

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 Working on the reducing agent metering system - vehicles with SCR catalytic converter	4
2.3 Adapting learnt value after draining reducing agent or renewing components	5
2.4 Safety precautions when working on vehicles with start/stop system	5
2.5 Safety precautions when using testers and measuring instruments during a road test	5
2.6 Safety precautions when working on the cooling system	6
2.7 Safety precautions when working on the subframe	6
2.8 Safety precautions when working on the exhaust system	6
3 Repair instructions	8
3.1 Rules for cleanliness	8
3.2 General notes	8
3.3 General repair instructions	9
3.4 Foreign particles in engine	10
3.5 Contact corrosion	10
3.6 Routing and attachment of pipes, hoses and wiring	10
3.7 Installing radiators and condensers	10
3.8 Checking vacuum system	10
10 - Removing and installing engine	12
1 Removing and installing engine	12
1.1 Removing engine	12
1.2 Separating engine and gearbox	64
1.3 Securing engine to engine and gearbox support	81
1.4 Installing engine	84
2 Assembly mountings	93
2.1 Exploded view - assembly mountings	93
2.2 Removing and installing engine mountings	94
3 Engine cover panel	98
3.1 Removing and installing engine cover panel	98
13 - Crankshaft group	99
1 Cylinder block (pulley end)	99
1.1 Exploded view - poly V-belt drive	99
1.2 Exploded view - sealing flange (pulley end)	101
1.3 Removing and installing poly V-belt	106
1.4 Removing and installing poly V-belt tensioner	108
1.5 Removing and installing vibration damper	109
1.6 Removing and installing bracket for ancillaries	110
1.7 Renewing crankshaft oil seal (pulley end)	110
1.8 Removing and installing sealing flange (pulley end)	112
2 Cylinder block (gearbox end)	116
2.1 Exploded view - drive plate	116
2.2 Removing and installing drive plate	117
2.3 Removing and installing sender wheel	119
2.4 Checking sender wheel	119
2.5 Renewing crankshaft oil seal (gearbox end)	120
3 Crankshaft	123

3.1	Exploded view - crankshaft	123
3.2	Crankshaft dimensions	125
3.3	Measuring axial clearance of crankshaft	125
3.4	Measuring radial clearance of crankshaft	126
4	Balance shaft	127
4.1	Exploded view - balance shaft	127
4.2	Renewing roller bearing for balance shaft	127
4.3	Removing and installing balance shaft	128
5	Pistons and conrods	131
5.1	Exploded view - pistons and conrods	131
5.2	Removing and installing pistons	133
5.3	Measuring piston projection at TDC	134
5.4	Checking pistons and cylinder bores	137
5.5	Checking radial clearance of conrod bearings	138
15 - Cylinder head, valve gear	139	
1	Cylinder head	139
1.1	Exploded view - cylinder head	139
1.2	Exploded view - cylinder head cover	141
1.3	Removing and installing cylinder head	143
1.4	Removing and installing cylinder head cover	149
1.5	Removing and installing seals for injectors	154
1.6	Checking compression	156
2	Timing chain cover	158
2.1	Exploded view - timing chain cover	158
2.2	Removing and installing timing chain cover	160
3	Chain drive	166
3.1	Exploded view - camshaft timing chains	166
3.2	Exploded view - drive chain for oil pump and high-pressure pump	168
3.3	Removing and installing camshaft timing chain	169
3.4	Removing camshaft timing chain from camshafts	178
3.5	Removing and installing drive chain for oil pump and high-pressure pump	186
4	Valve gear	189
4.1	Exploded view - valve gear	189
4.2	Measuring axial clearance of camshaft	192
4.3	Measuring radial clearance of camshaft	193
4.4	Removing and installing camshaft	194
4.5	Removing and installing valve stem oil seals	215
5	Inlet and exhaust valves	222
5.1	Machining valve seats	222
5.2	Checking valve guides	222
5.3	Checking valves	223
5.4	Valve dimensions	224
17 - Lubrication	225	
1	Sump/oil pump	225
1.1	Exploded view - sump/oil pump	225
1.2	Engine oil	229
1.3	Checking oil level	229
1.4	Removing and installing sump (bottom section)	229
1.5	Removing and installing sump (top section)	231
1.6	Removing and installing oil pump	236
1.7	Removing and installing oil level and oil temperature sender G266	237
2	Engine oil cooler	238
2.1	Exploded view - engine oil cooler	238

2.2	Removing and installing engine oil cooler	239
2.3	Removing and installing mounting plate for engine oil cooler/coolant shut-off valve	240
2.4	Removing and installing temperature regulator for engine oil cooler	240
3	Oil filter/oil pressure switches	242
3.1	Exploded view - oil filter housing/oil pressure switch	242
3.2	Checking oil pressure switch F22 / oil pressure switch for reduced oil pressure F378	243
3.3	Removing and installing oil pressure switch F22 / oil pressure switch for reduced oil pressure F378	243
3.4	Removing and installing oil temperature sender 2 G664	245
3.5	Removing and installing valve for oil pressure control N428	246
3.6	Checking oil pressure	246
3.7	Removing and installing oil filter housing	247
19 - Cooling	249	
1	Cooling system/coolant	249
1.1	Connection diagram - coolant hoses	249
1.2	Draining and filling cooling system	253
1.3	Checking cooling system for leaks	259
2	Coolant pump/thermostat assembly	262
2.1	Exploded view - coolant pump	262
2.2	Exploded view - coolant temperature senders	264
2.3	Exploded view - coolant shut-off valve	265
2.4	Removing and installing coolant pump	265
2.5	Removing and installing map-controlled engine cooling system thermostat F265	267
2.6	Removing and installing coolant valves	267
2.7	Removing and installing coolant shut-off valve	269
2.8	Removing and installing coolant temperature sender G62	270
2.9	Removing and installing temperature sender for engine temperature regulation G694	271
2.10	Removing and installing radiator outlet coolant temperature sender G83	272
3	Coolant pipes	274
3.1	Exploded view - coolant pipes	274
3.2	Removing and installing coolant pipes	275
4	Radiator/radiator fans	280
4.1	Exploded view - radiator/radiator fans	280
4.2	Exploded view - radiator cowl and radiator fans	282
4.3	Removing and installing radiator	282
4.4	Removing and installing radiator cowl	288
4.5	Removing and installing radiator fans	294
21 - Turbocharging/supercharging	295	
1	Turbocharger	295
1.1	Exploded view - turbocharger	295
1.2	Removing and installing turbocharger	297
1.3	Removing and installing turbocharger 1 control unit J724	300
2	Charge air system	312
2.1	Exploded view - charge air system	312
2.2	Removing and installing charge air cooler	314
2.3	Removing and installing charge pressure sender G31 / intake air temperature sender G42	316
2.4	Checking charge air system for leaks	317
23 - Mixture preparation - injection	321	
1	Injection system	321
1.1	Overview of fitting locations - injection system	321
1.2	Overview - fuel system	330

1.3	Filling and bleeding fuel system	332
1.4	Checking fuel system for leaks	333
2	Vacuum system	334
2.1	Connection diagram - vacuum system	334
2.2	Checking vacuum system	334
3	Air cleaner	336
3.1	Exploded view - air cleaner housing	336
3.2	Removing and installing air filter element	338
3.3	Removing and installing air cleaner housing	340
4	Intake manifold	342
4.1	Exploded view - intake manifold	342
4.2	Removing and installing intake manifold	343
4.3	Removing and installing intake manifold flap motor V157	348
4.4	Removing and installing throttle valve module J338	350
5	Injectors/high-pressure reservoir (rail)	351
5.1	Exploded view - injectors	351
5.2	Checking injectors	354
5.3	Performing adaption of correction values for injectors	355
5.4	Checking for injectors sticking open	355
5.5	Checking return flow rate of injectors with engine running	357
5.6	Checking return flow rate of injectors at starter cranking speed	360
5.7	Checking restrictor in fuel return line	362
5.8	Removing and installing injectors	363
5.9	Removing and installing high-pressure pipes	369
5.10	Removing and installing high-pressure reservoir (rail)	370
6	High-pressure pump	375
6.1	Exploded view - high-pressure pump	375
6.2	Removing and installing high-pressure pump	376
7	Senders and sensors	382
7.1	Checking fuel pressure regulating valve N276	382
7.2	Removing and installing fuel pressure regulating valve N276	385
7.3	Removing and installing fuel pressure sender G247	387
7.4	Removing and installing air mass meter G70	390
7.5	Removing and installing pressure differential sender G505	391
8	Lambda probe	393
8.1	Exploded view - Lambda probe, exhaust gas temperature senders and pressure sender	393
8.2	Removing and installing Lambda probe	394
9	Engine control unit	397
9.1	Wiring and component check with isolator box VAS 6606	397
9.2	Removing and installing engine/motor control unit J623	398
26	- Exhaust system	400
1	Exhaust pipes/silencers	400
1.1	Exploded view - silencers	400
1.2	Removing and installing front exhaust pipe	404
1.3	Separating exhaust pipes/silencers	407
1.4	Renewing tailpipes	408
1.5	Stress-free alignment of exhaust system	409
1.6	Checking exhaust system for leaks	410
2	Emission control system	411
2.1	Removing and installing particulate filter	411
3	SCR (selective catalytic reduction) system	415
3.1	Exploded view - reducing agent tank	415

3.2	Exploded view - pump for reducing agent V437	418
3.3	Exploded view - delivery unit for reducing agent	420
3.4	Exploded view - injector for reducing agent N474	422
3.5	Exploded view - control unit for reducing agent metering system	423
3.6	Removing and installing reducing agent supply line	423
3.7	Removing and installing delivery unit for reducing agent	425
3.8	Removing and installing injector for reducing agent N474	430
3.9	Draining active tank for reducing agent	431
3.10	Removing and installing active tank for reducing agent	433
3.11	Draining passive tank for reducing agent	436
3.12	Removing and installing passive tank for reducing agent	437
3.13	Removing and installing pressure sender for reducing agent metering system G686	440
3.14	Removing and installing pump for reducing agent V437	441
3.15	Checking control unit for reducing agent metering system J880	442
3.16	Removing and installing control unit for reducing agent metering system J880	442
3.17	Removing and installing transfer pump for reducing agent V436	444
4	Exhaust gas temperature control	447
4.1	Exploded view - exhaust gas temperature control	447
4.2	Removing and installing exhaust gas temperature sender	448
5	Exhaust gas recirculation	458
5.1	Exploded view - exhaust gas recirculation system	458
5.2	Removing and installing exhaust gas recirculation cooler	461
5.3	Removing and installing exhaust gas recirculation control motor V338	462
5.4	Removing and installing exhaust gas recirculation temperature sensor G98	463
6	Exhaust manifolds	465
6.1	Exploded view - exhaust manifold	465
6.2	Removing and installing exhaust manifold	466
28 - Glow plug system	471	
1	Glow plug system	471
1.1	Exploded view - glow plug system	471
1.2	Removing and installing glow plug	472
1.3	Checking glow plug	473
1.4	Removing and installing Hall sender G40	474
1.5	Removing and installing engine speed sender G28	475