

## Contents

<b>00 - Technical data</b>	<b>1</b>
<b>1 Identification</b>	<b>1</b>
1.1 Engine number/engine data	1
<b>2 Safety information</b>	<b>2</b>
2.1 Safety precautions when working on the high-voltage system	2
2.2 Safety precautions when working in the vicinity of high-voltage components	3
2.3 Safety precautions when working on the fuel supply system	3
2.4 Safety precautions when working on vehicles with start/stop system	4
2.5 Safety precautions when using testers and measuring instruments during a road test	4
2.6 Safety precautions when working on the cooling system	4
2.7 Safety precautions when working on the exhaust system	5
2.8 Safety precautions when working on the ignition system	5
<b>3 Repair instructions</b>	<b>6</b>
3.1 Identification plates	6
3.2 Use of impact wrenches	6
3.3 Safety precautions when working on the subframe	7
3.4 Rules for cleanliness	7
3.5 Performing adaptations after renewing a component	8
3.6 General notes	9
3.7 General repair instructions	9
3.8 Foreign material in engine	10
3.9 Cleaning engine	10
3.10 Contact corrosion	10
3.11 Routing and attachment of pipes, hoses and wiring	10
3.12 Nuts, bolts	11
3.13 Installing radiators and condensers	11
3.14 Checking vacuum system	11
<b>10 - Removing and installing engine</b>	<b>13</b>
<b>1 Safety information</b>	<b>13</b>
<b>2 Removing and installing engine</b>	<b>14</b>
2.1 Removing engine	14
2.2 Securing engine to engine and gearbox support	14
2.3 Installing engine	15
<b>3 Assembly mountings</b>	<b>16</b>
<b>4 Engine cover panel</b>	<b>17</b>
4.1 Removing and installing engine cover panel	17
<b>13 - Crankshaft group</b>	<b>18</b>
<b>1 Safety information</b>	<b>18</b>
<b>2 Cylinder block (pulley end)</b>	<b>19</b>
2.1 Assembly overview - cylinder block (pulley end)	19
2.2 Removing and installing poly V-belt	28
2.3 Removing and installing poly V-belt tensioner	30
2.4 Removing and installing vibration damper	34
2.5 Removing and installing bracket for ancillaries	51
2.6 Removing and installing engine support	58
<b>3 Cylinder block (gearbox end)</b>	<b>59</b>
3.1 Assembly overview - cylinder block (gearbox end)	59
3.2 Removing and installing drive plate	62
3.3 Removing and installing dual-mass flywheel	64
3.4 Removing and installing sealing flange (gearbox end)	66



3.5	Renewing needle bearing in drive plate	69
<b>4</b>	<b>Crankshaft</b>	<b>72</b>
4.1	Assembly overview - crankshaft	72
4.2	Crankshaft dimensions	75
4.3	Allocation of main bearing shells	75
4.4	Measuring axial clearance of crankshaft	77
4.5	Measuring radial clearance of crankshaft	78
4.6	Removing and installing sender wheel	79
<b>5</b>	<b>Balance shaft</b>	<b>81</b>
5.1	Assembly overview - balance shaft	81
5.2	Removing and installing balance shaft	84
5.3	Renewing oil seal for balance shaft (inlet side)	89
<b>6</b>	<b>Pistons and conrods</b>	<b>91</b>
6.1	Assembly overview - pistons and conrods	91
6.2	Removing and installing pistons	96
6.3	Removing and installing oil spray jets	98
6.4	Checking pistons and cylinder bores	100
6.5	Separating parts of new conrod	102
6.6	Checking radial clearance of conrod bearings	103
<b>15</b>	<b>Cylinder head, valve gear</b>	<b>104</b>
<b>1</b>	<b>Safety information</b>	<b>104</b>
<b>2</b>	<b>Timing chain cover</b>	<b>105</b>
2.1	Assembly overview - timing chain cover	105
2.2	Removing and installing timing chain cover	109
2.3	Renewing oil seal for vibration damper	115
<b>3</b>	<b>Chain drive</b>	<b>118</b>
3.1	Assembly overview - camshaft timing chains	118
3.2	Assembly overview - drive chain for balance shaft	121
3.3	Removing and installing bearing saddle	124
3.4	Removing and installing camshaft timing chain	130
3.5	Checking timing chain	148
3.6	Checking valve timing	150
<b>4</b>	<b>Cylinder head</b>	<b>156</b>
4.1	Assembly overview - cylinder head	156
4.2	Removing and installing cylinder head	160
4.3	Checking compression	167
<b>5</b>	<b>Valve gear</b>	<b>172</b>
5.1	Assembly overview - valve gear	172
5.2	Removing and installing camshaft	177
5.3	Installing ball for slider	199
5.4	Removing and installing cam adjustment actuators	200
5.5	Removing and installing camshaft control valve 1 N205	201
5.6	Removing and installing valve stem oil seals	202
<b>6</b>	<b>Inlet and exhaust valves</b>	<b>215</b>
6.1	Checking valve guides	215
6.2	Checking valves	216
6.3	Valve dimensions	216
<b>17</b>	<b>Lubrication</b>	<b>217</b>
<b>1</b>	<b>Safety information</b>	<b>217</b>
<b>2</b>	<b>Sump/oil pump</b>	<b>218</b>
2.1	Assembly overview - sump/oil pump	218
2.2	Engine oil	226

2.3	Removing and installing lower part of sump .....	226
2.4	Removing and installing oil pump .....	229
2.5	Removing and installing upper part of sump .....	232
2.6	Removing and installing oil level and oil temperature sender G266 .....	237
<b>3</b>	<b>Engine oil cooler .....</b>	<b>239</b>
3.1	Assembly overview - engine oil cooler .....	239
3.2	Removing and installing engine oil cooler .....	239
3.3	Removing and installing mechanical switching valve .....	240
<b>4</b>	<b>Crankcase breather .....</b>	<b>242</b>
4.1	Assembly overview - crankcase breather system .....	242
4.2	Removing and installing oil separator .....	243
4.3	Removing and installing tank breather pressure sensor 1 G950 .....	245
<b>5</b>	<b>Oil filter/oil pressure switches .....</b>	<b>246</b>
5.1	Assembly overview - oil filter .....	246
5.2	Assembly overview - oil pressure switches/oil pressure control .....	247
5.3	Removing and installing oil pressure switch F22 .....	251
5.4	Removing and installing oil pressure switch for reduced oil pressure F378 .....	251
5.5	Removing and installing stage 3 oil pressure switch F447 .....	252
5.6	Removing and installing valve for oil pressure control N428 .....	256
5.7	Removing and installing piston cooling jet control valve N522 .....	257
5.8	Checking oil pressure .....	258
5.9	Checking oil pressure and oil pressure switch .....	261
<b>19</b>	<b>Cooling .....</b>	<b>262</b>
<b>1</b>	<b>Safety information .....</b>	<b>262</b>
<b>2</b>	<b>Cooling system/coolant .....</b>	<b>263</b>
2.1	Connection diagram - coolant hoses .....	263
2.2	Checking cooling system for leaks .....	263
2.3	Draining and filling cooling system .....	268
<b>3</b>	<b>Coolant pump/thermostat assembly .....</b>	<b>271</b>
3.1	Assembly overview - coolant pump/thermostat .....	271
3.2	Assembly overview - electric coolant pump .....	273
3.3	Assembly overview - coolant temperature senders .....	273
3.4	Removing and installing electric coolant pump .....	275
3.5	Removing and installing coolant pump .....	275
3.6	Removing and installing toothed belt for coolant pump .....	277
3.7	Removing and installing actuator for engine temperature regulation N493 .....	280
3.8	Removing and installing coolant temperature sender G62 .....	283
3.9	Removing and installing radiator outlet coolant temperature sender G83 .....	284
3.10	Removing and installing coolant valves .....	284
<b>4</b>	<b>Coolant pipes .....</b>	<b>285</b>
<b>5</b>	<b>Radiator/radiator fans .....</b>	<b>286</b>
<b>21</b>	<b>Turbocharging/supercharging .....</b>	<b>287</b>
<b>1</b>	<b>Safety information .....</b>	<b>287</b>
<b>2</b>	<b>Turbocharger .....</b>	<b>288</b>
2.1	Assembly overview - turbocharger .....	288
2.2	Removing and installing turbocharger .....	294
2.3	Removing and installing turbocharger air recirculation valve N249 .....	304
2.4	Removing and installing charge pressure positioner V465 .....	305
<b>3</b>	<b>Charge air system .....</b>	<b>307</b>
3.1	Assembly overview - charge air system .....	307
3.2	Assembly overview - hose connections for charge air system .....	307
3.3	Removing and installing charge air cooler .....	308



3.4	Removing and installing charge pressure sender G31	308
3.5	Checking charge air system for leaks	308
<b>24</b>	<b>Mixture preparation - injection</b>	<b>310</b>
<b>1</b>	<b>Safety information</b>	<b>310</b>
<b>2</b>	<b>Injection system</b>	<b>311</b>
2.1	Overview of fitting locations - injection system	311
2.2	Checking fuel system for leaks	311
<b>3</b>	<b>Air filter</b>	<b>312</b>
<b>4</b>	<b>Intake manifold</b>	<b>313</b>
4.1	Assembly overview - intake manifold	313
4.2	Removing and installing intake manifold	316
4.3	Removing and installing throttle valve module GX3	317
4.4	Cleaning throttle valve module GX3	318
4.5	Removing and installing intake manifold flap valve N316	319
4.6	Checking intake manifold change-over function	319
<b>5</b>	<b>Injectors</b>	<b>322</b>
5.1	Assembly overview - fuel rail with injectors	322
5.2	Removing and installing fuel rail	326
5.3	Removing and installing injectors	327
5.4	Cleaning injectors	343
<b>6</b>	<b>Senders and sensors</b>	<b>345</b>
6.1	Removing and installing intake air temperature sender G42/intake manifold pressure sender G71	345
6.2	Removing and installing fuel pressure sender G247	346
6.3	Checking fuel pressure sender G247	347
6.4	Removing and installing fuel pressure sender for low pressure G410	352
6.5	Removing and installing pressure differential sender for particulate filter G1037	353
<b>7</b>	<b>High-pressure pump</b>	<b>356</b>
7.1	Assembly overview - high-pressure pump	356
7.2	Removing and installing high-pressure pump	362
7.3	Removing and installing high-pressure pipe	367
<b>8</b>	<b>Lambda probe</b>	<b>373</b>
8.1	Assembly overview - Lambda probe	373
8.2	Removing and installing Lambda probe	376
<b>9</b>	<b>Engine control unit</b>	<b>381</b>
<b>26</b>	<b>Exhaust system</b>	<b>382</b>
<b>1</b>	<b>Safety information</b>	<b>382</b>
<b>2</b>	<b>Exhaust pipes/silencers</b>	<b>383</b>
2.1	Assembly overview - silencers	383
2.2	Separating exhaust pipes/silencers	383
2.3	Removing and installing front silencers	383
2.4	Removing and installing silencers	383
2.5	Stress-free alignment of exhaust system	383
2.6	Checking exhaust system for leaks	383
<b>3</b>	<b>Emission control system</b>	<b>384</b>
3.1	Assembly overview - emission control system	384
3.2	Removing and installing catalytic converter	388
3.3	Removing and installing particulate filter	388
<b>4</b>	<b>Exhaust gas temperature regulation</b>	<b>389</b>
<b>5</b>	<b>Secondary air system</b>	<b>390</b>
5.1	Assembly overview - secondary air system	390
5.2	Removing and installing secondary air pump motor V101	392

5.3	Removing and installing secondary air inlet valve N112 .....	393
5.4	Removing and installing sender 1 for secondary air pressure G609 .....	393
5.5	Removing and installing resonator for secondary air system .....	394
<b>28</b>	<b>- Ignition system .....</b>	<b>396</b>
1	<b>Safety information .....</b>	<b>396</b>
2	<b>Ignition system .....</b>	<b>397</b>
2.1	Assembly overview - ignition system .....	397
2.2	Removing and installing ignition coils .....	399
2.3	Removing and installing knock sensor 1 G61 .....	402
2.4	Removing and installing Hall senders .....	403
2.5	Removing and installing engine speed sender G28 .....	405