ZF-Intarder (view from below)





Alternatively, the heat exchanger can be mounted to the bottom-end, horizontally, to the truck transmission.
Oil maintenance locations in line with the transmission type.

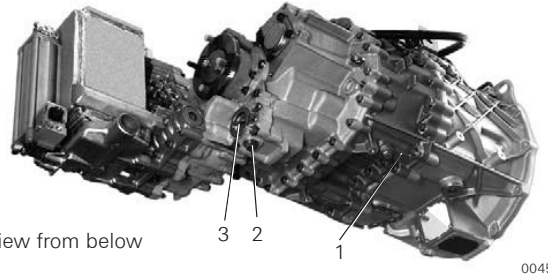


1 = Oil drain location transmission
2 = Oil drain location Intarder housing
3 = Oil filter cover Intarder housing
4 = Oil overflow and oil fill after oil change
9 = Oil filler plug after repair

Tightening torques refer to table on page 45.

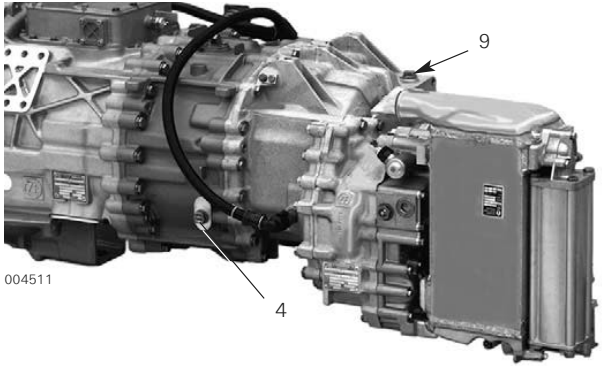
https://truckmanualshub.com/

Fig. 3
Ecomid transmission e.g.
12 AS 2301 / 16 AS 2601
(with ZF-Intarder)



View from below

004512



004511

Alternatively, the heat exchanger can be mounted to the bottom-end, horizontally, to the truck transmission.
Oil maintenance locations in line with the transmission type.



009552

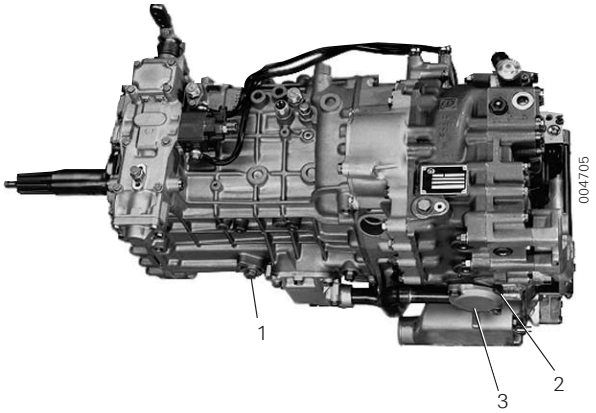
1 = Oil drain location transmission
2 = Oil drain location Intarder housing
3 = Oil filter cover Intarder housing
4 = Oil overflow and oil fill after oil change
9 = Oil filler plug after repair

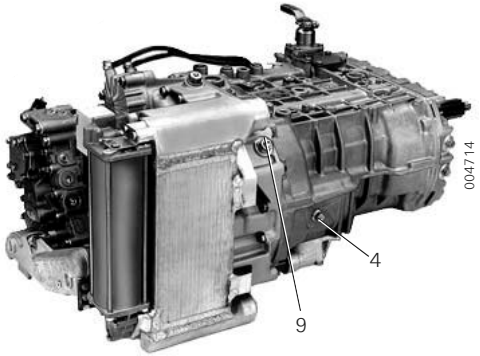
Tightening torques refer to table on page 45.

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4.5 Bus: Oil Drain, Oil Filler, and Oil Overflow Plugs

Fig. 4
Transmissions 8 S 2101 BD/BO with ZF-Intarder



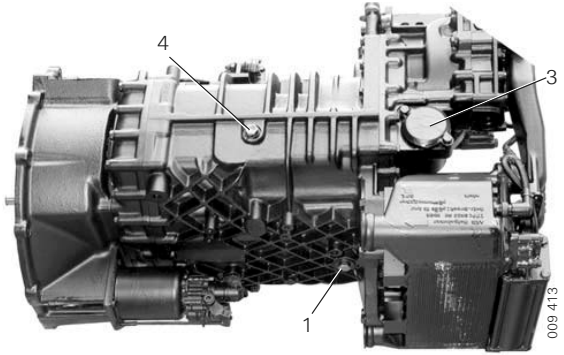


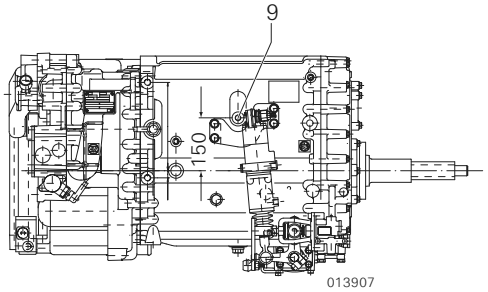
1 = Oil drain location transmission
2 = Oil drain location Intarder housing
3 = Oil filter cover Intarder housing
4 = Oil overflow and oil fill after oil change
9 = Oil filler plug after repair

Tightening torques refer to table on page 46.

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Fig. 5
Transmission
6 S 1600 IT, 6 S 1601 BD, 6 S 1701 BO, 6 S 1901 BO
alu heat exchanger at bottom



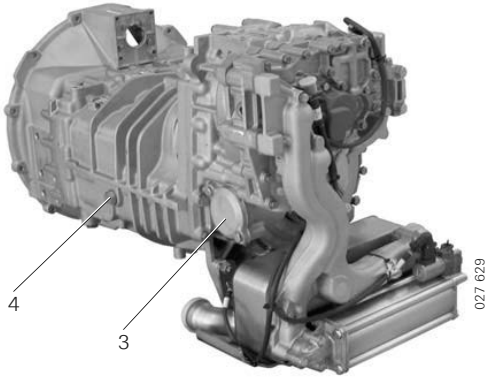


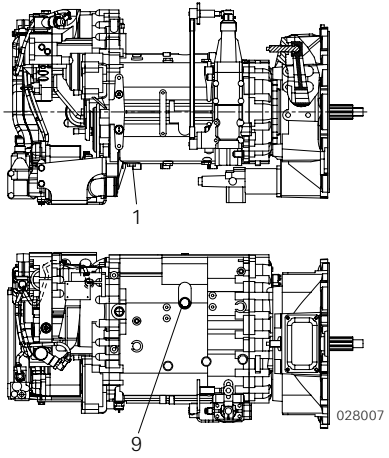
1 = Oil drain location transmission
3 = Oil filter cover Intarder housing
4 = Oil overflow and oil fill after oil change
9 = Oil filler plug after repair

Tightening torques refer to table on page 46.

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Fig. 6
Transmission
6 S 1600 IT, 6 S 1601 BD, 6 S 1701 BO, 6 S 1901 BO
stainless steel heat exchanger at bottom



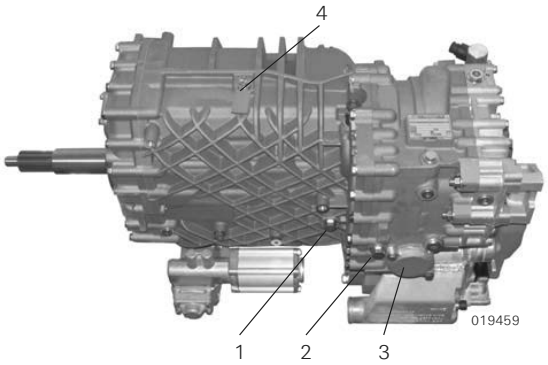


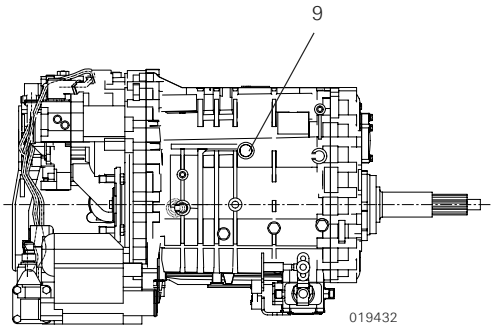
1 = Oil drain location transmission
3 = Oil filter cover Intarder housing
4 = Oil overflow and oil fill after oil change
9 = Oil filler plug after repair

Tightening torques refer to table on page 46.

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Fig. 7
Transmission
6 S 1600 IT, 6 S 1601 BD, 6 S 1701 BO, 6 S 1901 BO
alu heat exchanger on the right





1 = Oil drain location transmission
2 = Oil drain location Intarder housing
3 = Oil filter cover Intarder housing
4 = Oil overflow and oil fill after oil change
9 = Oil filler plug after repair

Tightening torques refer to table on page 46.

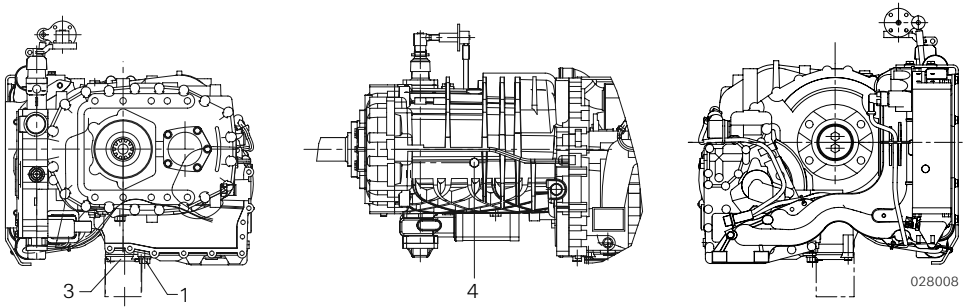
https://truckmanualshub.com/

Fig. 8
Transmission
6 S 1600 IT, 6 S 1601 BD, 6 S 1701 BO, 6 S 1901 BO
stainless steel heat exchanger on the right



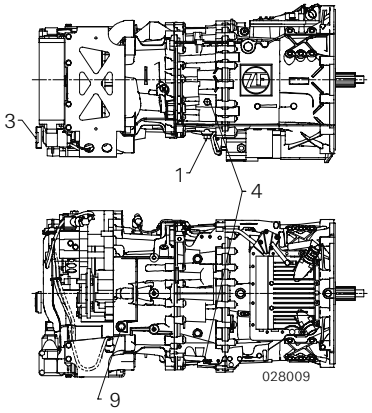
1 = Oil drain location transmission
2 = Oil drain location Intarder housing
3 = Oil filter cover Intarder housing
4 = Oil overflow and oil fill after oil change
9 = Oil filler plug after repair

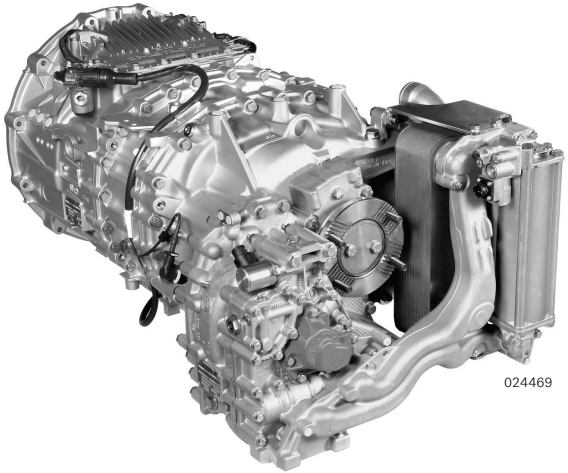
Tightening torques refer to table on page 46.



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Fig. 9
Transmission
AS Tronic mit Intarder
Refer to list at start of page 4.
stainless steel heat exchanger on the right





1 = Oil drain location transmission
2 = Oil drain location Intarder housing (below the oil filter)
3 = Oil filter cover Intarder housing
4 = Oil overflow and oil fill after oil change
9 = Oil filler plug after repair

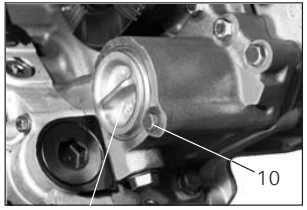
Tightening torques refer to table on page 46.

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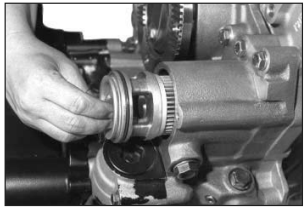
4.6 Oil Filter Replacement

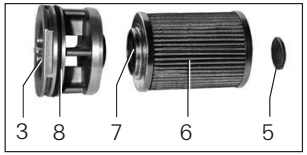
NOTE: Use new oil filter upon each individual oil change (order no. see table on pages 45 and 46).

⚠ **DANGER: When transmission oil is hot: Danger of burns!**



000529


000552



004467

ZF-Ecosplit / ZF-AS Tronic

Unscrew plug(s) **(10)** from oil filter housing cover (**3**).

Remove cover (**3**) with plugged-on filter.
Remove oil filter from filter cover.

Plug the oil filter housing cover (**3**) onto the new filter (**6**). Insert the complete unit until full home with the filter housing.

ZF-Ecomid / ZF-6 S 1600

Remove cover (**3**) and pull out filter from filter's housing.

(CAUTION: There is residual oil left in the oil filter housing!)

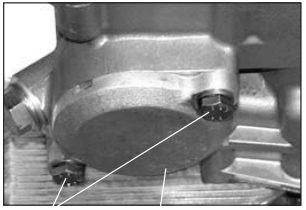
Check O-ring (**8**) on filter cover for damage and replace and grease if necessary.

Safely secure magnet (**5**) to the new filter.

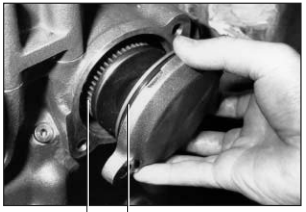
Grease the O-ring (**7**) of the new filter.

Insert new filter (**6**) in filter housing.

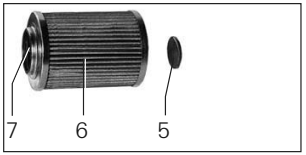
Mount cover (**3**) with screws (**10**).
For tightening torques refer to table on pages 45 and 46.



019485



004707



004467

https://truckmanualshub.com/

4.7 Oil Fill

After an oil change	or after repairs

NOTES

The transmission and fitted Intarder may only be filled with oil when the vehicle is horizontal and the engine is switched off. Drain oil. For oil grade and volume refer to table on pages 45 and 46.

Open oil overflow plug (**4**).	Open oil filler plug (**9**).
Fill transmission until oil overflows.	Fill in oil at position 9.
Screw oil overflow plug (**4**) back in with new sealing ring.	Screw in oil filler plug (**9**) with new sealing ring .

For tightening torques refer to table on pages 45 and 46.
Undertake test run: Distance of 2-5 km.

Test run: Do **NOT** engage Intarder.	Test run: At beginning, actuate Intarder **ONCE, BRIEFLY** (max. step) and then, set it back to step 0.

End of test run:
Vehicle stationary. **Do not engage Intarder.** Open oil overflow plug (**4**).

CAUTION
Check oil level again and if necessary, top up with oil until it overflows.

Screw oil overflow plug (**4**) back in with new sealing ring.

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4.8 Engine Coolant

CAUTION
After refilling the engine coolant, please pay strict attention to the instructions given by the vehicle manufacturer! Otherwise, damage may occur at the oil/water heat exchanger.

- **Engine coolant**
  (mixture made from fresh water and **anti-freeze/anti-corrosion agents)**
  – Recommended volume for **anti-freeze/anti-corrosion agent:**
  40 - 50 vol. %, to be checked with coolant inspector.

Anti-freeze and anti-corrosion agents
Basic fluid: Ethylenglycol with anti-corrosion inhibitors.

Fresh Water
pH value 6.5 - 8.5; overall hardness < 20 °dH

Change interval of the engine coolant:

- **At max. every 2 years** with aluminum heat exchanger (for fill as pre-mixture).

- **At max. every 4 years** with stainless steel heat exchanger (for fill as pre-mixture).

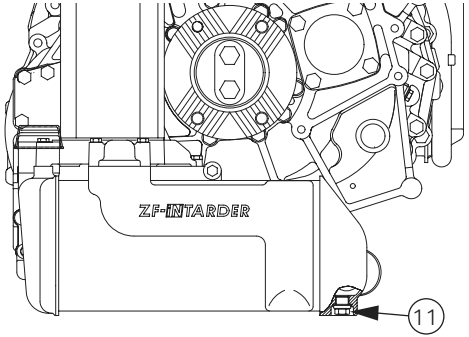
- In the case of deviating information (on shorter change intervals), always adhere to the instructions given by the vehicle and/or engine manufacturer.

NOTE
The entire cooling system must always be flushed with water prior to new fills.
The coolant must also be replaced immediately if sludge forms or if the coolant's concentration falls suddenly.

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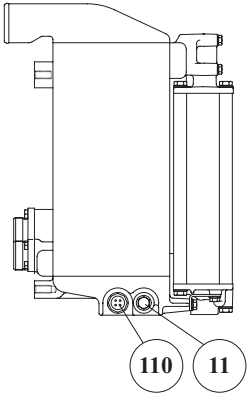
4.8.1 Drain Residual Coolant at the Alu Heat Exchanger

NOTE
After draining the residual coolant, screw in the drain plug (**11**) with the **new** sealing ring.
Tightening torque:
Also refer to table on pages 45 and 46.



Drain plug for residual coolant at alu heat exchanger

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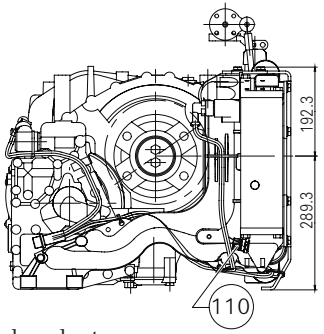
027986

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4.8.2 Drain Residual Coolant at the Stainless Steel Heat Exchanger

In the case of stainless steel heat exchangers, the temperature sensor (**110**) is also the residual coolant drain plug.

NOTE
After draining the residual coolant, screw in the temperature sensor with the **new** sealing ring.
Tightening torque:
Also refer to table on pages 45 and 46.



Drain plug for residual coolant
at stainless steel heat exchanger

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4.9 Bleeding the Intarder

Pressure differences are compensated for at the transmission's vent valve.

To this end, please consult the respective chapter of the transmission's Operating Instructions.

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Product family	Transmission type	Oil volume according to Oil change ca.	Oil volume according to Repair approx.*	Tightening torque [Nm] for position 1	2	4	9	10	11	Filter no.	Oil grade	Oil change intervals
Ecosplit	16 S 151 IT 16 S 1621 TD 16 S 1821 TO	11.0 dm³	18.5 dm³	M 38 120 or M 24 60	60	60	60	23	Drain plug at the alu heat exchanger: 35	6085 298 026	According to List of Lubricants TE-ML 02	Acording to List of Lubricants TE-ML 02 In line with the transmission type with the ZF-Intarder
16 S 181 IT 16 S 221 IT	16 S1921 TD 16 S 2221 TO 16 S 2221 TD 16 S 2521 TO	12.0 dm³	21.5 dm³									
16 S 251 IT	16 S 2721 TO	12.5 dm³	22.0 dm³									
Ecomid 9 S 109 IT	9 S 1111 TD/TO 9 S 1311 TO	12.0 dm³	21.0 dm³	120	60	60	60	46				
16 S 109 IT		12.5 dm³	22.0 dm³									
AS Tronic 12 AS 2301 IT	12 AS 1631 TD 12 AS 1931 TD/TO 12 AS 2131 TD/TO 12 AS 2331 TD/TO	12.0 dm³	21.0 dm³	60	60	60	60	23				
	12 AS 2341 TD 12 AS 2541 TD/TO 12 AS 2741 TO	13.5 dm³	23.5 dm³									
16 AS 2601 IT	16 AS 2231 TD 16 AS 2631 TO	13.0 dm³	23.0 dm³									

1 = Oil drain location transmission; 2 = Oil drain location Intarder housing; 4 = Oil overflow plug and oil fill after oil change;
9 = Oil filler plug after repair; 10 = Screws in the oil filter cover of the Intarder; 11 = Residual coolant drain

* If the heat exchanger is fitted horizontally, the oil quantity increases by 1 dm³.

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Product family	Transmission type	Oil volume according to Oil change ca.	Oil volume according to Repair approx.*	Tightening torque [Nm] for position 1	2	4	9	10	11	Filter no.	Oil grade	Oil change intervals
8 S 180 IT	8 S 2101 BD 8 S 2101 BO	12.0 dm³	21.0 dm³	120	60	60	60	46	Drain plug at the alu heat exchanger: 35 Drain plug (temperature sensor 110) at stainless steel heat exchanger: 40	6085 298 026	According to List of Lubricants TE-ML 02	According to List of Lubricants TE-ML 02 In line with the transmission type with the ZF-Intarder
6 S 1600 IT horizontal, to the right Heat exchanger bottom	6 S 1601 BD 6 S 1701 BO 6 S 1901 BO	13.5 dm³	21.5 dm³	120	-	60	60	46				
6 S 1600 IT horizontal, to the right Heat exchanger, right	6 S 1601 BD 6 S 1701 BO 6 S 1901 BO	19.0 dm³	25.0 dm³	120	60	60	60	46				
10 AS 2010 B IT 10 AS 2310 B IT 12 AS 2000 B IT 12 AS 2300 B IT	10 AS 2001 BD 10 AS 2001 BO 10 AS 2301 BD 10 AS 2301 BO 10 AS 2701 BO 12 AS 2001 BO 12 AS 2301 BO 12 AS 2701 BO	12.0 dm³	21.0 dm³	60	60	60	60	23				

1 = Oil drain location transmission; 2 = Oil drain location Intarder housing; 4 = Oil overflow plug and oil fill after oil change;
9 = Oil filler plug after repair; 10 = Screws in the oil filter cover of the Intarder; 11 = Residual coolant drain