

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 system	2
2.2 Safety precautions when working on vehicles with start/stop system	4
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	5
2.5 Safety precautions when working on the SCR system	5
2.6 Safety precautions when working on the exhaust system	6
3 Repair instructions	7
3.1 Rules for cleanliness	7
3.2 General notes	7
3.3 General repair instructions	8
3.4 Resetting SCR learnt values	9
3.5 Foreign material in engine	9
3.6 Contact corrosion	10
3.7 Routing and attachment of pipes, hoses and wiring	10
3.8 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	88
1.3 Securing engine to engine and gearbox support	126
1.4 Installing engine	131
2 Assembly mountings	145
2.1 Assembly overview - assembly mountings	145
2.2 Assembly overview - torque reaction support	145
2.3 Removing and installing engine mountings	146
2.4 Removing and installing torque reaction support and cross member	154
3 Engine cover panel	159
3.1 Removing and installing engine cover panel	159
13 - Crankshaft group	160
1 Cylinder block (pulley end)	160
1.1 Assembly overview - poly V-belt drive	160
1.2 Assembly overview - sealing flange (pulley end)	163
1.3 Removing and installing poly V-belt	169
1.4 Removing and installing poly V-belt tensioner	172
1.5 Removing and installing vibration damper	172
1.6 Removing and installing bracket for ancillaries	173
1.7 Renewing crankshaft oil seal (pulley end)	174
1.8 Removing and installing sealing flange (pulley end)	176
1.9 Removing and installing cover for sealing flange (pulley end)	181
2 Cylinder block (gearbox end)	182
2.1 Assembly overview - drive plate	182
2.2 Removing and installing drive plate	183
2.3 Renewing crankshaft oil seal (gearbox end)	184
2.4 Checking sender wheel	187
3 Crankshaft	189
3.1 Assembly overview - crankshaft	189



3.2	Crankshaft dimensions	193
3.3	Measuring axial clearance of crankshaft	193
3.4	Measuring radial clearance of crankshaft	194
4	Balance shaft	195
4.1	Assembly overview - balance shaft	195
4.2	Renewing roller bearing for balance shaft	195
4.3	Removing and installing balance shaft	197
5	Pistons and conrods	200
5.1	Assembly overview - pistons and conrods	200
5.2	Removing and installing pistons	204
5.3	Measuring piston projection at TDC	205
5.4	Checking pistons and cylinder bores	207
5.5	Checking radial clearance of conrod bearings	209
15	Cylinder head, valve gear	210
1	Cylinder head	210
1.1	Assembly overview - cylinder head	210
1.2	Assembly overview - cylinder head cover	214
1.3	Removing and installing cylinder head	217
1.4	Removing and installing cylinder head cover	229
1.5	Removing and installing seals for injectors	246
1.6	Checking compression	248
2	Timing chain cover	250
2.1	Assembly overview - timing chain cover	250
2.2	Removing and installing timing chain cover	254
3	Chain drive	274
3.1	Assembly overview - camshaft timing chains	274
3.2	Assembly overview - drive chain for oil pump and high-pressure pump	276
3.3	Removing and installing camshaft timing chain	277
3.4	Removing camshaft timing chain from camshafts	290
3.5	Removing and installing drive chain for oil pump and high-pressure pump	304
4	Valve gear	307
4.1	Assembly overview - valve gear	307
4.2	Measuring axial clearance of camshaft	310
4.3	Measuring radial clearance of camshaft	311
4.4	Removing and installing camshaft	312
4.5	Removing and installing valve stem oil seals	343
5	Inlet and exhaust valves	353
5.1	Machining valve seats	353
5.2	Checking valve guides	353
5.3	Checking valves	354
5.4	Valve dimensions	355
17	Lubrication	356
1	Sump/oil pump	356
1.1	Assembly overview - sump/oil pump	356
1.2	Engine oil	361
1.3	Removing and installing lower part of sump	361
1.4	Removing and installing upper part of sump	364
1.5	Removing and installing oil pump	371
1.6	Removing and installing oil level and oil temperature sender G266	372
2	Engine oil cooler	373
2.1	Assembly overview - engine oil cooler	373
2.2	Removing and installing engine oil cooler	374
2.3	Removing and installing mounting plate for engine oil cooler/coolant shut-off valve	375

2.4	Removing and installing temperature regulator for engine oil cooler	376
3	Oil filter/oil pressure switches	378
3.1	Assembly overview - oil filter housing/oil pressure switch	378
3.2	Removing and installing oil pressure switch F22/oil pressure switch for reduced oil pressure F378	379
3.3	Removing and installing oil temperature sender 2 G664	381
3.4	Checking oil pressure	382
3.5	Checking oil level	383
3.6	Removing and installing oil filter housing	383
3.7	Removing and installing valve for oil pressure control N428	385
19	Cooling	387
1	Cooling system/coolant	387
1.1	Connection diagram - coolant hoses	387
1.2	Checking cooling system for leaks	395
1.3	Draining and filling cooling system	398
2	Coolant pump/thermostat assembly	408
2.1	Assembly overview - coolant pump	408
2.2	Assembly overview - electric coolant pump	409
2.3	Assembly overview - coolant temperature senders	410
2.4	Assembly overview - coolant shut-off valve	411
2.5	Removing and installing coolant circulation pump V50	412
2.6	Removing and installing coolant pump	414
2.7	Removing and installing map-controlled engine cooling system thermostat F265	416
2.8	Removing and installing coolant temperature sender G62	417
2.9	Removing and installing radiator outlet coolant temperature sender G83	418
2.10	Removing and installing temperature sender for engine temperature regulation G694	420
2.11	Removing and installing coolant valves	421
3	Coolant pipes	425
3.1	Assembly overview - coolant pipes	425
3.2	Removing and installing coolant pipes	427
3.3	Removing and installing upper coolant pipes	430
4	Radiator/radiator fans	434
4.1	Assembly overview - radiator/radiator fans	434
4.2	Assembly overview - water radiator (left-side) for charge air cooling circuit	437
4.3	Removing and installing radiator	438
4.4	Removing and installing radiator cowl	444
4.5	Removing and installing radiator fans	452
4.6	Removing and installing water radiator for charge air cooling circuit	453
21	Turbocharging/supercharging	457
1	Turbochargers	457
1.1	Assembly overview - turbochargers	457
1.2	Removing and installing turbocharger	470
1.3	Removing and installing turbocharger 1 control unit J724	487
1.4	Checking vacuum unit for turbocharger	518
1.5	Renewing vacuum unit for turbocharger	526
2	Charge air system	528
2.1	Overview - charge air system	528
2.2	Assembly overview - charge air system	529
2.3	Removing and installing charge air cooler	533
2.4	Removing and installing charge pressure sender G31 / intake air temperature sender G42	536
2.5	Checking charge air system for leaks	536
23	Mixture preparation - injection	544



1	Injection system	544
1.1	Overview - fuel system	544
1.2	Overview of fitting locations - injection system	547
1.3	Filling and bleeding fuel system	562
1.4	Checking fuel system for leaks	562
2	Vacuum system	564
2.1	Connection diagram - vacuum system	564
2.2	Checking vacuum system	565
3	Injectors/high-pressure reservoir (rail)	567
3.1	Assembly overview - injectors	567
3.2	Checking injectors	570
3.3	Performing adaption of correction values for injectors	571
3.4	Checking for injectors sticking open	571
3.5	Measuring return flow rate of injectors with engine running	573
3.6	Checking return flow rate of injectors at starter cranking speed	577
3.7	Checking restrictor in fuel return line	580
3.8	Removing and installing injectors	581
3.9	Removing and installing high-pressure pipes	587
3.10	Removing and installing high-pressure reservoir (rail)	589
4	Air filter	595
4.1	Assembly overview - air filter housing	595
4.2	Removing and installing air filter housing	597
5	Intake manifold	600
5.1	Assembly overview - intake manifold	600
5.2	Removing and installing intake manifold	602
5.3	Removing and installing intake manifold flap motor V157	608
5.4	Removing and installing throttle valve module J338	610
6	Senders and sensors	612
6.1	Assembly overview - actuator for structure-borne sound and control unit for structure-borne sound	612
6.2	Removing and installing fuel pressure regulating valve N276	613
6.3	Checking fuel pressure regulating valve N276	616
6.4	Removing and installing fuel pressure sender G247	618
6.5	Removing and installing air mass meter G70	619
6.6	Removing and installing pressure differential sender G505	620
6.7	Removing and installing control unit for structure-borne sound J869/actuator for structure-borne sound R214	622
6.8	Removing and installing particulate sensor G784	623
6.9	Removing and installing control unit for NOx sender with NOx sender	625
6.10	Removing and installing engine sound generator control unit J943	633
7	Engine control unit	634
7.1	Wiring and component check with isolator box VAS 6606	634
7.2	Removing and installing engine/motor control unit J623	636
8	High-pressure pump	640
8.1	Assembly overview - high-pressure pump	640
8.2	Removing and installing high-pressure pump	642
8.3	Performing first fuel filling after installing high-pressure pump	649
9	Lambda probe	651
9.1	Assembly overview - Lambda probe	651
9.2	Removing and installing Lambda probe	658
26	Exhaust system	667
1	Exhaust pipes/silencers	667
1.1	Assembly overview - silencers	667
1.2	Removing and installing front exhaust pipe	680

1.3	Separating exhaust pipes/silencers	687
1.4	Renewing tailpipe	688
1.5	Stress-free alignment of exhaust system	689
1.6	Checking exhaust system for leaks	692
2	Emission control system	693
2.1	Removing and installing catalytic converter	693
2.2	Removing and installing catalytic converter heater control unit 1 J1021	696
2.3	Removing and installing particulate filter	698
2.4	Removing and installing SCR catalytic converter	713
3	SCR (selective catalytic reduction) system	718
3.1	Assembly overview - reducing agent tank	718
3.2	Assembly overview - reducing agent supply line	720
3.3	Assembly overview - delivery unit for reducing agent	721
3.4	Assembly overview - control unit for reducing agent metering system J880	722
3.5	Removing and installing reducing agent tank	723
3.6	Removing and installing reducing agent supply line	727
3.7	Removing and installing delivery unit for reducing agent	728
3.8	Removing and installing injector for reducing agent N474	731
3.9	Draining reducing agent tank	735
3.10	Removing and installing control unit for reducing agent metering system J880	737
4	Exhaust gas temperature regulation	740
4.1	Assembly overview - exhaust gas temperature regulation	740
4.2	Removing and installing exhaust gas temperature sender	747
5	Exhaust gas recirculation	766
5.1	Assembly overview - exhaust gas recirculation system	766
5.2	Removing and installing exhaust gas recirculation cooler	770
5.3	Removing and installing exhaust gas recirculation control motor V338	771
5.4	Removing and installing exhaust gas recirculation temperature sensor G98	773
6	Exhaust manifolds	775
6.1	Assembly overview - exhaust manifold	775
6.2	Removing and installing exhaust manifolds	778
28	- Glow plug system	787
1	Glow plug system	787
1.1	Assembly overview - glow plug system	787
1.2	Removing and installing glow plug	789
1.3	Checking glow plug	791
1.4	Removing and installing Hall sender G40	791
1.5	Removing and installing engine speed sender G28	792