

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 supply system	2
2.2 Safety precautions when using testers and measuring instruments during a road test	3
2.3 Safety precautions when working on the cooling system	3
2.4 Safety precautions when working on vehicles with start/stop system	3
2.5 Safety precautions when working on the SCR system	4
2.6 Safety precautions when working on the exhaust system	5
3 Repair instructions	6
3.1 Rules for cleanliness	6
3.2 General notes	6
3.3 General repair instructions	7
3.4 Performing adaptions after renewing a component	7
3.5 Cleaning engine	8
3.6 Bolts/nuts	8
3.7 Identification plates	8
3.8 Use of impact wrenches	9
3.9 Foreign material in engine	9
3.10 Contact corrosion	9
3.11 Routing and attachment of pipes, hoses and wiring	10
3.12 Installing radiators and condensers	10
10 - Removing and installing engine	11
1 Removing and installing engine	11
1.1 Removing engine	11
1.2 Separating engine and gearbox	28
1.3 Securing engine to engine and gearbox support	32
1.4 Installing engine	35
2 Assembly mountings	40
2.1 Assembly overview - assembly mountings	40
2.2 Supporting engine in installation position	42
2.3 Removing and installing engine mountings	45
2.4 Removing and installing gearbox mounting	46
2.5 Removing and installing pendulum support	48
2.6 Checking adjustment of assembly mountings	48
2.7 Adjusting assembly mountings	49
3 Engine cover panel	52
3.1 Removing and installing engine cover panel	52
13 - Crankshaft group	53
1 Cylinder block (pulley end)	53
1.1 Assembly overview - cylinder block (pulley end)	53
1.2 Assembly overview - sealing flange (pulley end)	56
1.3 Removing and installing poly V-belt	57
1.4 Removing and installing poly V-belt tensioner	59
1.5 Removing and installing vibration damper	59
1.6 Removing and installing bracket for ancillaries	60
1.7 Removing and installing engine support	62
1.8 Removing and installing sealing flange (pulley end)	62
2 Cylinder block (gearbox end)	66

2.1	Assembly overview - cylinder block (gearbox end)	66
2.2	Removing and installing flywheel	68
2.3	Renewing cylinder block cover (gearbox end)	70
2.4	Removing and installing sealing flange (gearbox end)	71
3	Crankshaft	92
3.1	Measuring axial clearance of crankshaft	92
3.2	Renewing needle bearing in crankshaft	93
4	Pistons and conrods	96
4.1	Assembly overview - pistons and conrods	96
4.2	Removing and installing pistons	99
4.3	Measuring piston projection at TDC	100
4.4	Checking pistons and cylinder bores	102
4.5	Separating parts of new conrod	104
4.6	Checking radial clearance of conrod bearings	105
15 - Cylinder head, valve gear	106
1	Toothed belt drive	106
1.1	Assembly overview - toothed belt guard	106
1.2	Assembly overview - toothed belt	107
1.3	Removing and installing toothed belt guard	109
1.4	Detaching toothed belt from camshaft	114
1.5	Removing and installing toothed belt	126
2	Cylinder head	140
2.1	Assembly overview - cylinder head	140
2.2	Assembly overview - cylinder head cover	143
2.3	Removing and installing cylinder head cover	145
2.4	Removing and installing seals for injectors	147
2.5	Removing and installing camshaft housing	148
2.6	Removing and installing cylinder head	153
2.7	Checking compression	161
3	Valve gear	164
3.1	Assembly overview - valve gear	164
3.2	Removing and installing camshaft oil seal	168
3.3	Removing and installing camshaft control valve 1 N205	170
3.4	Removing and installing camshaft adjuster	171
3.5	Removing and installing control valve for camshaft control valve 1 N205	175
3.6	Removing and installing valve stem oil seals	177
4	Inlet and exhaust valves	187
4.1	Checking valve guides	187
4.2	Checking valves	188
4.3	Valve dimensions	188
17 - Lubrication	189
1	Sump/oil pump	189
1.1	Assembly overview - sump/oil pump	189
1.2	Removing and installing oil pump	207
1.3	Removing and installing oil level and oil temperature sender G266	208
1.4	Engine oil	209
2	Engine oil cooler	210
3	Oil filter/oil pressure switches	211
3.1	Assembly overview - oil filter housing/oil pressure switches	211
3.2	Removing and installing oil filter housing	213
3.3	Removing and installing oil pressure switch F22	216
3.4	Removing and installing oil pressure switch for reduced oil pressure F378	217
3.5	Removing and installing valve for oil pressure control N428	218

3.6	Checking oil pressure	219
19 - Cooling		221
1	Cooling system/coolant	221
1.1	Connection diagram - coolant hoses	221
1.2	Checking cooling system for leaks	222
1.3	Draining and filling cooling system without electric vacuum pump VAS 6096/2	225
1.4	Filling cooling system with electric vacuum pump VAS 6096/2	236
1.5	Checking electric vacuum pump VAS 6096/2	244
1.6	Flushing cooling system	244
1.7	Flushing cooling system - quick reference guide	266
2	Coolant pump/thermostat assembly	268
2.1	Assembly overview - coolant pump/thermostat	268
2.2	Assembly overview - electric coolant pump	270
2.3	Assembly overview - coolant temperature senders	270
2.4	Removing and installing electric coolant pump	271
2.5	Removing and installing coolant pump	276
2.6	Removing and installing thermostat	277
2.7	Removing and installing coolant valve for cylinder head N489	278
2.8	Checking thermostat	279
2.9	Removing and installing coolant temperature sender G62	279
3	Coolant pipes	282
3.1	Assembly overview - coolant pipes	282
3.2	Removing and installing coolant pipes	284
4	Radiator/radiator fans	300
4.1	Assembly overview - radiator/radiator fans	300
4.2	Removing and installing radiator	303
4.3	Removing and installing water radiator for charge air cooling circuit	306
4.4	Removing and installing radiator cowl	309
4.5	Removing and installing radiator fan V7	311
21 - Turbocharging/supercharging		314
1	Turbocharger	314
1.1	Assembly overview - turbocharger	314
1.2	Removing and installing turbocharger	317
1.3	Renewing vacuum unit for turbocharger	325
2	Charge air system	330
2.1	Assembly overview - charge air system	330
2.2	Assembly overview - hose connections for charge air system	332
2.3	Removing and installing charge pressure sender G31	333
2.4	Removing and installing charge air temperature sender	333
2.5	Checking charge air system for leaks	334
23 - Mixture preparation - injection		340
1	Injection system	340
1.1	Overview of fitting locations - injection system	340
1.2	Overview - fuel system	347
1.3	Filling and bleeding fuel system	348
1.4	Checking fuel system for leaks	349
2	Vacuum system	350
2.1	Connection diagram - vacuum system	350
2.2	Checking vacuum system	350
3	Air filter	352
3.1	Assembly overview - air filter housing	352
3.2	Removing and installing air filter housing	354



4	Intake manifold	356
4.1	Assembly overview - intake manifold	356
4.2	Removing and installing throttle valve module J338	359
4.3	Removing and installing intake manifold	361
5	Injectors/high-pressure reservoir (rail)	366
5.1	Assembly overview - injectors	366
5.2	Assembly overview - high-pressure reservoir (rail)	368
5.3	Checking injectors	370
5.4	Performing adaption of correction values for injectors	370
5.5	Checking for injectors sticking open	371
5.6	Checking return flow rate of injectors with engine running	373
5.7	Checking return flow rate of injectors at starter cranking speed	376
5.8	Removing and installing injectors	377
5.9	Removing and installing high-pressure pipes	381
5.10	Removing and installing high-pressure reservoir (rail)	384
6	High-pressure pump	387
6.1	Assembly overview - high-pressure pump	387
6.2	Removing and installing high-pressure pump	388
7	Senders and sensors	393
7.1	Removing and installing fuel temperature sender G81	393
7.2	Removing and installing air mass meter G70	393
7.3	Checking fuel pressure regulating valve N276	394
7.4	Removing and installing fuel pressure regulating valve N276	396
7.5	Removing and installing fuel pressure sender G247	401
8	Lambda probe	404
8.1	Assembly overview - Lambda probe	404
8.2	Removing and installing Lambda probe	406
8.3	Removing and installing NOx sender	407
9	Engine control unit	409
9.1	Removing and installing engine control unit J623	409
26	- Exhaust system	412
1	Exhaust pipes/silencers	412
1.1	Assembly overview - silencers	412
1.2	Removing and installing front exhaust pipe	416
1.3	Removing and installing silencers	417
1.4	Separating exhaust pipes/silencer	418
1.5	Stress-free alignment of exhaust system	419
1.6	Checking exhaust system for leaks	421
2	Emission control system	423
2.1	Assembly overview - emission control system	423
2.2	Removing and installing emission control module	426
2.3	Removing and installing pressure differential sender G505	435
2.4	Removing and installing exhaust gas pressure sensor 1 G450	436
2.5	Removing and installing exhaust flap control unit J883	437
3	SCR (selective catalytic reduction) system	439
3.1	Assembly overview - reducing agent tank	439
3.2	Assembly overview - delivery unit for reducing agent	441
3.3	Assembly overview - reducing agent supply line	442
3.4	Unplugging connector for reducing agent line	443
3.5	Draining reducing agent tank	444
3.6	Removing and installing delivery unit for reducing agent	447
3.7	Removing and installing reducing agent tank	448
3.8	Removing and installing injector for reducing agent N474	451

3.9	Removing and installing control unit for reducing agent heater J891	453
4	Exhaust gas temperature regulation	454
4.1	Assembly overview - exhaust gas temperature regulation	454
4.2	Removing and installing exhaust gas temperature sender	456
5	Exhaust gas recirculation	462
5.1	Assembly overview - exhaust gas recirculation system	462
5.2	Removing and installing exhaust gas recirculation control motor V338	465
5.3	Removing and installing exhaust gas recirculation control motor 2 V339	466
5.4	Removing and installing exhaust gas recirculation cooler	467
5.5	Checking exhaust gas recirculation cooler for leaks	470
28 - Glow plug system	476	
1	Glow plug system	476
1.1	Assembly overview - glow plug system	476
1.2	Removing and installing glow plug	478
1.3	Removing and installing automatic glow period control unit J179	482
1.4	Removing and installing Hall sender G40	483
1.5	Removing and installing engine speed sender G28	483