



Contents

00 - Technical data	1
1 Safety information	1
1.1 Safety precautions when working on high-voltage system	1
1.2 Safety precautions when working in the vicinity of high-voltage components	2
1.3 Safety precautions when working on the fuel supply system	2
1.4 Safety precautions when using testers and measuring instruments during a road test	2
1.5 Safety precautions when working on the ignition system	3
1.6 Safety precautions when working on the cooling system	3
2 Identification	4
2.1 Engine number/engine data	4
3 Repair notes	6
3.1 Rules for cleanliness	6
3.2 Foreign material in engine	6
3.3 Contact corrosion	6
3.4 Routing and attachment of lines	7
3.5 Fitting radiator and condensers	7
3.6 Checking vacuum system	7
4 Hazard classification of high-voltage system	9
10 - Removing and installing engine	16
1 Removing and installing engine	16
1.1 Removing motor	16
1.2 Supporting engine/motor and gearbox/transmission unit using scissor-type assembly platform	22
1.3 Separating engine and gearbox	26
1.4 Securing engine on engine and gearbox support	28
1.5 Installing motor	30
2 Assembly mountings	35
2.1 Assembly overview – assembly mountings	35
2.2 Removing and installing engine mounting	37
2.3 Removing and installing gearbox mounting	38
2.4 Removing and installing pendulum support	39
2.5 Supporting engine in installation position	40
2.6 Checking adjustment of assembly mountings	44
2.7 Adjusting assembly mountings	45
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 – sealing flange, pulley end	48
1.2 Removing and installing engine support	50
1.3 Removing and installing vibration damper	51
1.4 Renewing crankshaft oil seal (pulley end)	52
1.5 Removing and installing sealing flange, pulley end	54
2 Cylinder block, gearbox side	57
2.1 Assembly overview – cylinder block, gearbox side	57
2.2 Removing and installing flywheel	59
2.3 Removing and installing sealing flange on gearbox side	61
3 Crankshaft	68
3.1 Crankshaft dimensions	68
3.2 Measuring axial clearance of crankshaft	68



4	Pistons and conrods	70
4.1	Assembly overview – pistons and conrods	70
4.2	Removing and installing pistons	72
4.3	Checking piston and cylinder bore	74
4.4	Separating new conrod	75
4.5	Checking radial clearance of conrods	76
4.6	Removing and installing oil spray jets	77
4.7	Setting piston to TDC (top dead centre)	78
15	Cylinder head, valve gear	83
1	Cylinder head	83
1.1	Assembly overview – cylinder head	83
1.2	Assembly overview – camshaft housing	85
1.3	Removing and installing cylinder head	87
1.4	Removing and installing camshaft housing	92
1.5	Checking compression	96
2	Toothed belt drive	99
2.1	Assembly overview – toothed belt cover	99
2.2	Assembly overview – toothed belt	99
2.3	Removing and installing toothed belt guard	101
2.4	Pre-assembling and fitting valve timing tool	102
2.5	Removing and installing toothed belt	109
2.6	Checking valve timing	115
2.7	Adjusting valve timing	116
2.8	Removing toothed belt from camshaft	126
3	Valve gear	132
3.1	Assembly overview – valve gear	132
3.2	Measuring axial play of camshaft	134
3.3	Removing and installing camshaft oil seal	135
3.4	Removing and installing camshaft adjuster	140
3.5	Removing and installing camshaft control valve 1 N205	148
3.6	Removing and installing exhaust camshaft control valve 1 N318	149
3.7	Removing and installing valve stem oil seals	149
4	Inlet and exhaust valves	159
4.1	Checking valve guides	159
4.2	Checking valves	159
4.3	Valve dimensions	160
17	Lubrication	161
1	Sump, oil pump	161
1.1	Assembly overview – sump/oil pump	161
1.2	Engine oil	165
1.3	Removing and installing lower part of sump	166
1.4	Removing and installing upper part of sump	170
1.5	Removing and installing oil pump	173
1.6	Removing and installing oil level and oil temperature sender G266	174
2	Engine oil cooler	176
2.1	Assembly overview - engine oil cooler	176
2.2	Removing and installing engine oil cooler	176
3	Crankcase breather	178
3.1	Assembly overview - crankcase breather system	178
3.2	Removing and installing oil separator	179
3.3	Removing and installing breather line	180
4	Oil filter, oil pressure switch	181
4.1	Assembly overview - oil filter/oil pressure switches	181



4.2	Removing and installing oil pressure switch F22	183
4.3	Removing and installing oil pressure switch for reduced oil pressure F378	184
4.4	Removing and installing valve for oil pressure control N428	186
4.5	Checking oil pressure	187
19	Cooling	189
1	Cooling system/coolant	189
1.1	Connection diagram – coolant hoses	189
1.2	Coolant hose schematic diagram, high-voltage system	193
1.3	Checking cooling system for leaks	194
1.4	Checking cooling system of high-voltage system for leaks	197
1.5	Draining and filling cooling system	206
1.6	Draining and adding coolant, high-voltage system	214
1.7	Checking filling quality, high-voltage system	223
1.8	Checking coolant level and topping up if necessary	226
1.9	Removing and installing coolant expansion tank	227
1.10	Assembly overview - coolant expansion tank	232
2	Coolant pump, regulation of cooling system	234
2.1	Assembly overview – coolant pump/thermostat	234
2.2	Assembly overview – electric coolant pump	237
2.3	Assembly overview – coolant temperature sender	239
2.4	Assembly overview – coolant valves	240
2.5	Removing and installing electric coolant pump	242
2.6	Removing and installing coolant pump	249
2.7	Removing and installing thermostat	252
2.8	Removing and installing toothed belt pulley for coolant pump	255
2.9	Removing and installing coolant temperature sender G62	256
2.10	Removing and installing radiator outlet coolant temperature sender G83	257
2.11	Removing and installing coolant valves	258
2.12	Removing and installing coolant temperature sender for heater G241	265
2.13	Removing and installing temperature sender after electric drive motor G788	266
3	Coolant pipes	268
3.1	Assembly overview – coolant pipes	268
3.2	Removing and installing coolant pipes	269
4	Radiator, radiator fan	275
4.1	Assembly overview - radiator/radiator fan	275
4.2	Assembly overview - radiator cowl and radiator fans	278
4.3	Removing and installing radiator	279
4.4	Removing and installing radiator cowl	281
4.5	Removing and installing radiator fan V7	283
21	Turbocharging/supercharging	285
1	Turbocharger	285
1.1	Assembly overview – turbocharger	285
1.2	Removing and installing turbocharger	287
1.3	Removing and installing charge pressure positioner V465	291
1.4	Removing and installing connection for turbocharger	292
2	Charge air system	296
2.1	Assembly overview – charge air system	296
2.2	Removing and installing charge pressure sender GX26	298
2.3	Removing and installing charge air cooler	299
2.4	Checking charge air system for leaks	299
2.5	Removing and installing air intake pipe	301
24	Mixture preparation - injection	304



1	Injection system	304
1.1	Overview of fitting locations - injection system	304
2	Injectors	311
2.1	Assembly overview - fuel rail with injectors	311
2.2	Removing and installing fuel rail	313
2.3	Removing and installing injectors	314
2.4	Cleaning injectors	319
3	Air filter	322
3.1	Assembly overview – air filter housing	322
3.2	Removing and installing air filter housing	324
3.3	Removing and installing resonator for intake air	325
4	Intake manifold	326
4.1	Assembly overview – intake manifold	326
4.2	Removing and installing intake manifold	328
4.3	Removing and installing throttle valve module GX3	330
4.4	Cleaning throttle valve module GX3	331
5	Senders and sensors	333
5.1	Removing and installing fuel pressure sender G247	333
5.2	Checking fuel pressure sender G247	334
5.3	Removing and installing intake manifold sender GX9	338
5.4	Removing and installing pressure differential sender for particulate filter G1037	339
6	Engine control unit	341
6.1	Removing and installing motor control unit J623	341
7	High-pressure pump	345
7.1	Assembly overview – high-pressure pump	345
7.2	Removing and installing high-pressure pump	346
7.3	Removing and installing high-pressure pipe	347
8	Lambda probe	349
8.1	Assembly overview – lambda probe	349
8.2	Removing and installing lambda probe	350
26 - Exhaust system		354
1	Exhaust pipes and silencers	354
1.1	Assembly overview – silencers	354
1.2	Separating exhaust pipes from silencers	355
1.3	Removing and installing silencer	356
1.4	Installation position of clamp	358
1.5	Aligning exhaust system free of stress	358
1.6	Checking exhaust system for leaks	358
2	Emission control	359
2.1	Assembly overview – emission control	359
2.2	Assembly overview – bracket and pipes for pressure differential sender for particulate filter	361
2.3	Removing and installing catalytic converter	363
2.4	Removing and installing particulate filter	366
3	Exhaust gas temperature regulation	367
3.1	Assembly overview – exhaust gas temperature regulation	367
3.2	Removing and installing parts of exhaust gas temperature regulation	368
28 - Ignition system		371
1	Ignition system	371
1.1	Assembly overview - ignition system	371
1.2	Removing and installing ignition coil with output stage	372
1.3	Removing and installing knock sensor 1 G61	375



1.4	Removing and installing Hall sender	376
1.5	Removing and installing engine speed sender G28	377
93	Electric drive systems	379
1	High-voltage components	379
1.1	Overview of fitting locations - high-voltage components	379
2	Warning stickers	381
2.1	Checking warning stickers	381
3	High-voltage battery unit	385
3.1	Assembly overview - high-voltage battery (installed)	385
3.2	Visual inspection of high-voltage battery 1 AX2	386
3.3	Diagnosis of high-voltage battery 1 AX2	387
3.4	Checking high-voltage battery for leaks	387
3.5	Leak test for high-voltage battery 1 AX2	387
3.6	Leak test in cooling system of high-voltage battery 1 AX2	388
3.7	Removing and installing high-voltage battery 1 AX2	388
3.8	Raising high-voltage battery 1 AX2	394
3.9	Opening high-voltage battery 1 AX2	396
3.10	Closing high-voltage battery 1 AX2	398
3.11	Voltage and insulation measurement	399
3.12	Charging and discharging battery modules	401
4	High-voltage battery components	403
4.1	Overview of fitting locations – high-voltage battery 1	403
4.2	Overview of fitting locations - battery modules	404
4.3	Overview of fitting locations - battery connectors	405
4.4	Assembly overview – battery housing	407
4.5	Assembly overview - switching unit for high-voltage battery	409
4.6	Assembly overview - battery module assembly	410
4.7	Assembly overview - battery modules	412
4.8	Assembly overview - high-voltage system connection	412
4.9	Assembly overview – wiring harnesses	413
4.10	Removing and installing switching unit for high-voltage battery SX6	414
4.11	Removing and installing wiring harness for high-voltage battery 1 AX2	416
4.12	Removing and installing coolant pipe	417
4.13	Removing and installing battery module assembly	419
4.14	Removing and installing battery module assembly wiring harness	424
4.15	Removing and installing high-voltage system connection	425
4.16	Removing and installing battery modules J1068 / J991	426
4.17	Removing and installing battery modules J992 / J993	429
4.18	Removing and installing battery modules J994 / J995	433
4.19	Removing and installing battery modules J996 / J997	436
5	Power and control electronics for electric drive	441
5.1	Assembly overview - power and control electronics for electric drive	441
5.2	Removing and installing power and control electronics for electric drive [JX1]	444
5.3	Removing and installing bracket for power and control electronics for electric drive JX1	448
5.4	Removing and installing high-voltage system fuse 3 S353	449
6	Electric drive motor	452
6.1	Removing and installing three-phase current drive VX54	452
6.2	Removing and installing drive motor temperature sender G712	452
6.3	Removing and installing drive motor rotor position sender 1 G713	452
7	High-voltage cables	453
7.1	Overview of fitting locations - high-voltage wiring	453
7.2	Removing and installing high-voltage wiring harness for high-voltage battery	454
7.3	Removing and installing high-voltage wiring harness for drive motor	457
7.4	Removing and installing high-voltage wire for high-voltage battery charging unit P25	460



7.5	Removing and installing high-voltage cable for high-voltage heater (PTC) P11	461
7.6	Removing and installing high-voltage wire for electrical air conditioner compressor	463
8	De-energising high-voltage system	465
8.1	De-energising high-voltage system	465
9	Re-energising high-voltage system	467
9.1	Re-energising high-voltage system	467
10	Potential equalisation lines	468
10.1	Overview of fitting locations - potential equalisation lines	468
11	Charging socket	469
11.1	Assembly overview - charging socket	469
11.2	Removing and installing high-voltage battery charging socket 1 UX4	470
11.3	Removing and installing actuator for high-voltage charging socket lock 1 F498	471
11.4	Removing and installing manual release mechanism of charging socket	474
12	Charging unit for high-voltage battery	475
12.1	Assembly overview - charging unit for high-voltage battery	475
12.2	Removing and installing charging unit 1 for high-voltage battery AX4	476
12.3	Removing and installing bracket for charging unit 1 for high-voltage battery AX4	479
13	Vehicle noise/engine sound	480
13.1	Overview of fitting locations - vehicle noise/engine sound	480
13.2	Removing and installing engine sound generator control unit J943	480