

## Contents

<b>00 - Technical data</b> .....	<b>1</b>
<b>1 Identification</b> .....	<b>1</b>
1.1 Engine number/engine data .....	1
1.2 Engine versions .....	1
<b>2 Safety information</b> .....	<b>3</b>
2.1 Safety precautions when working on the fuel supply system .....	3
2.2 Safety precautions when working on vehicles with start/stop system .....	3
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 .....	4
2.5 Safety precautions when working on the exhaust system .....	4
2.6 Safety precautions when working on the ignition system .....	5
<b>3 Repair instructions</b> .....	<b>6</b>
3.1 Rules for cleanliness .....	6
3.2 General notes .....	6
3.3 General repair instructions .....	7
3.4 Performing adaptations after renewing a component .....	8
3.5 Foreign material in engine .....	9
3.6 Cleaning engine .....	9
3.7 Contact corrosion .....	9
3.8 Routing and attachment of pipes, hoses and wiring .....	9
3.9 Installing radiators and condensers .....	10
3.10 Checking vacuum system .....	10
3.11 Nuts, bolts .....	10
3.12 Identification plates .....	11
3.13 Use of impact wrenches .....	11
3.14 Checking fuel system for leaks .....	12
<b>10 - Removing and installing engine</b> .....	<b>13</b>
<b>1 Removing and installing engine</b> .....	<b>13</b>
1.1 Removing engine .....	13
1.2 Separating engine and gearbox .....	13
1.3 Securing engine to engine and gearbox support .....	21
1.4 Installing engine .....	22
<b>2 Assembly mountings</b> .....	<b>23</b>
<b>3 Engine cover panel</b> .....	<b>24</b>
3.1 Removing and installing engine cover panel .....	24
<b>13 - Crankshaft group</b> .....	<b>25</b>
<b>1 Cylinder block (pulley end)</b> .....	<b>25</b>
1.1 Assembly overview - cylinder block (pulley end) .....	25
1.2 Removing and installing poly V-belt .....	27
1.3 Removing and installing poly V-belt tensioner .....	29
1.4 Removing and installing vibration damper .....	29
1.5 Removing and installing bracket for ancillaries .....	34
1.6 Removing and installing engine support .....	35
<b>2 Cylinder block (gearbox end)</b> .....	<b>36</b>
2.1 Assembly overview - cylinder block (gearbox end) .....	36
2.2 Assembly overview - drive plate .....	37
2.3 Removing and installing flywheel .....	38
2.4 Removing and installing drive plate .....	40
2.5 Removing and installing sealing flange (gearbox end) .....	42
<b>3 Crankshaft</b> .....	<b>46</b>



3.1	Assembly overview - crankshaft	46
3.2	Crankshaft dimensions	48
3.3	Allocation of main bearing shells	49
3.4	Renewing needle bearing in crankshaft	49
3.5	Measuring axial clearance of crankshaft	52
3.6	Measuring radial clearance of crankshaft	52
3.7	Removing and installing sender wheel	53
<b>4</b>	<b>Balance shaft</b>	<b>54</b>
4.1	Assembly overview - balance shaft	54
4.2	Removing and installing balance shaft	55
4.3	Renewing oil seal for balance shaft (inlet side)	59
<b>5</b>	<b>Pistons and conrods</b>	<b>61</b>
5.1	Assembly overview - pistons and conrods	61
5.2	Removing and installing pistons	65
5.3	Removing and installing oil spray jets	66
5.4	Checking pistons and cylinder bores	68
5.5	Separating parts of new conrod	69
5.6	Checking radial clearance of conrod bearings	70
<b>15</b>	<b>Cylinder head, valve gear</b>	<b>71</b>
<b>1</b>	<b>Timing chain cover</b>	<b>71</b>
1.1	Assembly overview - timing chain cover	71
1.2	Removing and installing timing chain cover	74
1.3	Renewing oil seal for vibration damper	77
<b>2</b>	<b>Chain drive</b>	<b>80</b>
2.1	Assembly overview - camshaft timing chains	80
2.2	Assembly overview - drive chain for balance shaft	82
2.3	Removing and installing bearing saddle	84
2.4	Removing and installing camshaft timing chain	88
2.5	Removing and installing drive chain for balance shaft	99
2.6	Checking valve timing	102
2.7	Checking chain elongation	105
<b>3</b>	<b>Cylinder head</b>	<b>107</b>
3.1	Assembly overview - cylinder head	107
3.2	Removing and installing cylinder head	110
3.3	Removing and installing vacuum pump	119
3.4	Checking compression	120
<b>4</b>	<b>Valve gear</b>	<b>123</b>
4.1	Assembly overview - valve gear	123
4.2	Removing and installing camshaft	127
4.3	Installing ball for slider	135
4.4	Removing and installing cam adjustment actuator	136
4.5	Removing and installing camshaft control valve 1 N205	137
4.6	Removing and installing valve stem oil seals	137
<b>5</b>	<b>Inlet and exhaust valves</b>	<b>147</b>
5.1	Checking valve guides	147
5.2	Checking valves	148
5.3	Valve dimensions	148
<b>17</b>	<b>Lubrication</b>	<b>149</b>
<b>1</b>	<b>Sump/oil pump</b>	<b>149</b>
1.1	Assembly overview - sump/oil pump	149
1.2	Engine oil	152
1.3	Removing and installing lower part of sump	153
1.4	Removing and installing upper part of sump	154

1.5	Removing and installing oil pump .....	157
1.6	Removing and installing oil level and oil temperature sender G266 .....	159
<b>2</b>	<b>Engine oil cooler</b> .....	<b>160</b>
2.1	Assembly overview - engine oil cooler .....	160
2.2	Removing and installing engine oil cooler .....	161
2.3	Removing and installing mechanical switching valve .....	161
<b>3</b>	<b>Crankcase breather</b> .....	<b>162</b>
3.1	Assembly overview - crankcase breather system .....	162
3.2	Removing and installing oil separator .....	163
<b>4</b>	<b>Oil filter/oil pressure switches</b> .....	<b>165</b>
4.1	Assembly overview - oil filter .....	165
4.2	Assembly overview - oil pressure switches/oil pressure control .....	166
4.3	Removing and installing piston cooling jet control valve N522 .....	168
4.4	Removing and installing valve for oil pressure control N428 .....	168
4.5	Removing and installing oil pressure switch F22 .....	169
4.6	Removing and installing oil pressure switch for reduced oil pressure F378 .....	169
4.7	Removing and installing stage 3 oil pressure switch F447 .....	169
4.8	Checking oil pressure .....	171
<b>19 - Cooling</b> .....		<b>175</b>
<b>1</b>	<b>Cooling system/coolant</b> .....	<b>175</b>
1.1	Connection diagram - coolant hoses .....	175
1.2	Checking cooling system for leaks .....	175
1.3	Draining and filling cooling system .....	179
<b>2</b>	<b>Coolant pump/thermostat assembly</b> .....	<b>180</b>
2.1	Assembly overview - coolant pump/thermostat .....	180
2.2	Assembly overview - electric coolant pump .....	182
2.3	Assembly overview - coolant temperature senders .....	184
2.4	Removing and installing electric coolant pump .....	186
2.5	Removing and installing coolant pump .....	190
2.6	Removing and installing toothed belt for coolant pump .....	193
2.7	Removing and installing actuator for engine temperature regulation N493 .....	195
2.8	Removing and installing coolant temperature sender G62 .....	197
2.9	Removing and installing radiator outlet coolant temperature sender G83 .....	198
2.10	Removing and installing coolant valves .....	199
<b>3</b>	<b>Coolant pipes</b> .....	<b>203</b>
3.1	Assembly overview - coolant pipes .....	203
3.2	Removing and installing coolant pipes .....	204
3.3	Removing and installing coolant pipes for gearbox .....	208
<b>4</b>	<b>Radiator/radiator fans</b> .....	<b>210</b>
<b>21 - Turbocharging/supercharging</b> .....		<b>211</b>
<b>1</b>	<b>Turbocharger</b> .....	<b>211</b>
1.1	Assembly overview - turbocharger .....	211
1.2	Removing and installing turbocharger .....	216
1.3	Removing and installing turbocharger air recirculation valve N249 .....	226
1.4	Removing and installing charge pressure positioner V465 .....	227
<b>2</b>	<b>Charge air system</b> .....	<b>229</b>
2.1	Assembly overview - charge air system .....	229
2.2	Assembly overview - hose connections for charge air system .....	229
2.3	Removing and installing charge air cooler .....	230
2.4	Removing and installing charge pressure sender G31 .....	230
2.5	Checking charge air system for leaks .....	230
<b>24 - Mixture preparation - injection</b> .....		<b>232</b>



<b>1</b>	<b>Injection system</b>	<b>232</b>
<b>2</b>	<b>Air filter</b>	<b>233</b>
<b>3</b>	<b>Intake manifold</b>	<b>234</b>
3.1	Assembly overview - intake manifold	234
3.2	Removing and installing intake manifold	236
3.3	Removing and installing throttle valve module GX3	246
3.4	Cleaning throttle valve module	247
3.5	Removing and installing intake manifold flap valve N316	248
3.6	Checking intake manifold change-over function	248
<b>4</b>	<b>Injectors</b>	<b>251</b>
4.1	Assembly overview - fuel rail with injectors	251
4.2	Removing and installing fuel rail	255
4.3	Removing and installing injectors	257
4.4	Cleaning injectors	268
<b>5</b>	<b>Senders and sensors</b>	<b>270</b>
5.1	Removing and installing fuel pressure sender G247	270
5.2	Checking fuel pressure sender G247	271
5.3	Removing and installing air mass meter G70	276
5.4	Removing and installing intake manifold sender GX9	276
5.5	Removing and installing fuel pressure sender for low pressure G410	277
5.6	Removing and installing pressure differential sender for particulate filter G1037	277
<b>6</b>	<b>High-pressure pump</b>	<b>279</b>
6.1	Assembly overview - high-pressure pump	279
6.2	Removing and installing high-pressure pump	284
6.3	Removing and installing high-pressure pipe	289
<b>7</b>	<b>Lambda probe</b>	<b>292</b>
7.1	Assembly overview - Lambda probe	292
7.2	Removing and installing Lambda probe	292
<b>8</b>	<b>Engine control unit</b>	<b>295</b>
<b>26 - Exhaust system</b>		<b>296</b>
<b>1</b>	<b>Exhaust pipes/silencers</b>	<b>296</b>
1.1	Assembly overview - silencers	296
1.2	Separating exhaust pipes/silencers	296
1.3	Removing and installing silencers	296
1.4	Stress-free alignment of exhaust system	296
1.5	Checking exhaust system for leaks	296
1.6	Installation position of clamp	296
<b>2</b>	<b>Emission control system</b>	<b>297</b>
2.1	Assembly overview - emission control system	297
2.2	Removing and installing catalytic converter	301
2.3	Removing and installing particulate filter	304
<b>3</b>	<b>Exhaust gas temperature regulation</b>	<b>309</b>
3.1	Assembly overview - exhaust gas temperature regulation	309
3.2	Removing and installing parts of exhaust gas temperature regulation	313
<b>4</b>	<b>Secondary air system</b>	<b>317</b>
4.1	Assembly overview - secondary air system	317
4.2	Removing and installing secondary air pump motor V101	319
4.3	Removing and installing secondary air inlet valve N112	320
4.4	Removing and installing sender 1 for secondary air pressure G609	321
<b>28 - Ignition system</b>		<b>322</b>
<b>1</b>	<b>Ignition system</b>	<b>322</b>
1.1	Assembly overview - ignition system	322

1.2	Removing and installing ignition coils .....	324
1.3	Removing and installing knock sensor 1 G61 .....	326
1.4	Removing and installing Hall senders .....	327
1.5	Removing and installing engine speed sender G28 .....	328