



Contents

00 - Technical data	1
1 Safety information	1
1.1 Safety regulations for working on fuel supply	1
1.2 Safety precautions when working on injection system	2
1.3 Safety precautions when working on the cooling system	2
1.4 Safety precautions when working on charge air system	4
1.5 General safety provisions	4
2 Identification	5
2.1 Engine number/engine data	5
3 Repair instructions	7
3.1 General notes on the lubrication system	7
3.2 Rules for cleanliness when working on fuel supply system or injection system	7
3.3 Rules for cleanliness during work on fuel system	8
3.4 General repair notes for working on fuel systems	8
10 - Removing and installing engine	11
1 Removing and installing engine	11
1.1 Removing engine	11
1.2 Separating engine from gearbox	23
1.3 Separating engine from dual clutch gearbox	25
1.4 Securing engine on engine and gearbox support	27
1.5 Installing engine	28
2 Assembly mountings	32
2.1 Assembly overview - assembly mountings	32
2.2 Adjusting assembly mountings	35
2.3 Removing and installing engine mounting	41
3 Engine cover panel	47
3.1 Removing and installing engine cover	47
13 - Crankshaft group	48
1 Cylinder block (pulley end)	48
1.1 Assembly overview - crankcase	48
1.2 Assembly overview - ancillary bracket	50
1.3 Assembly overview - sealing flange, belt pulley end	50
1.4 Assembly overview - poly V-belt drive with air conditioning compressor	52
1.5 Assembly overview - poly V-belt drive without air conditioner compressor	53
1.6 Removing and installing poly V-belt, vehicles with air conditioner	53
1.7 Removing and installing tensioner for poly V-belt	55
1.8 Removing and installing bracket for ancillaries	56
1.9 Removing and installing vibration damper	60
1.10 Removing and installing engine bracket	61
1.11 Renewing crankshaft oil seal - belt pulley end	67
1.12 Removing and installing sealing flange on pulley end	69
2 Cylinder block, gearbox end	73
2.1 Assembly overview - cylinder block, gearbox end	73
2.2 Removing and installing flywheel	74
2.3 Removing and installing sealing flange on gearbox side	75
3 Pistons and conrods	83
3.1 Assembly overview - pistons and conrods	83
3.2 Checking pistons and cylinder bores	85
3.3 Piston and cylinder dimensions	86
3.4 Measuring piston projection at TDC	86



3.5	Checking radial clearance of conrods	88
3.6	Separating new conrods	89
3.7	Removing and installing oil spray jets	89
4	Crankshaft	91
4.1	Assembly overview - crankshaft	91
4.2	Crankshaft dimensions	92
4.3	Measuring axial clearance of crankshaft	92
4.4	Measuring radial clearance of crankshaft	93
4.5	Renewing needle bearing in crankshaft	93
4.6	Renewing spur gear for crankshaft	95
15	Cylinder head, valve gear	99
1	Cylinder head	99
1.1	Assembly overview - cylinder head	99
1.2	Assembly overview - cylinder head cover	101
1.3	Removing and installing cylinder head	104
1.4	Removing and installing cylinder head cover	116
1.5	Removing and installing vacuum pump	119
1.6	Checking compression	120
2	Fully enclosing toothed belt guard	122
2.1	Assembly overview - fully enclosing toothed belt guard	122
2.2	Removing and installing upper toothed belt guard (fully enclosing)	123
2.3	Removing and installing lower toothed belt guard (fully enclosed)	124
2.4	Removing and installing rear toothed belt guard (fully enclosing)	125
3	Toothed belt drive	130
3.1	Assembly overview - toothed belt drive	130
3.2	Removing and installing toothed belt	132
4	Valve gear	146
4.1	Assembly overview - valve gear	146
4.2	Measuring axial clearance of camshaft	149
4.3	Measuring radial clearance of camshafts	150
4.4	Removing and installing camshafts	151
4.5	Removing and installing camshaft oil seal	157
4.6	Checking hydraulic compensation elements	162
4.7	Renewing valve stem seals with cylinder head installed	163
4.8	Renewing valve stem seals with cylinder head removed	166
5	Inlet and exhaust valves	171
5.1	Reworking valve seats	171
5.2	Checking valve guides	171
5.3	Checking valves	172
5.4	Valve dimensions	172
17	Lubrication	173
1	Sump, oil pump	173
1.1	Assembly overview - sump/oil pump	173
1.2	Removing and installing sump	175
1.3	Removing and installing oil pump	179
1.4	Removing and installing oil pump, with balancer shaft module	180
1.5	Engine oil:	181
1.6	Removing and installing oil level and oil temperature sender G266	181
2	Oil filter, oil pressure switch	183
2.1	Assembly overview - oil filter housing with engine oil cooler	183
2.2	Removing and installing oil filter housing with engine oil cooler	184
2.3	Removing and installing oil pressure switch F1	188
2.4	Checking oil pressure switch F1	189



2.5	Checking oil pressure	190
2.6	Measuring oil consumption	191
3	Engine oil cooler	192
3.1	Removing and installing engine oil cooler	192
4	Balancer shaft module	196
4.1	Assembly overview - balancer shaft module	196
4.2	Removing balancer shaft module	199
4.3	Installing a new balancer shaft module	201
4.4	Installing a previously used balancer shaft module again	205
5	Oil circuit	207
5.1	Assembly overview - oil supply line	207
5.2	Removing and installing oil line for turbocharger	208
19	Cooling	213
1	Cooling system/coolant	213
1.1	Coolant hose schematic diagram	213
1.2	Coolant hose connection diagram, gearbox side	215
1.3	Draining and adding coolant	216
1.4	Checking cooling system for leaks	224
1.5	Checking engine oil cooler for leaks	226
2	Coolant pump, regulation of cooling system	228
2.1	Assembly overview - coolant pump, thermostat	228
2.2	Removing and installing coolant pump	228
2.3	Removing and installing 4/2-way valve with thermostat	229
2.4	Removing and installing coolant temperature sender G62	232
2.5	Removing and installing radiator outlet coolant temperature sender G83	234
3	Radiator, radiator fan	236
3.1	Assembly overview - radiator/radiator fan	236
3.2	Removing and installing radiator	237
3.3	Removing and installing radiator cowl with radiator fan	238
4	Coolant pipes	240
4.1	Assembly overview - coolant pipes	240
4.2	Removing and installing front coolant pipe	241
4.3	Removing and installing upper front coolant pipe	245
4.4	Removing and installing left coolant pipe	246
4.5	Removing and installing right coolant pipe	248
21	Turbocharging/supercharging	251
1	Charge air system	251
1.1	Assembly overview - charge air system	251
1.2	Assembly overview - charge-air hose connections	252
1.3	Hose connections with screw-type clips	253
1.4	Removing and installing charge air cooler	253
1.5	Removing and installing charge air pipe	255
1.6	Removing and installing charge air pressure sender G31 / intake air temperature sender G42	256
1.7	Checking charge air system for leaks	257
2	Turbocharger	261
2.1	Assembly overview - turbocharger	261
2.2	Removing and installing turbocharger	265
2.3	Replacing vacuum unit with position sender for charge pressure positioner G581	270
2.4	Removing and installing charge pressure control solenoid valve N75	277
23	Mixture preparation - injection	279
1	Injection system	279



1.1	Schematic overview - fuel system	279
1.2	Overview of fitting locations - injection system	281
1.3	Checking fuel system for leaks	289
1.4	Filling and bleeding fuel system	289
2	Vacuum system	291
2.1	Connection diagram - vacuum system	291
2.2	Checking vacuum system	292
3	Injectors/high-pressure accumulator (rail)	300
3.1	Assembly overview - fuel rail and injectors	300
3.2	Adapting correction values for injectors	302
3.3	Testing injectors	303
3.4	Checking return flow rate of injectors with engine running	303
3.5	Checking return flow rate of injectors at starter speed	306
3.6	Checking for injectors sticking open	307
3.7	Checking low pressure fuel system	309
3.8	Removing and installing injectors	310
3.9	Removing and installing high-pressure lines	316
3.10	Removing and installing fuel rail	321
3.11	Removing and installing injector seal in cylinder head cover	325
4	High-pressure pump	328
4.1	Assembly overview - high-pressure pump	328
4.2	Removing and installing high-pressure pump	329
4.3	Checking high-pressure pump	332
5	Intake manifold	335
5.1	Assembly overview - intake manifold	335
5.2	Removing and installing intake manifold	336
5.3	Removing and installing throttle valve module GX3	339
6	Senders and sensors	342
6.1	Removing and installing exhaust gas pressure sensor 1 G450	342
6.2	Removing and installing air mass meter G70	343
6.3	Checking fuel pressure regulating valve N276	344
6.4	Removing and installing fuel pressure regulating valve N276	345
6.5	Removing and installing fuel pressure sender G247	349
7	Lambda probe	353
7.1	Removing and installing Lambda probe G39 with Lambda probe heater Z19	353
8	Air filter	355
8.1	Assembly overview - air filter	355
8.2	Removing and installing air filter housing	356
9	Engine control unit	358
9.1	Removing and installing engine (motor) control unit J623	358
9.2	Removing and installing anti-theft engine control unit J623	359
26 - Exhaust system		362
1	Exhaust pipes and silencers	362
1.1	Assembly overview - silencers	362
1.2	Cutting exhaust pipe	363
1.3	Aligning exhaust system free of stress	364
1.4	Installation position of clamp	365
2	Emission control	366
2.1	Assembly overview - particulate filter	366
2.2	Assembly overview - catalytic converter	367
2.3	Removing and installing particulate filter	368
3	Exhaust gas temperature regulation	377
3.1	Assembly overview - exhaust gas temperature regulation	377



3.2	Removing and installing exhaust gas temperature sender 1 G235	378
3.3	Removing and installing exhaust gas temperature sender 3 G495	379
3.4	Removing and installing exhaust gas temperature sender 4 G648	381
4	Exhaust gas recirculation	383
4.1	Assembly overview - exhaust gas recirculation	383
4.2	Removing and installing exhaust gas recirculation cooler	384
4.3	Checking changeover for exhaust gas recirculation cooler	386
4.4	Checking exhaust gas recirculation cooler for leaks	387
4.5	Cleaning exhaust gas recirculation system	388
28	Glow plug system	395
1	Glow plug system	395
1.1	Removing and installing glow plug	395
1.2	Removing and installing automatic glow period control unit J179	397
1.3	Removing and installing engine speed sender G28	398
1.4	Removing and installing Hall sender G40	399