



Contents

00 - Technical data	1
1 Technical data	1
1.1 Engine number	1
1.2 Engine data	2
10 - Removing and installing engine	3
1 Removing and installing engine	3
1.1 Removing engine	5
1.2 Removing engine from scissor-type assembly platform VAS 6131	13
1.3 Securing engine to assembly stand	14
1.4 Notes on installing	15
1.5 Assembly overview - engine mountings	16
1.6 Removing and installing engine mounting	16
13 - Crankshaft group	22
1 Dismantling and assembling engine	22
1.1 Assembly overview - poly V-belt drive	23
1.2 Removing and installing poly-V belt	27
1.3 Renewing crankshaft oil seal - pulley end	29
1.4 Removing and installing front sealing flange	31
1.5 Assembly overview - drive plate/dual-mass flywheel	35
1.6 Removing and installing drive plate	36
1.7 Removing and installing dual-mass flywheel	37
1.8 Extracting and driving in needle roller bearing for dual-mass flywheel	39
1.9 Renewing crankshaft oil seal (timing chain end)	40
1.10 Assembly overview - timing chain covers	42
1.11 Removing and installing timing chain covers	43
1.12 Assembly overview - balance shaft	52
1.13 Removing and installing balance shaft	53
2 Chain drive (engine codes BKS, BUN)	57
2.1 Assembly overview - drive chain for valve gear	57
2.2 Removing and installing drive chain for valve gear	59
2.3 Assembly overview - chain for balance shaft and oil pump	60
2.4 Removing and installing chain for balance shaft and oil pump	61
3 Chain drive (engine codes CASA, CASB, CASC, CATA)	67
3.1 Assembly overview - drive chain for valve gear	67
3.2 Removing and installing drive chain for valve gear	69
3.3 Assembly overview - chain for balance shaft and oil pump	70
3.4 Removing and installing chain for balance shaft and oil pump	71
4 Removing and installing crankshaft	77
4.1 Assembly overview - crankshaft	77
4.2 Crankshaft dimensions	81
4.3 Measuring axial clearance	81
4.4 Measuring radial clearance	82
5 Pistons and conrods	83
5.1 Assembly overview - pistons and conrods	83
5.2 Checking piston projection at TDC	88
5.3 Piston and cylinder dimensions	90
5.4 Checking radial clearance of conrods	90
15 - Cylinder head, valve gear	91
1 Cylinder head	91



1.1	Assembly overview - cylinder head	91
1.2	Assembly overview - cylinder head cover	94
1.3	Removing and installing cylinder head cover	97
1.4	Removing and installing cylinder head	104
1.5	Checking compression	113
1.6	Assembly overview - vacuum pump	115
2	Assembly overview - valve gear	117
2.1	Checking axial clearance of camshafts	119
2.2	Renewing camshaft oil seal	120
2.3	Removing and installing camshafts	123
2.4	Renewing valve stem seals	136
2.5	Checking hydraulic valve compensation elements	141
2.6	Valve dimensions	143
2.7	Checking valve guides	143
3	Chain drive for camshafts	145
3.1	Camshaft timing chain (engine codes BKS, BUN)	145
3.2	Camshaft timing chain (engine codes CASA, CASB, CASC, CATA)	171
17	Lubrication	198
1	Engine oil:	198
1.1	Oil capacities	198
1.2	Checking engine oil level	198
2	Parts of lubrication system	200
2.1	Assembly overview - oil pump, lower part of sump	200
2.2	Removing and installing lower part of sump	203
2.3	Removing and installing oil pump	211
2.4	Assembly overview - upper part of sump	212
2.5	Removing and installing oil pressure switch F1 (engine code CATA)	217
2.6	Removing and installing oil pressure control valve N428 (engine code CATA)	217
2.7	Removing and installing upper part of sump	218
3	Oil cooler, pressure control valve and oil filter housing	222
3.1	Assembly overview - oil cooler, pressure control valve, and oil filter housing	222
3.2	Removing and installing oil cooler	224
3.3	Removing and installing oil filter housing	225
3.4	Removing and installing pressure control valve for crankcase breather system	227
3.5	Removing and installing mounting plate for oil cooler, pressure control valve and oil filter housing	228
3.6	Removing and installing oil pressure switch F1/oil pressure switch for reduced oil pressure F378	229
3.7	Checking oil pressure and oil pressure switch	230
19	Cooling	233
1	Parts of cooling system	233
1.1	Assembly overview - radiator	234
1.2	Assembly overview - fan support	235
1.3	Assembly overview - thermostat and coolant pump	236
1.4	Coolant hose connection diagram	238
1.5	Removing and installing fan support	241
1.6	Draining and adding coolant	241
1.7	Removing and installing radiator	245
1.8	Removing and installing coolant pump	246
1.9	Removing and installing thermostat	248
1.10	Assembly overview - pump for exhaust gas recirculation cooler V400	249
1.11	Removing and installing pump for exhaust gas recirculation cooler V400	250
1.12	Assembly overview - coolant pipes	250
1.13	Removing and installing coolant pipes	253



1.14	Removing and installing coolant temperature sender G62	266
1.15	Checking cooling system for leaks	267
1.16	Checking coolant pump V36/fuel cooling pump V166	269
20	Fuel supply system	271
1	Parts of fuel supply system	271
1.1	Safety regulations for working on fuel supply	271
1.2	Rules for cleanliness	272
1.3	Procedure in event of misfuelling	272
1.4	Assembly overview - fuel tank with attachments	275
1.5	Emptying fuel tank	277
1.6	Removing and installing fuel tank with attached components	281
1.7	Removing and installing fuel delivery unit, fuel gauge sender and suction-jet pumps	284
1.8	Assembly overview - fuel filter with fuel cooler	286
1.9	Assembly overview - supplementary fuel pump V393	288
1.10	Checking fuel pump	290
1.11	Bleeding fuel system	310
1.12	Checking for leaks in the fuel system	310
1.13	Repairing accelerator mechanism	311
21	Turbocharging/supercharging	312
1	Charge air system with turbocharger	312
1.1	Rules for cleanliness	312
1.2	Assembly overview - turbocharger (engine codes BKS, BUN)	312
1.3	Removing and installing turbocharger (engine codes BKS, BUN)	314
1.4	Assembly overview - turbocharger (engine codes CASA, CASB, CASC)	317
1.5	Removing and installing turbocharger (engine codes CASA, CASB, CASC)	319
1.6	Assembly overview - turbocharger (engine code CATA)	324
1.7	Removing and installing turbocharger (engine code CATA)	326
1.8	Removing and installing turbocharger 1 control unit J724	333
1.9	Removing and installing parts of charge air cooling	346
1.10	Assembly overview - parts of charge air cooling system, left side	346
1.11	Assembly overview - parts of right charge air cooling	347
1.12	Parts of charge air cooling (engine code CATA)	348
23	Mixture preparation - injection	351
1	Repairing diesel direct injection system	351
1.1	Safety precautions	353
1.2	Rules for cleanliness and instructions for working on fuel system	353
1.3	Schematic overview of fuel system (engine codes BKS, BUN)	354
1.4	Assembly overview - fuel system (engine codes BKS, BUN)	355
1.5	Assembly overview - intake manifold (engine codes BKS, BUN)	357
1.6	Removing and installing upper part of intake manifold (engine codes BKS, BUN)	359
1.7	Removing and installing intake manifold flap motor V157 or intake manifold flap motor 2 V275 (engine codes BKS, BUN)	364
1.8	Removing and installing lower part of intake manifold (engine codes BKS, BUN)	375
1.9	Schematic overview of fuel system (engine codes CASA, CASB, CASC, CATA)	381
1.10	Assembly overview - fuel system (engine codes CASA, CASB, CASC, CATA)	384
1.11	Assembly overview - intake manifold (engine codes CASA, CASB, CASC, CATA)	387
1.12	Removing and installing upper part of intake manifold (engine codes CASA, CASB, CASC, CATA)	389
1.13	Removing and installing lower part of intake manifold (engine codes CASA, CASB, CASC, CATA)	392
1.14	Removing and installing injectors (piezo injectors)	396
1.15	Checking return flow rate of injectors (piezo injectors) with engine running	402
1.16	Checking return flow rate of injectors (piezo injectors) at cranking speed	404
1.17	Checking for injectors sticking open (piezo injectors)	407



1.18	Installing high-pressure lines	408
1.19	Checking pressure retention valve in fuel return line	411
1.20	Assembly overview - toothed belt for high-pressure pump (engine codes BKS, BUN)	412
1.21	Removing and installing toothed belt for high-pressure pump (engine codes BKS, BUN)	415
1.22	Assembly overview - toothed belt for high-pressure pump (engine codes CASA, CASB, CASC, CATA)	419
1.23	Removing and installing toothed belt for high-pressure pump (engine codes CASA, CASB, CASC, CATA)	421
1.24	Assembly overview - high-pressure pump (engine codes BKS, BUN)	431
1.25	Removing and installing high-pressure pump (engine codes BKS, BUN)	436
1.26	Assembly overview - high-pressure pump (engine codes CASA, CASB, CASC, CATA)	441
1.27	Removing and installing high-pressure pump (engine codes CASA, CASB, CASC, CATA)	443
1.28	Removing and installing fuel pressure regulating valve N276	444
1.29	Removing and installing fuel pressure sender G247	446
1.30	Assembly overview - air filter	447
1.31	Removing and installing exhaust gas pressure sensor 1 G450	449
2	Engine control unit	451
2.1	Removing and installing engine control unit	451
2.2	Removing and installing anti-theft engine control unit	451
26	Exhaust system	455
1	Parts of the exhaust system	455
1.1	Assembly overview - front exhaust pipe with catalytic converter and particulate filter (engine codes BKS, BUN, CASA, CASB, CASC)	456
1.2	Assembly overview - front exhaust pipe with catalytic converter, reduction catalytic converter and particulate filter (engine code CATA)	457
1.3	Removing and installing starter catalytic converter	460
1.4	Removing and installing particulate filter	464
1.5	Removing and installing reduction catalytic converter	467
1.6	Assembly overview - exhaust gas temperature regulator (engine code CATA)	468
1.7	Silencer with mountings	469
1.8	Replacing tail pipes	470
1.9	Aligning exhaust system free of stress	471
1.10	SCR system (selective catalytic reduction)	472
1.11	Assembly overview - exhaust manifold with intermediate pipe	494
1.12	Removing and installing left exhaust manifold	495
1.13	Removing and installing right exhaust manifold	498
1.14	Removing and installing intermediate pipe (left side)	501
1.15	Removing and installing intermediate pipe (right side)	502
2	Exhaust gas recirculation system (engine codes BKS, BUN)	506
2.1	Assembly overview - exhaust gas recirculation system	506
2.2	Checking mechanical exhaust gas recirculation valve	508
2.3	Removing and installing mechanical exhaust gas recirculation valve	508
2.4	Removing and installing exhaust gas recirculation cooler	509
3	Exhaust gas recirculation (engine codes CASA, CASB, CASC)	512
3.1	Assembly overview - exhaust gas recirculation system	512
3.2	Removing and installing exhaust gas recirculation control motor V338	514
3.3	Removing and installing exhaust gas recirculation cooler	516
3.4	Removing and installing exhaust gas recirculation temperature sensor G98	518
4	Exhaust gas recirculation (engine code CATA)	520
4.1	Assembly overview - exhaust gas recirculation system	520
4.2	Assembly overview - supplementary cooler for exhaust gas recirculation system	522
4.3	Removing and installing exhaust gas recirculation control motor V338	522
4.4	Removing and installing exhaust gas recirculation cooler	524
4.5	Removing and installing supplementary cooler for exhaust gas recirculation system	527
4.6	Removing and installing exhaust gas recirculation temperature sensor G98	530



28 - Glow plug system	532
1 Checking glow plug system	532
1.1 Assembly overview - Glow plugs, Hall sender, engine speed sender	532
1.2 Characteristics of ceramic glow plugs	533
1.3 Removing, installing and checking ceramic glow plugs	533
1.4 Removing and installing glow plugs, engine code CATA	535
1.5 Removing and installing metal glow plugs	537
1.6 Checking metal glow plugs	538
1.7 Removing and installing engine speed sender G28	539
1.8 Removing and installing Hall sender G40	540