



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	1
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 engine	14
1.1 Removing engine	14
1.2 Separating engine and gearbox	26
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	44
2.3 Removing and installing gearbox mounting	46
2.4 Removing and installing pendulum support	48
2.5 Supporting engine in installation position	49
2.6 Adjusting assembly mountings	59
2.7 Checking adjustment of assembly mountings	61
3 Engine cover panel	62
3.1 Removing and installing engine cover	62
13 - Crankshaft group	63
1 Cylinder block (pulley end)	63
1.1 Assembly overview - cylinder block (pulley end)	63
1.2 Assembly overview - sealing flange, belt pulley end	65
1.3 Removing and installing poly-V belt	67
1.4 Removing and installing tensioner for poly V-belt	68
1.5 Removing and installing vibration damper	69
1.6 Removing and installing bracket for ancillaries	70
1.7 Removing and installing engine support	72
1.8 Removing and installing sealing flange on pulley end	73
1.9 Renewing caps in cylinder block (pulley end)	76
2 Cylinder block, gearbox end	78
2.1 Assembly overview - cylinder block, gearbox end	78
2.2 Removing and installing flywheel	79
2.3 Removing and installing sealing flange on gearbox side	82
2.4 Renewing caps in cylinder block (gearbox end)	92



3	Crankshaft	94
3.1	Assembly overview - crankshaft	94
3.2	Crankshaft dimensions	95
3.3	Renewing needle bearing in crankshaft	96
3.4	Measuring axial clearance of crankshaft	99
4	Pistons and conrods	100
4.1	Assembly overview - pistons and conrods	100
4.2	Removing and installing pistons	104
4.3	Measuring piston projection at TDC	105
4.4	Checking pistons and cylinder bores	108
4.5	Checking radial clearance of conrods	110
15	Cylinder head, valve gear	111
1	Cylinder head	111
1.1	Assembly overview - cylinder head	111
1.2	Assembly overview - cylinder head cover	115
1.3	Removing and installing cylinder head	117
1.4	Removing and installing cylinder head cover	128
1.5	Removing and installing injector seals	130
1.6	Removing and installing camshaft housing	131
1.7	Checking compression	138
2	Toothed belt drive	141
2.1	Assembly overview - toothed belt cover	141
2.2	Assembly overview - toothed belt	141
2.3	Removing and installing toothed belt guard	143
2.4	Removing and installing toothed belt	150
2.5	Removing toothed belt from camshaft	164
3	Valve gear	170
3.1	Assembly overview - valve gear	170
3.2	Measuring axial play of camshaft	174
3.3	Removing and installing camshaft oil seal	175
3.4	Removing and installing camshaft control valve 1 N205	177
3.5	Removing and installing camshaft adjuster	177
3.6	Checking hydraulic compensation elements	184
3.7	Removing and installing valve stem seals	185
4	Inlet and exhaust valves	196
4.1	Checking valve guides	196
4.2	Checking valves	197
4.3	Valve dimensions	197
17	Lubrication	198
1	Sump, oil pump	198
1.1	Assembly overview - sump/oil pump	198
1.2	Removing and installing sump	200
1.3	Engine oil:	205
1.4	Removing and installing oil pump	205
1.5	Removing and installing oil level and oil temperature sender G266	206
2	Engine oil cooler	208
3	Oil filter, oil pressure switch	209
3.1	Assembly overview - oil filter housing, oil pressure switch	209
3.2	Removing and installing oil pressure switch F1	211
3.3	Removing and installing oil pressure switch for reduced oil pressure F378	213
3.4	Checking oil pressure	215
3.5	Removing and installing oil filter housing	215
3.6	Removing and installing oil pressure regulating valve N428	218



19 - Cooling	220
1 Cooling system/coolant	220
1.1 Connection diagram - coolant hoses	220
1.2 Checking cooling system for leaks	225
1.3 Draining coolant	228
1.4 Filling with coolant	232
1.5 Checking filling quality of cooling system	245
1.6 Checking electric vacuum pump VAS 6096/2	247
1.7 Flushing cooling system	248
2 Coolant pump, regulation of cooling system	272
2.1 Assembly overview - coolant pump, thermostat	272
2.2 Assembly overview - electric coolant pump	276
2.3 Assembly overview - coolant temperature sender	281
2.4 Removing and installing electric coolant pump	282
2.5 Removing and installing coolant pump	296
2.6 Removing and installing thermostat	296
2.7 Checking thermostat	300
2.8 Removing and installing coolant valve for cylinder head N489	301
2.9 Removing and installing coolant temperature sender G62	301
3 Coolant pipes	304
3.1 Assembly overview - coolant pipes	304
3.2 Removing and installing coolant pipes	306
4 Radiator, radiator fan	320
4.1 Assembly overview - radiator/radiator fan	320
4.2 Assembly overview - radiator cowl and radiator fan	325
4.3 Removing and installing radiator	326
4.4 Removing and installing water radiator for charge air cooling circuit	332
4.5 Removing and installing radiator cowl	337
4.6 Removing and installing radiator fan	341
21 - Turbocharging/supercharging	343
1 Turbocharger	343
1.1 Assembly overview - turbocharger	343
1.2 Removing and installing turbocharger	346
1.3 Renewing vacuum unit for turbocharger	352
1.4 Removing and installing connection for turbocharger	358
2 Charge air system	361
2.1 Assembly overview - charge air system	361
2.2 Removing and installing charge pressure sender G31	364
2.3 Checking charge air system for leaks	364
2.4 Removing and installing air pipe	367
2.5 Checking charge air cooler for leaks	368
23 - Mixture preparation - injection	374
1 Injection system	374
1.1 Schematic overview - fuel system	374
1.2 Overview of fitting locations - injection system	376
1.3 Filling/bleeding fuel system	382
1.4 Checking fuel system for leaks	383
2 Vacuum system	384
2.1 Connection diagram - vacuum system	384
2.2 Checking vacuum system	385
3 Injectors/high-pressure accumulator (rail)	386
3.1 Assembly overview - injectors	386



3.2	Assembly overview - fuel rail	388
3.3	Adapting correction values for injectors	389
3.4	Testing injectors	390
3.5	Checking return flow rate of injectors with engine running	391
3.6	Checking return flow rate of injectors at starter speed	394
3.7	Testing jammed-open injectors	396
3.8	Removing and installing injectors	397
3.9	Removing and installing high-pressure lines	401
3.10	Removing and installing fuel rail	404
4	Air filter	406
4.1	Assembly overview - air filter housing	406
4.2	Removing and installing air filter housing	410
5	Intake manifold	417
5.1	Assembly overview – intake manifold	417
5.2	Removing and installing intake manifold	421
5.3	Removing and installing throttle valve module J338	426
6	Senders and sensors	429
6.1	Removing and installing fuel pressure regulating valve N276	429
6.2	Checking fuel pressure regulating valve N276	433
6.3	Removing and installing fuel pressure sender G247	435
6.4	Removing and installing air mass meter G70	436
6.5	Removing and installing pressure differential sender G505	438
6.6	Removing and installing exhaust gas pressure sensor 1 G450	439
6.7	Removing and installing charge air temperature sender ahead of charge air cooler G810	440
6.8	Removing and installing charge air temperature sender after charge air cooler G811	441
6.9	Removing and installing fuel temperature sender G81	441
6.10	Removing and installing control unit for NOx sender GX30	443
6.11	Assembly overview - NOx sender control unit GX30	446
7	Engine control unit	448
7.1	Removing and installing engine control unit J623	448
7.2	Removing and installing engine (motor) control unit J623 with protective housing	452
8	High-pressure pump	464
8.1	Assembly overview - high-pressure pump	464
8.2	Removing and installing high-pressure pump	465
9	Lambda probe	470
9.1	Assembly overview - Lambda probe	470
9.2	Removing and installing Lambda probe	473
26	Exhaust system	479
1	Exhaust pipes and silencers	479
1.1	Assembly overview – silencers	479
1.2	Removing and installing front exhaust pipe	484
1.3	Separating exhaust pipes from silencers	485
1.4	Removing and installing silencer	488
1.5	Aligning exhaust system free of stress	492
1.6	Checking exhaust system for leaks	493
1.7	Installation position of clamp	494
1.8	Assembly overview - front exhaust pipe	498
1.9	Align end exhaust pipes	501
2	Emission control	502
2.1	Assembly overview – emission control	502
2.2	Removing and installing emission control module	508
2.3	Removing and installing catalytic converter	526
2.4	Removing and installing exhaust flap control unit J883	526



3	SCR system (selective catalytic reduction)	528
3.1	Assembly overview – reducing agent tank	528
3.2	Assembly overview - reducing agent supply line	531
3.3	Assembly overview - delivery module for reducing agent	532
3.4	Removing and installing reducing agent tank	533
3.5	Removing and installing front section of reducing agent supply line	540
3.6	Removing and installing delivery module for reducing agent	542
3.7	Removing and installing injector for reduction agent N474	545
3.8	Removing and installing control unit for reducing-agent heater J891	547
3.9	Assembly overview - injector for reducing agent N474	550
3.10	Draining reducing agent tank	551
3.11	Removing and installing rear section of reducing agent supply line	559
3.12	Disconnecting reducing agent supply line	561
3.13	SCR - resetting learnt values	564
4	Exhaust gas temperature regulation	565
4.1	Assembly overview – exhaust gas temperature regulation	565
4.2	Removing and installing exhaust gas temperature sender 1 G235	569
4.3	Removing and installing exhaust gas temperature sender 2 G448	571
4.4	Removing and installing exhaust gas temperature sender 3 G495	578
4.5	Removing and installing exhaust gas temperature sender 4 G648	583
5	Exhaust gas recirculation	589
5.1	Assembly overview – exhaust gas recirculation	589
5.2	Assembly overview - exhaust gas recirculation valve 1 GX5	591
5.3	Removing and installing exhaust gas recirculation cooler	592
5.4	Removing and installing exhaust gas recirculation valve 1 GX5	595
5.5	Removing and installing exhaust gas recirculation valve 2 GX6	597
5.6	Checking exhaust gas recirculation cooler for leaks	598
28	- Glow plug system	599
1	Glow plug system	599
1.1	Assembly overview - glow plug system	599
1.2	Removing and installing glow plug	600
1.3	Removing and installing automatic glow period control unit J179	604
1.4	Removing and installing Hall sender G40	604
1.5	Removing and installing engine speed sender G28	605