



## Contents

<b>00 - Technical data</b>	<b>1</b>
<b>1 Safety information</b>	<b>1</b>
1.1 Safety measures when working on fuel system	1
1.2 Safety measures when working on vehicles with start/stop system	1
1.3 Safety precautions when using testers and measuring instruments during a road test	2
1.4 Safety measures when working on cooling system	2
1.5 Safety measures when working on exhaust system	2
1.6 Safety precautions when working on the SCR system	3
1.7 Safety regulations for working on glow plug system	4
1.8 Safety measures when working on subframe	4
<b>2 Identification</b>	<b>5</b>
2.1 Engine number/engine data	5
<b>3 Repair notes</b>	<b>7</b>
3.1 Rules for cleanliness	7
3.2 General information	7
3.3 General repair notes	8
3.4 Adapting learnt value for SCR system	9
3.5 Foreign objects in engine	9
3.6 Contact corrosion	10
3.7 Routing and attachment of lines	10
3.8 Installing radiators and condensers	10
3.9 Checking vacuum system	10
<b>10 - Removing and installing engine</b>	<b>12</b>
<b>1 Removing and installing motor</b>	<b>12</b>
1.1 Removing motor	12
1.2 Separating engine and gearbox	34
1.3 Securing engine on engine and gearbox support	41
1.4 Installing engine	45
<b>2 Assembly mountings</b>	<b>50</b>
2.1 Assembly overview - assembly mountings	50
2.2 Removing and installing engine mounting	53
2.3 Removing and installing gearbox mountings	59
2.4 Supporting engine in installation position	60
<b>3 Engine cover panel</b>	<b>64</b>
3.1 Removing and installing engine cover	64
<b>13 - Crankshaft group</b>	<b>68</b>
<b>1 Cylinder block (pulley end)</b>	<b>68</b>
1.1 Assembly overview - cylinder block (pulley end)	68
1.2 Assembly overview - sealing flange, belt pulley end	71
1.3 Removing and installing poly-V belt	73
1.4 Removing and installing tensioner for poly V-belt	75
1.5 Removing and installing vibration damper	75
1.6 Removing and installing bracket for ancillaries	78
1.7 Removing and installing engine support	80
1.8 Renewing crankshaft oil seal - belt pulley end	81
1.9 Removing and installing sealing flange on pulley end	83
<b>2 Cylinder block, gearbox end</b>	<b>88</b>
2.1 Assembly overview - cylinder block, gearbox end	88
2.2 Removing and installing drive plate	88
2.3 Renewing crankshaft oil seal (gearbox end)	91



<b>3</b>	<b>Crankshaft</b>	<b>94</b>
3.1	Assembly overview - crankshaft	94
3.2	Crankshaft dimensions	96
3.3	Allocation of main bearing shells	97
3.4	Measuring axial clearance of crankshaft	98
3.5	Measuring radial clearance of crankshaft	99
3.6	Checking sender wheel	99
<b>4</b>	<b>Balancer shaft</b>	<b>101</b>
4.1	Assembly overview - balance shaft	101
4.2	Removing and installing balance shaft	101
<b>5</b>	<b>Pistons and conrods</b>	<b>110</b>
5.1	Assembly overview - pistons and conrods	110
5.2	Removing and installing pistons	114
5.3	Measuring piston projection at TDC	115
5.4	Checking pistons and cylinder bores	118
5.5	Checking radial clearance of conrods	120
<b>15</b>	<b>Cylinder head, valve gear</b>	<b>121</b>
<b>1</b>	<b>Cylinder head</b>	<b>121</b>
1.1	Assembly overview - cylinder head	121
1.2	Assembly overview - cylinder head cover	124
1.3	Removing and installing cylinder head	127
1.4	Removing and installing cylinder head cover	136
1.5	Removing and installing injector seals	142
1.6	Checking compression	143
<b>2</b>	<b>Cover for timing chain</b>	<b>145</b>
2.1	Assembly overview - cover for timing chain	145
2.2	Removing and installing timing chain cover	149
<b>3</b>	<b>Chain drive</b>	<b>162</b>
3.1	Assembly overview - camshaft timing chains	162
3.2	Assembly overview - drive chain for high pressure pump	164
3.3	Assembly overview - drive chain for oil pump	165
3.4	Assembly overview - intermediate drive	165
3.5	Removing camshaft timing chain from camshafts	166
3.6	Removing and installing camshaft timing chain	179
3.7	Removing and installing drive chain for high-pressure pump	191
3.8	Installing intermediate drive	193
<b>4</b>	<b>Valve gear</b>	<b>202</b>
4.1	Assembly overview - valve gear	202
4.2	Measuring axial play of camshaft	210
4.3	Measuring radial play of camshaft	212
4.4	Removing and installing camshaft	212
4.5	Checking hydraulic compensation elements	228
4.6	Removing and installing valve stem seals	230
<b>5</b>	<b>Inlet and exhaust valves</b>	<b>240</b>
5.1	Reworking valve seats	240
5.2	Checking valve guides	240
5.3	Checking valves	241
5.4	Valve dimensions	241
<b>17</b>	<b>Lubrication</b>	<b>242</b>
<b>1</b>	<b>Sump, oil pump</b>	<b>242</b>
1.1	Assembly overview - sump/oil pump	242
1.2	Engine oil:	247
1.3	Removing and installing lower part of sump	249



1.4	Removing and installing upper part of sump	252
1.5	Removing and installing oil pump	255
1.6	Removing and installing oil level and oil temperature sender G266	258
<b>2</b>	<b>Engine oil cooler</b>	<b>259</b>
2.1	Assembly overview - engine oil cooler	259
2.2	Removing and installing engine oil cooler	261
2.3	Removing and installing temperature regulator for engine oil cooler	262
<b>3</b>	<b>Crankcase ventilation</b>	<b>264</b>
3.1	Assembly overview - crankcase breather system	264
3.2	Removing and installing oil separator	265
<b>4</b>	<b>Oil filter, oil pressure switch</b>	<b>266</b>
4.1	Assembly overview - oil filter	266
4.2	Removing and installing oil pressure sender G10	268
4.3	Checking oil pressure	269
4.4	Removing and installing oil filter housing	269
4.5	Removing and installing oil pressure regulating valve N428	272
4.6	Removing and installing oil temperature sender 2 G664	272
<b>19 - Cooling</b>		<b>274</b>
<b>1</b>	<b>Cooling system/coolant</b>	<b>274</b>
1.1	Connection diagram - coolant hoses	274
1.2	Checking cooling system for leaks	278
1.3	Draining and adding coolant	281
<b>2</b>	<b>Coolant pump, regulation of cooling system</b>	<b>292</b>
2.1	Assembly overview - coolant pump	292
2.2	Assembly overview - electric coolant pump	294
2.3	Assembly overview - thermostat	294
2.4	Assembly overview - coolant temperature sender	296
2.5	Removing and installing electric coolant pump	297
2.6	Removing and installing coolant pump	299
2.7	Removing and installing thermostat housing	301
2.8	Removing and installing thermostat	303
2.9	Removing and installing coolant temperature sender G62	303
2.10	Removing and installing temperature sender for engine temperature regulation G694	304
2.11	Removing and installing coolant temperature sender 2 G802	306
2.12	Removing and installing coolant valves	307
<b>3</b>	<b>Coolant pipes</b>	<b>310</b>
3.1	Assembly overview - coolant pipes	310
3.2	Removing and installing coolant pipes	315
<b>4</b>	<b>Radiator, radiator fan</b>	<b>328</b>
4.1	Assembly overview - radiator/radiator fan	328
4.2	Assembly overview - auxiliary radiator	331
4.3	Removing and installing radiator	332
4.4	Removing and installing radiator cowl	338
4.5	Removing and installing radiator fan V7	341
4.6	Removing and installing auxiliary radiator	341
<b>21 - Turbocharging/supercharging</b>		<b>344</b>
<b>1</b>	<b>Turbocharger</b>	<b>344</b>
1.1	Assembly overview - turbocharger	344
1.2	Removing and installing turbocharger	349
<b>2</b>	<b>Charge air system</b>	<b>354</b>
2.1	Assembly overview - charge air system	354
2.2	Assembly overview - charge-air hose connections	355
2.3	Removing and installing charge air cooler	356



2.4	Removing and installing charge pressure sender G31	359
2.5	Checking charge air system for leaks	359
<b>23</b>	<b>Mixture preparation - injection</b>	<b>364</b>
<b>1</b>	<b>Injection system</b>	<b>364</b>
1.1	Schematic overview - fuel system	364
1.2	Overview of fitting locations - injection system	365
1.3	Filling/bleeding fuel system	372
1.4	Checking fuel system for leaks	373
<b>2</b>	<b>Vacuum system</b>	<b>374</b>
2.1	Connection diagram - vacuum system	374
2.2	Checking vacuum system	374
<b>3</b>	<b>Injectors/high-pressure accumulator (rail)</b>	<b>376</b>
3.1	Assembly overview - injectors	376
3.2	Testing injectors	380
3.3	Adapting correction values for injectors	381
3.4	Checking return flow rate of injectors with engine running	382
3.5	Checking return flow rate of injectors at starter speed	385
3.6	Testing jammed-open injectors	388
3.7	Check pressure retention valve in fuel return line	392
3.8	Removing and installing injectors	393
3.9	Removing and installing high-pressure lines	399
3.10	Removing and installing fuel rail	401
<b>4</b>	<b>Air filter</b>	<b>406</b>
4.1	Assembly overview - air filter housing	406
4.2	Removing and installing air filter housing	408
<b>5</b>	<b>Intake manifold</b>	<b>411</b>
5.1	Assembly overview - intake manifold	411
5.2	Removing and installing intake manifold upper part	415
5.3	Removing and installing lower part of intake manifold	420
5.4	Removing and installing intake manifold flap motor V157	421
5.5	Removing and installing throttle valve module J338	424
<b>6</b>	<b>Senders and sensors</b>	<b>426</b>
6.1	Checking fuel pressure regulating valve N276	426
6.2	Removing and installing fuel pressure regulating valve N276	428
6.3	Removing and installing fuel pressure sender G247	430
6.4	Removing and installing air mass meter G70	433
6.5	Removing and installing pressure differential sender G505	433
6.6	Removing and installing pressure differential sender 2 G524	435
6.7	Removing and installing NOx sender G295	436
6.8	Removing and installing NOx sender 2 G687	438
6.9	Removing and installing particle sensor G784	439
6.10	Removing and installing charge air temperature sender after charge air cooler G811	440
6.11	Removing and installing fuel temperature sender G81	441
6.12	Removing and installing fuel pressure sender for low-pressure G410	441
<b>7</b>	<b>Engine control unit</b>	<b>443</b>
7.1	Assembly overview – motor control unit	443
7.2	Removing and installing engine control unit J623	443
<b>8</b>	<b>High-pressure pump</b>	<b>445</b>
8.1	Assembly overview - high-pressure pump	445
8.2	Removing and installing high-pressure pump	448
<b>9</b>	<b>Lambda probe</b>	<b>454</b>
9.1	Assembly overview - Lambda probe	454
9.2	Removing and installing Lambda probe	456



<b>26 - Exhaust system</b>	<b>458</b>
<b>1 Exhaust pipes and silencers</b>	<b>458</b>
1.1 Assembly overview - silencers	458
1.2 Removing and installing front exhaust pipe	460
1.3 Separating exhaust pipes from silencers	465
1.4 Removing and installing silencer	466
1.5 Aligning exhaust system free of stress	468
1.6 Checking exhaust system for leaks	469
<b>2 Emission control</b>	<b>470</b>
2.1 Assembly overview - emission control	470
2.2 Removing and installing emission control module	473
2.3 Removing and installing trap catalytic converter	477
2.4 Removing and installing exhaust flap control unit J883	479
<b>3 SCR system (selective catalytic reduction)</b>	<b>481</b>
3.1 Assembly overview - tank for reducing agent	481
3.2 Assembly overview - reducing agent supply line	483
3.3 Assembly overview - control unit for reducing agent metering system	484
3.4 Relieving pressure in SCR system	485
3.5 Draining reducing agent tank	486
3.6 Removing and installing reducing agent tank	487
3.7 Removing and installing injector for reduction agent N474	489
3.8 Assembly overview - injector for reducing agent	491
3.9 Removing and installing control unit for reducing agent metering system J880	492
3.10 Removing and installing reducing agent quality sensor G849	493
<b>4 Exhaust gas temperature regulation</b>	<b>494</b>
4.1 Assembly overview - exhaust gas temperature regulation	494
4.2 Removing and installing exhaust gas temperature sender 1 G235	495
4.3 Removing and installing exhaust gas temperature sender 2 G448	497
4.4 Removing and installing exhaust gas temperature sender 3 G495	498
4.5 Removing and installing exhaust gas temperature sender 4 G648	500
<b>5 Exhaust gas recirculation</b>	<b>502</b>
5.1 Assembly overview - exhaust gas recirculation	502
5.2 Removing and installing exhaust gas recirculation valve	507
5.3 Removing and installing exhaust gas recirculation cooler	510
5.4 Removing and installing exhaust gas recirculation control motor 2 V339	514
5.5 Removing and installing exhaust gas recirculation temperature sensor G98	515
<b>6 Exhaust manifold</b>	<b>517</b>
6.1 Assembly overview - exhaust manifold	517
6.2 Removing and installing exhaust manifold	518
<b>28 - Glow plug system</b>	<b>523</b>
<b>1 Glow plug system</b>	<b>523</b>
1.1 Assembly overview - glow plug system	523
1.2 Removing and installing glow plug	525
1.3 Removing and installing automatic glow period control unit J179	528
1.4 Removing and installing Hall sender G40	529
1.5 Removing and installing engine speed sender G28	529