

Contents

| | |
|----------------------------------------------------------------------------------------|-----------|
| 00 - Technical data | 1 |
| 1 Identification | 1 |
| 1.1 Engine number / engine data | 1 |
| 2 Safety information | 2 |
| 2.1 Safety precautions when working on the fuel system | 2 |
| 2.2 Safety precautions when working on vehicles with start/stop system | 2 |
| 2.3 Safety precautions when using testers and measuring instruments during a road test | 3 |
| 2.4 Safety precautions when working on the cooling system | 3 |
| 2.5 Safety precautions when working on the exhaust system | 3 |
| 2.6 Safety precautions when working on the SCR system | 4 |
| 2.7 Safety precautions when working on the glow plug system | 5 |
| 3 Repair instructions | 6 |
| 3.1 Identification plates | 6 |
| 3.2 Use of impact wrenches | 6 |
| 3.3 Rules for cleanliness | 7 |
| 3.4 General notes | 7 |
| 3.5 General repair instructions | 9 |
| 3.6 Foreign material in engine | 10 |
| 3.7 Cleaning engine | 10 |
| 3.8 Contact corrosion | 10 |
| 3.9 Routing and attachment of pipes, hoses and wiring | 11 |
| 3.10 Installing radiators and condensers | 11 |
| 3.11 Performing adaptations after renewing a component | 11 |
| 10 - Removing and installing engine | 13 |
| 1 Removing and installing engine | 13 |
| 2 Assembly mountings | 14 |
| 3 Engine cover panel | 15 |
| 3.1 Removing and installing engine cover panel | 15 |
| 13 - Crankshaft group | 16 |
| 1 Cylinder block (pulley end) | 16 |
| 1.1 Assembly overview - cylinder block (pulley end) | 16 |
| 1.2 Assembly overview - sealing flange (pulley end) | 23 |
| 1.3 Removing and installing poly V-belts | 24 |
| 1.4 Removing and installing poly V-belt tensioner | 29 |
| 1.5 Removing and installing vibration damper | 31 |
| 1.6 Removing and installing bracket for ancillaries | 33 |
| 1.7 Removing and installing engine support | 37 |
| 1.8 Renewing crankshaft oil seal (pulley end) | 37 |
| 1.9 Removing and installing sealing flange (pulley end) | 39 |
| 2 Cylinder block (gearbox end) | 43 |
| 2.1 Assembly overview - cylinder block (gearbox end) | 43 |
| 2.2 Removing and installing drive plate | 43 |
| 2.3 Renewing crankshaft oil seal (gearbox end) | 46 |
| 3 Crankshaft | 49 |
| 3.1 Assembly overview - crankshaft | 49 |
| 3.2 Crankshaft dimensions | 52 |
| 3.3 Allocation of main bearing shells | 52 |
| 3.4 Measuring axial clearance of crankshaft | 55 |
| 3.5 Measuring radial clearance of crankshaft | 56 |
| 3.6 Checking sender wheel | 57 |



| | | |
|-----------|---------------------------------------------------------------------|------------|
| 4 | Balance shaft | 59 |
| 4.1 | Assembly overview - balance shaft | 59 |
| 4.2 | Removing and installing balance shaft | 59 |
| 4.3 | Renewing roller bearing | 67 |
| 5 | Pistons and conrods | 70 |
| 5.1 | Assembly overview - pistons and conrods | 70 |
| 5.2 | Removing and installing pistons | 74 |
| 5.3 | Measuring piston projection at TDC | 75 |
| 5.4 | Checking pistons and cylinder bores | 78 |
| 5.5 | Checking radial clearance of conrod bearings | 80 |
| 15 | - Cylinder head, valve gear | 81 |
| 1 | Timing chain cover | 81 |
| 1.1 | Assembly overview - timing chain cover | 81 |
| 1.2 | Removing and installing timing chain cover | 85 |
| 2 | Chain drive | 99 |
| 2.1 | Assembly overview - camshaft timing chains | 99 |
| 2.2 | Assembly overview - drive chain for high-pressure pump | 101 |
| 2.3 | Assembly overview - drive chain for oil pump | 102 |
| 2.4 | Assembly overview - intermediate drive | 103 |
| 2.5 | Removing camshaft timing chain from camshafts | 104 |
| 2.6 | Removing and installing camshaft timing chain | 117 |
| 2.7 | Removing and installing drive chain for high-pressure pump | 129 |
| 2.8 | Installing intermediate drive | 131 |
| 3 | Cylinder head | 140 |
| 3.1 | Assembly overview - cylinder head | 140 |
| 3.2 | Assembly overview - cylinder head cover | 143 |
| 3.3 | Removing and installing cylinder head | 149 |
| 3.4 | Removing and installing cylinder head cover | 158 |
| 3.5 | Removing and installing seals for injectors | 163 |
| 3.6 | Checking compression | 164 |
| 4 | Valve gear | 167 |
| 4.1 | Assembly overview - valve gear | 167 |
| 4.2 | Measuring axial clearance of camshaft | 176 |
| 4.3 | Measuring radial clearance of camshaft | 178 |
| 4.4 | Removing and installing camshaft | 179 |
| 4.5 | Removing and installing valve stem oil seals | 196 |
| 5 | Inlet and exhaust valves | 207 |
| 5.1 | Reworking valve seats | 207 |
| 5.2 | Checking valve guides | 207 |
| 5.3 | Checking valves | 208 |
| 5.4 | Valve dimensions | 208 |
| 17 | - Lubrication | 210 |
| 1 | Sump/oil pump | 210 |
| 1.1 | Assembly overview - sump/oil pump | 210 |
| 1.2 | Engine oil | 215 |
| 1.3 | Removing and installing lower part of sump | 215 |
| 1.4 | Removing and installing upper part of sump | 219 |
| 1.5 | Removing and installing oil pump | 222 |
| 1.6 | Removing and installing oil level and oil temperature sender G266 | 224 |
| 2 | Engine oil cooler | 226 |
| 2.1 | Assembly overview - engine oil cooler | 226 |
| 2.2 | Removing and installing engine oil cooler | 228 |
| 2.3 | Removing and installing temperature regulator for engine oil cooler | 229 |

| | | |
|-----------|-----------------------------------------------------------------------------------------|------------|
| 3 | Crankcase breather | 232 |
| 3.1 | Assembly overview - crankcase breather system | 232 |
| 3.2 | Removing and installing oil separator | 233 |
| 4 | Oil filter/oil pressure switch | 234 |
| 4.1 | Assembly overview - oil filter | 234 |
| 4.2 | Removing and installing oil filter housing | 236 |
| 4.3 | Removing and installing oil pressure sender G10 | 237 |
| 4.4 | Checking oil pressure | 238 |
| 4.5 | Removing and installing valve for oil pressure control N428 | 238 |
| 4.6 | Removing and installing oil temperature sender 2 G664 | 239 |
| 19 | - Cooling | 243 |
| 1 | Cooling system/coolant | 243 |
| 1.1 | Connection diagram - coolant hoses | 243 |
| 1.2 | Checking cooling system for leaks | 243 |
| 1.3 | Draining and filling cooling system | 247 |
| 2 | Coolant pump/thermostat assembly | 250 |
| 2.1 | Assembly overview - coolant pump | 250 |
| 2.2 | Assembly overview - electric coolant pump | 251 |
| 2.3 | Assembly overview - thermostat | 251 |
| 2.4 | Assembly overview - coolant temperature senders | 253 |
| 2.5 | Removing and installing electric coolant pump | 254 |
| 2.6 | Removing and installing coolant pump | 254 |
| 2.7 | Removing and installing thermostat | 257 |
| 2.8 | Removing and installing thermostat housing | 258 |
| 2.9 | Removing and installing coolant temperature sender G62 | 258 |
| 2.10 | Removing and installing temperature sender for engine temperature regulation G694 | 260 |
| 2.11 | Removing and installing coolant valves | 261 |
| 3 | Coolant pipes | 263 |
| 4 | Radiator/radiator fans | 264 |
| 21 | - Turbocharging/supercharging | 265 |
| 1 | Turbocharger | 265 |
| 1.1 | Assembly overview - turbocharger | 265 |
| 1.2 | Removing and installing turbocharger | 270 |
| 2 | Charge air system | 276 |
| 2.1 | Assembly overview - charge air system | 276 |
| 2.2 | Assembly overview - hose connections for charge air system | 276 |
| 2.3 | Removing and installing charge air cooler | 277 |
| 2.4 | Removing and installing charge pressure sender G31 | 277 |
| 2.5 | Removing and installing charge air temperature sender | 278 |
| 2.6 | Checking charge air system for leaks | 278 |
| 23 | - Mixture preparation - injection | 283 |
| 1 | Injection system | 283 |
| 1.1 | Overview - fuel system | 283 |
| 1.2 | Overview of fitting locations - injection system | 283 |
| 1.3 | Filling and bleeding fuel system | 283 |
| 1.4 | Checking fuel system for leaks | 284 |
| 2 | Vacuum system | 285 |
| 2.1 | Connection diagram - vacuum system | 285 |
| 2.2 | Checking vacuum system | 285 |
| 3 | Air filter | 287 |
| 4 | Intake manifold | 288 |



| | | |
|----------------------------|--------------------------------------------------------------------|------------|
| 4.1 | Assembly overview - intake manifold | 288 |
| 4.2 | Removing and installing upper part of intake manifold | 295 |
| 4.3 | Removing and installing lower part of intake manifold | 301 |
| 4.4 | Removing and installing intake manifold flap control unit GX14 | 303 |
| 4.5 | Removing and installing throttle valve module GX3 | 305 |
| 5 | Injectors/high-pressure reservoir (rail) | 307 |
| 5.1 | Assembly overview - injectors | 307 |
| 5.2 | Checking injectors | 312 |
| 5.3 | Performing adaption of correction values for injectors | 312 |
| 5.4 | Checking return flow rate of injectors with engine running | 313 |
| 5.5 | Checking return flow rate of injectors at starter cranking speed | 318 |
| 5.6 | Checking pressure retention valve in fuel return line | 321 |
| 5.7 | Checking for injectors sticking open | 323 |
| 5.8 | Removing and installing injectors | 326 |
| 5.9 | Installing high-pressure pipes | 339 |
| 5.10 | Removing and installing high-pressure reservoir (rail) | 341 |
| 6 | Senders and sensors | 347 |
| 6.1 | Removing and installing air mass meter G70 | 347 |
| 6.2 | Removing and installing fuel temperature sender G81 | 347 |
| 6.3 | Removing and installing fuel pressure sender G247 | 348 |
| 6.4 | Removing and installing fuel pressure sender for low pressure G410 | 350 |
| 6.5 | Checking fuel pressure regulating valve N276 | 351 |
| 6.6 | Removing and installing fuel pressure regulating valve N276 | 351 |
| 6.7 | Removing and installing pressure differential sender G505 | 357 |
| 7 | High-pressure pump | 358 |
| 7.1 | Assembly overview - high-pressure pump | 358 |
| 7.2 | Removing and installing high-pressure pump | 361 |
| 8 | Lambda probe | 369 |
| 8.1 | Assembly overview - Lambda probe | 369 |
| 8.2 | Removing and installing Lambda probe | 371 |
| 8.3 | Removing and installing NOx senders | 372 |
| 8.4 | Removing and installing particulate sensor G784 | 372 |
| 9 | Engine control unit | 373 |
| 26 - Exhaust system | | 374 |
| 1 | Exhaust pipes/silencers | 374 |
| 1.1 | Assembly overview - silencers | 374 |
| 1.2 | Removing and installing front exhaust pipe | 374 |
| 1.3 | Separating exhaust pipes/silencers | 374 |
| 1.4 | Removing and installing silencers | 374 |
| 1.5 | Stress-free alignment of exhaust system | 374 |
| 1.6 | Checking exhaust system for leaks | 374 |
| 2 | Emission control system | 376 |
| 2.1 | Assembly overview - emission control system | 376 |
| 2.2 | Removing and installing emission control module | 382 |
| 2.3 | Removing and installing ammonia trap | 382 |
| 2.4 | Removing and installing exhaust flap control unit J883 | 385 |
| 3 | SCR (selective catalytic reduction) system | 387 |
| 3.1 | Assembly overview - reducing agent tank | 387 |
| 3.2 | Assembly overview - reducing agent supply line | 387 |
| 3.3 | Assembly overview - reducing agent supply line | 389 |
| 3.4 | Removing and installing front reducing agent supply line | 390 |
| 3.5 | Releasing pressure in SCR system | 393 |
| 3.6 | Draining reducing agent tank | 394 |
| 3.7 | Removing and installing reducing agent tank | 394 |

| | | |
|-----------|------------------------------------------------------------------------------|------------|
| 3.8 | Removing and installing injector for reducing agent N474 | 394 |
| 3.9 | Removing and installing control unit for reducing agent metering system J880 | 396 |
| 4 | Exhaust gas temperature regulation | 397 |
| 4.1 | Assembly overview - exhaust gas temperature regulation | 397 |
| 4.2 | Removing and installing exhaust gas temperature sender 1 G235 | 398 |
| 4.3 | Removing and installing exhaust gas temperature sender 2 G448 | 400 |
| 4.4 | Removing and installing exhaust gas temperature sender 3 G495 | 401 |
| 4.5 | Removing and installing exhaust gas temperature sender 4 G648 | 403 |
| 5 | Exhaust gas recirculation | 405 |
| 5.1 | Assembly overview - exhaust gas recirculation system | 405 |
| 5.2 | Removing and installing exhaust gas recirculation cooler | 410 |
| 5.3 | Installing repair kit for exhaust gas recirculation cooler | 414 |
| 5.4 | Removing and installing exhaust gas recirculation temperature sensor G98 | 417 |
| 5.5 | Removing and installing pressure sender for exhaust gas recirculation G691 | 418 |
| 6 | Exhaust manifold | 420 |
| 6.1 | Assembly overview - exhaust manifold | 420 |
| 6.2 | Removing and installing exhaust manifold | 420 |
| 28 | Glow plug system | 421 |
| 1 | Glow plug system | 421 |
| 1.1 | Assembly overview - glow plug system | 421 |
| 1.2 | Removing and installing glow plug | 424 |
| 1.3 | Removing and installing automatic glow period control unit J179 | 427 |
| 1.4 | Removing and installing Hall sender G40 | 429 |
| 1.5 | Removing and installing engine speed sender G28 | 429 |