



Contents

| | |
|--|-----------|
| 00 - Technical data | 1 |
| 1 Identification | 1 |
| 1.1 Engine number/engine data | 1 |
| 2 Safety precautions | 2 |
| 2.1 Safety precautions when working on the fuel supply system | 2 |
| 2.2 Safety precautions when working on the cooling system | 2 |
| 2.3 Safety precautions when working on vehicles with start/stop system | 3 |
| 2.4 Safety precautions when using testers and measuring instruments during a road test | 3 |
| 2.5 Safety precautions when working on the ignition system | 3 |
| 3 Repair instructions | 4 |
| 3.1 Rules for cleanliness | 4 |
| 3.2 Foreign particles in engine | 4 |
| 3.3 Contact corrosion | 4 |
| 3.4 Routing and attachment of pipes, hoses and wiring | 5 |
| 3.5 Nuts, bolts | 5 |
| 3.6 Identification plates | 5 |
| 3.7 Use of impact wrenches | 5 |
| 3.8 Installing radiators and condensers | 6 |
| 3.9 Checking vacuum system | 6 |
| 10 - Removing and installing engine | 8 |
| 1 Removing and installing engine | 8 |
| 1.1 Removing engine | 8 |
| 1.2 Separating engine and gearbox | 27 |
| 1.3 Securing engine to engine and gearbox support | 33 |
| 1.4 Installing engine | 34 |
| 2 Assembly mountings | 39 |
| 2.1 Exploded view - assembly mountings | 39 |
| 2.2 Supporting engine in installation position | 40 |
| 2.3 Removing and installing engine mountings | 43 |
| 2.4 Adjusting assembly mountings | 44 |
| 2.5 Checking adjustment of assembly mountings (engine/gearbox mountings) | 49 |
| 13 - Crankshaft group | 52 |
| 1 Cylinder block (pulley end) | 52 |
| 1.1 Exploded view - poly V-belt drive | 52 |
| 1.2 Exploded view - sealing flange (pulley end) | 54 |
| 1.3 Removing and installing poly V-belts | 55 |
| 1.4 Removing and installing poly V-belt tensioner | 57 |
| 1.5 Removing and installing vibration damper | 59 |
| 1.6 Removing and installing bracket for ancillaries | 60 |
| 1.7 Removing and installing sealing flange (pulley end) | 61 |
| 2 Cylinder block (gearbox end) | 65 |
| 2.1 Exploded view - flywheel | 65 |
| 2.2 Removing and installing flywheel | 66 |
| 2.3 Checking sender wheel | 67 |
| 2.4 Renewing crankshaft oil seal (gearbox end) | 68 |
| 3 Crankshaft | 71 |
| 3.1 Exploded view - crankshaft | 71 |
| 3.2 Crankshaft dimensions | 73 |
| 3.3 Renewing needle bearing in crankshaft | 73 |
| 3.4 Measuring axial clearance of crankshaft | 75 |



| | | |
|-----------|--|------------|
| 3.5 | Measuring radial clearance of crankshaft | 76 |
| 4 | Pistons and conrods | 77 |
| 4.1 | Exploded view - pistons and conrods | 77 |
| 4.2 | Removing and installing pistons | 78 |
| 4.3 | Checking pistons and cylinder bores | 80 |
| 4.4 | Separating parts of new conrod | 81 |
| 4.5 | Checking radial clearance of conrod bearings | 82 |
| 15 | Cylinder head, valve gear | 83 |
| 1 | Timing chain cover | 83 |
| 1.1 | Exploded view - timing chain cover | 83 |
| 1.2 | Removing and installing timing chain cover | 85 |
| 2 | Chain drive | 94 |
| 2.1 | Exploded view - camshaft timing chains | 94 |
| 2.2 | Exploded view - drive chain for valve gear | 95 |
| 2.3 | Removing and installing camshaft timing chain | 95 |
| 2.4 | Removing and installing drive chain for valve gear | 103 |
| 3 | Cylinder head | 105 |
| 3.1 | Exploded view - cylinder head | 105 |
| 3.2 | Removing and installing cylinder head | 107 |
| 3.3 | Removing and installing cylinder head cover | 116 |
| 3.4 | Checking compression | 117 |
| 4 | Valve gear | 120 |
| 4.1 | Exploded view - valve gear | 120 |
| 4.2 | Measuring axial clearance of camshaft | 123 |
| 4.3 | Measuring radial clearance of camshaft | 124 |
| 4.4 | Removing and installing camshaft | 124 |
| 4.5 | Checking hydraulic compensation elements | 128 |
| 4.6 | Removing and installing valve stem oil seals | 130 |
| 4.7 | Removing and installing camshaft control valve 1 N205 | 137 |
| 4.8 | Removing and installing exhaust camshaft control valve 1 N318 | 138 |
| 5 | Inlet and exhaust valves | 139 |
| 5.1 | Checking valve guides | 139 |
| 5.2 | Checking valves | 140 |
| 5.3 | Valve dimensions | 141 |
| 17 | Lubrication | 142 |
| 1 | Sump/oil pump | 142 |
| 1.1 | Exploded view - sump/oil pump | 142 |
| 1.2 | Engine oil | 145 |
| 1.3 | Removing and installing sump (bottom section) | 145 |
| 1.4 | Removing and installing sump (top section) | 147 |
| 1.5 | Removing and installing oil pump | 153 |
| 1.6 | Removing and installing oil level and oil temperature sender G266 | 158 |
| 2 | Engine oil cooler | 159 |
| 2.1 | Exploded view - engine oil cooler | 159 |
| 2.2 | Removing and installing engine oil cooler | 160 |
| 2.3 | Removing and installing oil filter housing | 161 |
| 3 | Crankcase breather | 164 |
| 3.1 | Removing and installing pressure control valve for crankcase breather system | 164 |
| 4 | Oil filter/oil pressure switches | 167 |
| 4.1 | Removing and installing oil pressure switch F22 | 167 |
| 4.2 | Removing and installing oil pressure switch F1 / F378 | 169 |
| 4.3 | Checking oil pressure | 169 |



| | | |
|-----------|---|------------|
| 4.4 | Removing and installing valve for oil pressure control N428 | 170 |
| 19 | Cooling | 173 |
| 1 | Cooling system/coolant | 173 |
| 1.1 | Connection diagram - coolant hoses | 173 |
| 1.2 | Checking cooling system for leaks | 175 |
| 1.3 | Draining and filling cooling system | 177 |
| 2 | Coolant pump/thermostat assembly | 184 |
| 2.1 | Exploded view - coolant pump/thermostat | 184 |
| 2.2 | Removing and installing electric coolant pump | 185 |
| 2.3 | Removing and installing coolant valves | 186 |
| 2.4 | Removing and installing coolant pump | 187 |
| 2.5 | Removing and installing thermostat | 189 |
| 2.6 | Removing and installing coolant distributor housing | 191 |
| 2.7 | Removing and installing coolant temperature sender G62 | 192 |
| 3 | Coolant pipes | 194 |
| 3.1 | Exploded view - coolant pipes | 194 |
| 3.2 | Removing and installing coolant pipes | 195 |
| 3.3 | Removing and installing coolant pipes for gearbox | 200 |
| 4 | Radiator/radiator fans | 202 |
| 4.1 | Exploded view - radiator/radiator fans | 202 |
| 4.2 | Removing and installing radiator | 204 |
| 4.3 | Removing and installing radiator cowl with radiator fans | 207 |
| 4.4 | Removing and installing radiator fan V7 | 209 |
| 4.5 | Removing and installing auxiliary radiator | 209 |
| 21 | Turbocharging/supercharging | 214 |
| 1 | Turbocharger | 214 |
| 1.1 | Exploded view - turbocharger | 214 |
| 1.2 | Removing and installing turbocharger air recirculation valve N249 | 217 |
| 1.3 | Removing and installing turbocharger | 218 |
| 2 | Charge air system | 225 |
| 2.1 | Exploded view - charge air system | 225 |
| 2.2 | Removing and installing charge air cooler | 227 |
| 2.3 | Removing and installing charge pressure sender G31 / intake air temperature sender 2 G299 | 229 |
| 2.4 | Checking charge air system for leaks | 229 |
| 24 | Mixture preparation - injection | 232 |
| 1 | Injection system | 232 |
| 1.1 | Overview of fitting locations - injection system | 232 |
| 2 | Air cleaner | 239 |
| 2.1 | Exploded view - air cleaner housing | 239 |
| 2.2 | Removing and installing air cleaner housing | 240 |
| 3 | Intake manifold | 242 |
| 3.1 | Exploded view - intake manifold | 242 |
| 3.2 | Removing and installing intake manifold (top section) | 245 |
| 3.3 | Removing and installing intake manifold (bottom section) with fuel rail | 247 |
| 3.4 | Removing and installing throttle valve module J338 | 249 |
| 4 | Injectors | 252 |
| 4.1 | Exploded view - fuel rail with injectors | 252 |
| 4.2 | Removing and installing injectors | 253 |
| 5 | Senders and sensors | 259 |
| 5.1 | Removing and installing fuel pressure sender G247 | 259 |
| 5.2 | Removing and installing fuel pressure sender for low pressure G410 | 260 |



| | | |
|-----------|---|------------|
| 5.3 | Removing and installing intake air temperature sender G42 / intake manifold pressure sender G71 | 261 |
| 6 | High-pressure pump | 262 |
| 6.1 | Exploded view - high-pressure pump | 262 |
| 6.2 | Removing and installing high-pressure pump | 263 |
| 6.3 | Removing and installing high-pressure pipe | 264 |
| 6.4 | Checking fuel pressure and residual pressure (up to high-pressure pump) | 267 |
| 7 | Lambda probe | 272 |
| 7.1 | Exploded view - Lambda probe | 272 |
| 7.2 | Removing and installing Lambda probe | 273 |
| 8 | Engine control unit | 277 |
| 8.1 | Removing and installing engine/motor control unit J623 | 277 |
| 26 | - Exhaust system | 283 |
| 1 | Exhaust pipes/silencers | 283 |
| 1.1 | Exploded view - silencers | 283 |
| 1.2 | Stress-free alignment of exhaust system | 284 |
| 1.3 | Checking exhaust system for leaks | 285 |
| 2 | Emission control system | 286 |
| 2.1 | Removing and installing catalytic converter | 286 |
| 2.2 | Removing and installing starter catalytic converter | 286 |
| 2.3 | Checking vacuum unit for exhaust flap | 287 |
| 3 | Exhaust gas temperature control | 289 |
| 3.1 | Exploded view - exhaust gas temperature control | 289 |
| 3.2 | Removing and installing exhaust gas temperature sender | 290 |
| 4 | Exhaust manifold | 292 |
| 4.1 | Removing and installing exhaust manifold | 292 |
| 28 | - Ignition system | 293 |
| 1 | Ignition system | 293 |
| 1.1 | Exploded view - ignition system | 293 |
| 1.2 | Test data - spark plugs | 294 |
| 1.3 | Removing and installing ignition coils | 294 |
| 1.4 | Removing and installing knock sensor | 296 |
| 1.5 | Removing and installing Hall senders | 297 |
| 1.6 | Removing and installing engine speed sender G28 | 297 |