



Contents

00 - Technical data	1
1 Safety information	1
1.1 Safety regulations for working on fuel supply	1
1.2 Safety measures when working on vehicles with a start/stop system	2
1.3 Safety precautions when using testers and measuring instruments during a road test	2
1.4 Safety precautions when working on the cooling system	2
1.5 Safety precautions when working on the SCR system	2
1.6 Safety precautions when working on exhaust system	3
2 Identification	5
2.1 Engine number/engine data	5
3 Repair notes	8
3.1 Rules for cleanliness	8
3.2 Foreign objects in engine	8
3.3 Contact corrosion	8
3.4 Routing and attachment of lines	9
3.5 Fitting radiator and condensers	9
4 Technical data	11
4.1 Coolant	12
10 - Removing and installing engine	14
1 Removing and installing motor	14
1.1 Removing motor	14
1.2 Separating engine and gearbox	27
1.3 Securing engine on engine and gearbox support	31
1.4 Installing engine	33
2 Assembly mountings	38
2.1 Assembly overview - assembly mountings	38
2.2 Removing and installing engine mounting	40
2.3 Removing and installing gearbox mountings	41
2.4 Removing and installing pendulum support	43
2.5 Supporting engine in installation position	45
2.6 Adjusting assembly mountings	57
2.7 Checking adjustment of assembly mountings (engine and gearbox mountings)	59
3 Engine cover panel	60
3.1 Removing and installing engine cover	60
13 - Crankshaft group	61
1 Cylinder block (pulley end)	61
1.1 Assembly overview - cylinder block (pulley end)	61
1.2 Assembly overview - sealing flange, belt pulley end	63
1.3 Removing and installing poly-V belt	65
1.4 Removing and installing tensioner for poly V-belt	66
1.5 Removing and installing vibration damper	67
1.6 Removing and installing bracket for ancillaries	68
1.7 Removing and installing engine support	70
1.8 Removing and installing sealing flange on pulley end	71
2 Cylinder block, gearbox end	74
2.1 Assembly overview - cylinder block, gearbox end	74
2.2 Removing and installing flywheel	75
2.3 Removing and installing sealing flange on gearbox side	77
3 Crankshaft	98
3.1 Assembly overview - crankshaft	98



3.2	Crankshaft dimensions	100
3.3	Renewing needle bearing in crankshaft	100
3.4	Measuring axial clearance of crankshaft	103
4	Pistons and conrods	105
4.1	Assembly overview - pistons and conrods	105
4.2	Removing and installing pistons	108
4.3	Measuring piston projection at TDC	110
4.4	Checking pistons and cylinder bores	112
4.5	Separating new conrod	114
4.6	Checking radial clearance of conrods	115
15	Cylinder head, valve gear	116
1	Cylinder head	116
1.1	Assembly overview - cylinder head	116
1.2	Assembly overview - cylinder head cover	120
1.3	Removing and installing cylinder head	122
1.4	Removing and installing cylinder head cover	133
1.5	Removing and installing injector seals	135
1.6	Removing and installing camshaft housing	137
1.7	Checking compression	143
2	Toothed belt drive	145
2.1	Assembly overview - toothed belt cover	145
2.2	Assembly overview - toothed belt	145
2.3	Removing and installing toothed belt guard	147
2.4	Removing and installing toothed belt	154
2.5	Removing toothed belt from camshaft	168
3	Valve gear	173
3.1	Assembly overview - valve gear	173
3.2	Measuring axial play of camshaft	177
3.3	Removing and installing camshaft oil seal	178
3.4	Removing and installing camshaft adjuster	180
3.5	Removing and installing camshaft control valve 1 N205	187
3.6	Checking hydraulic compensation elements	187
3.7	Removing and installing valve stem seals	188
4	Inlet and exhaust valves	199
4.1	Checking valve guides	199
4.2	Checking valves	200
4.3	Valve dimensions	200
17	Lubrication	201
1	Sump, oil pump	201
1.1	Assembly overview - sump/oil pump	201
1.2	Engine oil:	207
1.3	Removing and installing sump	208
1.4	Removing and installing lower part of sump	212
1.5	Removing and installing upper part of sump	216
1.6	Removing and installing oil pump	219
1.7	Removing and installing oil level and oil temperature sender G266	221
2	Engine oil cooler	224
3	Oil filter, oil pressure switch	225
3.1	Assembly overview - oil filter housing, oil pressure switch	225
3.2	Removing and installing oil pressure switch F1	227
3.3	Removing and installing oil pressure switch for reduced oil pressure F378	229
3.4	Checking oil pressure	230
3.5	Removing and installing oil filter housing	231



3.6	Removing and installing oil pressure regulating valve N428	234
4	Oil circuit	236
4.1	Removing and installing oil supply line	236
4.2	Removing and installing oil return line for turbocharger	237
19	Cooling	239
1	Cooling system/coolant	239
1.1	Connection diagram - coolant hoses	239
1.2	Checking cooling system for leaks	246
1.3	Draining coolant	249
1.4	Filling with coolant	252
1.5	Checking filling quality of cooling system	265
1.6	Checking electric vacuum pump VAS 6096/2	267
1.7	Flushing cooling system	268
1.8	Flushing cooling system, quick reference guide	290
2	Coolant pump, regulation of cooling system	292
2.1	Assembly overview - coolant pump, thermostat	292
2.2	Assembly overview - electric coolant pump	296
2.3	Assembly overview - coolant temperature sender	302
2.4	Removing and installing electric coolant pump	304
2.5	Removing and installing coolant pump	322
2.6	Removing and installing thermostat	323
2.7	Checking thermostat	326
2.8	Removing and installing coolant valve for cylinder head N489	327
2.9	Removing and installing coolant temperature sender G62	327
3	Coolant pipes	329
3.1	Assembly overview - coolant pipes	329
3.2	Removing and installing coolant pipes	331
4	Radiator, radiator fan	347
4.1	Assembly overview - radiator/radiator fan	347
4.2	Assembly overview - radiator cowl and radiator fan	351
4.3	Assembly overview - radiator blind	353
4.4	Removing and installing radiator	356
4.5	Removing and installing water radiator for charge air cooling circuit	359
4.6	Removing and installing radiator cowl	363
4.7	Removing and installing radiator fan	366
4.8	Removing and installing radiator blind	367
4.9	Removing and installing radiator blind control motor V544	369
21	Turbocharging/supercharging	375
1	Turbocharger	375
1.1	Assembly overview - turbocharger	375
1.2	Removing and installing turbocharger	383
1.3	Renewing vacuum unit for turbocharger	403
1.4	Removing and installing connection for turbocharger	412
2	Charge air system	414
2.1	Assembly overview - charge air system	414
2.2	Removing and installing charge pressure sender G31	417
2.3	Checking charge air system for leaks	417
2.4	Checking charge air cooler for leaks	420
2.5	Removing and installing air pipe	425
23	Mixture preparation - injection	428
1	Injection system	428
1.1	Schematic overview - fuel system	428



1.2	Overview of fitting locations - injection system	430
1.3	Filling/bleeding fuel system	442
1.4	Checking fuel system for leaks	443
2	Vacuum system	444
2.1	Connection diagram - vacuum system	444
2.2	Checking vacuum system	445
3	Injectors/high-pressure accumulator (rail)	446
3.1	Assembly overview - injectors	446
3.2	Assembly overview - fuel rail	448
3.3	Adapting correction values for injectors	449
3.4	Testing injectors	450
3.5	Checking return flow rate of injectors with engine running	451
3.6	Checking return flow rate of injectors at starter speed	453
3.7	Testing jammed-open injectors	455
3.8	Removing and installing injectors	457
3.9	Removing and installing high-pressure lines	461
3.10	Removing and installing fuel rail	463
4	Air filter	465
4.1	Assembly overview - air filter housing	465
4.2	Removing and installing air filter housing	468
5	Intake manifold	470
5.1	Assembly overview - intake manifold	470
5.2	Removing and installing intake manifold	474
5.3	Removing and installing throttle valve module J338	478
6	Senders and sensors	482
6.1	Removing and installing fuel pressure regulating valve N276	482
6.2	Checking fuel pressure regulating valve N276	487
6.3	Removing and installing fuel pressure sender G247	488
6.4	Removing and installing air mass meter G70	490
6.5	Removing and installing pressure differential sender G505	492
6.6	Removing and installing exhaust gas pressure sensor 1 G450	495
6.7	Removing and installing NOx sender 2 G687	496
6.8	Removing and installing charge air temperature sender ahead of charge air cooler G810	498
6.9	Removing and installing charge air temperature sender after charge air cooler G811	499
6.10	Removing and installing fuel temperature sender G81	499
6.11	Removing and installing control unit for NOx sender GX30	501
6.12	Removing and installing temperature and pressure sender for low-pressure fuel system GX20	509
7	Engine control unit	511
7.1	Removing and installing engine control unit J623	511
8	High-pressure pump	518
8.1	Assembly overview - high-pressure pump	518
8.2	Removing and installing high-pressure pump	519
9	Lambda probe	523
9.1	Assembly overview - Lambda probe	523
9.2	Removing and installing Lambda probe	526
26	Exhaust system	530
1	Exhaust pipes and silencers	530
1.1	Assembly overview - silencers	530
1.2	Assembly overview - front exhaust pipe	536
1.3	Removing and installing front exhaust pipe	538
1.4	Separating exhaust pipes from silencers	539
1.5	Removing and installing rear silencer	541
1.6	Aligning exhaust system free of stress	543



1.7	Checking exhaust system for leaks	544
1.8	Installation position of clamp	544
2	Emission control	547
2.1	Assembly overview - emission control	547
2.2	Removing and installing catalytic converter	551
2.3	Removing and installing particulate filter	554
2.4	Removing and installing emission control module	554
2.5	Removing and installing exhaust flap control unit J883	566
3	SCR system (selective catalytic reduction)	568
3.1	Assembly overview - tank for reducing agent	568
3.2	Assembly overview - reducing agent supply line	570
3.3	Assembly overview - delivery module for reducing agent	571
3.4	Removing and installing reducing agent tank	571
3.5	Removing and installing front section of reducing agent supply line	574
3.6	Removing and installing delivery module for reducing agent	583
3.7	Removing and installing injector for reduction agent N474	586
3.8	Removing and installing control unit for reducing-agent heater J891	589
3.9	Assembly overview - injector for reducing agent	592
3.10	Draining reducing agent tank	594
3.11	Removing and installing rear section of reducing agent supply line	597
3.12	Removing and installing filler pipe for reducing agent tank	598
3.13	Disconnecting reducing agent supply line	600
3.14	SCR - resetting learnt values	603
4	Exhaust gas temperature regulation	605
4.1	Assembly overview - exhaust gas temperature regulation	605
4.2	Removing and installing exhaust gas temperature sender 1 G235	609
4.3	Removing and installing exhaust gas temperature sender 2 G448	616
4.4	Removing and installing exhaust gas temperature sender 3 G495	626
4.5	Removing and installing exhaust gas temperature sender 4 G648	631
5	Exhaust gas recirculation	634
5.1	Assembly overview - exhaust gas recirculation	634
5.2	Assembly overview - exhaust gas recirculation valve 1 GX5	638
5.3	Removing and installing exhaust gas recirculation cooler	639
5.4	Removing and installing exhaust gas recirculation valve 1 GX5	647
5.5	Removing and installing exhaust gas recirculation valve 2 GX6	648
5.6	Removing and installing exhaust gas recirculation temperature sensor G98	650
5.7	Checking exhaust gas recirculation cooler for leaks	653
28	Glow plug system	654
1	Glow plug system	654
1.1	Assembly overview - glow plug system	654
1.2	Removing and installing glow plug	656
1.3	Removing and installing automatic glow period control unit J179	659
1.4	Removing and installing Hall sender G40	659
1.5	Removing and installing engine speed sender G28	660