



Contents

00 - Technical data	1
1 Identification	1
1.1 Engine number/engine data	1
2 Safety information	3
2.1 Safety regulations for working on fuel supply	3
2.2 Safety precautions when using testers and measuring instruments during a road test	3
2.3 Safety measures when working on vehicles with a start/stop system	4
2.4 Safety precautions when working on the cooling system	4
2.5 Safety precautions when working on the SCR system	4
2.6 Safety precautions when working on exhaust system	5
3 Repair instructions	7
3.1 Rules for cleanliness	7
3.2 Foreign objects in engine	7
3.3 Checking vacuum system	7
10 - Removing and installing engine	8
1 Removing and installing motor	8
1.1 Removing motor	8
1.2 Separating engine and gearbox	31
1.3 Securing engine on engine and gearbox support	36
1.4 Installing engine	38
2 Assembly mountings	42
2.1 Assembly overview - assembly mountings	42
2.2 Supporting engine in installation position	43
2.3 Adjusting assembly mountings	48
3 Engine cover panel	50
3.1 Removing and installing engine cover	50
13 - Crankshaft group	52
1 Cylinder block (pulley end)	52
1.1 Assembly overview - poly V-belt drive	52
1.2 Removing and installing poly-V belt	56
1.3 Removing and installing tensioner for poly V-belt	61
1.4 Removing and installing bracket for ancillaries	61
1.5 Removing and installing engine bracket	64
1.6 Assembly overview - cylinder block (pulley end)	72
1.7 Removing and installing sealing flange on pulley end	74
1.8 Renewing crankshaft oil seal - belt pulley end	77
2 Cylinder block, gearbox end	81
2.1 Assembly overview - cylinder block, gearbox end	81
2.2 Removing and installing flywheel	82
2.3 Removing and installing sealing flange on gearbox side	84
3 Crankshaft	97
3.1 Assembly overview - crankshaft	97
3.2 Renewing needle bearing in crankshaft	98
3.3 Crankshaft dimensions	101
4 Pistons and conrods	102
4.1 Assembly overview - pistons and conrods	102
4.2 Measuring piston projection at TDC	107
4.3 Separating new conrod	109
4.4 Checking radial clearance of conrods	110



15 - Cylinder head, valve gear	111
1 Cylinder head	111
1.1 Assembly overview - cylinder head	111
1.2 Removing and installing cylinder head	115
1.3 Assembly overview - cylinder head cover	125
1.4 Removing and installing cylinder head cover	127
1.5 Removing and installing vacuum pump	131
1.6 Checking compression	133
2 Toothed belt drive	136
2.1 Assembly overview - toothed belt	136
2.2 Removing and installing toothed belt	138
3 Valve gear	161
3.1 Assembly overview - valve gear	161
3.2 Measuring axial play of camshaft	163
3.3 Measuring radial play of camshaft	164
3.4 Removing and installing camshaft oil seal	165
3.5 Removing and installing camshaft	172
3.6 Checking hydraulic compensation elements	181
3.7 Removing and installing valve stem seals	182
4 Inlet and exhaust valves	191
4.1 Valve dimensions	191
4.2 Reworking valve seats	191
4.3 Checking valve guides	191
4.4 Checking valves	193
17 - Lubrication	194
1 Sump, oil pump	194
1.1 Assembly overview - sump/oil pump	194
1.2 Removing and installing sump	200
1.3 Removing and installing oil level and oil temperature sender	204
1.4 Removing and installing oil pump	206
1.5 Engine oil:	207
2 Engine oil cooler	209
2.1 Assembly overview - engine oil cooler	209
2.2 Removing and installing engine oil cooler	210
3 Oil filter, oil pressure switch	213
3.1 Assembly overview - oil filter	213
3.2 Removing and installing oil filter housing	214
3.3 Removing and installing oil pressure switch	218
3.4 Checking oil pressure and oil pressure switch	219
4 Balancer shaft module	222
4.1 Assembly overview - balancer shaft module	222
4.2 Removing and installing balance shaft module	225
19 - Cooling	235
1 Cooling system/coolant	235
1.1 Coolant hose connection diagram	235
1.2 Checking cooling system for leaks	236
1.3 Draining and adding coolant	240
2 Coolant pump, regulation of cooling system	247
2.1 Assembly overview - coolant pump, thermostat	247
2.2 Removing and installing coolant pump	247
2.3 Removing and installing 4/2-way valve with thermostat	249
2.4 Electric coolant pump	255



2.5	Removing and installing coolant temperature sender	260
3	Coolant pipes	265
3.1	Assembly overview - coolant pipes	265
3.2	Removing and installing coolant pipes	267
4	Radiator, radiator fan	279
4.1	Assembly overview - radiator/radiator fan	279
4.2	Removing and installing radiator	279
4.3	Removing and installing radiator cowl with radiator fan	282
4.4	Removing and installing radiator fan	283
21	- Turbocharging/supercharging	285
1	Turbocharger	285
1.1	Assembly overview - turbocharger	285
1.2	Removing and installing turbocharger	287
1.3	Renewing vacuum unit for turbocharger	295
2	Charge air system	302
2.1	Assembly overview - charge air system	302
2.2	Removing and installing charge air cooler	303
2.3	Assembly overview - charge-air hose connections	305
2.4	Removing and installing charge pressure sender	306
2.5	Checking charge air system for leaks	307
23	- Mixture preparation - injection	311
1	Injection system	311
1.1	Schematic overview - fuel system	311
1.2	Filling/bleeding fuel system	313
1.3	Checking fuel system for leaks	314
2	Injectors/high-pressure accumulator (rail)	315
2.1	Assembly overview - injectors	315
2.2	Adapting correction values for injectors	318
2.3	Testing jammed-open injectors	319
2.4	Removing and installing injectors	321
2.5	Removing and installing fuel rail	325
2.6	Removing and installing high-pressure lines	329
3	High-pressure pump	334
3.1	Assembly overview - high-pressure pump	334
3.2	Removing and installing high-pressure pump	336
4	Senders and sensors	342
4.1	Checking fuel pressure regulating valve	342
4.2	Removing and installing fuel pressure regulating valve	343
4.3	Removing and installing fuel pressure sender	345
4.4	Removing and installing air mass meter	348
4.5	Removing and installing NOx sender 2 G687	349
4.6	Removing and installing differential pressure sensor	349
5	Lambda probe	351
5.1	Removing and installing Lambda probe	351
6	Vacuum system	353
6.1	Vacuum hose connection diagram	353
6.2	Checking vacuum system	354
7	Air filter	357
7.1	Assembly overview - air filter housing	357
7.2	Removing and installing air filter housing	359
8	Intake manifold	362
8.1	Assembly overview - intake manifold	362



8.2	Removing and installing intake manifold	363
8.3	Removing and installing throttle valve module	368
9	Engine control unit	370
9.1	Removing and installing engine control unit	370
26 - Exhaust system		375
1	Exhaust pipes and silencers	375
1.1	Assembly overview - silencers	375
1.2	Aligning exhaust system free of stress	378
1.3	Installation position of clamp	379
2	Emission control	381
2.1	Assembly overview - emission control	381
2.2	Removing and installing particulate filter	384
2.3	Removing and installing catalytic converter	393
3	SCR system (selective catalytic reduction)	399
3.1	Assembly overview - tank for reducing agent	399
3.2	Draining reducing agent tank	400
3.3	Removing and installing reducing agent tank	404
3.4	Assembly overview - delivery module for reducing agent	407
3.5	Removing and installing heater element (heater cup)	409
3.6	Assembly overview - reducing agent supply line	414
3.7	Removing and installing reducing agent supply line	415
3.8	Removing and installing injector for reducing agent	418
4	Exhaust gas temperature regulation	420
4.1	Assembly overview - exhaust gas temperature regulation	420
4.2	Removing and installing parts of exhaust gas temperature regulation	422
5	Exhaust gas recirculation	429
5.1	Assembly overview - exhaust gas recirculation	429
5.2	Checking changeover for exhaust gas recirculation cooler	431
5.3	Removing and installing exhaust gas recirculation cooler	431
5.4	Checking exhaust gas recirculation cooler for leaks	434
5.5	Cleaning exhaust gas recirculation system	440
28 - Glow plug system		448
1	Glow plug system	448
1.1	Removing and installing glow plug	448
1.2	Removing and installing automatic glow period control unit	450
1.3	Removing and installing Hall sender	451
1.4	Removing and installing engine speed sender	452