



Contents

00 - Technical data	1
1 Identification	1
1.1 Engine number/engine data	1
2 Safety information	3
2.1 Safety regulations for working on fuel supply	3
2.2 Safety precautions when working on injection system	4
2.3 Safety precautions when working on the cooling system	4
2.4 Safety precautions when working on charge air system	6
2.5 General safety provisions	6
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	162
4.8	Renewing valve stem seals with cylinder head removed	165
5	Inlet and exhaust valves	170
5.1	Reworking valve seats	170
5.2	Checking valve guides	170
5.3	Checking valves	171
5.4	Valve dimensions	171
17	Lubrication	172
1	Sump, oil pump	172
1.1	Assembly overview - sump/oil pump	172
1.2	Removing and installing sump	174
1.3	Removing and installing oil pump	178
1.4	Removing and installing oil pump, with balancer shaft module	179
1.5	Engine oil:	180
1.6	Removing and installing oil level and oil temperature sender G266	180
2	Oil filter, oil pressure switch	182
2.1	Assembly overview - oil filter housing with engine oil cooler	182
2.2	Removing and installing oil filter housing with engine oil cooler	183
2.3	Removing and installing oil pressure switch F1	187
2.4	Checking oil pressure switch F1	188



2.5	Checking oil pressure	189
2.6	Measuring oil consumption	190
3	Engine oil cooler	191
3.1	Removing and installing engine oil cooler	191
4	Balancer shaft module	195
4.1	Assembly overview - balancer shaft module	195
4.2	Removing balancer shaft module	198
4.3	Installing a new balancer shaft module	200
4.4	Installing a previously used balancer shaft module again	204
5	Oil circuit	206
5.1	Assembly overview - oil circuit	206
5.2	Removing and installing oil line for turbocharger	207
19	Cooling	212
1	Cooling system/coolant	212
1.1	Coolant hose schematic diagram	212
1.2	Coolant hose connection diagram, gearbox side	213
1.3	Draining and adding coolant	214
1.4	Checking cooling system for leaks	222
1.5	Checking engine oil cooler for leaks	224
2	Coolant pump, regulation of cooling system	226
2.1	Assembly overview - coolant pump, thermostat	226
2.2	Removing and installing coolant pump	226
2.3	Removing and installing 4/2-way valve with thermostat	227
2.4	Removing and installing coolant temperature sender G62	230
2.5	Removing and installing radiator outlet coolant temperature sender G83	232
3	Radiator, radiator fan	234
3.1	Assembly overview - radiator/radiator fan	234
3.2	Removing and installing radiator	235
3.3	Removing and installing radiator cowl with radiator fan	236
4	Coolant pipes	238
4.1	Assembly overview - coolant pipes	238
4.2	Removing and installing front coolant pipe	239
4.3	Removing and installing upper front coolant pipe	243
4.4	Removing and installing left coolant pipe	244
4.5	Removing and installing right coolant pipe	246
21	Turbocharging/supercharging	249
1	Charge air system	249
1.1	Assembly overview - charge air system	249
1.2	Assembly overview - charge-air hose connections	250
1.3	Hose connections with screw-type clips	251
1.4	Removing and installing charge air cooler	251
1.5	Removing and installing charge air pipe	253
1.6	Removing and installing charge air pressure sender G31 / intake air temperature sender G42	254
1.7	Checking charge air system for leaks	255
2	Turbocharger	259
2.1	Assembly overview - turbocharger	259
2.2	Removing and installing turbocharger	263
2.3	Replacing vacuum unit with position sender for charge pressure positioner G581	268
2.4	Removing and installing charge pressure control solenoid valve N75	274
23	Mixture preparation - injection	277
1	Injection system	277



1.1	Schematic overview - fuel system	277
1.2	Overview of fitting locations - injection system	279
1.3	Checking fuel system for leaks	287
1.4	Filling and bleeding fuel system	287
2	Vacuum system	289
2.1	Connection diagram - vacuum system	289
2.2	Checking vacuum system	290
3	Injectors/high-pressure accumulator (rail)	298
3.1	Assembly overview - fuel rail and injectors	298
3.2	Adapting correction values for injectors	300
3.3	Testing injectors	301
3.4	Checking return flow rate of injectors with engine running	301
3.5	Checking return flow rate of injectors at starter speed	304
3.6	Checking for injectors sticking open	305
3.7	Checking low pressure fuel system	307
3.8	Removing and installing injectors	308
3.9	Removing and installing high-pressure lines	314
3.10	Removing and installing fuel rail	319
3.11	Removing and installing injector seal in cylinder head cover	323
4	High-pressure pump	326
4.1	Assembly overview - high-pressure pump	326
4.2	Removing and installing high-pressure pump	327
4.3	Checking high-pressure pump	330
5	Intake manifold	333
5.1	Assembly overview - intake manifold	333
5.2	Removing and installing intake manifold	334
5.3	Removing and installing throttle valve module GX3	337
6	Senders and sensors	340
6.1	Removing and installing exhaust gas pressure sensor 1 G450	340
6.2	Removing and installing air mass meter G70	341
6.3	Checking fuel pressure regulating valve N276	342
6.4	Removing and installing fuel pressure regulating valve N276	343
6.5	Removing and installing fuel pressure sender G247	347
7	Lambda probe	351
7.1	Removing and installing Lambda probe G39	351
8	Air filter	353
8.1	Assembly overview - air filter housing	353
8.2	Removing and installing air filter housing	354
9	Engine control unit	356
9.1	Removing and installing engine (motor) control unit J623	356
9.2	Removing and installing anti-theft engine control unit J623	357
26	- Exhaust system	360
1	Exhaust pipes and silencers	360
1.1	Assembly overview - silencers	360
1.2	Cutting exhaust pipe	361
1.3	Aligning exhaust system free of stress	362
1.4	Installation position of clamp	363
2	Emission control	364
2.1	Assembly overview - particulate filter	364
2.2	Assembly overview - catalytic converter	365
2.3	Removing and installing particulate filter	366
3	Exhaust gas temperature regulation	375
3.1	Assembly overview - exhaust gas temperature regulation	375



3.2	Removing and installing exhaust gas temperature sender 1 G235	376
3.3	Removing and installing exhaust gas temperature sender 3 G495	377
3.4	Removing and installing exhaust gas temperature sender 4 G648	379
4	Exhaust gas recirculation	381
4.1	Assembly overview - exhaust gas recirculation	381
4.2	Removing and installing exhaust gas recirculation cooler	382
4.3	Checking changeover for exhaust gas recirculation cooler	384
4.4	Checking exhaust gas recirculation cooler for leaks	385
4.5	Cleaning exhaust gas recirculation system	386
28	Glow plug system	393
1	Glow plug system	393
1.1	Removing and installing glow plug	393
1.2	Removing and installing automatic glow period control unit J179	395
1.3	Removing and installing engine speed sender G28	395
1.4	Removing and installing Hall sender G40	397