



## Contents

<b>00 - Technical data</b>	<b>1</b>
<b>1 Safety information</b>	<b>1</b>
1.1 Safety precautions when working on the fuel supply system	1
1.2 Safety measures when working on vehicles with start/stop system	1
1.3 Safety precautions when using testers and measuring instruments during a road test	2
1.4 Safety precautions when working on the cooling system	2
1.5 Safety precautions when working on the ignition system	2
1.6 Safety precautions when working on the exhaust system	3
<b>2 Identification</b>	<b>4</b>
2.1 Engine number/engine data	4
<b>3 Repair instructions</b>	<b>5</b>
3.1 Rules for cleanliness	5
3.2 General notes	5
3.3 General repair notes	6
3.4 Foreign material in engine	6
3.5 Contact corrosion	6
3.6 Routing and attachment of lines	7
3.7 Fitting radiator and condensers	7
3.8 Checking vacuum system	7
3.9 Instructions for checking Delphi injection system for suspected damage to high-pressure pump	8
<b>10 - Removing and installing engine</b>	<b>14</b>
<b>1 Removing and installing engine</b>	<b>14</b>
1.1 Removing motor	14
1.2 Securing engine on engine and gearbox support	31
1.3 Installing motor	34
1.4 Modifying engine bracket T10229	37
1.5 Converting adapter 10 - 222 A /23 with adapter 10 - 222 A /23-1	38
<b>2 Assembly mountings</b>	<b>40</b>
2.1 Assembly overview – assembly mountings	40
2.2 Supporting engine in installation position	42
2.3 Removing and installing engine mounting	43
2.4 Removing and installing engine mounting	49
<b>13 - Crankshaft group</b>	<b>54</b>
<b>1 Cylinder block, pulley end</b>	<b>54</b>
1.1 Assembly overview – cylinder block, pulley end	54
1.2 Assembly overview – sealing flange, pulley end	56
1.3 Assembly overview - poly V-belt drive	58
1.4 Removing and installing poly-V belt	64
1.5 Removing and installing poly V-belt tensioner	66
1.6 Removing and installing bracket for ancillaries	67
1.7 Removing and installing vibration damper	70
1.8 Renewing crankshaft oil seal (pulley end)	71
1.9 Removing and installing sealing flange, pulley end	74
<b>2 Cylinder block, gearbox side</b>	<b>79</b>
2.1 Assembly overview – cylinder block, gearbox side	79
2.2 Removing and installing flywheel	80
2.3 Removing and installing sealing flange on gearbox side	82
<b>3 Crankshaft</b>	<b>94</b>
3.1 Assembly overview - crankshaft	94



3.2	Crankshaft dimensions	95
3.3	Allocation of main bearing shells	96
3.4	Measuring axial clearance of crankshaft	96
3.5	Measuring radial clearance of crankshaft	97
3.6	Renewing needle bearing in crankshaft	98
3.7	Renewing spur gear for crankshaft	99
<b>4</b>	<b>Pistons and conrods</b>	<b>104</b>
4.1	Assembly overview – pistons and conrods	104
4.2	Removing and installing pistons	107
4.3	Separating new conrod	108
4.4	Checking piston and cylinder bore	109
4.5	Checking radial clearance of conrods	110
4.6	Measuring piston projection at TDC	111
4.7	Removing and installing oil spray jets	113
<b>15</b>	<b>Cylinder head, valve gear</b>	<b>115</b>
<b>1</b>	<b>Cylinder head</b>	<b>115</b>
1.1	Assembly overview – cylinder head	115
1.2	Assembly overview - cylinder head cover	119
1.3	Removing and installing cylinder head	124
1.4	Removing and installing cylinder head cover	136
1.5	Removing and installing injector seals	143
1.6	Removing and installing vacuum pump	147
1.7	Checking compression	151
<b>2</b>	<b>Fully enclosing toothed belt guard</b>	<b>153</b>
2.1	Assembly overview - fully enclosing toothed belt guard	153
2.2	Removing and installing fully enclosing toothed belt guard	156
<b>3</b>	<b>Toothed belt drive</b>	<b>162</b>
3.1	Assembly overview – toothed belt	162
3.2	Removing and installing toothed belt	164
<b>4</b>	<b>Valve gear</b>	<b>181</b>
4.1	Assembly overview – valve gear	181
4.2	Measuring axial play of camshaft	184
4.3	Measuring radial clearance of camshaft	185
4.4	Removing and installing camshaft oil seal	185
4.5	Removing and installing camshaft	188
4.6	Checking hydraulic compensation elements	198
4.7	Removing and installing valve stem oil seals	199
<b>5</b>	<b>Inlet and exhaust valves</b>	<b>204</b>
5.1	Reworking valve seats	204
5.2	Checking valve guides	204
5.3	Valve dimensions	205
<b>17</b>	<b>Lubrication</b>	<b>206</b>
<b>1</b>	<b>Sump, oil pump</b>	<b>206</b>
1.1	Assembly overview – sump/oil pump	206
1.2	Removing and installing oil sump	212
1.3	Removing and installing oil pump	217
1.4	Engine oil	219
1.5	Removing and installing oil level and oil temperature sender G266	220
<b>2</b>	<b>Engine oil cooler</b>	<b>222</b>
2.1	Assembly overview - engine oil cooler	222
2.2	Removing and installing engine oil cooler	224
2.3	Checking engine oil cooler for leaks	228
<b>3</b>	<b>Oil filter, oil pressure switch</b>	<b>231</b>



3.1	Assembly overview - oil filter housing	231
3.2	Removing and installing oil pressure switch F1	231
3.3	Checking oil pressure	232
3.4	Removing and installing oil filter housing, mono-turbo	234
<b>4</b>	<b>Balancer shaft module</b>	<b>238</b>
4.1	Removing and installing balance shaft module	238
<b>19</b>	<b>Cooling</b>	<b>246</b>
<b>1</b>	<b>Cooling system/coolant</b>	<b>246</b>
1.1	Draining and filling cooling system	246
1.2	Checking cooling system for leaks	255
1.3	Assembly overview - cooling system	257
1.4	Connection diagram for coolant hoses - vehicles with basic equipment	259
1.5	Connection diagram for coolant hoses - vehicles with additional heat exchanger	261
1.6	Connection diagram for coolant hoses - vehicles with auxiliary heater	266
1.7	Connection diagram for coolant hoses - vehicles with additional heat exchanger and auxiliary heater	270
1.8	Connection diagram for coolant hoses - vehicles with basic equipment from week 45/10	273
1.9	Connection diagram for coolant hoses - vehicles with additional heat exchanger from week 45/10	275
1.10	Connection diagram for coolant hoses - vehicles with auxiliary heater from week 45/10	279
1.11	Connection diagram for coolant hoses - vehicles with additional heat exchanger and supplementary heater from week 45/10	283
<b>2</b>	<b>Coolant pump, regulation of cooling system</b>	<b>288</b>
2.1	Assembly overview - coolant pump and ball thermostat (4/2-way valve)	288
2.2	Assembly overview - electric coolant pump	288
2.3	Removing and installing coolant pump	289
2.4	Removing and installing continued coolant circulation pump V51	292
2.5	Removing and installing 4/2-way valve with thermostat	294
2.6	Removing and installing Y-thermostat	299
2.7	Removing and installing coolant temperature sender G62	300
2.8	Removing and installing radiator outlet coolant temperature sender G83	303
<b>3</b>	<b>Radiator, radiator fan</b>	<b>308</b>
3.1	Assembly overview - radiator/radiator fan	308
3.2	Assembly overview - radiator cowl and radiator fans	310
3.3	Removing and installing radiator	310
3.4	Removing and installing radiator cowl with radiator fan V7	318
<b>21</b>	<b>Turbocharging/supercharging</b>	<b>320</b>
<b>1</b>	<b>Turbocharger</b>	<b>320</b>
1.1	Assembly overview - turbocharger	320
1.2	Assembly overview - connecting pipes (bi-turbo)	330
1.3	Removing and installing turbocharger	332
1.4	Removing and installing exhaust manifold gasket (bi-turbo)	367
1.5	Removing and installing compressor housing and turbine housing (bi-turbo)	377
1.6	Checking vacuum unit for turbocharger	380
1.7	Renewing vacuum unit for turbocharger	389
1.8	Removing and installing connecting pipes (bi-turbo)	403
<b>2</b>	<b>Charge air system</b>	<b>411</b>
2.1	Assembly overview - charge air system	411
2.2	Assembly overview - hose connections for charge air system	415
2.3	Removing and installing charge air cooler	419
2.4	Removing and installing intake air temperature sender G42 with charge air pressure sender G31	424
2.5	Removing and installing exhaust gas flap valve N220	425
2.6	Removing and installing charge pressure control solenoid valve N75	426



2.7	Checking charge air system for leaks	428
2.8	Removing and installing charge pressure sender 2 G447	432
<b>23</b>	<b>Mixture preparation - injection</b>	<b>434</b>
<b>1</b>	<b>Injection system</b>	<b>434</b>
1.1	Overview of fitting locations - injection system	434
1.2	Schematic overview - fuel system	444
1.3	Assembly overview - fuel system	446
1.4	Checking fuel system for leaks	452
<b>2</b>	<b>Vacuum system</b>	<b>453</b>
2.1	Connection diagram - vacuum system	453
2.2	Testing vacuum system for leaks, bi-turbo	457
2.3	Testing vacuum system for leaks, mono-turbo	466
2.4	Checking vacuum system for leaks, "four-wheel drive"	473
<b>3</b>	<b>Injectors/high-pressure reservoir (rail)</b>	<b>481</b>
3.1	Removing and installing fuel rail	481
3.2	Removing and installing high-pressure lines	485
3.3	Removing and installing injectors	492
3.4	Testing injectors	498
3.5	Checking open injectors	506
3.6	Checking pressure retention valve in fuel return line	508
3.7	Checking low pressure fuel system	511
3.8	Checking fuel pump delivery rate	513
<b>4</b>	<b>Air filter</b>	<b>515</b>
4.1	Assembly overview – air filter housing	515
4.2	Removing and installing air filter housing	518
<b>5</b>	<b>Intake manifold</b>	<b>521</b>
5.1	Assembly overview – intake manifold	521
5.2	Removing and installing intake manifold	521
5.3	Removing and installing throttle valve module GX3	526
<b>6</b>	<b>Senders and sensors</b>	<b>528</b>
6.1	Removing and installing air mass meter G70	528
6.2	Removing and installing fuel pressure regulating valve N276	530
6.3	Checking fuel pressure regulating valve N276	532
6.4	Removing and installing fuel pressure sender G247	534
6.5	Removing and installing exhaust gas pressure sensor 1 G450	536
<b>7</b>	<b>Engine control unit</b>	<b>540</b>
7.1	Removing and installing motor control unit J623	540
<b>8</b>	<b>High-pressure pump</b>	<b>542</b>
8.1	Removing and installing high-pressure pump	542
8.2	Checking high-pressure pump	546
<b>26</b>	<b>Exhaust system</b>	<b>550</b>
<b>1</b>	<b>Exhaust pipes and silencers</b>	<b>550</b>
1.1	Assembly overview – silencers	550
1.2	Removing and installing front exhaust pipe	554
1.3	Separating exhaust pipes from silencers	556
1.4	Checking exhaust system for leaks	557
1.5	Aligning exhaust system free of stress	557
1.6	Installation position of clamp	559
<b>2</b>	<b>Emission control</b>	<b>560</b>
2.1	Assembly overview - particulate filter	560
2.2	Assembly overview - catalytic converter, four-wheel drive vehicles	565
2.3	Removing and installing particulate filter	567



2.4	Removing and installing catalytic converter	573
<b>3</b>	<b>Exhaust gas recirculation</b>	<b>577</b>
3.1	Assembly overview – exhaust gas recirculation	577
3.2	Removing and installing exhaust gas recirculation cooler	580
3.3	Removing and installing exhaust gas recirculation valve 1 GX5	592
3.4	Checking exhaust gas recirculation cooler for leaks	593
<b>28</b>	<b>Glow plug system</b>	<b>597</b>
<b>1</b>	<b>Glow plug system</b>	<b>597</b>
1.1	Checking glow plug system	597
1.2	Removing and installing glow plug	597
1.3	Checking glow plug	600
1.4	Optical characteristics of glow plugs	601
1.5	Removing and installing engine speed sender G28	601
1.6	Removing and installing Hall sender G40	603