

## Contents

<b>00 - Technical data</b>	<b>1</b>
1     Engine number	1
2     Engine data	2
3     Safety precautions	4
4     General repair instructions	6
4.1 Rules for cleanliness when working on fuel supply system, injection system and turbocharger/ supercharger	6
4.2 Contact corrosion	6
4.3 Installing radiators, condensers and charge air coolers	6
4.4 Checking vacuum system	6
4.5 Routing and attachment of pipes, hoses and wiring	7
4.6 Checking for leaks in the fuel system	7
<b>10 - Removing and installing engine</b>	<b>8</b>
1     Removing engine	8
2     Securing engine to engine and gearbox support	28
3     Installing engine	29
3.1 Diagrams of hose connections	33
3.2 Fitting locations of electronic components in engine compartment	38
4     Exploded view - assembly mountings	39
<b>13 - Crankshaft group</b>	<b>40</b>
1     Cylinder block (pulley end)	40
1.1 Exploded view - poly V-belt drive	40
1.2 Removing and installing poly V-belt	41
1.3 Removing and installing tensioner for poly V-belt	43
1.4 Removing and installing vibration damper	43
1.5 Exploded view - toothed belt drive	44
1.6 Removing and installing toothed belt	46
2     Sealing flanges and dual-mass flywheel/drive plate	52
2.1 Exploded view - sealing flanges and dual-mass flywheel/drive plate	52
2.2 Renewing crankshaft oil seal (pulley end)	54
2.3 Removing and installing sealing flange (pulley end)	56
2.4 Removing and installing dual-mass flywheel - vehicles with manual gearbox	60
2.5 Extracting and driving in needle bearing for dual-mass flywheel	62
2.6 Removing and installing drive plate - vehicles with automatic gearbox	63
2.7 Renewing sealing flange (gearbox end)	65
3     Crankshaft	67
3.1 Exploded view - crankshaft	67
3.2 Crankshaft dimensions	69
3.3 Measuring axial clearance of crankshaft	70
3.4 Measuring radial clearance of crankshaft	70
3.5 Removing and installing drive chain sprocket	71
4     Pistons and conrods	73
4.1 Exploded view - pistons and conrods	73
4.2 Piston and cylinder dimensions	76
4.3 Measuring radial clearance of conrods	76
<b>15 - Cylinder head, valve gear</b>	<b>77</b>
1     Cylinder head	77
1.1 Exploded view - cylinder head	77
1.2 Removing and installing cylinder head cover (left-side)	80

1.3	Removing and installing cylinder head cover (right-side) . . . . .	83
1.4	Removing cylinder head (left-side) . . . . .	86
1.5	Removing cylinder head (right-side) . . . . .	90
1.6	Installing cylinder head . . . . .	93
1.7	Checking compression . . . . .	96
<b>2</b>	<b>Valve gear . . . . .</b>	<b>102</b>
2.1	Exploded view - valve gear . . . . .	102
2.2	Measuring axial clearance of camshafts . . . . .	105
2.3	Measuring radial clearance of camshafts . . . . .	106
2.4	Renewing oil seals for camshafts . . . . .	106
2.5	Renewing oil seal for Hall sender and sealing cap on cylinder head (left-side) . . . . .	108
2.6	Renewing oil seal for Hall sender on cylinder head (right-side) . . . . .	109
2.7	Removing and installing camshafts and camshaft adjuster . . . . .	112
2.8	Checking hydraulic bucket tappets . . . . .	116
2.9	Renewing valve stem oil seals with cylinder head installed . . . . .	117
2.10	Renewing valve stem oil seals with cylinder head removed . . . . .	122
2.11	Valve dimensions . . . . .	126
2.12	Checking valve guides . . . . .	127
2.13	Checking valves . . . . .	128
2.14	Machining valve seats . . . . .	128
<b>3</b>	<b>Checking variable valve timing . . . . .</b>	<b>131</b>
3.1	Checking function of variable valve timing . . . . .	131
3.2	Checking camshaft control valves (solenoid valves) . . . . .	133
<b>17 - Lubrication</b>	<b>139</b>	
<b>1</b>	<b>Lubrication system . . . . .</b>	<b>139</b>
1.1	Exploded view - sump, oil pump, oil filter, oil cooler . . . . .	139
1.2	Removing and installing oil level and oil temperature sender G266 . . . . .	143
1.3	Removing sump (bottom section) . . . . .	144
1.4	Installing sump (bottom section) - engines with moulded gasket . . . . .	145
1.5	Installing sump (bottom section) - engines with liquid gasket . . . . .	145
1.6	Removing and installing oil pump . . . . .	146
1.7	Checking chain tensioner for oil pump . . . . .	148
1.8	Removing and installing drive chain or chain tensioner for oil pump . . . . .	148
1.9	Removing and installing sump (top section) . . . . .	149
1.10	Renewing oil retention valves . . . . .	156
1.11	Removing and installing oil pressure switch F1 . . . . .	157
1.12	Checking oil pressure . . . . .	158
1.13	Checking oil pressure switch F1 . . . . .	158
1.14	Engine oil . . . . .	160
1.15	Checking engine oil level . . . . .	160
<b>19 - Cooling</b>	<b>161</b>	
<b>1</b>	<b>Cooling system . . . . .</b>	<b>161</b>
1.1	Connection diagram - coolant hoses . . . . .	161
1.2	Draining and filling cooling system . . . . .	163
<b>2</b>	<b>Coolant pump and thermostat . . . . .</b>	<b>170</b>
2.1	Exploded view - coolant pump and thermostat . . . . .	170
2.2	Removing and installing coolant pump . . . . .	170
2.3	Removing and installing thermostat . . . . .	171
2.4	Checking thermostat . . . . .	176
<b>3</b>	<b>Coolant pipes . . . . .</b>	<b>177</b>
3.1	Exploded view - coolant pipes . . . . .	177
3.2	Removing and installing continued coolant circulation pump V51 . . . . .	178
3.3	Removing and installing coolant pipe (front) . . . . .	179

3.4	Removing and installing coolant pipe (small) .....	181
3.5	Removing and installing coolant pipe (rear) .....	182
<b>4</b>	<b>Radiator and radiator fans</b> .....	<b>185</b>
4.1	Exploded view - radiator and radiator fans .....	185
4.2	Removing and installing radiator .....	186
4.3	Removing and installing viscous fan .....	189
4.4	Removing and installing poly V-belt pulley for viscous fan .....	190
4.5	Checking radiator fan .....	190
4.6	Removing and installing radiator fan V7 (right-side) .....	191
4.7	Removing and installing radiator fan 2 V177 (front) .....	192
4.8	Checking cooling system for leaks .....	193
<b>21 - Turbocharging/supercharging</b> .....	<b>196</b>	
<b>1</b>	<b>Checking charge air system with turbocharger</b> .....	<b>196</b>
1.1	Test requirements for checking turbocharging system .....	196
1.2	Connection diagram for charge pressure control and overrun air recirculation control .....	196
1.3	Checking turbocharger and charge pressure control .....	196
1.4	Checking charge pressure control .....	200
1.5	Checking charge pressure control solenoid valve N75 .....	203
1.6	Checking charge pressure sender G31 .....	208
1.7	Checking by-pass air cut-off valve for central idling speed N8 .....	212
1.8	Checking mechanical air recirculation valves .....	216
<b>2</b>	<b>Turbocharger</b> .....	<b>218</b>
2.1	Exploded view - turbocharger .....	218
2.2	Removing and installing turbocharger (left-side) .....	221
2.3	Removing and installing turbocharger (right-side) .....	223
2.4	Installing air hoses .....	227
<b>3</b>	<b>Charge air cooling</b> .....	<b>228</b>
3.1	Air duct .....	228
3.2	Exploded view - charge air cooler .....	229
3.3	Removing and installing charge air cooler .....	230
<b>26 - Exhaust system</b> .....	<b>232</b>	
<b>1</b>	<b>Silencers</b> .....	<b>232</b>
1.1	Exploded view - silencers .....	232
1.2	Removing and installing front exhaust pipe (left-side) with starter catalytic converter and main catalytic converter .....	239
1.3	Removing and installing front exhaust pipe (right-side) with starter catalytic converter and main catalytic converter .....	245
1.4	Removing and installing exhaust manifold (left-side) .....	251
1.5	Removing and installing exhaust manifold (right-side) .....	251
1.6	Separating centre and rear silencers .....	252
1.7	Stress-free alignment of exhaust system .....	253
1.8	Aligning tailpipes - vehicles with concealed tailpipes .....	254
1.9	Aligning tailpipes - vehicles with visible tailpipes .....	255
1.10	Checking exhaust system for leaks .....	255
<b>2</b>	<b>Exhaust gas temperature monitoring</b> .....	<b>256</b>
2.1	Checking function of exhaust gas temperature monitoring .....	256
2.2	Checking exhaust gas temperature sender .....	259
2.3	Removing and installing exhaust gas temperature sender 1 G235 .....	262
2.4	Removing and installing exhaust gas temperature sender 1 for bank 2 G236 .....	265
<b>3</b>	<b>Secondary air system</b> .....	<b>272</b>
3.1	Principle and function .....	272
3.2	Checking secondary air inlet valve N112 .....	274
3.3	Checking secondary air pump relay J299 and activation .....	278

3.4	Checking combination valves for secondary air system for correct operation and leakage .....	284
3.5	Exploded view - secondary air pump .....	286
3.6	Removing and installing secondary air pump .....	287
3.7	Removing and installing combination valve for secondary air system (left-side) .....	289
3.8	Removing and installing combination valve for secondary air system (right-side) .....	291