



Contents

| | |
|--|------------|
| 00 - Technical data | 1 |
| 1 Identification | 1 |
| 1.1 Engine number, engine data | 1 |
| 2 Safety instructions | 4 |
| 2.1 Safety precautions when working on fuel supply system | 4 |
| 2.2 Safety measures for working on vehicles with start/stop system | 4 |
| 2.3 Safety measures for a test drive with test and measuring device | 4 |
| 2.4 Safety precautions when working on cooling system | 5 |
| 2.5 Safety precautions when working on the SCR system | 5 |
| 2.6 Safety precautions when working on the exhaust system | 6 |
| 3 Repair instructions | 7 |
| 3.1 Rules of cleanliness | 7 |
| 3.2 Foreign bodies in the engine | 7 |
| 3.3 Contact corrosion | 7 |
| 3.4 Cable laying and fastening | 8 |
| 3.5 Assembly of radiators and condensers | 8 |
| 10 - Removing and installing engine | 9 |
| 1 Removing and installing engine | 9 |
| 1.1 Removing engine | 9 |
| 1.2 Attach engine attached to engine and gearbox mount | 22 |
| 1.3 Installing engine | 25 |
| 2 Assembly bracket | 30 |
| 2.1 Overview of components- assembly bracket | 30 |
| 2.2 Removing and installing engine mount | 32 |
| 2.3 Removing and installing gearbox mount | 33 |
| 2.4 Removing and installing pendulum support | 36 |
| 2.5 Support the engine in its installed position | 39 |
| 2.6 Adjusting the unit mounting | 51 |
| 2.7 Check assembly bracket setting | 54 |
| 3 Engine trim panel | 55 |
| 3.1 Removing and installing engine trim panel | 55 |
| 13 - Crankshaft group | 56 |
| 1 Cylinder block (pulley end) | 56 |
| 1.1 Assembly overview - cylinder block (pulley end) | 56 |
| 1.2 Summary of components - sealing flange on the belt pulley side | 59 |
| 1.3 Removing and installing V-ribbed belt | 60 |
| 1.4 Removing and installing tensioning pulley for V-ribbed belt | 62 |
| 1.5 Removing and installing ribbed belt pulley | 63 |
| 1.6 Removing and installing bracket for auxiliary units | 64 |
| 1.7 Removing and installing engine support | 66 |
| 1.8 Removing and installing the sealing flange on the belt pulley side | 68 |
| 1.9 Replace the sealing cap of the cylinder block on the pulley side | 71 |
| 2 Cylinder block, gearbox end | 73 |
| 2.1 Summary of components - cylinder block on gearbox side | 73 |
| 2.2 Removing and installing flywheel | 76 |
| 2.3 Removing and installing sealing flange on gearbox side | 79 |
| 2.4 Replace the sealing cap of the cylinder block on the gearbox side | 99 |
| 3 Crankshaft | 102 |
| 3.1 Summary of components - crankshaft | 102 |
| 3.2 Replace the needle bearing in the crankshaft | 103 |



| | | |
|---|---|------------|
| 3.3 | Measuring axial play of crankshaft | 106 |
| 4 | Pistons and conrods | 108 |
| 4.1 | Summary of components - piston and conrod | 108 |
| 4.2 | Separating new connecting rod | 112 |
| 4.3 | Removing and installing the piston | 113 |
| 4.4 | Measure piston projection in TDC | 114 |
| 4.5 | Check piston and cylinder bore | 116 |
| 15 - Cylinder head, valve gear | 119 | |
| 1 | Cylinder head | 119 |
| 1.1 | Summary of components - cylinder head | 119 |
| 1.2 | Assembly overview - cylinder head cover | 123 |
| 1.3 | Removing and installing cylinder head | 125 |
| 1.4 | Removing and installing cylinder head cover | 136 |
| 1.5 | Removing and installing gasket rings for injection units | 138 |
| 1.6 | Removing and installing camshaft housing | 139 |
| 1.7 | Checking compression | 144 |
| 2 | Toothed belt drive | 147 |
| 2.1 | Summary of components - toothed belt guard | 147 |
| 2.2 | Summary of components - toothed belt | 148 |
| 2.3 | Removing and installing toothed belt guard | 150 |
| 2.4 | Removing and installing toothed belt | 156 |
| 2.5 | Remove the toothed belt from the camshaft | 170 |
| 3 | Valve gear | 175 |
| 3.1 | Summary of components - valve gear | 175 |
| 3.2 | Removing and installing gasket ring for camshaft | 178 |
| 3.3 | Checking hydraulic balancing elements | 180 |
| 3.4 | Removing and installing valve stem seals | 181 |
| 4 | Inlet and exhaust valves | 192 |
| 4.1 | Inspecting valve guides | 192 |
| 4.2 | Testing valves | 193 |
| 4.3 | Valve dimensions | 193 |
| 17 - Lubrication | 194 | |
| 1 | Sump, oil pump | 194 |
| 1.1 | Summary of components - pan/oil pump | 194 |
| 1.2 | Removing and installing oil pan | 201 |
| 1.3 | Removing and installing the bottom part of the oil sump | 206 |
| 1.4 | Removing and installing top part of the oil sump | 210 |
| 1.5 | Removing and installing oil pump | 215 |
| 1.6 | Removing and installing oil level and oil temperature sender G266 | 216 |
| 2 | Engine oil cooler | 220 |
| 3 | Oil filter, oil pressure switch | 221 |
| 3.1 | Summary of components - oil filter housing/oil pressure switch | 221 |
| 3.2 | Removing and installing oil pressure switch F1 | 223 |
| 3.3 | Removing and installing oil pressure switch for reduced oil pressure F378 | 225 |
| 3.4 | Testing oil pressure | 226 |
| 3.5 | Removing and installing oil filter housing | 227 |
| 3.6 | Removing and installing valve for oil pressure control N428 | 230 |
| 19 - Cooling | 232 | |
| 1 | Cooling system, coolant | 232 |
| 1.1 | Connection diagram - coolant hoses | 232 |
| 1.2 | Check cooling system for leaks | 242 |
| 1.3 | Draining and filling coolant | 246 |



| | | |
|-----------|---|------------|
| 1.4 | Checking the filling quality | 263 |
| 1.5 | Checking the electric vacuum pump VAS 6096/2 | 266 |
| 1.6 | Flushing the cooling system | 267 |
| 1.7 | Flushing cooling system, quick start guide | 288 |
| 2 | Coolant pump, regulation of cooling system | 290 |
| 2.1 | Summary of components - coolant pump/thermostat | 290 |
| 2.2 | Summary of components - electric coolant pump | 294 |
| 2.3 | Summary of components - coolant temperature transmitter | 300 |
| 2.4 | Removing and installing electric coolant pump | 301 |
| 2.5 | Removing and installing coolant pump | 320 |
| 2.6 | Removing and installing coolant regulator | 321 |
| 2.7 | Testing the coolant regulator | 326 |
| 2.8 | Removing and installing coolant valve for cylinder head N489 | 327 |
| 2.9 | Removing and installing coolant temperature transmitter G62 | 327 |
| 3 | Coolant pipes | 330 |
| 3.1 | Summary of components - coolant pipe | 330 |
| 3.2 | Removing and installing coolant pipes | 332 |
| 4 | Radiator, radiator fan | 354 |
| 4.1 | Summary of components - radiator / radiator fan | 354 |
| 4.2 | Summary of components - fan shroud and radiator fan | 361 |
| 4.3 | Removing and installing radiator | 363 |
| 4.4 | Removing and installing charge air cooling circuit | 371 |
| 4.5 | Removing and installing fan shroud | 388 |
| 4.6 | Removing and installing radiator fan V7 | 393 |
| 4.7 | Removing and installing radiator blind | 395 |
| 4.8 | Removing and installing the radiator blind control motor V544 | 397 |
| 4.9 | Summary of components - radiator blind | 402 |
| 21 | - Turbocharging/supercharging | 406 |
| 1 | Exhaust gas turbocharger | 406 |
| 1.1 | Summary of components - exhaust gas turbocharger | 406 |
| 1.2 | Removing and installing exhaust gas turbocharger | 415 |
| 1.3 | Replacing exhaust gas turbocharger pressure box | 431 |
| 1.4 | Removing and installing the exhaust gas turbocharger connection fitting | 444 |
| 2 | Charge-air system | 446 |
| 2.1 | Summary of components - charge air system | 446 |
| 2.2 | Removing and installing charge pressure sender G31 | 449 |
| 2.3 | Checking the charge-air system for leak-tightness | 449 |
| 2.4 | Installing and removing the air guide pipe | 453 |
| 2.5 | Leak testing the charge air cooler | 455 |
| 23 | - Mixture preparation - injection | 462 |
| 1 | Injection system | 462 |
| 1.1 | Schematic overview - fuel system | 462 |
| 1.2 | Installation location overview - fuel injection system | 464 |
| 1.3 | Filling/bleeding the fuel system | 476 |
| 1.4 | Check the fuel system for tightness | 477 |
| 2 | Vacuum system | 478 |
| 2.1 | Connection diagram - Vacuum system | 478 |
| 2.2 | Checking the vacuum system | 479 |
| 3 | Injection units / high pressure accumulators (fuel distributors) | 480 |
| 3.1 | Summary of components - injection units (injectors) | 480 |
| 3.2 | Summary of components - High pressure reservoir (fuel distributor) | 482 |
| 3.3 | Adjust the correction values for injection units | 483 |
| 3.4 | Check injection units | 484 |



| | | |
|----------------------------|---|------------|
| 3.5 | Check injection unit return quantity with engine running | 485 |
| 3.6 | Check injection unit return flow quantity at starter speed | 491 |
| 3.7 | Checking the injection units in open state | 495 |
| 3.8 | Removing and installing the injection units | 497 |
| 3.9 | Removing and installing high pressure lines | 503 |
| 3.10 | Removing and installing high pressure reservoir (fuel distributor) | 506 |
| 4 | Air filter | 510 |
| 4.1 | Summary of components - air filter housing | 510 |
| 4.2 | Removing and installing air filter housing | 512 |
| 4.3 | Removing and installing the air guide on the lock carrier | 515 |
| 5 | Intake manifold | 517 |
| 5.1 | Summary of components - intake manifold | 517 |
| 5.2 | Removing and installing intake manifold | 521 |
| 5.3 | Removing and installing the throttle valve control unit J338 | 525 |
| 6 | Senders and sensors | 529 |
| 6.1 | Removing and installing the fuel pressure control valve N276 | 529 |
| 6.2 | Check fuel pressure control valve N276 | 537 |
| 6.3 | Removing and installing fuel pressure sender G247 | 538 |
| 6.4 | Removing and installing air flow mass meter G70 | 539 |
| 6.5 | Removing and installing differential pressure transmitter G505 | 542 |
| 6.6 | Removing and installing pressure sensor for exhaust gas 1 G450 | 545 |
| 6.7 | Removing and installing NOx transmitter 2 G687 | 547 |
| 6.8 | Removing and installing intake air temperature sender G42 | 549 |
| 6.9 | Removing and installing charge air temperature transmitter after charge air cooler G811 | 550 |
| 6.10 | Removing and installing fuel temperature transmitter G81 | 550 |
| 6.11 | Removing and installing NOx transmitter control unit GX30 | 552 |
| 6.12 | Removing and installing fuel low pressure temperature and pressure sender GX20 | 561 |
| 7 | Engine control unit | 563 |
| 7.1 | Removing and installing engine control unit J623 | 563 |
| 8 | High pressure pump | 568 |
| 8.1 | Summary of components - high pressure pump | 568 |
| 8.2 | Removing and installing the high pressure pump | 569 |
| 9 | Lambda probe | 574 |
| 9.1 | Summary of components - lambda probe | 574 |
| 9.2 | Removing and installing Lambda probe | 578 |
| 26 - Exhaust system | | 583 |
| 1 | Exhaust pipes/silencers | 583 |
| 1.1 | Summary of components - silencers | 583 |
| 1.2 | Removing and installing pre-exhaust pipe | 592 |
| 1.3 | Separating exhaust pipes/silencers | 593 |
| 1.4 | Removing and installing middle silencer | 595 |
| 1.5 | Removing and installing silencers | 597 |
| 1.6 | Align exhaust system free of stress | 604 |
| 1.7 | Inspecting the exhaust system for leaks | 605 |
| 1.8 | Installation position of clamping sleeve | 605 |
| 1.9 | Summary of components - pre-exhaust pipe | 607 |
| 1.10 | Align exhaust tailpipes | 611 |
| 2 | Cleansing exhaust emissions | 612 |
| 2.1 | Summary of components - exhaust gas cleaning | 612 |
| 2.2 | Removing and installing catalytic converter | 619 |
| 2.3 | Removing and installing exhaust gas cleaning module | 621 |
| 2.4 | Removing and installing the exhaust flap control unit J883 | 633 |
| 3 | SCR system (Selective Catalytic Reduction) | 635 |



| | | |
|--|---|------------|
| 3.1 | Summary of components - reduction agent tank | 635 |
| 3.2 | Summary of components - delivery line for reduction agent | 641 |
| 3.3 | Summary of components - delivery module for reduction agent | 645 |
| 3.4 | Removing and installing reduction agent tank | 646 |
| 3.5 | Removing and installing the front part of the delivery line for reduction agent | 656 |
| 3.6 | Removing and installing the delivery module for reduction agent | 675 |
| 3.7 | Removing and installing the injection valve for reduction agent N474 | 677 |
| 3.8 | Removing and installing the control unit for reduction agent heater J891 | 681 |
| 3.9 | Summary of components - injection valve for reduction agent | 683 |
| 3.10 | Removing and installing the rear section of the delivery line for reduction agent | 685 |
| 3.11 | Removing and installing the filler tube for reduction agent tank | 691 |
| 3.12 | Disconnect delivery line for reduction agent | 699 |
| 3.13 | Reset SCR learning values | 704 |
| 4 | Exhaust temperature regulation | 705 |
| 4.1 | Summary of components - exhaust temperature regulation | 705 |
| 4.2 | Removing and installing the exhaust gas temperature transmitter 1 G235 | 709 |
| 4.3 | Removing and installing the exhaust gas temperature transmitter 2 G448 | 715 |
| 4.4 | Removing and installing the exhaust gas temperature transmitter 3 G495 | 718 |
| 4.5 | Removing and installing the exhaust gas temperature transmitter 4 G648 | 722 |
| 5 | Exhaust gas recirculation | 725 |
| 5.1 | Summary of components - Exhaust gas recirculation | 725 |
| 5.2 | Summary of components - exhaust gas recirculation 1 GX5 | 729 |
| 5.3 | Removing and installing radiator for exhaust gas recirculation | 730 |
| 5.4 | Removing and installing exhaust gas recirculation valve 1 GX5 | 744 |
| 5.5 | Removing and installing exhaust gas recirculation valve 2 GX6 | 746 |
| 5.6 | Removing and installing temperature sensor for exhaust gas recirculation G98 | 747 |
| 5.7 | Test air-tightness of the radiator for exhaust gas recirculation | 751 |
| 28 - Glow plug system | 752 | |
| 1 | Glow plug system | 752 |
| 1.1 | Summary of components - Glow plug system | 752 |
| 1.2 | Removing and installing glow plugs | 753 |
| 1.3 | Removing and installing automatic glow period control unit J179 | 757 |
| 1.4 | Removing and installing Hall sender G40 | 757 |
| 1.5 | Removing and installing the engine speed transmitter G28 | 758 |