

Contents

| | | |
|-----------|---|-----------|
| 00 | Technical data | 1 |
| 1 | Engine number | 1 |
| 2 | Engine data | 2 |
| 3 | Safety precautions | 3 |
| 3.1 | Safety precautions when working on the fuel system | 3 |
| 3.2 | Working on vehicles with start/stop system | 4 |
| 3.3 | Using testers and measuring instruments during a road test | 5 |
| 3.4 | Safety precautions when working on the cooling system | 5 |
| 3.5 | Safety precautions when working on the SCR system | 6 |
| 3.6 | Resetting SCR learnt values | 7 |
| 3.7 | Safety precautions when working on the exhaust system | 7 |
| 4 | General repair instructions | 8 |
| 4.1 | Rules for cleanliness when working on fuel supply system, injection system and turbocharger | 8 |
| 4.2 | Checking for leaks in the fuel system | 8 |
| 4.3 | Foreign particles in engine | 9 |
| 4.4 | Contact corrosion | 9 |
| 4.5 | Routing and attachment of pipes, hoses and wiring | 9 |
| 4.6 | Installing radiators, condensers and charge air coolers | 9 |
| 4.7 | Checking vacuum system | 9 |
| 10 | Removing and installing engine | 11 |
| 1 | Removing engine | 11 |
| 2 | Separating engine and gearbox | 28 |
| 3 | Securing engine to engine and gearbox support | 36 |
| 4 | Installing engine | 40 |
| 5 | Assembly mountings | 45 |
| 5.1 | Exploded view - assembly mountings | 45 |
| 5.2 | Removing and installing engine mountings and engine cross member | 46 |
| 13 | Crankshaft group | 52 |
| 1 | Cylinder block (pulley end) | 52 |
| 1.1 | Exploded view - poly V-belt drive | 52 |
| 1.2 | Removing and installing poly V-belt | 55 |
| 1.3 | Removing and installing tensioner for poly V-belt | 57 |
| 1.4 | Removing and installing vibration damper | 58 |
| 1.5 | Removing and installing bracket for ancillaries | 58 |
| 1.6 | Exploded view - oil seal and sealing flange (pulley end) | 58 |
| 1.7 | Renewing crankshaft oil seal (pulley end) | 63 |
| 1.8 | Removing and installing sealing flange (pulley end) | 64 |
| 1.9 | Removing and installing cover for sealing flange (pulley end) | 68 |
| 2 | Cylinder block (gearbox end) | 69 |
| 2.1 | Exploded view - drive plate | 69 |
| 2.2 | Removing and installing drive plate | 70 |
| 2.3 | Removing and installing sender wheel | 71 |
| 2.4 | Checking sender wheel | 72 |
| 2.5 | Renewing crankshaft oil seal (gearbox end) | 72 |
| 3 | Crankshaft | 75 |
| 3.1 | Exploded view - crankshaft | 75 |
| 3.2 | Crankshaft dimensions | 77 |
| 3.3 | Measuring axial clearance of crankshaft | 77 |
| 3.4 | Measuring radial clearance of crankshaft | 78 |



| | | |
|-----------|---|------------|
| 4 | Pistons and conrods | 79 |
| 4.1 | Exploded view - pistons and conrods | 79 |
| 4.2 | Measuring radial clearance of conrods | 81 |
| 4.3 | Removing and installing pistons | 82 |
| 4.4 | Measuring piston projection at "TDC" | 83 |
| 4.5 | Checking pistons and cylinder bores | 85 |
| 15 | Cylinder head, valve gear | 87 |
| 1 | Chain drive | 87 |
| 1.1 | Exploded view - timing chain covers | 87 |
| 1.2 | Removing and installing timing chain covers (top) | 90 |
| 1.3 | Removing and installing timing chain cover (bottom) | 93 |
| 1.4 | Exploded view - camshaft timing chain | 95 |
| 1.5 | Removing timing chain from camshafts | 97 |
| 1.6 | Removing and installing camshaft timing chain | 105 |
| 1.7 | Exploded view - drive chain for oil pump and high-pressure pump | 114 |
| 1.8 | Removing and installing drive chain for oil pump and high-pressure pump | 115 |
| 1.9 | Exploded view - balance shaft | 117 |
| 1.10 | Removing and installing balance shaft | 118 |
| 1.11 | Renewing roller bearing for balance shaft | 119 |
| 2 | Cylinder head | 121 |
| 2.1 | Exploded view - cylinder head cover | 121 |
| 2.2 | Removing and installing cylinder head cover (left-side) | 123 |
| 2.3 | Removing and installing cylinder head cover (right-side) | 126 |
| 2.4 | Renewing injector seals | 129 |
| 2.5 | Exploded view - cylinder head | 130 |
| 2.6 | Removing and installing cylinder head | 133 |
| 2.7 | Checking compression | 138 |
| 3 | Valve gear | 141 |
| 3.1 | Exploded view - valve gear | 141 |
| 3.2 | Measuring axial clearance of camshafts | 143 |
| 3.3 | Measuring radial clearance of camshafts | 145 |
| 3.4 | Removing camshafts and re-installing used camshafts - cylinder bank 1 (right-side) | 145 |
| 3.5 | Removing and renewing camshafts or camshaft bearings - cylinder bank 1 (right-side) | 152 |
| 3.6 | Removing camshafts and re-installing used camshafts - cylinder bank 2 (left-side) | 158 |
| 3.7 | Removing and renewing camshafts or camshaft bearings - cylinder bank 2 (left-side) | 164 |
| 3.8 | Renewing valve stem oil seals with cylinder head installed | 169 |
| 3.9 | Renewing valve stem oil seals with cylinder head removed | 172 |
| 3.10 | Valve dimensions | 176 |
| 3.11 | Machining valve seats | 176 |
| 3.12 | Checking valve guides | 176 |
| 3.13 | Checking valves | 177 |
| 17 | Lubrication | 178 |
| 1 | Sump (bottom section) and oil pump | 178 |
| 1.1 | Exploded view - sump (bottom section) and oil pump | 178 |
| 1.2 | Removing and installing oil level and oil temperature sender G266 | 181 |
| 1.3 | Removing and installing sump (bottom section) | 181 |
| 1.4 | Removing and installing oil pump with vacuum pump | 187 |
| 2 | Sump (top section) | 188 |
| 2.1 | Exploded view - sump (top section) | 188 |
| 2.2 | Removing and installing valve for oil pressure control N428 | 189 |
| 2.3 | Removing and installing sump (top section) | 190 |
| 3 | Oil filter housing, oil pressure switches, engine oil cooler | 195 |
| 3.1 | Exploded view - oil filter housing, oil pressure switches | 195 |

| | | |
|-----------|---|------------|
| 3.2 | Checking oil pressure switch F22 / oil pressure switch for reduced oil pressure F378 | 196 |
| 3.3 | Removing and installing oil pressure switch F22 / oil pressure switch for reduced oil pressure F378 | 197 |
| 3.4 | Removing and installing oil temperature sender 2 G664 | 197 |
| 3.5 | Removing and installing oil filter housing | 198 |
| 3.6 | Exploded view - engine oil cooler | 199 |
| 3.7 | Removing and installing engine oil cooler | 201 |
| 3.8 | Removing and installing mounting plate for engine oil cooler and coolant shut-off valve | 202 |
| 3.9 | Removing and installing temperature regulator for engine oil cooler | 202 |
| 3.10 | Checking oil pressure | 204 |
| 3.11 | Engine oil | 204 |
| 3.12 | Checking oil level | 204 |
| 19 | Cooling | 205 |
| 1 | Cooling system | 205 |
| 1.1 | Connection diagram - coolant hoses | 205 |
| 1.2 | Draining and filling cooling system | 207 |
| 1.3 | Checking cooling system for leaks | 213 |
| 2 | Coolant pump, thermostat | 216 |
| 2.1 | Exploded view - coolant pump | 216 |
| 2.2 | Removing and installing coolant pump | 216 |
| 2.3 | Removing and installing map-controlled engine cooling system thermostat F265 | 217 |
| 3 | Coolant pipes, coolant shut-off valve, coolant temperature sender | 218 |
| 3.1 | Exploded view - coolant pipes on engine | 218 |
| 3.2 | Removing and installing non-return valve - cylinder bank 1 (right-side) | 220 |
| 3.3 | Removing and installing non-return valve - cylinder bank 2 (left-side) | 222 |
| 3.4 | Removing and installing coolant pipe (top) on engine | 224 |
| 3.5 | Removing and installing coolant pipe (front) on engine | 224 |
| 3.6 | Removing and installing coolant pipe (left-side) on engine | 226 |
| 3.7 | Removing and installing coolant pipe (bottom left) on engine | 226 |
| 3.8 | Exploded view - coolant pipes on gearbox | 228 |
| 3.9 | Removing and installing coolant pipe (left-side) on gearbox | 230 |
| 3.10 | Removing and installing coolant pipes (top left) on gearbox | 231 |
| 3.11 | Exploded view - coolant shut-off valve | 233 |
| 3.12 | Removing and installing coolant shut-off valve | 234 |
| 3.13 | Exploded view - coolant temperature senders | 235 |
| 3.14 | Removing and installing temperature sender for engine temperature regulation G694 | 236 |
| 3.15 | Removing and installing radiator outlet coolant temperature sender G83 | 238 |
| 3.16 | Removing and installing coolant temperature sender G62 | 239 |
| 4 | Radiator, radiator cowl and radiator fans | 240 |
| 4.1 | Exploded view - radiator | 240 |
| 4.2 | Removing and installing radiator | 242 |
| 4.3 | Exploded view - radiator cowl and radiator fans | 245 |
| 4.4 | Removing and installing radiator cowl | 246 |
| 4.5 | Removing and installing radiator fans V7 and V177 | 249 |
| 21 | Turbocharging/supercharging | 250 |
| 1 | Turbocharger | 250 |
| 1.1 | Exploded view - turbocharger | 250 |
| 1.2 | Removing and installing turbocharger | 252 |
| 1.3 | Removing and installing turbocharger 1 control unit J724 | 255 |
| 2 | Charge air cooling | 267 |
| 2.1 | Exploded view - air pipes, air hoses | 267 |
| 2.2 | Exploded view - charge air cooler | 268 |
| 2.3 | Removing and installing charge pressure sender G31 / intake air temperature sender G42 | 270 |



| | | |
|-----------|---|------------|
| 2.4 | Removing and installing charge air cooler | 270 |
| 2.5 | Checking charge air system for leaks | 272 |
| 26 | - Exhaust system | 276 |
| 1 | Silencer for vehicles without SCR catalytic converter | 276 |
| 1.1 | Exploded view - silencers | 276 |
| 1.2 | Removing and installing starter catalytic converter | 278 |
| 1.3 | Removing and installing particulate filter | 279 |
| 2 | Silencer for vehicles with SCR catalytic converter | 283 |
| 2.1 | Exploded view - silencers | 283 |
| 2.2 | Removing and installing starter catalytic converter | 287 |
| 2.3 | Removing and installing SCR catalytic converter | 289 |
| 2.4 | Removing and installing particulate filter | 290 |
| 3 | Exhaust system | 292 |
| 3.1 | Renewing tailpipes | 292 |
| 3.2 | Stress-free alignment of exhaust system | 292 |
| 3.3 | Checking exhaust system for leaks | 293 |
| 4 | Exhaust manifolds | 294 |
| 4.1 | Exploded view - exhaust manifold | 294 |
| 4.2 | Removing and installing exhaust manifold (left-side) | 295 |
| 4.3 | Removing and installing exhaust manifold (right-side) | 297 |
| 5 | Exhaust gas temperature control | 300 |
| 5.1 | Exploded view - exhaust gas temperature senders | 300 |
| 5.2 | Removing and installing exhaust gas temperature sender 1 G235 | 303 |
| 5.3 | Removing and installing exhaust gas temperature sender 2 G448 | 305 |
| 5.4 | Removing and installing exhaust gas temperature sender 3 G495 | 305 |
| 5.5 | Removing and installing exhaust gas temperature sender 4 G648 | 307 |
| 5.6 | Removing and installing particulate sensor G784 | 309 |
| 6 | Exhaust gas recirculation | 310 |
| 6.1 | Exploded view - exhaust gas recirculation system | 310 |
| 6.2 | Removing and installing exhaust gas recirculation control motor V338 | 313 |
| 6.3 | Removing and installing exhaust gas recirculation cooler | 314 |
| 6.4 | Removing and installing exhaust gas recirculation temperature sensor G98 | 315 |
| 7 | Reducing agent metering system | 317 |
| 7.1 | Exploded view - injector for reducing agent N474 | 317 |
| 7.2 | Removing and installing injector for reducing agent N474 | 318 |
| 7.3 | Exploded view - active tank for reducing agent with attached components | 319 |
| 7.4 | Draining active tank for reducing agent | 322 |
| 7.5 | Removing and installing pump for reducing agent V437 | 323 |
| 7.6 | Removing and installing pressure sender for reducing agent metering system G686 | 324 |
| 7.7 | Removing and installing active tank for reducing agent | 325 |
| 7.8 | Removing and installing reservoir for reducing agent | 327 |
| 7.9 | Removing and installing reducing agent tank cap switch F502 | 330 |
| 7.10 | Exploded view - passive tank for reducing agent with attached components | 330 |
| 7.11 | Removing and installing passive tank for reducing agent | 332 |
| 7.12 | Draining passive tank for reducing agent | 333 |
| 7.13 | Removing and installing transfer pump for reducing agent V436 | 335 |
| 7.14 | Exploded view - control unit for reducing agent metering system J880 | 336 |
| 7.15 | Checking control unit for reducing agent metering system J880 | 337 |
| 7.16 | Removing and installing control unit for reducing agent metering system J880 | 337 |