



Contents

00 - Technical data	1
1 Identification	1
1.1 Engine number/engine data	1
2 Safety information	3
2.1 Safety precautions during work on fuel system	3
2.2 Safety measures when working on vehicles with a start/stop system	3
2.3 Safety precautions when using testers and measuring instruments during a road test	4
2.4 Safety precautions when working on the cooling system	4
2.5 Safety precautions when working on the SCR system	5
2.6 Safety precautions when working on exhaust system	6
3 Repair instructions	7
3.1 Rules for cleanliness	7
3.2 Adapting learnt value for SCR system	7
3.3 Foreign objects in engine	7
3.4 Contact corrosion	8
3.5 Routing and attachment of lines	8
3.6 Fitting radiator and condensers	8
10 - Removing and installing engine	9
1 Removing and installing engine	9
1.1 Removing engine	9
1.2 Separating engine and gearbox	25
1.3 Securing engine on engine and gearbox support	35
1.4 Installing engine	39
2 Assembly mountings	44
2.1 Assembly overview – assembly mountings	44
2.2 Removing and installing engine mounting	46
2.3 Removing and installing engine mounting	48
2.4 Supporting engine in installation position	50
3 Engine cover panel	53
3.1 Removing and installing engine cover	53
13 - Crankshaft group	54
1 Cylinder block (pulley end)	54
1.1 Assembly overview - poly V-belt drive	54
1.2 Assembly overview - sealing flange, belt pulley end	58
1.3 Removing and installing poly-V belt	64
1.4 Removing and installing tensioner for poly V-belt	66
1.5 Removing and installing vibration damper	66
1.6 Removing and installing bracket for ancillaries	67
1.7 Renewing crankshaft oil seal - belt pulley end	67
1.8 Removing and installing sealing flange on pulley end	69
1.9 Removing and installing cover for sealing flange (pulley end)	73
2 Cylinder block, gearbox end	75
2.1 Assembly overview - drive plate	75
2.2 Removing and installing drive plate	75
2.3 Removing and installing sender wheel	77
2.4 Checking sender wheel	77
2.5 Renewing crankshaft oil seal (gearbox end)	78
3 Crankshaft	81
3.1 Assembly overview - crankshaft	81
3.2 Crankshaft dimensions	83



3.3	Allocation of main bearing shells	84
3.4	Measuring axial clearance of crankshaft	85
3.5	Measuring radial clearance of crankshaft	86
4	Balancer shaft	87
4.1	Assembly overview - balance shaft	87
4.2	Renewing roller bearing for balance shaft	87
4.3	Removing and installing balance shaft	89
5	Pistons and conrods	92
5.1	Assembly overview - pistons and conrods	92
5.2	Measuring piston projection at "TDC"	96
5.3	Checking pistons and cylinder bores	98
5.4	Checking radial clearance of conrods	100
15 - Cylinder head, valve gear	101	
1	Cylinder head	101
1.1	Assembly overview - cylinder head	101
1.2	Assembly overview - cylinder head cover	105
1.3	Removing and installing cylinder head	108
1.4	Removing and installing cylinder head cover	115
1.5	Removing and installing injector seals	121
1.6	Checking compression	121
2	Cover for timing chain	124
2.1	Assembly overview - cover for timing chain	124
2.2	Removing and installing timing chain cover	128
3	Chain drive	137
3.1	Assembly overview - camshaft timing chains	137
3.2	Assembly overview - drive chain for oil pump and high-pressure pump	139
3.3	Removing and installing camshaft timing chain	140
3.4	Removing camshaft timing chain from camshafts	153
3.5	Removing and installing drive chain for oil pump and high-pressure pump	164
4	Valve gear	168
4.1	Assembly overview - valve gear	168
4.2	Measuring axial play of camshaft	171
4.3	Measuring radial play of camshaft	172
4.4	Removing and installing camshaft	173
4.5	Checking hydraulic compensation elements	205
4.6	Removing and installing valve stem oil seals	207
5	Inlet and exhaust valves	217
5.1	Reworking valve seats	217
5.2	Checking valve guides	217
5.3	Checking valves	218
5.4	Valve dimensions	218
17 - Lubrication	220	
1	Sump, oil pump	220
1.1	Assembly overview - sump/oil pump	220
1.2	Engine oil:	225
1.3	Removing and installing lower part of sump	227
1.4	Removing and installing upper part of sump	232
1.5	Removing and installing oil pump	236
1.6	Removing and installing oil level and oil temperature sender	238
2	Oil filter, oil pressure switch	240
2.1	Assembly overview - oil filter housing, oil pressure switch	240
2.2	Removing and installing oil filter housing	242
2.3	Removing and installing oil pressure regulating valve N428	244



2.4	Checking oil pressure and oil pressure switch	244
2.5	Removing and installing oil pressure switch	246
3	Engine oil cooler	248
3.1	Assembly overview - engine oil cooler	248
3.2	Removing and installing engine oil cooler	249
3.3	Removing and installing mounting plate for engine oil cooler/coolant shut-off valve	250
3.4	Removing and installing temperature regulator for engine oil cooler	251
19 - Cooling		253
1	Cooling system/coolant	253
1.1	Connection diagram - coolant hoses	253
1.2	Checking cooling system for leaks	255
1.3	Draining and adding coolant	257
1.4	Draining cooling system	265
1.5	Checking filling quality	267
2	Coolant pump, regulation of cooling system	269
2.1	Assembly overview - coolant pump	269
2.2	Assembly overview - coolant shut-off valve	270
2.3	Assembly overview - coolant temperature sender	270
2.4	Removing and installing coolant pump	271
2.5	Removing and installing thermostat	272
2.6	Removing and installing coolant temperature sender G62	273
2.7	Removing and installing radiator outlet coolant temperature sender G83	273
2.8	Removing and installing temperature sender for engine temperature regulation G694	274
2.9	Removing and installing coolant shut-off valve	276
3	Coolant pipes	277
3.1	Assembly overview - coolant pipes	277
3.2	Removing and installing coolant pipes	281
4	Radiator, radiator fan	291
4.1	Assembly overview - radiator/radiator fan	291
4.2	Removing and installing radiator cowl with radiator fan	292
4.3	Removing and installing radiator module	293
4.4	Dismantling radiator module	297
21 - Turbocharging/supercharging		299
1	Turbocharger	299
1.1	Assembly overview - turbocharger	299
1.2	Removing and installing turbocharger	302
1.3	Removing and installing turbocharger 1 control unit J724	309
2	Charge air system	324
2.1	Assembly overview - charge air system	324
2.2	Assembly overview - charge-air hose connections	325
2.3	Removing and installing charge air cooler	327
2.4	Removing and installing charge pressure sender G31	329
2.5	Removing and installing air intake pipe	330
2.6	Checking charge air system for leaks	333
23 - Mixture preparation - injection		341
1	Injection system	341
1.1	Schematic overview - fuel system	341
1.2	Overview of fitting locations - injection system	344
1.3	Filling/bleeding fuel system	349
1.4	Checking fuel system for leaks	349
2	Vacuum system	350
2.1	Connection diagram – vacuum system	350



3	Injectors/high-pressure accumulator (rail)	351
3.1	Assembly overview - injectors	351
3.2	Adapting correction values for injectors	354
3.3	Checking return flow rate of injectors with engine running	354
3.4	Checking return flow rate of injectors at starter speed	356
3.5	Checking open injectors	359
3.6	Checking restrictor in fuel return line	361
3.7	Removing and installing injectors	362
3.8	Removing and installing high-pressure lines	367
4	Air filter	370
4.1	Assembly overview - air filter housing	370
4.2	Removing and installing air filter housing	370
5	Intake manifold	373
5.1	Assembly overview – intake manifold	373
5.2	Removing and installing intake manifold	376
5.3	Removing and installing intake manifold flap motor V157	381
5.4	Removing and installing throttle valve module J338	383
6	Senders and sensors	385
6.1	Removing and installing fuel pressure regulating valve N276	385
6.2	Removing and installing fuel pressure sender G247	387
6.3	Removing and installing air mass meter G70	390
6.4	Removing and installing pressure differential sender G505	391
6.5	Removing and installing NOx sender G295	392
6.6	Removing and installing NOx sender 2 G687	393
6.7	Removing and installing particle sensor G784	394
7	Engine control unit	396
7.1	Removing and installing engine (motor) control unit J623 with protective housing	396
8	High-pressure pump	398
8.1	Assembly overview - high-pressure pump	398
8.2	Removing and installing high-pressure pump	400
9	Lambda probe	407
9.1	Assembly overview - Lambda probe	407
9.2	Removing and installing Lambda probe 1 before catalytic converter GX10	413
26 - Exhaust system		415
1	Exhaust pipes and silencers	415
1.1	Assembly overview – silencers	415
1.2	Replacing tail pipes	417
1.3	Aligning exhaust system free of stress	418
1.4	Checking exhaust system for leaks	419
2	Emission control	420
2.1	Assembly overview – emission control	420
2.2	Removing and installing catalytic converter	427
2.3	Removing and installing particulate filter	429
2.4	Removing and installing reduction catalytic converter	433
3	SCR system (selective catalytic reduction)	434
3.1	Assembly overview – reducing agent tank	434
3.2	Assembly overview - delivery module for reducing agent	434
3.3	Assembly overview - reducing agent supply line	436
3.4	Draining reducing agent tank	438
3.5	Removing and installing reducing agent tank	442
3.6	Removing and installing reducing agent supply line	445
3.7	Removing and installing injector for reduction agent N474	448
3.8	Removing and installing pump for reducing agent V437	452



3.9	Removing and installing heater element (heater cup)	454
3.10	Disconnecting reducing agent supply line	457
4	Exhaust manifold	461
4.1	Assembly overview - exhaust manifold	461
4.2	Removing and installing exhaust manifold	462
5	Exhaust gas temperature regulation	467
5.1	Assembly overview – exhaust gas temperature regulation	467
5.2	Removing and installing parts of exhaust gas temperature regulation	474
6	Exhaust gas recirculation	483
6.1	Assembly overview – exhaust gas recirculation	483
6.2	Removing and installing exhaust gas recirculation control motor V338	487
6.3	Removing and installing exhaust gas recirculation cooler	488
6.4	Removing and installing exhaust gas recirculation temperature sensor G98	489
28 - Glow plug system	491	
1	Glow plug system	491
1.1	Assembly overview – glow plug system	491
1.2	Removing and installing glow plug	491
1.3	Removing and installing engine speed sender G28	493
1.4	Removing and installing Hall sender G40	493