

Workshop Manual VW Marine Boat Engine

Engine	ВСТ	ANF	BCU	ANG	BCV
code	ANH	BTW			
Booklet 5-Cyl. Diesel Engine					
Edition	10.01				

Service Department. Technical Information

Table of Contents

00	Technical data	Page
	Safety Precautions and Technical Data - Safety precautions - Technical data - Engine characteristics	00-1 00-1 00-5 00-6
01	Self-diagnosis	Page
	Self diagnosis - Properties of self diagnosis - Technical data of self diagnosis - Connecting fault reader	01-1 01-1 01-2 01-4
	Fault memory Fault memory - Interrogating fault memory - - Erasing fault memory -	01-10 01-10 01-12
	Fault table	01-14
	Final control diagnosis Carrying out final control diagnosis	01-33 01-33
	Measuring value blocks - Safety measures	01-37 01-37
	- Reading measuring value blocks	01-37
	- Evaluating measuring value blocks at idle speed with ignition on	01-40
	 Evaluating measuring value blocks at full load, engine code letters ANF, BC1 Evaluating measuring value blocks at full load, engine code letters ANG, ANH, BCU, BCV 	01-58 01-64

10	Removing and installing engine	Page
	Removing and installing engine	10-1 10-2 10-7
	 Installing engine Unit mounting and gearbox bells 	10-8 10-10
13	Crankshaft group	Page
	Dismantling and assembling engine	13-1 13-18
	Removing and installing sealing flange and flywheel - Removing and installing two-part flywheel - Renewing crankshaft oil seal -belt pulley end- - Renewing oil seal for crankshaft -flywheel end-	13-21 13-24 13-26 13-28
	Removing and installing crankshaft	13-30 13-33
	Dismantling and assembling piston and conrod - Checking piston height at TDC - Piston and cylinder dimensions	13-34 13-42 13-44
15	Cylinder head, Valve gear	Page
	Removing and installing cylinder head - Removing and installing toothed belt for camshaft - Removing and installing cylinder head - Checking compression pressure	15-1 15-9 15-20 15-24

	Servicing valve gear - Reworking valve seats - Checking valve guides - Renewing valve guides - Renewing valve stem seals - Removing and installing camshaft - Checking hydraulic bucket tappets	15-27 15-34 15-36 15-37 15-39 15-41 15-43
17	Lubrication	Page
	Removing and installing parts of lubrication system - Removing and installing oil sump - Checking oil pressure and oil pressure switch	17-1 17-18 17-22
19	Cooling system	Page
	Removing and installing parts of cooling system - Parts of cooling system - seawater side - Dismantling and assembling seawater filter - Parts of cooling system on engine - Dismantling and assembling housing-radiator package - Connection diagram for coolant hoses - Draining and filling coolant - Removing and installing seawater pump - Dismantling and assembling seawater pump	19-1 19-3 19-10 19-12 19-16 19-20 19-20 19-30 19-34

20	Fuel supply system	Page
	Parts of fuel supply	20-1 20-2
	- Servicing fuel filter	20-7
	- Safety precautions when working on fuel supply system	20-9
	- Rules for cleanliness	20-9
	- Servicing throttle controls	20-11
	- Checking accelerator position sender	20-13
	- Adjusting accelerator position sender	20-19
21	Charging	Page
	Turbocharger with and without charge air system	21-1
	- Removing and installing turbocharger with attached parts	21-1
	- Removing and installing parts of intercooler	21-6
	- Rules for cleanliness	21-9
	- Removing and installing turbocharger	21-10
	- Dismantling and assembling intercooler	21-17
	Checking boost pressure system	21-21
	- Checking turbocharger	21-21
23	Mixture preparation, Injection	Page
	Servicing diesel direct injection system	23-1
	- Rules for cleanliness	23-2
	- Fitting location overview	23-3
	- Removing and installing toothed belt for injection pump	23-10
	- Servicing injection pump	23-12
	- Dismantling and assembling air filter	23-17

- Removing and installing, tensioning toothed belt for injection pump	23-18
- Removing and installing injection pump	23-25
- Checking and adjusting commencement of injection dynamically	23-31
- Removing and installing injectors	23-35
- Checking injectors	23-37
- Renewing O-ring on cover of injection timing device	23-39
Checking components and functions	23-41
- Checking power supply for diesel direct injection system	23-41
- Checking engine speed sender	23-47
- Checking intake manifold pressure sender	23-49
- Checking coolant temperature sender	23-54
- Checking intake manifold temperature sender	23-58
- Checking fuel temperature sender	23-64
- Checking modulating piston movement sender and quantity adjuster	23-69
- Checking needle lift sender	23-76
- Checking injection distributor control range	23-79
Checking additional signals	23-84
- Checking clutch switch	23-84
- Checking engine speed signal	23-86
Engine control unit	23-88
- Renewing engine control unit	23-88
- Checking terminating resistor for data bus	23-90
Exhaust system	Page
Removing and installing parts of exhaust system	26-1
- Exhaust system without turbocharger	26-2
- Exhaust system with turbocharger	26-3

27	Starter, Current supply	Page
	Starter	27-1
	- Removing and installing starter	27-2
	Alternator	27-5
	- Compact alternator with ribbed V-belt drive	27-5
	- Check carbon brushes for alternator	27-7
	- Renewing ribbed V-belt pulley on alternator	27-7
	- Checking ribbed V-belt	27-9
	- Alternator brackets and ribbed V-belt routing	27-10
	- Overview of ribbed V-belt drives	27-14
	- Removing and installing ribbed V-belt	27-17
	- 230 V additional alternator	27-22
	- Exploded view of additional 230 V alternator	27-23
	- Removing and installing additional 230 V alternator	27-25
	- Fault displays on 230 V additional alternator	27-29
28	Glow plug system	Page
	Checking glow plug system	28-1
	- Checking glow plugs	28-3
48	Steering	Page
	Exploded view: Power steering pump, reservoir, hydraulic lines	48-1
	- Function overview: Power steering pump, oil cooler, hydraulic lines, reservoir	48-2
	- Exploded view: Power steering pump	48-4
	- Checking feed pressure of power steering pump	48-7

- Removing and installing power steering pump 48-9

90 Gauges, Instruments

Instrument panel	90-1
- Removing and installing instrument panel	90-1
- Removing and installing individual instruments	90-2
- Function overview of instrumentation	90-3

97 Wiring

Page

Fuse box/relay plate	97-1
- Removing and fuse box/relay plate	97-1
- Connection assignment on fuse box/relay plate	97-4
- Removing and installing earth switch-off relay	97-11
- Wiring loom versions	97-14
Wiring loom and connector repair	97-16

Page

Safety Precautions and Technical Data

Safety precautions

Introduction

This Workshop Manual contains technical data, descriptions and repair instructions for the 5-cylinder Volkswagen marine boat engine with and without turbocharger.

The individual repair groups of the Volkswagen marine boat engine are listed in the contents.

General information

Spare parts for electrical systems and fuel systems are subject to legal provisions. Genuine Volkswagen Marine parts comply with these provisions. Injuries and damage caused from the use of non-genuine spare parts is excluded from the guarantee.

Volkswagen marine boat engines are certified in accordance with BSO 2 under the certificate numbers: M 103 300 05, M 103 300 06 and M 103 300 07.

Important

Read the safety precautions carefully before beginning with the repair instructions. The dangers and safety measures that should always be observed when operating and preforming maintenance on the engine are listed in the following:

- Stop the engine by switching off the power supply to the engine at the stop switch of the central electrics.
- Always conduct maintenance work with the engine switched off. However, certain adjustment work must be carried out with the engine running. When the engine is running, make sure loose clothing, long hair or tools cannot get caught in rotating parts and cause serious injuries.
- During maintenance work or test drives, be sure to wear appropriate shoes (deck shoes) and work clothing.
- Never start an engine equipped with a turbocharger without the air filter mounted. The rotating compressor in the turbocharger can cause serious injuries. Objects that get into the intake duct can cause mechanical damage.
- Stop the engine and close the seawater valve when working on the cooling system.

- Open the cap of the cooling system extremely carefully when the engine is hot (danger of scalding) and do not remove the cap until the pressure is completely released.
- Connect and disconnect the cables of the glow plug and fuel injection system - including measurement device cables - only when the ignition is switched off.
- If the engine is to be run at starting speed without actually starting, e.g. during a compression test, disconnect all connectors for the injection pump.
- Only use motor oils approved by Volkswagen Marine (⇒ Operating Manual for Volkswagen Marine Boat Engine).
- Only start the engine in a well-ventilated area. When operating the engine in a closed room, make sure that the exhaust bases are routed out of the working area with a suitable ventilation system.
- Exercise extreme caution in case of leaks in the fuel system. Wear protective goggles when testing the injectors. Fuel spraying down can cause serious injuries due to the high injection pressure.

- Incorrect connection of the battery can lead to sparks that cause an explosion. Avoid open flame and welding work near the battery.
- Hydrogen gas escapes when charging batteries that forms a highly explosive mixture with oxygen. Therefore, wear protective goggles and appropriate protective clothing. As the mixture is heavier than air, it can collect in the bilge. Use only onboard charging units and so-called gel batteries if possible.

Torques

- The tighten torques for screw connections are tightened with a torque spanner. All torques listed in this Workshop Manual refer to the cleaned thread, screw/bolt head and contact surfaces.
- When tightening to a specified torque setting and a rotating angle, first apply the specified torque with a torque spanner. Then additionally tighten to the specified angle using the protractor scale.



Technical Data

Engine number

The engine number ("engine code" and "serial number") is located on the left-hand side next to the injection pump on the cylinder block.

The engine number consists of up to nine characters (alphanumeric). The first part (maximum of 3 code characters) represents the "engine code", the second part (six places) the "serial number". If more than 999,999 engines with the same code have been produced, the first of the six places is renewed with a letter.

In addition, an information plate with "engine code letters" and "serial number" is located on the upper section of the toothed belt guard.

Engine characteristics

Code letters		ВСТ	ANF
Manufactured		06.01 ►	06.01 >
Displacement	I	2.5	2.5
Output	kW at rpm	40/2500	55/3600
Torque	Nm at rpm	155/2250	155/2250
Bore	Ømm	81	81
Stroke	mm	95.5	95.5
Compression ratio		19.0	19.0
CZ	at least	49	49
Firing order		1-2-4-5-3	1-2-4-5-3
Turbocharging		-	-
Charge air cooling		-	-
Self-Diagnosis		х	×
Weight (dry, with sub-assem- blies, cooling system and coupling flange)	kg	260	260
Certificate No. as per BSO 2		M 103 300 05	M 103 300 05

Code letters		BCU	ANG	BCV	ANH
Manufactured		06.01 ≻	06.01 ≻	06.01 ≻	06.01 ≻
Displacement	I	2.5	2.5	2.5	2.5
Output	kW at rpm	74/2600	88/3250	108/4000	111/4000
Torque	Nm at rpm	270/2500	275/2500	310/1900	310/1900
Bore	Ømm	81	81	81	81
Stroke	mm	95.5	95.5	95.5	95.5
Compression ratio		19.0	19.0	19.0	19.0
CZ	at least	49	49	49	49
Firing order		1-2-4-5-3	1-2-4-5-3	1-2-4-5-3	1-2-4-5-3
Turbocharging		Х	х	х	х
Intercooler		-	-	х	х
Self-Diagnosis		Х	х	х	х
Weight (dry, with sub-assem- blies, cooling system and coupling flange)	kg	275	275	280	280
Certificate No. as per BSO 2		M 103 300 06	M 103 300 06	M 103 300 07	M 103 300 07

Self-Diagnosis

Properties of the Self-Diagnosis

The control unit for the diesel direct injection system is equipped with a fault memory.

If faults occur in the sensors or components monitored, these are stored in the fault memory together with details of the type of fault.

Faults that only occur temporarily (sporadically) are also printed out with the supplement "sporadically occurring fault". These faults appear on the display with the supplement "/SP".

The cause of sporadic faults can be, for example, a loose connection or a brief break in the line. If a sporadic fault no longer occurs after 50 warm-up phases, it is deleted from the fault memory.

If faults that influence the vehicle handling are detected, the glow period warning lamp flashes.

The stored faults can be read out with the fault output device V.A.G 1552 or the new tester VAS $5052 \Rightarrow$ page 01-10.

After the fault(s) has (have) been eliminated, the fault memory must be erased \Rightarrow page 01-12.

Note:

General information on self-diagnosis is contained in the operating manual for the fault output device V.A.G 1552 (VAS 5052).

Technical Data for the Self-Diagnosis

Equipment

- The data is interchanged between the control unit and fault output device V.A.G 1551 in the "Rapid data transfer" operating mode.
- ◆ Fault memory: Permanent and temporary memory¹⁾
- ¹⁾ Will be deleted after the 50th warm-up phase if the fault has not occurred again.

Reading out control unit version

The control unit version is displayed when the fault output device V.A.G 1552 or the tester VAS 5052 is connected and the control unit for the engine electronics is selected \Rightarrow page 01-4.

Selectable functions using the tester V.A.G 1552 or VAS 5052 under address word 01, engine electronics

Note:

Please consult the following table to see the requirements for selection of the desired functions.

Function		Condition				
Functions on V.A.G 1552/VAS 5052		Engine stopped, Engine runs at idle ignition switched on		Boat in driving mode		
01	Reading out control unit version	yes	yes	yes		
02	Interrogate fault memory	yes ¹⁾	yes	yes		
03	Final control diagnosis	yes	yes	no		
04	Basic setting	no	yes	no		
05	Erase fault memory	yes	yes	yes		
06	End output	yes	yes	yes		
80	Read measurement value block	yes	yes	yes		

¹⁾ Only carry out with ignition switched on when engine fails to start.



V.A.G 1551/3

Connecting fault reader

All functions possible with the fault output device V.A.G 1552 can also be carried out with the tester VAS 5051, VAS 5052 or V.A.G 1551.

Connect V.A.G 1552

Connecting VAS 5052 \Rightarrow page 01-7

Special tools, workshop equipment, test and measuring equipment and accessories required

♦ Fault reader V.A.G 1552

♦ Cable V.A.G 1551/3

Testing Requirements

- The battery voltage must be at least 11.5 V.
- Fuse 33 OK.



Procedure

- Unscrew the cover of the diagnosis connection on the main panel.
- Connect the fault output device V.A.G 1552 with the cable V.A.G 1551/3.

Note:

You can also connect the V.A.G 1552 to the diagnosis plug in the central electrics \Rightarrow Fitting location overview, page 23-3.

 Depending on the function desired, you must: switch on the ignition or start the engine ⇒ page 01-3, "Selectable Functions" table.

Notes:

- If the display remains dark, check the power supply for the diagnosis plug using the CFD:
- \Rightarrow Current flow diagrams
- ◆ If the displays indicated in the work procedure are not achieved:
- \Rightarrow Operating instructions for the fault output device

Vehicle system test Enter address word XX

 065906018 T150-5
 MDC 0000SG 3601 →

 Coding 00001
 WSC00000

- If input errors produce the message "Fault in the data interchange!", remove the cable from the fault output device, reconnect it and repeat the work steps.
- Display:

HELP

- Keep an eye on the information that appears on the display while operating the fault output device:
- Press buttons 0 and 1 for "Engine electronics" address word and confirm entry with Q button.
- The control unit identification appears on the display of the fault output device V.A.G 1552, e.g.:
 - ♦ 065906018 = part no. of the control unit (for current control unit version, see Spare Parts Catalogue)
 - ◆ T150-5 = 5-cyl. TDI engine with 150 bhp
 - MDC 0000SG = Injection system (Marine Diesel Electronic Control)
 - ♦ 3601 = Software version of control unit
 - ◆ Coding 00001 = Coding variant
 - WSC xxxxx = Dealership identifier
 - Press the \rightarrow button.

Rapid data transfer	
Select function XX	

HELP <

Display:

- See repair procedures for further procedure.



Connecting VAS 5052

Special tools, workshop equipment, test and measuring equipment and accessories required

◆ Fault output device VAS 5052

Testing Requirements

- The battery voltage must be at least 11.5 V.
- Fuse 33 OK.



Procedure

- Unscrew the cover of the diagnosis connection on the main panel.
- Connect the plug of the diagnosis cable to the diagnosis connection.

Note:

You can also connect the VAS 5052 to the diagnosis plug in the central electrics \Rightarrow Fitting location overview, page 23-3.

Select operating mode:

- Press the button for "Vehicle Self-Diagnosis" on the display.

Select vehicle system:

- Press the button "01 - engine electronics on the display.

The control-unit identification of the engine control unit appears on the display.

Selecting diagnosis function:

All diagnosis functions that can be carried out are available on the display.

- Press the button for the desired function on the display.

Notes:

The display fields in the functions 04 - Basic setting and 08 - Reading measurement value block, are shown from top to bottom.

The following test procedures are described for the fault output device V.A.G 1552.

VA.G 1552
W00-1188
100-1100

Rapid data transfer	HELP	
Select function XX		

X faults detected!

Fault memory

Interrogate fault memory

Special tools, workshop equipment, test and measuring equipment and accessories required

 Fault output device V.A.G 1552 with cable V.A.G 1551/3 or fault output device VAS 5052

Procedure

- Connect the fault output device V.A.G 1552 (VAS 5052) and select the engine electronics control unit with the "Address word" 01. Here, the engine should be idling.
 - (Connecting fault output device and selecting engine control unit \Rightarrow page 01-4)

Only if the engine does not start:

- Switch on the ignition.

Display:

- Keep an eye on the information that appears on the display while operating the vehicle system tester:
- Press the keys 0 and 2 for the function "Query fault memory" and confirm the input using the Q key.
- The display shows the number of faults stored or "No faults detected!".

— 01-10 ———

If one or more faults are stored:

With the \rightarrow key you can now display the individual fault numbers with the related texts.

- Press the → key repeatedly until all the previously stored faults have been displayed and the display is as follows:
- Eliminate the Faults using the fault table \Rightarrow page 01-14.
- Then erase the fault memory
 ⇒ page 01-12

If the memory contains no faults:

- Press the \rightarrow -button.
- Display:
 - Press keys 0 and 6 for "End data transfer" function and acknowledge entry with Q key.

Rapid data transfer Select function XX

Rapid data transfer	HELP
Select function XX	

HELP



Rapid data transfer	HELP	
Select function XX		
Rapid data transfer	HELP	

Rapid data transfer Select function XX

Erase fault memory

Special tools, workshop equipment, test and measuring equipment and accessories required

 Fault output device V.A.G 1552 with cable V.A.G 1551/3 or fault output device VAS 5052

Test condition

• Fault rectified

Note:

After the fault has been rectified, the fault memory must again be queried as described below and then deleted.

Procedure

- Connect the fault output device V.A.G 1552 (VAS 5052) and select the engine electronics control unit with the "Address word" 01. Here, the engine should be idling.

(Connecting fault output device and selecting engine control unit \Rightarrow page 01-4)

Display:

- Press the keys 0 and 2 for the function "Query fault memory" and confirm the input using the Q key.
- Press the → key repeatedly until all the previously stored faults have been displayed and the display is as follows:

- 01-12 ——

Rapid data transfer→Fault memory has been erased!Rapid data transferHELPSelect function XX

- Press the keys 0 and 5 for the function "Delete fault memory" and confirm the input using the Q key.

Display:

- If the fault memory cannot be deleted, there is still a fault to be rectified.
- Press the \rightarrow -button.
- Display:
 - Press keys 0 and 6 for "End data transfer" function and acknowledge entry with Q key.

Fault table

Notes:

- The fault table is arranged according to the 5-digit fault code on the left-hand side.
- In addition, the so-called P-codes, e.g. P0118, are output. These P-codes can currently be ignored, as they will first be used in future self-diagnosis systems.
- Explanations on the fault types (e.g. "break/short circuit to earth"):
- \Rightarrow Operating instructions for the fault output device
- If components are output as defective: First check the cables and connectors to these components and the earth cables of the system using the current flow diagram. Only when no faults are found here should components be replaced. This especially applies when faults are output as "sporadic" (SP).
- Erase the fault memory after eliminating existing faults.

Output on V.A.G 1552/VAS 5052, e.g.:

16502 P0118 035 Coolant temperature sender -G62 Signal too large Sporadic fault

Explanation:

- ♦ 16502 = Fault code
- ♦ P0118 = Additional fault code
- ♦ 035 = Fault type as number
- Coolant temperature sender -G62 = Defective current path or fault location
- Signal too large = Fault type as text
- Sporadic fault = Fault not always present, e.g. loose contact

Output on V.A.G 1552/VAS 5052	Possible Cause(s) of Fault(s)	Possible effects	Remedying the Fault
16705 P0321			
Engine speed sender -G28			
Implausible signal	 G28 defective Distance between speed sender and sender wheel too large Metal chips on G28 or retaining base loose 	 Preheating warning lamp flashes Engine does not start Engine dies No display on rev counter 	- Check G28 ⇒ page 23-47
16706 P0322			
Engine speed sender -G28			
No signal	 G28 defective Break in wiring or short circuit 	 Preheating warning lamp flashes Engine does not start Engine dies No display on rev counter 	- Check G28 ⇒ page 23-47

Output on V.A.G 1552/VAS 5052	Possible Cause(s) of Fault(s)	Possible effects	Remedying the Fault
16989 P0605			
Control unit defective	 Internal defect in control unit 	 Preheating warning lamp may flash Poor driveability Engine stops 	- Renew J248 ⇒ page 23-88
17563 P1155			
Intake manifold pressure sender -G71			
Short to positive	 Short to positive G71 defective 	 Glow plug warning lamp flashes Reduced power 	 Check G71 ⇒ page 23-49 Check turbocharger ⇒ page 21-21; Checking boost pressure system; Checking turbocharger

Output on V.A.G 1552/VAS 5052	Possible Cause(s) of Fault(s)	Possible effects	Remedying the Fault
17564 P1156			
Intake manifold pressure sender -G71			
Open circuit/ Short to earth	 G71 defective Break in wiring or short circuit to earth 	 Glow plug warning lamp flashes Reduced power Increased emissions 	 Check G71 ⇒ page 23-49
17565 P1157			
Intake manifold pressure sender -G71			
Supply voltage	 G71 defective Break in wiring or short circuit 	 Glow plug warning lamp flashes Reduced power Increased emissions 	 Check G71 ⇒ page 23-49

Output on V.A.G 1552/VAS 5052	Possible Cause(s) of Fault(s)	Possible effects	Remedying the Fault
17568 P1160			
Intake manifold tem- perature sender -G72			
Short circuit to earth	 G72 defective Wiring has short circuit to earth Intake manifold temperature or ambient temperature too high 	 Switches to default value 136.8°C 	- Check G72 ⇒ page 23-58
17569 P1161			
Intake manifold tem- perature sender -G72			
Short to positive	 G72 defective Break in wiring or short circuit to positive 	 Switches to default value 136.8 °C 	- Check G72 ⇒page 23-58

Output on V.A.G 1552/VAS 5052	Possible Cause(s) of Fault(s)	Possible effects	Remedying the Fault
17570 P1162			
Fuel temperature sender -G81			
Short circuit to earth	 G81 defective Wiring has short circuit to earth 	 ♦ Goes to default value - 5,34 °C ♦ Increased emissions 	 Check G81 ⇒ page 23-64
17571 P1163			
Fuel temperature sender -G81			
Short to positive	 G81 defective Break in wiring or short circuit to positive 	 ♦ Goes to default value - 5,34 °C ♦ Increased emissions 	 Check G81 ⇒ page 23-64

Output on V.A.G 1552/VAS 5052	Possible Cause(s) of Fault(s)	Possible effects	Remedying the Fault
17653 P1245			
Needle lift sender -G80			
Short circuit to earth	 G80 defective Wiring has short circuit to earth 	 Glow plug warning lamp flashes Engine runs roughly Reduced power Increased emissions 	- Check G80 ⇒ page 23-76
17654 P1246			
Needle lift sender -G80			
Implausible signal	 G80 defective Injection line to injector with needle lift sender not OK Fuel shortage Air in fuel system 	 Glow plug warning lamp flashes Engine runs roughly Reduced power Increased emissions 	- Check G80 ⇒ page 23-76

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Output on V.A.G 1552/VAS 5052	Possible Cause(s) of Fault(s)	Possible effects	Remedying the Fault
17655 P1247			
Needle lift sender -G80			
Short to positive	 G80 defective Break in wiring or short circuit 	 Glow plug warning lamp flashes Engine runs roughly Reduced power Increased emissions 	- Check G80 ⇒ page 23-76
17656 P1248			
Commencement of injection control			
Control difference	 Commencement of injection valve (N108) defective Needle lift sender (G80) defective Fuel tank empty Fuel supply not OK, fuel shortage Point of injection not OK 	 Glow plug warning lamp flashes Engine runs roughly Reduced power Increased emissions Poor cold starting behaviour 	 Check N108 ⇒ page 01-33, Final control diagnosis Check G80 ⇒ page 23-76 Fuel filter or fuel line clogged Check and adjust commencement of injection ⇒ page 23-31
Output on V.A.G 1552/VAS 5052	Possible Cause(s) of Fault(s)	Possible effects	Remedying the Fault
---	---------------------------------------	---	---
17659 P1251 Commencement of injection valve -N108			
Short to positive	 Short to positive 	 Glow plug warning lamp flashes Engine knocks in idle, as commencement of injection is constantly set to "advance" Reduced power 	 Check N108 ⇒ page 01-33, Final control diagnosis

Output on V.A.G 1552/VAS 5052	Possible Cause(s) of Fault(s)	Possible effects	Remedying the Fault
17660 P1252			
Commencement of injection valve -N108			
Open circuit/ Short to earth	 Break in wiring Commencement of injection valve defective 	 Glow plug warning lamp flashes Engine knocks in idle, as commencement of injection is constantly set to "advance" Reduced power 	 Check N108 ⇒ page 01-33, Final control diagnosis
	 Short circuit to earth 	 Glow plug warning lamp flashes Lack of power, as com- mencement of injection is constantly set to "retard" Reduced power 	

Output on V.A.G 1552/VAS 5052	Possible Cause(s) of Fault(s)	Possible effects	Remedying the Fault
17663 P1255			
Coolant temperature sender -G62			
Short circuit to earth	 G62 defective Wiring has short circuit to earth 	 Glow plug warning lamp flashes Black smoke during starting Preheating is always carried out for approx. 20 sec. 	- Check G62 ⇒page 23-54
17664 P1256			
Coolant temperature sender -G62			
Short to positive	 G62 defective Break in wiring or wiring has short circuit to posi- tive 	 Glow plug warning lamp flashes Black smoke during starting Preheating is always carried out for approx. 20 sec. 	- Check G62 ⇒page 23-54

Output on V.A.G 1552/VAS 5052	Possible Cause(s) of Fault(s)	Possible effects	Remedying the Fault
17762 P1354			
Modulating piston movement sender -G149			
Electrical fault in circuit	 Injection pump defective Break in wiring or short circuit 	 Preheating warning lamp flashes Engine stops 	- Check G149 ⇒ page 23-69
17945 P1537			
Fuel cut-off valve -N109			
Malfunction	 N109 defective, leaky or sticking 	 Preheating warning lamp flashes 	 Check N109 ⇒ page 23-54, ⇒ page 01-33, Final control diagnosis

Output on V.A.G 1552/VAS 5052	Possible Cause(s) of Fault(s)	Possible effects	Remedying the Fault
17946 P1538			
Fuel cut-off valve -N109			
Open circuit/ Short to earth	 N109 defective Break in wiring or short circuit to earth 	 Preheating warning lamp flashes 	 Check N109 ⇒ page 23-54, ⇒ page 01-33, Final control diagnosis
17969 P1561			
Quantity adjuster -N146			
Control difference	 Injection pump defective Break in wiring or short circuit 	 Glow plug warning lamp flashes Engine stops 	- Check N146 ⇒ page 23-69

Output on V.A.G 1552/VAS 5052	Possible Cause(s) of Fault(s)	Possible effects	Remedying the Fault
17970 P1562			
Quantity adjuster -N146			
Upper stop value	 Quantity adjuster (N146) defective/blocked Upper stop value reached 	 Preheating warning lamp flashes Reduced power 	- Check N146 ⇒ page 23-69
17971 P1563			
Quantity adjuster -N146			
Lower stop value	 Quantity adjuster (N146) defective/blocked Lower stop value reached 	 Preheating warning lamp flashes Black smoke Rough idling 	 Check N146 ⇒ page 23-69

Output on V.A.G 1552/VAS 5052	Possible Cause(s) of Fault(s)	Possible effects	Remedying the Fault
17978 P1570			
Engine control unit blocked	 Attempted tampering Incorrect control unit 	 Preheating warning lamp flashes Engine starts briefly and then dies again 	- Renew J248 ⇒ page 23-88
18008 P1600			
Voltage supply Ter.15			
Voltage too low	 No voltage with ignition switched on (Terminal 15) 	 Poor driveability and engine stops 	 Check power supply of the control unit for diesel direct injection system ⇒ page 23-41

Output on V.A.G 1552/VAS 5052	Possible Cause(s) of Fault(s)	Possible effects	Remedying the Fault
18009 P1601			
Voltage supply relay - Terminal 30 -J317	 Voltage supply relay terminal 30 (J317) defective Relay sticks (sporadic) 	 Engine does not start Poor driveability and engine stops 	 Check power supply of the control unit for diesel direct injection system ⇒ page 23-41
18026 P1618			
Glow plug relay -J52			
Short to positive	 Wiring has short circuit to positive J52 defective 	 Preheating warning lamp flashes No preheating Poor cold starting behaviour 	 Check J52 ⇒ page 01-33, Final control diagnosis

Output on V.A.G 1552/VAS 5052	Possible Cause(s) of Fault(s)	Possible effects	Remedying the Fault
18027 P1619			
Glow plug relay -J52			
Open circuit/ Short to earth	 Break in wiring or short circuit to earth J52 defective 	 Preheating warning lamp flashes No preheating Poor cold starting behaviour 	 Check J52 ⇒ page 01-33, Final control diagnosis
18039 P1631			
Accelerator lever posi- tion sender -G79			
Signal too high	 ◆ G79 defective 	 Preheating warning lamp flashes Increased idling speed 	 Check G79: ⇒ page 20-13; Checking accelerator lever position sender

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Output on V.A.G 1552/VAS 5052	Possible Cause(s) of Fault(s)	Possible effects	Remedying the Fault
18040 P1632 Accelerator lever posi- tion sender -G79 Supply voltage	 Operating voltage too high or too low Break in wiring 	 Preheating warning lamp flashes 	 Check G79: ⇒ page 20-13; Checking accelerator lever position sender

Output on V.A.G 1552/VAS 5052	Possible Cause(s) of Fault(s)	Possible effects	Remedying the Fault
18047 P1639 Accelerator lever posi- tion sender 1/2 G79+G185 ¹⁾			
Implausible signal	 ♦ G79 defective 	 Preheating warning lamp flashes Increased idling speed 	 Check G79: ⇒ page 20-13; Checking accelerator lever position sender
18048 P1640			
Control unit -J248 defective	 Internal defect in control unit 	 Preheating warning lamp flashes Poor driveability 	- Renew J248 ⇒ page 23-88

¹⁾ Incorrect fault text display. The correct display is: Accelerator lever position sender -G79 Implausible signal



Final control diagnosis

Carry out diagnosis of actuators

Special tools, workshop equipment, test and measuring equipment and accessories required

 Fault output device V.A.G 1552 with cable V.A.G 1551/3 or fault output device VAS 5052

With the diagnosis of actuators, the following components are activated in the order stated.

- 1. Commencement of injection valve (N108)
- 2. Fuel cut-off valve (N109)
- 3. Glow plug relay (J52)
- 4.Glow period warning lamp (K29)

Notes:

- The activation of the individual actuators is limited to 30 secs, but it can be terminated at any time by pressing the " key.
- Before the diagnosis of actuators is repeated, the ignition must be switched off.

Select function XX	
Fast data interchange	Q
020202 diagnosis of actuators	~
Final control element diagnosis	\rightarrow
Commencement of injection valve -N	V108

Rapid data transfor

- Procedure
- Connect the fault output device V.A.G 1552 (VAS 5052) and select the engine electronics control unit with the "Address word" 01. Here, the engine should be idling.

(Connecting fault output device and selecting engine control unit \Rightarrow page 01-4)

Display:

- Keep an eye on the information that appears on the display while operating the vehicle system tester:
- Press the keys 0 and 3 for the function "Diagnosis of actuators".

Display:

- Confirm the input using the Q key.
- Display:

Activating the valve produces a clearly audible change in the sound of combustion (knocking).

If a change in the sound of combustion is audible:

- Check injection timing device adjustment range ⇒ page 23-79
- Press the \rightarrow -button.
- Display:

The engine must come to a standstill.

Final control element diagnosis Fuel cut-off valve -N109

 \rightarrow

Final control element diagnosis Glow plug relay -J52

Final control element diagnosis Glow period warning lamp -K29

 \rightarrow

 \rightarrow

If the engine does not come to a standstill.

- Switch off the ignition.
- Unscrew the fuel cut-off valve and clean it to remove swarf and dirt that might have accumulated.
- Repeat the diagnosis of actuators. If the engine again does not come to a standstill, replace the fuel cut-off value \Rightarrow page 23-13, item 5.
- Continue the diagnosis of actuators with the engine off and the ignition on.
- Press the \rightarrow -button.

Display:

The relay must click.

Note:

The glow plug relay is located in the central electrics.

If the relay does not click:

- Check the glow plug relay:
- \Rightarrow Current Flow Diagrams binder
- Press the \rightarrow -button.
- Display:

The warning lamp must flash.

If the warning lamp does not flash:

- Check the glow period warning lamp:
- ⇒ Current Flow Diagrams binder
- Press the \rightarrow -button.
- Display:

HELP

- Press keys 0 and 6 for "End data transfer" function and acknowledge entry with Q key.
- Switch off the ignition.

Rapid data transfer Select function XX



Safety Measures

If test and measuring devices are required during test drives, the following must be observed:

The test and measuring devices must be secured in the boat and must be operated by a second person.

Read measurement value block

Special tools, workshop equipment, test and measuring equipment and accessories required

 Fault output device V.A.G 1552 with cable V.A.G 1551/3 or fault output device VAS 5052

Test conditions

- The coolant temperature must be at least 70 °C.
- All electrical consumers, e.g. hydraulic pumps or 230 V additional alternators must be switched off.
- No fault must be stored in the fault memory ⇒ page 01-10, retrieve fault memory.



Rapid data transfer	HELP
Select function XX	

Read measuring value blockHELPEnter display group number XXX

Read meas	e block 1	\rightarrow	
1	2	3	4

Rapid data transfer	HELP
Select function XX	

Procedure

- Connect the fault output device V.A.G 1552 (VAS 5052) and select the engine electronics control unit with the "Address word" 01. Here, the engine should be idling.

(Connecting fault output device and selecting engine control unit \Rightarrow page 01-4)

Display:

- Press keys 0 and 8 for "Read measuring value block" function and acknowledge entry with Q key.
- Display:

Note:

The display group number 001 is an example for illustrating the procedure.

- Press keys 0, 0 and 1 for "Display group number 1" and acknow-ledge entry with Q key.
- Display: (1...4 = display fields)
 - Press the \rightarrow -button.
- Display:
 - Press the keys 0 and 6 for the function "quit output" and confirm the input using the Q key.

- 01-38 ——

Note:

To switch into another display group, proceed as follows:

Display group	V.A.G 1552
Up	Press † key
Down	Press the ↓ key
Skip	Press C key

Evaluate measuring value blocks at idle speed with ignition on

Display group 000 at idling (warm engine, coolant temperature not below 70 °C)

Dis	Display group 000 (display values, decimal)												
• E	Engine runs at idle												
Read measurement value block 0				 Display 									
x	х	х	Х	х	х	х	Х	х	х				
1	2	3	4	5	6	7	8	9	10				
										Air quantity	do not observe		
								Inta	Сос	plant temperature	88198	20100 °C	
									ake r	manifold temperature	0182	10135 °C	
							Со	olan	t ten	nperature	3795	70110 °C	
						Atr	nosp	oher	ic pr	essure	do not observe		
					Inta	ake r	man	ifold	pres	ssure	do not observe		
				Inje	ectio	n qu	ianti	ty			1145	2.29.0 mg/stroke	
Throttle lever position								on		0	0 %		
Commencement of injection Engine code letters: ANF, BCT Engine code letters: ANH, ANG, BCU, BCV							inje : AN : AN	ectio IF, B IH, A	n CT ANG,	0150 073	9° before TDC.3° after TDC 2.8° before TDC.3° after TDC		
	Engine speed									3639	750820rpm		

01-40 ——



Display on V.A.G 1552	Possible Cause(s) of Fault(s)	Remedying the Fault
below 2.2 mg/stroke	 Injection pump too rich 	- Replace injection pump \Rightarrow page 23-25
over 9 mg/stroke	♦ Engine too cold	 Allow engine to run with increased speed and repeat the check
	 Injection pump too lean 	- Replace injection pump \Rightarrow page 23-25

Evaluation: Display of voltage from modulating piston movement sender

Display on V.A.G 1552	Possible Cause(s) of Fault(s)	Remedying the Fault
below 1.25 V	 Injection pump too rich 	- Replace injection pump \Rightarrow page 23-25
above 2.00 V	♦ Engine too cold	 Allow engine to run with increased speed and repeat the check
	 Injection pump too lean 	- Replace injection pump \Rightarrow page 23-25

Display group 002 at idling (warm engine, coolant temperature not below 70 °C)



Display on V.A.G 1552	Possible Cause(s) of Fault(s)	Remedying the Fault
1100 %	 Accelerator lever position sender -G79 defective 	 Check G79 ⇒ page 20-13; Checking accelerator lever position sender
	◆ Cable brake to G79	

Evaluation: Display of operating mode

Meaning of numbers in 3-digit numerical block for operating mode of engine:

	Meaning when display digits = 1								
х	Х	х	Operating mode of engine						
		0	Do not observe						
	1		Idle switch closed						
0			Do not observe						

Display group 004 -Commencement of injection-						
Read meas	urement valu	ue block 4	→	✓ Display		
xxxx rpm	xx.x ° bef.(after) TDC	xx.x ° bef.(after) TDC	xxx %			
1	2	3	4	◀ Display fields	Setpoint value	Evaluation
				Pulse duty factor from com- mencement of injection valve	2095 %	
			Commenc Engine coo Engine coo ANH, ANG	ement of injection (actual) de letters: ANF, BCT de letters: 6, BCU, BCV	9° before TDC3° after TDC 2.8° before TDC3° after TDC	⇒ page 01-46
		Commence Engine code Engine code	ment of inj e letters: Al e letters: Al	ection (setpoint) NF, BCT NH, ANG, BCU, BCV	9° before TDC3° after TDC 2.8° before TDC3° after TDC	⇒ page 01-46
	Engine spe	ed			750820rpm	

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Evaluation: Display of commencement of injection (setpoint)

Display on V.A.G 1552	Possible Cause(s) of Fault(s)	Remedying the Fault
above 2.8° before TDC or above 9° before TDC	◆ Engine too cold	 Allow engine to warm up with increased speed and repeat check.

Evaluation: Display of commencement of injection (actual)

Display on V.A.G 1552	Possible Cause(s) of Fault(s)	Remedying the Fault
above 2.8° before TDC or above 9° before TDC	◆ Engine too cold	 Allow engine to warm up with increased speed and repeat check.
	 Injection pump stops too "early" 	 Check commencement of injection dynami- cally and adjust ⇒ page 23-31
	 Commencement of injection valve -N108 defective 	 Check N108 ⇒ page 01-33, final control diagnosis
later than 3° after TDC	 Injection pump stops much too "late" 	 Check commencement of injection dynami- cally and adjust ⇒ page 23-31
	 Injection timing device blocked 	 Check N108 ⇒ page 01-33, final control diagnosis
	 Commencement of injection valve -N108 defective 	

01-46 -

Display group 006 -Switch positions-						
Read measurement value block 6		→	Display			
	XXX	XXXXXX	XXX			
1	2	3	4	 Display fields 	Setpoint value	Evaluation
				Cruise control system	255	
			Cruise cor	ntrol system	do not observe	
		Switch posi	tions			⇒ page 01-47
No display						

Evaluation: Display of switch positions

Meaning of numbers in 3-digit numerical block for switch positions:

	Meaning when display digits = 1								
x	х	х	Switch positions						
		1	Decrease in idling speed (engaging and disengaging						
	1		do not observe						
0			do not observe						



¹⁾ It is not possible to specify setpoint values for temperatures. With the engine cold, the temperature values of the fuel, intake air and coolant must naturally match the ambient temperature. If a value deviates to an obvious extent, the relevant sender must be checked.

Display on V.A.G 1552	Possible Cause(s) of Fault(s)	Remedying the Fault	
- 5.4 °C	 Short circuit or fuel temperature sender -G81 defective 	 Check G81 ⇒ page 23-64 In a fault situation, the measurement value block shows a fuel temperature of -5.4 °C 	

Evaluation: Display of intake manifold temperature or intake air temperature

Display on V.A.G 1552	Possible Cause(s) of Fault(s)	Remedying the Fault
approx. 136.8 °C	 Intake manifold temperature sender -G72 defective 	 Check G72 ⇒ page 23-58 In a fault situation, the measurement value block shows a constant intake manifold or intake air temperature of approx. 136.8 °C

Evaluation: Display of coolant temperature

Display on V.A.G 1552	Possible Cause(s) of Fault(s)	Remedying the Fault	
Large deviation from ambient temperature	 Short circuit or coolant temperature sender -G62 defective 	 Check G62 ⇒ page 23-54 In a fault situation, the fuel temperature is displayed instead 	

Display gro	Display group 013 -Idling rest control-					
Read measurement value block 13 \rightarrow			→	◄ Display		
x.xx mg/ stroke	x.xx mg/ stroke	x.xx mg/ stroke	x.xx mg/ stroke			
1	2	3	4	◀ Display fields	Setpoint value	Evaluation
				Smooth-running controller injec- tion quantity cyl. 4	- 2.0+ 2.0 mg/ stroke	⇒ page 01-52
			Smooth-ru cyl. 3	nning controller injection quantity	- 2.0+ 2.0 mg/ stroke	⇒ page 01-52
		Smooth-rur	ning contro	oller injection quantity cyl. 2	- 2.0+ 2.0 mg/ stroke	⇒ page 01-52
	Smooth-rur	ning control	ler injectior	n quantity cyl. 1	- 2.0+ 2.0 mg/ stroke	⇒ page 01-52

Display group 014 at idling (warm engine, coolant temperature not below 70 °C)



Evaluation: Display of idle running control

- The fuel injection system has an idle running control. Differences in performance between the individual cylinders (parts tolerances, nozzle flow rate, compression etc.) can be detected and balanced out by selective distribution of the injection quantity when idling.
- The detection takes place when the engine is idling via the signal from the engine speed sender, which supplies five signals per crankshaft revolution to the control unit. If the signals come in the same rhythm, all the cylinders have the same performance. If one cylinder has reduced performance, the crankshaft requires a longer interval for the next half crankshaft revolution. On the other hand, a cylinder performing at a higher level accelerates the crankshaft to such an extent that it requires a very short interval
- If the control unit has detected a deviation, the cylinder in question is immediately supplied with a greater or smaller injection quantity, until the engine again runs "smoothly".
- In measurement value block 013 and 014 the injection quantity differences of the individual cylinders are displayed. Display group 013 shows Cylinder 1 to Cylinder 4. The display for Cylinder 5 appears in display group 014.
- ◆ +... mg/stroke: The respective cylinder is more powerful and is therefore supplied with less fuel.
- ◆ -... mg/stroke: The respective cylinder is less powerful and is therefore supplied with more fuel.

Display group 015

The displayed values are of no significance for trouble-shooting in service.

Display group 015 -Fuel consumption-						
Read measurement value block 15 \rightarrow			\rightarrow	✓ Display		
xxxx rpm	xx.x mg/ stroke	xx.xx l/h	xx.x mg/ stroke			
1	2	3	4	 Display fields 	Setpoint value	Evaluation
				Injection quantity required (specified by driver via accelerator)		
			Fuel consu	Imption		
		Injection qu	antity (actu	al)		
Engine speed						

Display group 019 -quantity adjuster-						
Read measurement value block 19			\rightarrow	→ I Display		
x.xxx V	x.xxx V					
1	2	3	4	◄ Display fields	Setpoint value	Evaluation
				No display		
			No display	/		
		Voltage fror (start-limit)	n modulati	ng piston movement sender	4.1004.800 V	⇒ page 01-55
	Voltage from modulating piston movement sender (stop-limit)					⇒ page 01-55

Evaluation: Display of voltage from modulating piston movement sender (stop and start-limit)

Display on V.A.G 1552	Possible Cause(s) of Fault(s)	Remedying the Fault	
Setpoint outside tolerance	 Quantity adjuster of injection pump mis- adjusted 	- Replace injection pump \Rightarrow page 23-25	

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Note:

If a 0 appears in the display, there is a fault in data bus operation.

Evaluating the measurement value blocks at full load, engine code letters ANF, BCT

Display group 000 at full load (test drive with warm engine, coolant temperature not below 70 °C)

Notes:

- For the tests, accelerate the boat at full throttle.
- When the specified engine speed is reached, the measurement values must be printed out or read off (2nd person required).
| Dis | Display group 000 (display values, decimal) | | | | | | | | | | | |
|---|--|---|-----|--------------------|-----------------------|----------------------|-------------------------|--------------------|------------------------------------|------------------------------------|------------------|----------------------------------|
| Read measurement value block 0 | | | | | | | | 0 | | ✓ Display | | |
| х | Х | Х | Х | Х | Х | х | Х | Х | Х | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Display fields | Setpoint value | corresponds to |
| | | | | | | | | | | Air quantity | do not observe | |
| | | | | | | | | | Сос | plant temperature | 88198 | 20100 °C |
| | | | | | | | Intake m
Coolant tem | | | manifold temperature | 0182 | 10135 °C |
| | | | | | | | | | | nperature | 3795 | 70110 °C |
| | | | | | | Atn | nosp | bher | ic pr | essure | do not observe | |
| | | | | | Inta | ake r | man | ifold | pres | ssure | do not observe | |
| | | | | Inje
Eng
Eng | ectio
gine
gine | n qu
code
code | ianti
e let
e let | ty
ters
ters | : AN
: BC | F
T | 110125
105125 | 2225 mg/stroke
2125 mg/stroke |
| | | | Thr | ottle | e leve | er po | ositio | on | | | 255 | 100 % |
| Commencement of injection
Engine code letters: ANF
Engine code letters: BCT | | | | | | | inje
: AN
: BC | 150175
112169 | 119° bef. TDC
10.56° before TDC | | | |
| | Engine speed
Engine code letters: ANF
Engine code letters: BCT | | | | | | | | 163182
110130 | 34003800 rpm
23002700 rpm | | |

Display group 004 at full load (test drive with warm engine, coolant temperature not below 70 °C)

Notes:

- For the tests, accelerate the boat at full throttle.
- When the specified engine speed is reached, the measurement values must be printed out or read off (2nd person required).

Display gro	Display group 004 -Commencement of injection-							
Read meas	urement val	ue block 4	→	◄ Display				
xxxx rpm	xx.x ° bef.(after) TDC	xx.x ° bef.(after) TDC	xxx %					
1	2	3	4	 Display fields 	Setpoint value	Evaluation		
				Pulse duty factor from com- mencement of injection valve	2095 %	⇒ page 01-60		
			Commenc	ement of injection (actual)	approx. commence- ment of injection (setpoint)	⇒ page 01-60		
		Commence Engine code Engine code	ment of inj e letters: A e letters: B	ection (setpoint) NF CT	119° bef. TDC 10.56° bef. TDC			
	Engine spe Engine cod Engine cod	ed e letters: AN e letters: BC	F		34003800 rpm 23002700 rpm			

Evaluation: Display of commencement of injection (actual)

Display on V.A.G 1552	Possible Cause(s) of Fault(s)	Remedying the Fault
In the event of too large a deviation from the setpoint value (approx. 5°)	 Commencement of injection valve -N108 defective 	 Check N108 ⇒ page 01-33, final control diagnosis
	 Injection pump stops very incorrectly 	 Check commencement of injection dynamically and adjust ⇒ page 23-31
	♦ Air in fuel system	- Check fuel supply

Evaluation: Display of pulse duty factor from commencement of injection valve

Display on V.A.G 1552	Possible Cause(s) of Fault(s)	Remedying the Fault
below 20 or above 95 %	 Commencement of injection valve -N108 defective 	 Check N108 ⇒ page 01-33, final control diagnosis
		 Check commencement of injection dynamically and adjust ⇒ page 23-31
		- Check fuel supply

Display group 008 at full load (test drive with warm engine, coolant temperature not below 70 °C)

Notes:

- For the tests, accelerate the boat at full throttle.
- When the specified engine speed is reached, the measurement values must be printed out or read off (2nd person required).

Display gro	Display group 008 -Limitation quantities-								
Read meas	urement valu	ue block 8	\rightarrow	✓ Display					
xxxx rpm	xx.x mg/ stroke	xx.x mg/ stroke	xx.x mg/ stroke						
1	2	3	4	 Display fields 	Setpoint value	Evaluation			
				Injection quantity limitation due to air mass intake (smoke avoid- ance)	5052 mg/stroke				
			Injection q (torque lim Engine coo Engine coo	uantity limitation by speed itation) de letters: ANF de letters: BCT	2225 mg/stroke 2125 mg/stroke	⇒ page 01-62			
Injection qu			antity (spea	cified by driver)	2530 mg/stroke	⇒ page 01-62			
Engine speed Engine code letters: ANF Engine code letters: BCT					34003800 rpm 23002700 rpm				

Evaluation: Display of injection quantity (specified by driver)

Display on V.A.G 1552	Possible Cause(s) of Fault(s)	Remedying the Fault
below 25 mg/stroke	♦ No full throttle	- Repeat test at full throttle.
	 Accelerator lever position sender -G79 defective 	 Check G79 ⇒ page 20-13; Checking accelerator lever position sender

Evaluation: Display of injection quantity limitation by speed (torque limitation)

Display on V.A.G 1552	Possible Cause(s) of Fault(s)	Remedying the Fault		
below 21 or 22 mg/ stroke	 Engine speed too high or too low 	 Read off the setpoint at the specified engine speed 		

Evaluating the measurement value blocks at full load, engine code letters ANG, ANH, BCU, BCV

Display group 000 at full load (test drive with warm engine, coolant temperature not below 70 °C)

Notes:

- For the tests, accelerate the boat at full throttle.
- When the specified engine speed is reached, the measurement values must be printed out or read off (2nd person required).

Dis	Display group 000 (display values, decimal)												
Read measurement value block 0										✓ Display			
х	Х	Х	Х	Х	Х	Х	Х	Х	Х				
1	2	3	4	5	6	7	8	9	10	 Display fields 	Display fields Setpoint value co		
										Air quantity	do not observe		
									Сос	plant temperature	88198	20100 °C	
								Inta	ake r	manifold temperature	0182	10135 °C	
							Сос	olant	ten	nperature	3795	70110 °C	
						Atn	nosp	oheri	c pr	essure	do not observe		
					Inta	ake r	mani	ifold	pres	ssure	191221	19502250 mbar	
		Injection quantity Engine code letters: ANG Engine code letters: BCU			G U	160220 175215	3245 mg/stroke 3543 mg/stroke						
				Inje	ectio	n qu	ianti	ty			160220	3245 mg/stroke	
			Thr	ottle	leve	er po	ositio	on			255	100 %	
		Cor Eng Eng	nme jine jine	nencement of injection e code letters: ANG e code letters: BCU					٦		106150 50144	95.5° bef. TDC 8.51.0° before TDC	
	Eng	gine	spe	əd							114134	24002800 rpm	

01-64 —

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Dis	Display group 000 (display values, decimal)											
Read measurement value block 0 🛛 ┥ Di							lock	0		 Display 		
х	х	х	Х	х	х	Х	Х	х	х		_	_
1	2	3	4	5	6	7	8	9	10	 Display fields 	Setpoint value	corresponds to
										Air quantity	do not observe	
									Сос	plant temperature	88198	20100 °C
								Inta	ake r	nanifold temperature	0182	10135 °C
							Co	olant	t ten	nperature	3795	70110 °C
						Atr	nosp	oher	ic pr	essure	do not observe	
					Inta	ake i	man	ifold	pres	ssure	191221	19502250 mbar
				Inje Eng Eng	ection quantity Igine code letters: ANH Igine code letters: BCV				: AN : BC	H √	175225 170215	3545 mg/stroke 3443 mg/stroke
			Thr	ottle	e leve	er po	ositio	on			255	100 %
	Commencement of injection Engine code letters: ANH Engine code letters: BCV					194255 162213	1812.5° bef. TDC 1410° before TDC					
	Eng	gine	spe	ed							136150	2,8503,150 rpm

Display group 004 at full load (test drive with warm engine, coolant temperature not below 70 °C)

Notes:

- For the tests, accelerate the boat at full throttle.
- When the specified engine speed is reached, the measurement values must be printed out or read off (2nd person required).

Engine code letters ANG, BCU

Display gro	Display group 004 -Commencement of injection-							
Read meas	urement valu	ue block 4	\rightarrow	◄ Display				
xxxx rpm	xx.x ° bef.(after) TDC	xx.x ° bef.(after) TDC	xxx %					
1	2	3	4	◀ Display fields	Setpoint value	Evaluation		
				Pulse duty factor from com- mencement of injection valve	2095 %	⇒page 01-68		
			Commenc	ement of injection (actual)	approx. commence- ment of injection (setpoint)	⇒ page 01-68		
		Commence Engine code Engine code	ment of inj e letters: Al e letters: B(ection (setpoint) NG CU	95.5° bef. TDC 8.51.0° bef. TDC			
	Engine spe	ed			24002800 rpm			

Display gro	isplay group 004 -Commencement of injection-								
Read meas	urement valu	ue block 4	\rightarrow	◄ Display					
xxxx rpm	xx.x ° bef.(after) TDC	xx.x ° bef.(after) TDC	xxx %						
1	2	3	4	◄ Display fields	Setpoint value	Evaluation			
				Pulse duty factor from com- mencement of injection valve	2095 %	⇒ page 01-68			
			Commenc	ement of injection (actual)	approx. commence- ment of injection (setpoint)	⇒ page 01-68			
Commencement o Engine code letter Engine code letter			ment of inj e letters: Al e letters: B	ection (setpoint) NH CV	1812.5° bef. TDC 1410° bef. TDC				
	Engine spe	ed			2,8503,150 rpm				

Evaluation: Display of commencement of injection (actual)

Display on V.A.G 1552	Possible Cause(s) of Fault(s)	Remedying the Fault		
In the event of too large a deviation from the setpoint value (approx. 5°)	 Commencement of injection valve -N108 defective 	 Check N108 ⇒ page 01-33, final control diagnosis 		
	 Injection pump stops very incorrectly 	 Check commencement of injection dynamically and adjust ⇒ page 23-31 		
	♦ Air in fuel system	- Check fuel supply		

Evaluation: Display of pulse duty factor from commencement of injection valve

Display on V.A.G 1552	Possible Cause(s) of Fault(s)	Remedying the Fault
below 20 or above 95 %	 Commencement of injection valve -N108 defective 	 Check N108 ⇒ page 01-33, final control diagnosis
		 Check commencement of injection dynamically and adjust ⇒ page 23-31
		- Check fuel supply

Display group 008 at full load (test drive with warm engine, coolant temperature not below 70 °C)

Notes:

- For the tests, accelerate the boat at full throttle.
- When the specified engine speed is reached, the measurement values must be printed out or read off (2nd person required).

Engine code letters ANG, BCU

Display group 008 -Limitation quantities-						
Read measurement value block 8 \rightarrow		 Display 				
xxxx rpm	xx.x mg/ stroke	xx.x mg/ stroke	xx.x mg/ stroke			
1	2	3	4	 Display fields 	Setpoint value	Evaluation
				Injection quantity limitation due to air mass intake (smoke avoid- ance)	5052 mg/stroke	
			Injection quantum (torque lim Engine coordinate coordin	uantity limitation by speed itation) de letters: ANG de letters: BCU	3244 mg/stroke 3543 mg/stroke	⇒ page 01-71
		Injection qu	antity (spec	cified by driver)	4348 mg/stroke	⇒ page 01-71
Engine speed			24002800rpm			

Display group 008 -Limitation quantities-						
Read measurement value block 8 \rightarrow		✓ Display				
xxxx rpm	xx.x mg/ stroke	xx.x mg/ stroke	xx.x mg/ stroke			
1	2	3	4	 Display fields 	Setpoint value	Evaluation
				Injection quantity limitation due to air mass intake (smoke avoid- ance)	5052 mg/stroke	
			Injection q (torque lim Engine coo Engine coo	uantity limitation by speed itation) de letters: ANH de letters: BCV	3545 mg/stroke 3443 mg/stroke	⇒ page 01-71
		Injection qu	iantity (spec	cified by driver)	4246 mg/stroke	⇒ page 01-71
Engine speed				2,8503,150 rpm		

Evaluation: Display of injection quantity (specified by driver)

Display on V.A.G 1552	Possible Cause(s) of Fault(s)	Remedying the Fault
below 42 mg/stroke or 43 mg/stroke	♦ No full throttle	- Repeat test at full throttle.
	 Accelerator lever position sender -G79 incorrectly adjusted or defective 	 Check G79 and adjust if necessary ⇒ page 20-13; Checking accelerator lever position sender

Evaluation: Display of injection quantity limitation by speed (torque limitation)

Display on V.A.G 1552	Possible Cause(s) of Fault(s)	Remedying the Fault
below 32 mg/stroke or 34 mg/stroke or 35 mg/stroke	 Engine speed too high or too low 	 Read off the setpoint at the specified engine speed

Display group 010 at full load (test drive with warm engine, coolant temperature not below 70 °C)

Notes:

- For the tests, accelerate the boat at full throttle.
- When the specified engine speed is reached, the measurement values must be printed out or read off (2nd person required).

Display group 010 -Air values-						
Read measurement value block 10		\rightarrow	✓ Display			
xxxx/min	xxxx mbr	xxxx mbr	xxx.x %			
1	2	3	4	 Display fields 	Setpoint value	Evaluation
				Accelerator pedal position	100 %	⇒ page 01-73
			Intake ma	nifold pressure (boost pressure)	19502250 mbar	⇒ page 01-73
		Atmospheri	c pressure	(air pressure)	do not observe	
Engine speed Engine code letters: ANG, BCU Engine code letters: ANH, BCV					24002800 rpm 28503150 rpm	

Evaluation: Display of intake manifold pressure (boost pressure)

Display on V.A.G 1552	Possible Cause(s) of Fault(s)	Remedying the Fault
below 1950 mbar	 Boost pressure system leaky Linkage on turbocharge does not move smoothly Turbocharger defective 	 Check turbocharger ⇒ page 21-21; Checking boost pressure system; Checking turbocharger
above 2250 mbar	 Hose of boost pressure control has fallen off or is plugged Linkage on turbocharge does not move smoothly Pressure unit on turbocharger defective 	

Evaluation: Display of accelerator position

Display on V.A.G 1552	Possible Cause(s) of Fault(s)	Remedying the Fault
below 100 %	♦ No full throttle	- Repeat test at full throttle.
	 Accelerator lever position sender -G79 defective 	 Check G79 ⇒ page 20-13; Servicing throttle controls



Removing and installing engine

Special tools, workshop equipment, test and measuring equipment and accessories required

Note:

For conducting assembly work on the removed engine, it is advisable to use the clamp VW 313 and the engine and gearbox support VW 540.

- ♦ VW 313 Clamp
- VW 540 Engine and gearbox support with additional set VW 540/1A
- 3033 Lifting tackle with holder 3180 and additional hook 10-222A/2
- ◆ V.A.G 1331 Torque spanner (5 50 Nm)
- ◆ V.A.G 1332 Torque spanner (40 200 Nm)
- ♦ VAS 5024 Fitting tool for spring clips

10-1 —





- ♦ 3094 Hose clamp or 3093 Hose clamp
- ♦ Cable ties

Removing engine

Note:

Depending on the type and equipment of the boat, the work described here in the following for removing and installing the engine may differ slightly.

- Remove the engine cover.
- All cable ties released or cut open when removing engine must be remounted in same locations when installing engine.
- Depending on the boat design, the engine can be removed with or without the gearbox.
- Pull off the central plug -arrow- of the battery connection.



 Screw the central plug of the instrumentation off the connection of the fuse box/relay plate in the direction of the arrow.

Note:

Before removing the fuel supply line, clamp it off with the hose clamp 3094.

Important!

Lay a cleaning cloth around the connection point before disconnecting the fuel lines. Then catch the fuel running out by carefully pulling off the hose.

Note:

Please observe the disposal regulations.

- Loosen the hose clip of the fuel supply line -2- on the fuel lift pump -1- and pull off the hose in the direction of the arrow.





Note:

Before removing the fuel return line, clamp it off with the hose clamp 3094.

- Also remove the fuel return line -1- on the combination radiator (for fuel and hydraulic oil/gear oil) -2-.

Note:

Before removing the connection lines, clamp them off with hose clamps 3094 and mark.

 On boats with an external heater and hot water supply system, the two connection lines -arrows- must be sealed off with clamps.





- Unscrew the throttle linkage -1- at the bracket -2-.
 - Unclip the throttle linkage -1-at the accelerator lever position sender -arrow-.
 - Close the seawater valve.



- Drain off the seawater at the drain screw -2- on the combination radiator (for fuel and hydraulic oil/gear oil) -1- ⇒ page 19-8, Fig. 2.
 - Carefully clamp off the seawater supply hose -3- at the combination radiator -1-.

Engine with additional alternator

- Disconnect the electrical connection lines from the additional alternator.

Engine with power steering pump

- Clamp off hydraulic lines of the power steering pump:
- \Rightarrow page 48-4; Assembly overview: Power steering pump
- Allow hydraulic fluid to drain off and catch.

Note:

Please observe the disposal regulations.

Engine with reversing gear

- Disconnect the connection lines from the reversing gear on the combination radiator (for fuel and hydraulic oil/gear oil).

Further procedure for all engines

- Disconnect gearbox/Z-drive at flange.
- Unscrew unit mountings on the engine and gearbox side -arrows-.
 - Remove exhaust system \Rightarrow page 26-1, Removing and installing parts of exhaust system.







- Hook in the lifting tackle 3033 as follows and lift the engine out of the boat with the workshop crane as follows.

Notes:

- If the engine is removed with the reversing gear, the gearbox must also be supported.
- Lifting out with sling gear at a flat angle is not permissible.

Mounting engine on repair stand

To conduct assembly work, the engine must be mounted on the clamp VW 313 of the repair stand with the engine and gearbox support VW 540.

Note:

Before mounting the engine and gearbox support VW 540, the gearbox bell must be removed.

- Mount the engine on the clamp VW 313 with the engine and gearbox support VW 540 and supplemental set VW 540/1 A.

10-7 —



<image>

Installing engine

Installation is carried out in the reverse order while observing the following:

- Check whether dowel sleeves -arrows- for centring the engine/gearbox bell are present in the cylinder block and insert if necessary.
- Screw the gearbox bell firmly onto the engine.
- Install and align the engine.

Note:

When installing the gearbox, observe the manufacturer's specifications for the respective gearbox.

Further procedure after installing the engine

- Screw the engine mounting onto the boat hull -arrows-.

Note:

Observe the manufacturer's specifications for the tightening torque of the mounting screws on the boat hull.

Engine with additional alternator

- Connect the electrical lines to the additional alternator.



Engine with power steering pump

- Install the hydraulic line of the power steering pump.
- \Rightarrow page 48-4; Assembly overview: Power steering pump

Engine with reversing gear

- Connect the connection lines from the reversing gear on the combination radiator (for fuel and hydraulic oil/gear oil).

Further procedure for all engines

- Attach the central plug to the fuse box/relay plate and to the battery connection.
- Connect the connection lines -arrows- if a heater and hot water supply is installed (do not interchange return line -1- and supply line -2-).
 - Connect the seawater line to the combination radiator (for fuel and hydraulic oil/gear oil).
- Install exhaust system ⇒ page 26-1, Removing and installing parts of exhaust system.
- Fill with coolant \Rightarrow page 19-26.
- Top up the hydraulic oil with the engine running in the top-up tank.

Note:

If the engine is started without seawater cooling, the ribbed V-belt for the seawater pump must be removed, as otherwise the impeller of the seawater pump will be destroyed.

10-9 —

- Start engine and interrogate fault memory:
- \Rightarrow page 01-10; Fault memory; Interrogating fault memory
- Install the engine cover.

Unit mounting and gearbox bells

- Unit mounting:
 - 1 Bearings
 - 2 Engine height adjustment
 - 3 Washer
 - 4 Mounting nut

60 Nm + 90° (¹/₄ turn.)





- Gearbox bell for reversing gear (SAE-7):
 - 1 Mounting bolt 60 Nm
 - 2 Gearbox bell



- Gearbox bell for Mercruiser:
 - 1 Mounting bolt 60 Nm
 - 2 Gearbox bell



- Gearbox bell for VOLVO SX/DP-S and OMC:
 - 1 Mounting bolt 60 Nm
 - 2 Gearbox bell



- Gearbox bell for VOLVO SP-E/DP-E:
 - 1 Mounting bolt 60 Nm
 - 2 Gearbox bell
 - 3 Bearings
 - 4 Circlip
 - 5 Circlip
 - 6 Seal
 - 7 Input shaft



Dismantling and assembling engine

Notes:

- If large quantities of metal chips and abrasion caused by seizing, such as crankshaft and conrod bearing damage, is found in the engine oil, the oil cooler must be renewed and the oil channels thoroughly cleaned to prevent subsequent damage.
- Defective injectors can lead to heavy engine knocking and indicate bearing damage. In the case of complaints, run the engine at idle and loosen the union nuts on the injection lines consecutively. If the knocking disappears after loosening a union nut, this indicates a defective injector.

Check injectors:

⇒ page 23-37; Checking injectors



- $I \Rightarrow page 13-3$
- II ⇒ page 13-6
- III⇒page 13-9
- $IV \Rightarrow page 13-14$



Part I

1 - Dust cap

2 - 20 Nm

3 - Idler pulley

4 - 40 Nm

5 - Tensioner for ribbed V-belt

- To relax the ribbed V-belt, swivel with 16 mm open-end spanner
 - ⇒ page 13-18

6 - Tensioner

7 - Retainer

- ◆ For power steering pump
- For 12 V alternator and 12V/24V/230V additional alternator
- When installing an additional alternator, additional attachment parts are required:

 \Rightarrow page 27-10; Alternator brackets and ribbed V-belt routing



- 8 40 Nm
- 9 Bearing bushes
 - ♦ Renew if damaged
- 10 40 Nm
- 11 Shim
- 12 Idler pulley
 - Watch position when installing toothed belt

 \Rightarrow page 15-9, Removing and installing, tensioning toothed belt for camshaft

13 - 20 Nm

14 - Ribbed V-belt

- Mark running direction before removing
- Check for wear



15 - Washer

- Diamond disc must be installed
- ♦ Renew
- Must be diamond-coated

16 - Vibration damper with ribbed V-belt pulley

- Watch securing when mounting
- 17 20 Nm

18 - 160 Nm + $^{1}/_{2}$ (180 °) additional turn

- ♦ Renew
- Use brace T 01900 to loosen and tighten
- Removing and installing, tensioning toothed belt for camshaft
 - ⇒ page 15-9



Part II

1 - Upper section of toothed belt guard

2 - Toothed belt for camshaft

- Check for wear
- ◆ Always renew after removal
- ♦ Do not kink
- ♦ Removing and installing, tensioning
 ⇒ page 15-9

3 - Mounting bolt for camshaft sprocket

- Observe marking for bolt steel on bolt head:
 - 8.8 = 85 Nm
 - 10.9 = 100 Nm
- ♦ Use brace 3036 to loosen and tighten



4 - Camshaft sprocket

- Remove from camshaft taper by striking with hammer using drift through hole of toothed belt guard
- Watch position when installing toothed belt

 \Rightarrow page 15-9, Removing and installing, tensioning toothed belt for camshaft

5 - Rear toothed belt guard

6 - 20 Nm

Mount with sealing compound

7 - 10 Nm

Mount with sealing compound

8 - Coolant pump

- ♦ Without oblong hole
- Check for smooth running
- Renew completely if damaged or leaky

13-7 –



- 9 O-ring
 - Renew if damaged or leaky

10 - Lower section of toothed belt guard

11 - Tensioner

12 - Toothed belt sprocket for crankshaft

♦ Removing and installing
 ⇒ page 15-9, Removing and instal-

ling, tensioning toothed belt for camshaft

13 - Toothed belt guard


Part III

1 - Intake manifold

- Engine code letters BCV, ANH; removing and installing with integrated intercooler ⇒ page 21-17
- 2 Gasket
 - ♦ Renew
- 3 20 Nm

4 - Connecting piece

- For crankcase ventilation
- 5 Gasket
 - ♦ Renew if damaged

6 - To oil separator

7 - Cylinder head cover

- With gasket
- Before fitting, thoroughly clean sealing surface of cylinder head with a clean cloth



8 - Cylinder head screw

- ♦ Renew
- Observe order when loosening and tightening

 \Rightarrow page 15-20, Installing cylinder head

9 - Oil deflector

10 - Drive sprocket for injection pump

 Removing and installing, tensioning toothed belt for injection pump:

⇒ page 23-18: Removing and installing, tensioning toothed belt for injection pump

11 - Mounting bolt for drive sprocket of injection pump

- ♦ 160 Nm
- Oil thread and contact surface
- ♦ Use brace 3036 to loosen and tighten



12 - Toothed belt for injection pump

- Check for wear
- ♦ Always renew after removal
- Do not kink
- Removing and installing, tensioning toothed belt for injection pump:
- ⇒ page 23-18: Removing and installing, tensioning toothed belt for injection pump

13 - Idler pulley

- Ensure proper installation position:
- ⇒ page 23-18: Removing and installing, tensioning toothed belt for injection pump

14 - 20 Nm

15 - Hydraulic oil reservoir

♦ With Z-drive

16 - Bracket

- ◆ For hydraulic oil reservoir
- ♦ With Z-drive



17 - 10 Nm

18 - 20 Nm

19 - Flange cover

 Only on engines without power steering

20 - Gasket

♦ Renew

21 - Cylinder head gasket

- ♦ Renew
- ♦ Observe marking
- ⇒ page13-43
- Renew all coolant after renewing

22 - Cylinder head

- Check for warping
 - \Rightarrow page 15-8, Fig. 1
- Installing \Rightarrow page 15-20
- ◆ Renew all coolant after renewing
- Removing and installing injectors:
- ⇒ page 23-35; Removing and installing injectors



- 23 Cup packing
 - ◆ Renew if damaged
- 24 End cover
 - ◆ Replace seal if damaged
- 25 Intake manifold pressure sender G 71 with intake manifold temperature sender G 72
 - ♦ Check
- ⇒ page 23-49; Check intake manifold pressure sender
- 26 20 Nm



Part IV

1 - Cylinder block

- ♦ Removing and installing sealing flange and flywheel ⇒ page 13-21
- ♦ Removing and installing crankshaft
 ⇒ page 13-30
- ◆ Dismantling and assembling piston and conrod ⇒ page 13-34
- ◆ Renew if damaged

2 - Guide sleeve

3 - Bracket

4 - Tensioner

- ◆ Removing and installing:
- ⇒ page 23-18: Removing and installing, tensioning toothed belt for injection pump

5 - 15 Nm



- 6 Mounting nut for injection pump sprocket
 - ♦ 90 Nm
 - ♦ Use brace 3036 to loosen and tighten

7 - Removing Injection Pump Sprocket

- Removing and installing:
- ⇒ page 23-25; Removing and installing injection pump
 - 8 30 Nm
 - 9 Mounting bolt for bracket ♦ 45 Nm
- 10 O-ring
 - ♦ Renew if damaged



- 11 Engine speed sender (G28)
 - ♦ Check:
- ⇒ page 01-10; Fault memory; Interrogating fault memory
- 12 10 Nm

13 - Woodruff key

check that securely seated

14 - Injection pump

- Removing and installing:
- ⇒ page 23-25; Removing and installing injection pump

15 - 25 Nm

♦ With taper

16 - Oil sump

- ♦ Removing and installing
 ⇒ page 17-18
- Clean sealing surface before assembly



17 - 20 Nm

M8, install bolt with hexagon head on gearbox side

18 - 15 Nm

 M6, with flywheel installed: Turn flywheel so that bolts are accessible

19 - Injection lines

- ♦ Tighten with 25 Nm
- Remove with ring spanner 3035
- always remove complete set of lines
- Do not change shape of bends



Removing and installing ribbed V-belt

Notes:

- ♦ The ribbed V-belt for the seawater pump must be removed ⇒ page 19-30, Removing and installing seawater pump.
- Mark the running direction before removing the ribbed V-belt. Ensure proper seating in the belt pulley when installing.

Removing ribbed V-belt

- Relax tensioner in direction of arrow with 16 mm open-end spanner and remove ribbed V-belt from belt pulleys.

Installing ribbed V-belt

Note:

Before installing the ribbed V-belt, make sure that all units (alternator, additional alternator, power steering pump) are securely mounted.

- Lay ribbed V-belt on vibration damper with ribbed V-belt pulley.
- Lift tensioner with 16 mm open-end spanner in direction of arrow, lay on ribbed V-belt and tension.



- Belt drive without power steering pump and without additional alternator
 - Start engine and check belt routing.



- Belt drive with power steering pump and without additional alternator
 - Start engine and check belt routing.



- Belt drive with additional alternator and without power steering pump
 - Start engine and check belt routing.

Note:

When mounting a 24 V/230 V additional alternator, it must be secured with an additional bracket.



- Belt drive with power steering pump and additional alternator
 - Start engine and check belt routing.

Note:

When mounting a 24 V/230 V additional alternator, it must be secured with an additional bracket.



Removing and installing sealing flange and flywheel

1 - Seal

- ♦ Renew ⇒ page 13-26
- 2 O-ring
 - ♦ Renew
- 3 10 Nm
- 4 Vacuum line
- 5 Intake pipe
- 6 Circlip
- 7 Flywheel
 - When removing and installing; lock with brace 10-201
 - ♦ Removing and installing two-part flywheel ⇒ page 13-24



- 8 Drive plate
- 9 20 Nm
- 10 Driver
 - ♦ For VOLVO SX/DP-S Z-drive
 - ◆ For Mercruiser Z-drive
- 11 Washer
- 12 40 Nm
- 13 Driver
 - ♦ For reversing gear
 - ◆ For VOLVO SP-E/DP-E Z-drive
- 14 60 Nm + ¹/₄ (90 °) additional turn ♦ Renew

15 - Sealing flange

- ♦ Renew \Rightarrow page 13-28
- With sealing ring, only renew completely
- Must be seated on dowel sleeves



16 - Cylinder block

- ♦ Removing and installing crankshaft
 ⇒ page 13-30
- Dismantling and assembling piston and conrod
 - ⇒ page 13-34

17 - Oil pump driver

- ♦ With 4 drive journals
- ♦ Burst open to pull off
- Heat new driver to max. 200 °C before fitting

18 - Gasket

♦ Renew

19 - Oil pump

- Watch driver on crankshaft when installing, Item 17
- Only renew entire unit
- Must be seated on dowel sleeves
- Dismantling and assembling
- \Rightarrow page 17-1, Removing and installing parts of lubrication system

20 - 20 Nm



V.A.G 1332

B

Removing and installing two-part flywheel

Special tools, workshop equipment, test and measuring equipment and accessories required

♦ 10-201 Brace

◆ V.A.G 1332 Torque spanner (40 - 200 Nm)

Removing

Note:

To unscrew the mounting bolts from the drive plate and the two-part flywheel, use the brace 10-201.

flywhee

W00-0428



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- Unscrew the bolts -arrows- from the drive plate -2- on the two-part flywheel -1- and pull the drive plate of the dowel pins.

- Now screw the mounting bolts -arrow- out of the two-part flywheel -1-.
 - Remove the two-part flywheel.

Fitting

Note:

To secure the mounting bolts of the drive plate and the two-part flywheel, use the brace 10-201.

- Position the two-part flywheel on the crankshaft.
- Insert new mounting bolts and tighten hand-tight diagonally.
- Tighten mounting bolts to 60 Nm and turn 90° (1/4 turn)

further (turning further can be carried out in several steps).

13-25 -



Renewing crankshaft oil seal -belt pulley end-

Special tools, workshop equipment, test and measuring equipment and accessories required

♦ 3203 Oil seal puller

◆ 2080 A Mounting sleeve for oil seal







Removing

- Remove toothed belt for camshaft: ⇒ page 15-9 Removing and installing, tensioning toothed belt for camshaft
- Screw inner section of oil seal puller 3203 two turns (approx. 3 mm) out of outer section and lock in place with knurled screw.
- Oil threaded head of oil seal puller, position and screw into oil seal as far as possible using high pressure.
 - Unscrew knurled screw and turn inner section against crankshaft until oil seal is pulled out.

Fitting

- Lightly oil sealing lips of oil seal.
- Push oil seal over guide sleeve from 2080 A.
- Press in oil seal as far as possible with pressure sleeve from 2080 A and central bolt of vibration damper.
- Installing and tensioning toothed belt:
 - \Rightarrow page 15-9 Removing and installing, tensioning toothed belt for camshaft.





Renewing oil seal for crankshaft -flywheel end-

Special tools, workshop equipment, test and measuring equipment and accessories required

◆ V.A.G 1331 Torque spanner (5 - 50 Nm)

Removing

- Remove flywheel \Rightarrow page 13-21, Item 7
- Remove sealing flange -1-.

Notes:

- Do not dismantle sealing flange further.
- Only renew entire unit.

Fitting

Note:

The oil seal of the sealing flange is provided with an mounting aid.

- Push sealing flange evenly onto crankshaft flange by hand and carefully remove mounting aid.
- Install flywheel and tighten new mounting bolts with Tighten to 60 Nm and turn 90° (1/4 turn) further.



Removing and installing crankshaft

1 - Oil pump driver

- ♦ With 4 drive journals
- ♦ Burst open to pull off
- Heat new driver to max. 200 °C before fitting

2 - Bearing shell 1, 2, 3, 5 and 6

- For bearing cap without lubrication groove
- For cylinder block with lubrication groove
- Do not interchange used bearing shells (mark)

3 - Bearing cap

- Bearing cap 1: Belt pulley end
- Bearing cap 4 with recesses for thrust washers
- Retaining lugs of bearing shells of cylinder block/bearing cap must be positioned above each other



4 - 65 Nm

5 - Crankshaft

- Axial clearance new: 0.07 0.18 mm
 Wear limit: 0.25 mm
- Measure radial clearance with Plastigage new: 0.016 - 0.075 mm
 - New: 0.016 0.075 mr Wear limit: 0.16 mm
- Do not turn crankshaft during radial clearance measurement
- ♦ For crankshaft dimensions
 ⇒ page 13-33

6 - Sender wheel

◆ For engine speed sender (G28)

7 - 25 Nm

♦ Renew

8 - Thrust washer

- ♦ For bearing cap 4
- ♦ Watch fixing



- 9 Bearing shell 4
 - For bearing cap without lubrication groove
 - For cylinder block with lubrication groove

10 - Thrust washer

◆ For cylinder block, bearing 4

11 - Cylinder block

- Dismantling and assembling piston and conrod
 - ⇒ page 13-34

Crankshaft dimensions

(Dimensions in mm)

Grinding dimension	Crankshaft bearing	Conrod bearing
	journal dim.	journal dim.
Basic	-0.022 58.00	-0.022 47.80
dimension	-0.042	-0.042
Step I	-0.022 57.75	-0.022 47.55
	-0.042	-0.042
Step II	-0.022 57.50	-0.022 47.30
	-0.042	-0.042
Chara III	-0.022	-0.022
Step III	-0.042	-0.042



Dismantling and assembling piston and conrod

- 1 Piston rings
 - ♦ Offset seam by 120 °
 - Remove and install with piston ring pliers
 - ♦ Marked "TOP" on crown
 - Check gap clearance \Rightarrow fig. 1
 - Check height clearance \Rightarrow fig. 2

2 - Circlip



- 3 Piston
 - Mark installation position and cylinder assignment
 - Arrow on piston crown points toward belt pulley end
 - ♦ Install with piston-ring scuff band
 - Renew piston in case of cracks on piston skirt
 - ♦ With notch for oil spray nozzles
 - Checking piston height at TDC
 - ⇒ page 13-42

4 - Conrod

- ♦ Only renew as a set
- Mark assignment to cylinder -A-
- installation position: Markings -B- face toward belt pulley end



- 5 Oil spray nozzle
 - ♦ For piston cooling
- 6 10 Nm
 - ◆ Fit with AMV 188 100 02
- 7 Conrod bolt, 30 Nm + $^{1}/_{4}$ (90 °) additional turn
 - ♦ Renew
 - ♦ Oil thread and contact surface
 - Use old bolt for measuring radial clearance
- 8 Conrod cover
 - Mark assignment to cylinder -A-
 - installation position: Markings -B- face toward belt pulley end



- 9 Bearing shell
 - Ensure proper installation position
 - Do not interchange used bearing shells
 - Ensure firm seating in retaining lugs
 - Axial clearance
 Wear limit: 0.40 mm
 - Measure radial clearance with Plastigage:

Wear limit: 0.08 mm

Do not turn crankshaft during radial clearance measurement

10 - Cylinder block

- Check cylinder bore
 - ⇒Fig. 3
- ♦ For piston and cylinder dimensions
 ⇒ page 13-44

11 - Piston pin

- In case of binding, heat piston to 60 °C
- ♦ Remove and install with drift VW 222a

13-37 —



Fig. 1 Checking piston-ring gap clearance

Special tools, workshop equipment, test and measuring equipment and accessories required

♦ Feeler gauge

Test procedure

- Push in ring perpendicular from top into lower cylinder opening, approx. 15 mm from cylinder rim.

Piston ring Dimensions in mm	New	Wear limit
1st compression ring	0.25 - 0.45	1.0
2nd compression ring	0.20 - 0.40	1.0
Oil scraper ring	0.25 - 0.50	1.0



Fig. 2 Checking piston-ring height clearance

Special tools, workshop equipment, test and measuring equipment and accessories required

♦ Feeler gauge

Test procedure

Clean ring groove before the test.

Piston ring Dimensions in mm	New	Wear limit
1st compression ring	0.07 - 0.11	0.25
2nd compression ring	0.05 - 0.08	0.25
Oil scraper ring	0.03 - 0.06	0.15



Fig. 3 Checking cylinder bore

Special tools, workshop equipment, test and measuring equipment and accessories required

Inside precision measuring device: 50 - 100 mm

Test procedure

- Measure at 3 points diagonally in lateral direction -A- and longitudinal direction -B-. Differences compared to nominal dimension max. 0.08 mm

Note:

The measurement of the cylinder bore may not be carried out when the cylinder block is mounted on the repair stand with the engine support VW 540, as incorrect measurements are possible.



Fig. 4 Piston installation position and piston/cylinder assignment

Piston in cylinder 1 and 2:

Large valve pocket for inlet valve toward flywheel end -arrows-

Piston in cylinder 3, 4 and 5:

Large valve pocket for inlet valve toward belt pulley end -arrows-

Note:

With new pistons, the assignment to the cylinder is stamped on the piston crown with paint.

- Piston for cylinder 1 and 2: Marking 1/2
- Piston for cylinder 3, 4 and 5: Marking 3/4/5





Checking piston height at TDC

Special tools, workshop equipment, test and measuring equipment and accessories required

♦ VW 382/7 Measuring bridge

- ♦ VW 385/17 End dimension plate
- ♦ Dial gauge



Test procedure

When installing new pistons or a short engine, the piston height at TDC must be checked. Depending on the piston overhang, the corresponding cylinder head gasket must be installed in accordance with the following table:

Piston overhang	Marking Notches/holes	
up to - 0.96 mm 0.96 mm	1	
0.97 mm 1.01 mm	2	
above 1.01 mm	3	



Marking of cylinder head gasket

- ♦ Part No. = arrow A
- ♦ Notches/holes = arrow B

Note:

If different values are measured during overhang measurement of the pistons, the greatest dimension applies for the assignment of the gasket.

13-43

For piston and cylinder dimensions

Grinding dimension for cylinder bore		Piston dia.	Cylinder bore dia.
Basic dimension	mm	80.96	81.01
Step I	mm	81.21	81.26


Removing and installing cylinder head

Checking compression pressure \Rightarrow page 15-24.

Notes:

- When installing a replacement cylinder head with a mounted camshaft, the contact surfaces between the bucket tappets and the cam surface must be oiled after the head is installed.
- The plastic washers provided to protect the open valves may not be removed until directly prior to fitting the cylinder head.
- When renewing the cylinder head, the entire coolant must be renewed.



1 - 20 Nm

2 - Connecting piece

For crankcase ventilation

3 - To oil separator

4 - Cylinder head screw

- ♦ Renew
- Observe order when loosening and tightening

 \Rightarrow page 15-20, Installing cylinder head

5 - Toothed belt for injection pump

- Check for wear
- ♦ Always renew after removal
- Do not kink
- Removing and installing, tensioning toothed belt for injection pump:
- ⇒ page 23-18: Removing and installing, tensioning toothed belt for injection pump



6 - Drive sprocket for injection pump

- Removing and installing, tensioning toothed belt for injection pump:
- ⇒ page 23-18: Removing and installing, tensioning toothed belt for injection pump

7 - Mounting bolt for drive sprocket of injection pump

- ♦ 160 Nm
- ♦ Oil thread and contact surface
- ♦ Use brace 3036 to loosen and tighten

8 - Cover for hydraulic oil reservoir

9 - 20 Nm

10 - Idler pulley

- Ensure proper installation position:
- ⇒ page 23-18: Removing and installing, tensioning toothed belt for injection pump



- **11 Hydraulic oil reservoir** ♦ With Z-drive
- 12 Gasket
 - ♦ Renew
- 13 Retainer
 - ◆ For hydraulic oil reservoir
 - ♦ With Z-drive
- 14 10 Nm
- 15 Flange cover
- 16 20 Nm
- 17 Rear toothed belt guard
- 18 10 Nm
- 19 20 Nm



20 - Toothed belt for camshaft

- Check for wear
- ♦ Always renew after removal
- Do not kink
- ♦ Removing and installing, tensioning toothed belt for camshaft
 ⇒ page 15.9
 - ⇒ page 15-9

21 - Upper section of toothed belt guard

22 - Mounting bolt for camshaft sprocket

- Observe marking for bolt steel on bolt head:
 - 8.8 = 85 Nm
 - 10.9 = 100 Nm
- ♦ Use brace 3036 to loosen and tighten



23 - Camshaft sprocket

- Remove from camshaft taper by striking with hammer using drift through hole of toothed belt guard
- Watch position when installing toothed belt:

 \Rightarrow page 15-9, Removing and installing, tensioning toothed belt for camshaft

24 - Cylinder head gasket

- ♦ Renew
- ♦ Observe marking
 - \Rightarrow page 15-8, Fig. 2
- Renew all coolant after renewing

25 - Retainer



26 - Cylinder head

- Check for warping
- ⇒ page 15-8, Fig. 1
- Installing \Rightarrow page 15-20
- Renew all coolant after renewing
- Removing and installing injectors:
- ⇒ page 23-35; Removing and installing injectors

27 - Oil deflector

28 - Cylinder head cover

- ♦ With gasket
- Before fitting, thoroughly clean sealing surface of cylinder head with a clean cloth

29 - Gasket

♦ Renew if damaged

30 - Cup packing

Renew if damaged

31 - End cover

Replace seal if damaged



Fig. 1 Checking cylinder head for warping

Special tools, workshop equipment, test and measuring equipment and accessories required

- ♦ Straight-edge
- ◆ Feeler gauge

Max. permissible warping: 0,2 mm

Note:

It is not permissible to remachine Diesel cylinder heads.



Fig. 2 Cylinder head gasket marking

- ♦ Part No. = arrow A
- ♦ Notches/holes = arrow B

Note:

Depending on the piston overhand, cylinder head gaskets of various thicknesses are installed. When renewing the gasket, install a new gasket with the same marking.



Removing and installing, tensioning toothed belt for camshaft

Special tools, workshop equipment, test and measuring equipment and accessories required

- ◆ 2065 A Adjustment ruler
- ◆ 2068 A Adjustment device for TDC point
- ♦ 3036 Brace
- ♦ 3355 Ring spanner
- ◆ V.A.G 1332 Torque spanner (40 200 Nm)

Not shown:

- ◆ T 01900 Brace
- ♦ T 01901 TDC sender





◆ Torque wrench (5 - 50 Nm) V.A.G 1331

◆ Torque wrench (150 - 800 Nm) V.A.G 1601

Removing

- Remove the engine cover.
- Remove ribbed V-belt \Rightarrow page 13-18.
- Remove upper section of toothed belt guard.



- Remove the tensioner for the ribbed V-belt.
- Turn crankshaft in engine rotating direction to TDC position of cylinder 1:
- Remove toothed belt guard for toothed belts and cylinder head cover.
- Tighten brace T 01900 on engine block -arrows- to 40 Nm
- Unscrew vibration damper/toothed belt-crankshaft at central bolt.
- Unscrew the brace T 01900 from the engine block.
- Check the TDC position:
- The markings of the vibration damper and the lower section of the toothed belt guard must be vertically aligned -arrow-.



- Engine installed:
 - The marking -A- on the injection pump pulley is to be located in the visible area of the injection pump marking -arrow-.

Notes:

- This state is only achieved in every 2nd TDC position and is used exclusively to check the TDC position.
- The marking -A- indicates that the injection pump is positioned on Cylinder 1.



- Screw the TDC sender T 01901 into the opening of the clutch bell.
 - The TDC sender must engage, otherwise the crankshaft must be turned until the TDC sender is heard and felt to engage.



- Engine removed:
 - Set adjustment device for TDC 2068 A to 96.9 mm -arrow A-, left notch of vernier gauge is reference point.
 - Screw in adjustment device as shown. Turn crankshaft until TDC marking on flywheel aligns with edge of adjustment device -arrow B-.
 - The marking -A- on the injection pump pulley is to be located in the area of the injection pump marking -arrow-.

Notes:

- This state is only achieved in every 2nd TDC position and is used exclusively to check the TDC position.
- The marking -A- indicates that the injection pump is positioned on Cylinder 1.
- Remove toothed belt for injection pump ⇒ page 23-18; Removing and installing, tensioning toothed belt for injection pump
- Unscrew 4 mounting bolts M8 of vibration damper/toothed belt pulley-crankshaft.
- Unscrew central bolt for vibration damper.
- Remove vibration damper.
- Remove toothed belt guard at bottom \Rightarrow page 13-8, item 13.
- Relax tensioner for toothed belt with ring spanner 3355.

15-13 –

- Remove toothed belt.

Installing, tensioning

Engine installed:

- Check whether TDC sender T 01901 is screwed in and engaged.

Engine removed:

- Check whether TDC marking on flywheel and reference mark are aligned.
- Lock camshaft in place with adjustment ruler 2065 A.





- Centre adjustment ruler as follows:

Turn the locked camshaft until one end of the adjustment ruler strikes the cylinder head. Measure the resulting clearance at the other end of the adjustment ruler with a feeler gauge. Push a feeler gauge with half the clearance dimension between the adjustment ruler and the cylinder head. Now turn the camshaft until the adjustment ruler contacts the feeler gauge. Insert a second feeler gauge with the same dimension between the adjustment ruler and the cylinder head at the other end.

Loosen mounting bolt of camshaft sprocket ¹/₂ turn. Separate camshaft sprocket from taper of camshaft by striking with a hammer (with drift through hole of rear toothed belt guard).



- Install tensioner -1- so that tab -2- of tensioner is seated in anti-twist pin of lower section of toothed belt guard.
 - Lay on new toothed belt for camshaftdrive.
 - Tighten mounting bolt of tensioner hand-tight.



- To tension toothed belt, turn tensioner clockwise -direction of arrowwith ring spanner 3355 until right edge of pointer -A- is aligned with right edge of pointer -B-.

Note:

The right edge of pointer -A- may not be turned past the right edge of pointer -B-, as otherwise there is danger of pre-damage to the tensioner.

However, if it is accidentally turned too far once, the tensioner must be completely relaxed and retensioned. The eccentric may not be turned back only by the dimension it was turned too far.

- Tighten mounting bolt of tensioner with 20 Nm
- Check whether crankshaft is still at TDC of cylinder 1 and correct if necessary.

Engine installed:

Note:

Unscrew TDC sender T 01901 from gearbox bell.

- Tighten mounting bolt for camshaft sprocket with brace 3036. Observe marking for bolt steel on bolt head:

8.8 = 85 Nm

- 10.9 = 100 Nm
- Remove adjustment ruler 2065 A from camshaft.
 - Install bottom toothed belt guard.
 - Fit vibration damper with new central bolt.







- Screw brace T 01900 onto engine block with 40 Nm -arrows-, tighten vibration damper/toothed belt pulley-crankshaft at central bolt to 160 Nm and turn 180° (1/2 turn) further (turning further can be carried out in several steps).
 - Unscrew the brace T 01900.
 - Tighten 4 mounting bolts M8 of vibration damper/toothed belt pulley-crankshaft with 20 Nm.



- Turn crankshaft two rotations in engine rotating direction until crankshaft is positioned at TDC for cylinder 1 again.
- Check pointer position of tensioner again. If right edges of pointers
 -A- and -B- do not align, tensioning must be repeated.

- Toothed belt for injection pump
 ⇒ page 23-18, Removing and installing, tensioning toothed belt for injection pump
- Install toothed belt guard for toothed belt and cylinder head cover.
- Install tensioner for ribbed V-belt.
- Install ribbed V-belt \Rightarrow page 13-18.
- Install the engine cover.



Removing and installing cylinder head

Special tools, workshop equipment, test and measuring equipment and accessories required

- ♦ V.A.G 1306 Catch pan
- ◆ V.A.G 1331 Torque spanner (5 50 Nm)
- ◆ V.A.G 1332 Torque spanner (40 200 Nm)

Preconditions

- The engine may be a maximum of hand-warm.
- The pistons may not be at top dead centre.

Removing

- Remove the engine cover.
- Drain the coolant \Rightarrow page 19-26.
- Remove ribbed V-belt \Rightarrow page 13-18.
- Remove upper toothed belt guard and cylinder head cover.
- Take toothed belt off camshaft pulley and remove camshaft pulley
 ⇒ page 15-9, Removing and installing toothed belt for camshaft.
- Loosen cylinder head bolts in specified order and unscrew.
 - Carefully remove cylinder head.

	7	9	(11)	5	3
4	6	(12)	10	8	2
					N15-0148

Fitting

Notes:

- ◆ Always renew cylinder head bolts.
- Remove gasket residues from the cylinder head and cylinder block when making repairs. Make sure that not long grooves or scratches result. When using emery paper the grain may not be below 100.
- Thoroughly remove sanding and grinding residues.
- Do not remove the new cylinder head gasket from the package until directly prior to installation.
- Handle the gasket with extreme care. Damage to the silicone layer and in the bead area results in leaks.
- Set crankshaft to the TDC marking before fitting cylinder head.
- Turn crankshaft in direction opposite engine rotating direction until no piston is at TDC.
- Check whether dowel sleeves for guiding cylinder head are located in cylinder head and insert if necessary.
- Fit cylinder head gasket.
- Fit cylinder head, insert cylinder head bolts and tighten hand-tight.



- Tighten cylinder head in four steps in tightening order shown as follows:
 - 1. Pre-tighten with torque spanner: Step I = 40 Nm
 Step II = 60 Nm
 - 2. Turn further with rigid spanner: Step III = 1/4 turn (90 °) Step IV = 1/4 turn (90 °)

Notes:

- ◆ Loosen cylinder head: Reverse order.
- It is not necessary to retighten the cylinder head bolts following repairs.
- After mounting cylinder head, turn camshaft so that cams for cylinder 1 point upward evenly. Set crankshaft to TDC in engine rotating direction before fitting toothed belt.

How to install toothed belt and adjust control times \Rightarrow page 15-9, Removing and installing toothed belt for camshaft.

How to pour in new coolant \Rightarrow page 19-26.

- Install the engine cover.



Checking compression pressure

Special tools, workshop equipment, test and measuring equipment and accessories required

- ◆ V.A.G 1381 Compression pressure tester
- ◆ V.A.G 1763 Compression pressure tester
- ♦ V.A.G 1381/12 Adapter
- ♦ 3220 Flexible-head spanner
- ♦ V.A.G 1331 Torque spanner (5 50 Nm)



Test condition

• Engine oil temperature at least 30 °C.

Test procedure

- Remove the engine cover.
- Pull plug of injection pump off fuse box/relay plate.
- Disconnect plugs from all glowplugs.
- Remove all glow plugs with flexible-head spanner 3220.
- Screw in adapter V.A.G 1381/12 in place of glow plugs.
- Check compression pressure with compression pressure tester V.A.G 1381 or V.A.G 1763.

Note:

For instructions on using the tester \Rightarrow Operating Manual.

- Actuate starter until no further pressure increase is indicated by tester.

Compression pressure values:

New: 30 - 35 bar gauge pressure Wear limit: 28 bar gauge pressure

Permissible difference between all cylinders: 5 bar

- Install glow plugs with flexible-head spanner 3220 Tightening torque: 15 Nm.
- Interrogate fault memory:
- \Rightarrow page 01-10; Fault memory; Interrogating fault memory

Note:

Faults are saved when the connectors to the injection pump are separated. Therefore, interrogate the fault memory and clear it if necessary.

- Install the engine cover.



Servicing valve gear

Note:

Cylinder heads with minor cracks (max. 0.5 mm wide) between the valve seats can still be used without shortening the service life.

1 - Bearing cap

- Installation position \Rightarrow Fig. 2
- ♦ For installation sequence
 ⇒ page 15-41, Removing and installing camshaft

2 - 20 Nm

3 - Camshaft

- Check axial clearance \Rightarrow fig. 1
- Removing and installing
 - ⇒ page 15-41
- Check radial clearance with Plastigage
 - Wear limit: 0.11 mm
- ♦ Run-out: max. 0.01 mm
- Marking, value timing \Rightarrow fig. 4



4 - Bucket tappet

- ♦ Do not interchange
- With hydraulic valve clearance compensation
- Check \Rightarrow page 15-43
- Lay down with running surface downward
- Check axial clearance of camshaft before installing
 - \Rightarrow Fig. 1
- ♦ Oil running surface

5 - Valve cotters

6 - Upper valve spring retainer

7 - Valve spring

 ♦ Removing and installing: Cylinder head removed: With valve spring compressor 2037 installed: → page 15-39

pressor 2037 installed: \Rightarrow page 15-39, Renewing valve stem seals



8 - Valve stem seal

• Renew \Rightarrow page 15-39

9 - Repair valve guide

- Repair guide with shoulder
- Check \Rightarrow page 15-36
- ♦ Renew \Rightarrow page 15-37

10 - Seal

- Remove to remove and install bearing cap
- Removing and installing, tensioning toothed belt for injection pump:
- ⇒ page 23-18: Removing and installing, tensioning toothed belt for injection pump

11 - Glow plug

- Removing and installing, checking glow plug:
- \Rightarrow page 28-3; Checking glowplug
- 12 30 Nm
- 13 Clamp



14 - Injector

- Removing and installing injectors:
- ⇒ page 23-35; Removing and installing injectors

15 - Heat shield

♦ Renew

16 - Cylinder head

- Observe note
 - ⇒ page 15-27
- ♦ Reworking valve seats
 ⇒ page 15-34

17 - Valves

• Valve dimensions \Rightarrow fig. 3

18 - Seal

- Remove to remove and install bearing cap
- Removing and installing, tensioning toothed belt for camshaft
 page 15.9
 - ⇒ page 15-9

19 - Valve guide

- Check \Rightarrow page 15-36
- ♦ Renew ⇒ page 15-37



Fig. 1 Checking camshaft, axial clearance

Special tools, workshop equipment, test and measuring equipment and accessories required

- ♦ VW 387 Universal dial gauge holder
- ♦ Dial gauge

Wear limit: max. 0.15 mm

Carry out measurement with bucket tappets removed and first and last bearing cap mounted.



Fig. 2 Installation position of camshaft bearing cap

Observe centre offset. Before installing the camshaft, fit bearing cap and determine installation position.



Fig. 3 Valve dimensions

Note:

Valves may not be reworked. Only grinding in is permitted.

Dimension		Inlet valve	Exhaust valve
Ø a	mm	36.00	31.50
Øb	mm	7.97	7.95
С	mm	96.85	96.85
α	∠°	45	45



Fig. 4 Camshaft marking, valve timing

Marking

- ◆ Base circle of cams: a = 38 mm dia.
- Marking with stamped-in numbers and letters on the camshaft:

Cylinder 1 -arrow A-	WZO
Cylinder 2 -arrow B-	046/074

Valve timing for 1 mm valve lift

Inlet opens after TDC	8.0 °
Inlet closes after BDC	28.0 °
Exhaust opens before BDC	37.0 °
Exhaust closes before TDC	10.0 °

Reworking valve seats

Special tools, workshop equipment, test and measuring equipment and accessories required

- Depth dimension
- ◆ Valve-seat machining device

Notes:

- When servicing engines with leaky valves, it is not sufficient to machine or renew the valve seats and valves. Especially on engines with higher kilometrage it is necessary to check the valve guides for wear.
- Only rework valve seat so far that a proper surface condition is achieved. Before reworking the maximum permissible reworking dimension must be calculated. If the reworking dimension is exceeded, the operation of the hydraulic valve clearance compensation is no longer ensured and the cylinder head must be renewed.

Calculate maximum permissible reworking dimension

- Insert valve and press firmly against valve seat.

Note:

If the valve is renewed as part of repair work, use a new valve for measurement.



- Measure distance -a- between valve stem end and upper edge of cylinder head.
 - Calculate maximum permissible reworking dimension from measured distance -a- and minimum dimension.

Minimum dimension: Inlet valve 35.8 mm Exhaust valve 36.1 mm

Measured distance minus minimum dimension = maximum permissible reworking dimension.

Example:

Measured distance	36.5 mm
- Minimum dimension	35.8 mm
= Max. perm. reworking dimens	sion 0.7 mm



Reworking valve seats

Dimension		Inlet valve seat	Exhaust valve seat	
Øa	mm	37.20 ¹⁾	33.20 ¹⁾	
Øb	mm	34.80	30.40	
с	mm	2.70	2.05	
45°		Valve seat angle		
15°		Correction angle		

¹⁾ Maximum outside diameter of correction cutter



Checking valve guides

Special tools, workshop equipment, test and measuring equipment and accessories required

- ◆ VW 387 Universal dial gauge holder
- ♦ Dial gauge


Test procedure

- Insert new valve in guide. Valve stem end must be flush with guide. Due to different stem diameters, only inlet valve can be used in inlet guide and exhaust valve in exhaust guide.

Rock: max. 1.3mm

Renewing valve guides

Special tools, workshop equipment, test and measuring equipment and accessories required

♦ 10-206 Drift





♦ 10-215 Hand reamer and cutting fluid

Removing

- Clean and check cylinder head. Heads with valve seal inserts that cannot be reworked or cylinder heads which have already been machined to the minimum dimension are not suitable for replacing the valve guides.
- Press out worn guides with driver 10-206 from camshaft side (valve guide with shoulder repair guides from combustion chamber side).

Fitting

- Moisten new guides with oil and press into cold cylinder head up to shoulder with driver 10-206 from camshaft side.

Note:

After the guide makes contact with the shoulder, the press-in pressure may not be increased above 1.0 t, as otherwise the shoulder may break off.

- Ream valve guide by hand with hand reamer 10-215. Be sure to use cutting fluid when doing so.
- Rework valve seats \Rightarrow page 15-34.



Renewing valve stem seals

Special tools, workshop equipment, test and measuring equipment and accessories required

- ♦ 2036 Service device
- ♦ 3047 A Puller
- ♦ 10-204 Press-on device
- ♦ VW 541/1A Service lever
- ♦ VW 541/5 Pressure piece





Removing

(with cylinder head installed)

- Remove camshaft \Rightarrow page 15-41.
- Remove bucket tappets (do not interchange) and lay down with running surface facing downward.
- Move piston of respective cylinder into top dead centre (TDC) position.
- Fit service device 2036 and adjust mounting to stud height.
- Remove valve springs with valve lever VW 541/1A and pressure piece.

Note:

The valves are supported on the piston crown in the process.

- Pull off valve stem seals with puller 3047A.





Fitting

- To prevent damage to new valve stem seals, push plastic sleeve -Aonto valve stem.
- Oil valve stem seal -B- insert in press-on device 10-204 and carefully push onto valve guide.

Removing and installing camshaft

Special tools, workshop equipment, test and measuring equipment and accessories required

◆ Torque wrench (5 - 50 Nm) V.A.G 1331

Removing

- Remove toothed belt for camshaft ⇒ page 15-9, Removing and installing, tensioning toothed belt for camshaft
- Remove toothed belt for injection pump ⇒ page 23-18; Removing and installing, tensioning toothed belt for injection pump
- First remove bearing cap 1 and 3. Loosen bearing cap 2 and 4 alternately and diagonally.



Fitting

Notes:

- When installing the camshaft, the cams for cylinder 1 must face upward.
- When installing the bearing caps, watch centre offset of hole by fitting bearing cap and determining installation position prior to installation.
- Oil camshaft running surfaces.
- Tighten bearing caps 2 and 4 alternately and diagonally with 20 Nm
- Install bearing caps 1 and 3 and also tighten with 20 Nm
- Install and tension toothed belt for camshaft \Rightarrow page 15-9 Removing and installing, tensioning toothed belt for camshaft.
- Toothed belt for injection pump ⇒ page 23-18, Removing and installing, tensioning toothed belt for injection pump

Note:

After installing new bucket tappets, the motor may not be started for approx. 30 minutes. Hydraulic compensation elements must settle (otherwise the valves set down on the pistons).

Checking hydraulic bucket tappets

Special tools, workshop equipment, test and measuring equipment and accessories required

- ♦ Feeler gauge
- ◆ Wood or plastic wedge

Notes:

- Only renew bucket tappets in complete sets (cannot be adjusted or serviced).
- Irregular valve noises are normal during starting.

Test procedure

- Start engine and run until a coolant temperature of approx. 80°C is reached.
- Increase speed to approx. 2500 rpm for 2 minutes.

If the hydraulic bucket tappets are still loud, determine the defective tappet(s) as follows:

- Remove the engine cover.
- Remove cylinder head cover.
- Turn crankshaft in engine rotating direction until cams of bucket tappets to be checked are facing upward.

- 15-43 ——



- Determine clearance between cam and bucket tappet.
- If clearance is greater then 0.1 mm, renew bucket tappet. If clearance less than 0.1 mm or not clearance is determined, continue check as follows:
- Press down bucket tappet with wood or plastic wedge. If travel is greater than
 0.1 mm until opening of valve is felt, renew tappet.

Note:

After installing new bucket tappets, the motor may not be started for approx. 30 minutes. Hydraulic compensation elements must settle (otherwise the valves set down on the pistons).

- Install the engine cover.

Removing and installing parts of lubrication system

Note:

If large quantities of metal chips and abrasion caused by seizing, such as crankshaft and conrod bearing damage, is found in the engine oil, the oil cooler must be renewed and the oil channels thoroughly cleaned to prevent subsequent damage.

Check oil pressure \Rightarrow page 17-22

Oil capacity:

with oil filter 6.5 I

Engine oil specifications:

Use only motor oil in accordance with TL 52173, VW Standard 50300.

Notes:

- The VW Marine Longlife Oil is recommended which, compared to ordinary longlife oil for passenger cars, is provided with additives for increased corrosion protection. The increased share of corrosion protection is particularly important for longer standstill times and winter storage.
- An annual oil change at the end of the season is generally specified.



- $I \Rightarrow page 17-3$
- II ⇒ page 17-7
- III⇒page 17-10
- IV⇒ page 17-14



Part I

- 1 160 Nm + $^{1}/_{2}$ (180 °) additional turn
 - ♦ Renew
 - To loosen and tighten, use brace T 01900
 - Removing and installing, tensioning toothed belt for camshaft
 - ⇒ page 15-9

2 - 20 Nm

3 - Ribbed V-belt

- Mark running direction before removing
- Check for wear
- ♦ Removing and installing
 - ⇒ page 13-18



- 4 Vibration damper with ribbed V-belt pulley
 - Watch securing when mounting
- 5 Upper section of toothed belt guard

6 - Toothed belt for camshaft

- Check for wear
- ◆ Always renew after removal
- ♦ Do not kink
- ♦ Removing and installing, tensioning
 ⇒ page 15-9

7 - Mounting bolt for camshaft sprocket

- Observe marking for bolt steel on bolt head:
 - 8.8 = 85 Nm
 - 10.9 = 100 Nm
- ♦ Use brace 3036 to loosen and tighten



- 8 Camshaft sprocket
 - Watch position when installing toothed belt

 \Rightarrow page 15-9, Removing and installing, tensioning toothed belt for camshaft

9 - Rear toothed belt guard

10 - 20 Nm

Mount with sealing compound

11 - 10 Nm

Mount with sealing compound

12 - Lower section of toothed belt guard

13 - Oil pump

- ♦ Watch driver on crankshaft when installing ⇒ page 17-13, item 30
- Only renew entire unit
- Must be seated on dowel sleeves

14 - Closing cover



- 15 Oil pump gears
 - Marking "D" faces toward closing cover

16 - Oil-pressure relief valve, 40 Nm

 Opening pressure: 5.3 - 6.3 bar gauge pressure

17 - Seal

• Renew \Rightarrow page 13-26

18 - Toothed belt sprocket for crankshaft

19 - Washer

- ♦ Renew
- Must be diamond-coated

20 - Toothed belt guard

21 - Tensioner



Part II

1 - Connection piece

◆ For crankcase ventilation

2 - Connecting hose

- ◆ For crankcase ventilation
- Secured with clamps
- 3 Retaining plate
- 4 Washer
- 5 10 Nm
- 6 15 Nm
- 7 Round bearing
- 8 10 Nm



- 9 Cover for pressure control valve
- 10 O-ring
 - ♦ Renew
- 11 5 Nm
- 12 Retaining clip
- 13 Oil separator
- 14 Oil separator housing
- 15 25 Nm
- 16 Gasket
 - ♦ Renew if damaged
- 17 To oil return line
 - $\blacklozenge \Rightarrow$ page 17-10, item 3
- 18 Retainer
 - ◆ For accelerator lever position sender
 - ◆ For oil separator reservoir



- 19 Sealing plug
- 20 Seal
 - ♦ Renew
- 21 Cylinder block



Part III

- 1 Cap
 - ◆ Replace seal if damaged

2 - Cup packing

- ♦ Renew if damaged
- 3 From oil separator reservoir
- 4 Oil return line

5 - Oil spray nozzle

- For piston cooling
- 6 10 Nm
 - ◆ Fit with AMV 188 100 02

7 - Adapter, 50 Nm

- Pinch off and renew sealing ring in case of leaks
- 8 Spring for oil-pressure holding valve
- 9 Oil-pressure holding valve



10 - 10 Nm

11 - 20 Nm

 M8, install bolt with hexagon head on flywheel side

12 - From seawater filter

13 - 20 Nm

14 - Combination radiator

- ♦ For fuel
- ◆ For hydraulic oil/gear oil

15 - To seawater pump

16 - 15 Nm

 M6, with flywheel installed: Turn flywheel so that notches align with bolts



17 - Seal

♦ Renew if damaged

18 - Oil drain plug, 50 Nm

19 - Oil sump

- Removing and installing
- ⇒ page 17-18
- ◆ Clean sealing surface before assembly

20 - Vacuum line

- Clean screen when dirty
- 21 Gasket
 - ♦ Renew

22 - O-ring

Renew if damaged

23 - Flange cover

- Only on engines without turbocharger
- Oil return-line connection on engines with turbocharger

17-12 —



24 - Hollow screw, 30 Nm

25 - Seal

- ♦ Renew if damaged
- Use only aluminium sealing rings
- 26 Vacuum line
- 27 Oil extraction pump
- 28 Oil drain line
- 29 Gasket
 - ♦ Renew

30 - Driver

- ♦ For oil pump
- ♦ With 4 drive journals
- Heat new driver to max. 200 °C before fitting
- 31 Cylinder block
- 32 Step



Part IV

1 - Oil filter

 Observe installation instructions on oil filter

2 - O-ring

♦ Renew

3 - Oil filter cover, 25 Nm

4 - 20 Nm

5 - Oil dip stick

- Oil level may not exceed max. marking!
- Measurement only applies for horizontal engine installation

6 - Guide tube

- ♦ For oil dip stick
- With connection piece for oil return line

7 - Gasket

♦ Renew if damaged



- 8 Retaining clip
- 9 20 Nm
- 10 Sealing plug
 - On engines with turbocharger, connection of oil supply line
- 11 Gasket
 - ♦ Renew
- 12 Sealing plug, 40 Nm
- 13 Seal
 - ♦ Renew
- 14 0.9 bar oil pressure switch/sender (F1), 25 Nm
 - Check \Rightarrow page 17-22
- 15 Oil cooler bracket
 - Installation position fixed with dowel pins

17-15 —



- 16 Hollow screw, 70 Nm
- 17 Retaining clip
- 18 20 Nm
- 19 Hose clamp
- 20 From engine block
- 21 To housing-radiator package

22 - Oil cooler

- Coat contract surfaces outside of sealing ring with AMV 188 100 02
- Ensure clearance to surrounding components
- ♦ Observe note
 ⇒ page 17-1
- 23 Gasket
 - ♦ Renew if damaged
- 24 Oil cooler cap, 30 Nm



- 25 Oil return line
- 26 Oil supply line
- 27 25 Nm

28 - Cup oil-filter bracket

 Mounted on housing-radiator package



Removing and installing oil sump

Special tools, workshop equipment, test and measuring equipment and accessories required

- ♦ V.A.G 1331 Torque spanner (5 50 Nm)
- ♦ Hand drill with plastic brush insert
- Silicone sealing compound with original part number D176404 A2
- ♦ Flat scraper

Removing

Note:

The oil sump can only be removed with the engine raised or removed.

- Actuate the switch of the electric oil change pump and suck all oil out of the engine.
- Unscrew the mounting bolts from the gearbox bell to the oil sump.





- Unscrew the oil sump.
- If necessary, the oil pan must be separated by tapping lightly with a rubber mallet.
- Remove the sealant residues on the cylinder block with a flat scraper.
- Remove the sealant residues on the oil sump with a rotating brush, e.g. a hand drill with a plastic brush insert (wear protective goggles).
- Clean the sealing surfaces. They must be oil and grease-free.

Fitting

Notes:

- Observe the expiration date of the sealing compound.
- The oil sump must be installed within 5 minutes after applying the silicone sealing compound.
- Cut off the tube nozzle at the front marking (Ø of the nozzle approx.
 3 mm).

- Apply the silicone sealing compound to the clean sealing surface of the oil sump as shown. The sealing compound bead must:
 - ♦ be 2 3 mm thick
 - Run past the bolt holes on the inside -arrows-

Note:

The sealing compound bead may not be thicker, as otherwise excess sealing compound can get into the oil sump and clog the screen in the oil-pump suction line.

- Immediately position the oil sump and slightly tighten all oil sump bolts.

Note:

The oil sump must align flush with the cylinder block and the gearbox bell.

- Tighten the M6 oil sump bolts with 15 Nm
- Tighten the M8 oil sump bolts with 20 Nm
- Tighten the oil sump/gearbox bell bolts with 60 Nm

Note:

After fitting the oil sump, the sealing compound must dry for approx. 30 minutes. Do not pour in motor oil until after this time.

Further assembly is carried out in the opposite order of removal.



Checking oil pressure and oil pressure switch

Special tools, workshop equipment, test and measuring equipment and accessories required

- ♦ V.A.G 1342 Oil pressure tester
- ♦ V.A.G 1527 B Diode test lamp
- ♦ V.A.G 1594 A Auxiliary test set



Note:

Operating test and servicing of optical and acoustic oil pressure indicator: ⇒ Current flow diagrams

Test procedure

- Remove 0.9 bar oil pressure switch (F1) and carefully screw in tester.
- Screw hose connection from tester V.A.G 1342 into oil cooler bracket in place of oil pressure switch.
- Lay brown wire of tester to contact -M- (ground) of oil pressure switch.
- Connect diode test lamp V.A.G 1527 B to battery positive (+) and 0.9 bar oil pressure switch (F1) and to contact -WK- (warning contact) of oil pressure switch with auxiliary wires from V.A.G 1594 A LED must light up.
 - Start engine and slowly increase speed. At

0.75 - 1.05 bar gauge pressure LED must go out, otherwise Replace 0.9 bar oil pressure switch.

 Increase speed further. At 2000 rpm and 80 °C oil temperature, oil gauge pressure is to be at least 2.0 bar. At higher speed oil gauge pressure may not exceed 5.0 bar

 Renew oil-pressure relief valve (⇒ page 17-6, item 16) or oilpressure holding valve (⇒ page 17-10, item 9) if necessary.

Removing and installing parts of cooling system

Notes:

- When the engine is hot, the cooling system is pressurised. Before repairs, release pressure if necessary (carefully open cap of housing-radiator package).
- Hose connections are secured with spring clips. Use only spring clips when making repairs.
- The assembly tool VAS 5024 or the pliers V.A.G 1921 are recommended for mounting the spring clips.
- Paint areas damaged on during removal and installation must be touched up immediately (danger of corrosion).

Test the cooling system for leaks with the cooling system tester V.A.G 1274.

Parts of cooling system on seawater side \Rightarrow page 19-3.

Parts of cooling system on engine \Rightarrow 19-12.

Dismantling and assembling housing-radiator package \Rightarrow page 19-16.

Connection diagram for coolant hoses \Rightarrow page 19-20.

Draining and filling coolant \Rightarrow page 19-26.

Coolant mixing specifications \Rightarrow page 19-26, Draining and filling coolant.



Parts of cooling system on seawater side

1-20 Nm

2 - Intake manifold

- Engine code letters BCV, ANH with integrated intercooler
- ♦ Removing and installing
 ⇒ page 21-17

3 - From air filter

4 - 20 Nm

5 - Reactive anode

- Check and renew if necessary:
- ⇒ Inspection service; Work Descriptions for Service Work; Checking reactive anode and replacing if necessary
 - Renew if worn by more than 50% (10 mm)



- 6 Sealing plug
- 7 Seal
 - ♦ Renew

8 - Connecting piece

- Mark installation position before removing
- 9 To exhaust-pipe connection piece

10 - Housing-radiator package

- ◆ Dismantling and assembling
 ⇒ page 19-16
- Install with assembly aid T 01902 \Rightarrow Fig. 3

11 - Drain plug

◆ Draining and filling coolant
 ⇒ page 19-8, Fig. 1

12 - Seawater supply line

13 - Seawater filter

◆ Dismantling and assembling
 ⇒ page 19-10


- 14 Connecting hose
- 15 Gasket ♦ Renew
- 16 Return line for power steering/ reversing gear
- 17 To hydraulic oil reservoir
- 18 Return line of injection pump
- 19 Connection of fuel return line to tank

20 - Combination radiator

- ♦ For fuel
- ◆ For hydraulic oil/gear oil
- With seawater drain screw \Rightarrow Fig. 2

21 - Connecting hose



22 - 25 Nm

23 - Belt pulley

◆ To remove, use water pump key V.A.G 1590

24 - Seawater pump

♦ Removing and installing
 ⇒ page 19-30

25 - Washer

26 - Connecting hose

 On engines without intercooling, direct to seawater pump connection

27 - Connecting hose

 On engines without intercooling, direct to housing-radiator package connection

Note:

On engines without intercooling, instead of Items 26 and 27 only a hose is installed that connects the seawater pump to the housingradiator package.



- 28 20 Nm
- 29 End cover
 - Test pressure 1.3 1.5 bar gauge pressure



Fig. 1 Seawater drain screw

Note:

Push a suitable hose onto the drain screw and then catch the seawater flowing out.

Open the drain screw -arrow- 1 turn and drain off seawater.



Fig. 2 Seawater drain screw on combination radiator for hydraulic system/gearbox and fuel

Open the drain screw -2- approx. ½ turn and drain off seawater.



Fig. 3 Installing housing-radiator package

Special tools, workshop equipment, test and measuring equipment and accessories required

♦ T 01902 Assembly aid

Fitting

- Screw the guide pin of the assembly aid T 01902 into the cylinder head.
- Assembly the housing-radiator package with the gaskets on the guide pins and screw in the mounting bolts for the housing hand-tight.
- Unscrew the guide pins with the assembly aid T 01902.
- Screw in the remaining mounting bolts hand-tight
- Screw housing-radiator package onto cylinder head Tightening torque: 20 Nm



Dismantling and assembling seawater filter

- 1 Sight glass
- 2 End cover
- 3 Washer
- 4 10 Nm
- 5 Seawater filter
 - Filter must be checked and cleaned regularly
- 6 O-ring
 - Renew if damaged or leaky
- 7 Seawater supply line
- 8 Connecting piece
 - Seal off with Teflon tape before screwing in



- 9 Seawater filter housing
 - Mounted in engine compartment
- 10 Connecting hose
- **11 To combination radiator**
- 12 Seal
 - ♦ Renew
- 13 Drain plug



Parts of cooling system on engine

1 - To housing-radiator package

- ♦ Supply line
- ◆ Dismantling and assembling
 ⇒ page 19-16
- Install with assembly aid
 T 01902 ⇒ page 19-9, Fig. 3
- ♦ Connection diagram for coolant hoses ⇒ page 19-20

2 - To housing-radiator package

- ♦ Return line
- ◆ Dismantling and assembling
 ⇒ page 19-16
- Install with assembly aid
 T 01902 ⇒ page 19-9, Fig. 3
- ♦ Connection diagram for coolant hoses ⇒ page 19-20

3 - Coolant hose

 ♦ Connection diagram for coolant hoses ⇒ page 19-20

4 - To connection piece

- ♦ Hose connection
 - \Rightarrow page 19-16, Item 6

19-12 –



5 - Connection piece

6 - Coolant hose

- Engine code letters BCT, ANF to exhaust-pipe connection piece
- Engine code letters BCU, ANG, BCV, ANH to turbocharger

7 - 10 Nm

8 - Coolant pipe

9 - Coolant drain hose

- ♦ With drain screw
- Draining and filling coolant
 - ⇒ page 19-26

10 - Return line of external heater and hot water supply

- 11 Sealing plug
 - Only when external heater and hot water supply is not installed



12 - Supply line of external heater and hot water supply

13 - Coolant temperature sender (G2)

- ♦ blue
- ♦ 2-pin
- ♦ Check:
- ⇒ page 01-10; Fault memory; Interrogating fault memory

14 - Coolant temperature sender (G62)

- with coolant temperature gauge sender (G2)
- ♦ Yellow
- ♦ 4-pin
- ♦ Check:
- ⇒ page 01-10; Fault memory; Interrogating fault memory

15 - O-ring

Renew if damaged or leaky



16 - Retaining clip

check that securely seated

17 - Connecting piece

18 - Connecting piece

For thermostat

19 - Thermostat

- ◆ Check: Heat thermostat in water bath
- ♦ Start of opening approx. 80 °C
- ♦ Opening stroke at least 7 mm

20 - 20 Nm

21 - Coolant pump

- Check for smooth running
- Only renew completely in case of damage and leaks

22 - Toothed belt for camshaft

- ♦ Check for wear
- ♦ Always renew after removal
- Do not kink
- ♦ Removing and installing, tensioning
 ⇒ page 15-9



Dismantling and assembling housing-radiator package

- 1 Capl
 - Test pressure 1.3 1.5 bar gauge pressure
- 2 20 Nm
- 3 Housing-radiator package
 - Install with assembly aid
 T 01902 ⇒ page 19-9, Fig. 3
- 4 O-ring
 - Renew if damaged or leaky
- 5 Water level sender (G120) ♦ Check
- ⇒ Current Flow Diagrams binder

6 - Connection piece

- ♦ For coolant hose
 - \Rightarrow page 19-12, item 4



7 - Locking ball

8 - Seal

- ♦ Renew if damaged
- Use only aluminium sealing rings

9 - Sealing plug, 40 Nm

10 - Connecting piece

Mark installation position before removing

11 - To exhaust-pipe connection piece

12 - 20 Nm

13 - Drain plug

◆ Draining and filling coolant
 ⇒ page 19-8, Fig. 1

14 - Intermediate plate

 Mark installation position before removing



15 - Reactive anode

- Check and renew if necessary:
- ⇒ Inspection service; Work Descriptions for Service Work; Checking reactive anode and replacing if necessary
 - Renew if worn by more than 50% (10 mm)

16 - Sealing plug

- 17 Gasket
 - ♦ Renew

18 - Connection hose to intercooler

 On engines without intercooling, direct to seawater pump connection

19 - Heat exchanger

- Mark installation position before removing
- 20 Washer



21 - 20 Nm

22 - Coolant vent hose

23 - To cylinder head

 ♦ Connection diagram for coolant hoses ⇒ page 19-20

24 - Banjo bolt, 20 Nm



Connection diagram for coolant hoses

Engine code letters BCT, ANF

Engine code letters BCU, ANG \Rightarrow page 19-22

Engine code letters BCV, ANH \Rightarrow page 19-24

- 1 Seawater inlet
- 2 Seawater filter
- **3 Combination radiator**
 - ♦ For fuel
 - ◆ For hydraulic oil/gear oil
- 4 Seawater pump
- 5 Main heat exchanger
- 6 Seawater outlet



- 7 Exhaust-pipe connection piece
- 8 Thermostat
- 9 Cylinder block
- 10 Oil cooler
- 11 Coolant expansion tank
- 12 Exhaust plenum chamber
- 13 Housing-radiator package



Engine code letters BCU, ANG

- 1 Seawater inlet
- 2 Seawater filter
- **3** Combination radiator
 - ♦ For fuel
 - ◆ For hydraulic oil/gear oil
- 4 Seawater pump
- 5 Main heat exchanger
- **6** Exhaust-pipe connection piece
- 7 Seawater outlet
- 8 Turbocharger
- 9 Thermostat
- 10 Cylinder block



- 11 Oil cooler
- 12 Coolant expansion tank
- 13 Exhaust plenum chamber
- 14 Housing-radiator package



Engine code letters BCV, ANH

- 1 Seawater inlet
- 2 Seawater filter
- **3** Combination radiator
 - ♦ For fuel
 - ◆ For hydraulic oil/gear oil
- 4 Seawater pump
- 5 Intake manifold
 - ♦ With intercooler
- **6** Exhaust-pipe connection piece
- 7 Seawater outlet
- 8 Turbocharger
- 9 Thermostat



- 10 Cylinder block
- 11 Oil cooler
- 12 Coolant expansion tank
- 13 Exhaust plenum chamber
- 14 Housing-radiator package
- 15 Main heat exchanger



Draining and filling coolant

Special tools, workshop equipment, test and measuring equipment and accessories required

- ◆ T10007 Refractometer
- ♦ V.A.G 1306 Catch pan
- ♦ VAS 5024 Fitting tool for spring clips



Draining

- Open cap of housing-radiator package.
- Drain coolant via drain screw -1- below thermostat housing.

Note:

Please observe the coolant disposal regulations!

Filling

Notes:

- Only G 12 as per TL VW 774 D may be used as a coolant additive. Distinguishing characteristic: Red colour
- G 12 may never be mixed with other coolant additives!

Important!

The coolant additives -G 11- and -G 12- cannot be mixed. If they are mixed, serious engine damage will result.

• If the liquid in the coolant system is brown, G 12 has been mixed with another coolant. In this case the coolant must be renewed.



- G 12 and coolant additives with the reference "as per TL VW 774 D (C)" prevent frost and corrosion damage, scale deposits and increase the boiling temperature. For these reasons the cooling system must always be filled with radiator antifreeze and anti-corrosion agent throughout the year.
- Especially in countries with a tropical climate, the coolant contributes to the operating safety due to the higher boiling point when the engine is subjected to heavy loads.
- The frost protection must be ensured down to approximately -25 °C (in countries with an arctic climate down to approximately -35 °C).
- The coolant concentration may not be reduced during the warmer season or in warmer countries by adding water. The coolant additive share must be at least 33 %.
- If stronger frost protection is required for climatic reasons, the percentage of G 12 can be increased, however only up to 60 % (frost protection down to approximately -40 5C), as otherwise the frost protection will be reduced again and the cooling efficiency worsened.
- To determine the current frost protection density, the refractometer T10007 is recommended.
- If the cylinder head or cylinder head gasket has been renewed, do not reuse used coolant.

Recommended mixing ratio:

Antifreeze percentage ¹⁾	G12	Water
33 %	4.0 I	8.0

¹⁾ Antifreeze percentage may not exceed 60 %; frost protection and cooling efficiency decrease with higher percentage.

- Slowly pour in coolant (filling duration approx. 5 minutes).

Note:

If the engine is started without seawater cooling, the ribbed V-belt for the seawater pump must be removed, as otherwise the impeller will be damaged.

- Start engine and run at idle for a maximum of 2 minutes while adding missing coolant.
- Close cap of housing exhaust manifold.
- Run engine until warm.
- Check coolant level and top up if necessary.



Removing and installing seawater pump

Special tools, workshop equipment, test and measuring equipment and accessories required

- ◆ T10007 Refractometer
- ♦ V.A.G 1306 Catch pan
- ♦ V.A.G 1331 Torque spanner (5 50 Nm)
- ♦ VAS 5024 Fitting tool for spring clips



Removing

Notes:

- ♦ Always renew gaskets and seals.
- Only use aluminium seals when renewing.
- Unscrew drain screw -2- approx. ½ turn on radiator for fuel and hydraulic oil/gear oil -1- and drain off seawater.

- Open drain screw -arrow - approx. 1 turn on housing-radiator package and also drain off seawater.



Y19-0005	

 Relax tensioner in direction of arrow with 16 mm open-end spanner and remove ribbed V-belt from belt pulleys.

- Disconnect hose connections -1- and -2- on quick-release coupling of seawater pump.
 - Unscrew mounting screws -arrows- through notches of belt pulley and carefully take out seawater pump with belt pulley.



Fitting

Installation is carried out in the reverse order while observing the following:

- Insert seawater pump in bracket and tighten mounting bolts -arrows-. Tightening torque: 20 Nm
 - Install ribbed V-belt.



Dismantling and assembling seawater pump

Special tools, workshop equipment, test and measuring equipment and accessories required

- ◆ Torque wrench (5 50 Nm) V.A.G 1331
- ◆ T 01904 JABSCO puller



Removing

- Remove the seawater pump \Rightarrow page 19-30.
- Unscrew the cover -1- of the seawater pump -2-.



 Lever the rubber protection cap -3- off the impeller -2- of the seawater pump -1- with a suitable screwdriver

- T 01904
- Carefully pull the impeller -2- out of the seawater-pump drive shaft -1- with the puller T 01904.



Fitting

- Thoroughly clean the inside housing of the seawater pump of dirt and deposits.

Notes:

- Lightly grease the drive shaft before fitting the impeller.
- Always renew seals after removal.
- If the impeller shows damage or traces of wear, it must always be renewed.
- Press the impeller -2- flush onto the drive shaft of the seawater pump -1- and seal off with the rubber protection cap -3-.

Note:

Install new round sealing ring when assembling the seawater pump.

- Screw the cover -5- onto the seawater pump -1- with a new round sealing ring -4- diagonally and hand-tight.
- Now tighten the screws -6- with 4 Nm
- Install the seawater pump \Rightarrow page 19-30.

Parts of fuel supply

Dismantling and assembling parts of fuel supply \Rightarrow page 20-2.

Servicing fuel filter \Rightarrow page 20-7.

Observe safety precautions \Rightarrow page 20-9.

Observe rules for cleanliness \Rightarrow page 20-9.

Notes:

- ◆ Hose connections are secured with spring clips.
- Fuel hoses on the engine may only be secured with spring clips. It is not permissible to use clamps or screw clips.
- The assembly tool VAS 5024 or the pliers V.A.G 1921 are recommended for mounting the spring clips.
- Paint areas damaged on during removal and installation must be touched up immediately (danger of corrosion).



Dismantling and assembling parts of fuel supply

- 1 20 Nm
- 2 Bracket with fuel filter
 - ♦ With vent screw
- 3 Supply line
 - Ensure firm seating
- 4 to the injection pump
- 5 Fuse box/relay plate
 - With stud bolt for fuel filter bracket

6 - Rubber bush

- Rubber bushes may not twist during removal and installation
- 7 20 Nm



- 8 Retainer
 - Mounted on engine block
 - With mounting for fuse box/relay plate

9 - 10 Nm

- Rubber bushes may not twist when tightening and loosening screws
- 10 10 Nm
- 11 Fuel lift pump
- 12 Mounting clip for fuel pump
- **13 Electrical connection**
- 14 Supply line
 - ♦ Ensure firm seating



- 15 Water drain screw with water warning device
 - Function of water warning device: an excessively high water level in the filter is signalled via a warning lamp in the instrument panel
 - To drain the filter, unscrew the screw approx. 1 turn and allow approx.
 100 cm³ of liquid to drain out

16 - Return line

from the injection pump

17 - Hose connection

18 - Combination radiator

- ♦ For fuel
- ◆ For hydraulic oil/gear oil

19 - to fuel tank

- 20 Seal
 - ♦ Renew


- 21 Hose connection
- 22 Hollow screw, 15 Nm

23 - Drain valve

- For draining circulation pre-filter with water separator
- Press in yellow knob and turn
- 24 From fuel tank
- 25 Hose connection
- 26 To fuel lift pump
- 27 Circulation pre-filter with water separator

28 - Filter insert

- ♦ Renew if soiled
- Bleed fuel system after renewing filter



- 29 Spring cartridge
- 30 Filter cover
 - With vent screw
- 31 Washer
- 32 10 Nm
 - ◆ Tighten screws diagonally
- 33 Vent screw



Servicing the Fuel Filter

- 1 Banjo bolt, 30 Nm
- 2 Seal
 - ♦ Renew
- 3 Supply line
 - Ensure firm seating

4 - Fuse box/relay plate

- With mounting for fuel filter bracket
- 5 To the injection pump

6 - Bracket for fuel supply filter

- ♦ With vent screw
- 7 20 Nm
- 8 Fuel supply filter
 - ◆ Renew if damaged

20-7 —



- 9 Water drain screw with water warning device
 - Function of water warning device: an excessively high water level in the filter is signalled via a warning lamp in the instrument panel
 - To drain the filter, unscrew the screw approx. 1 turn and allow approx. 100 cm³ of liquid to drain out

10 - From fuel lift pump

11 - Supply line

- Ensure firm seating
- 12 Vent screw

Safety precautions when working on fuel supply system

Observe the following when working on the fuel supply:

Avoid skin contact with fuel! Wear fuel-proof gloves!

Rules regarding cleanliness

When working on the fuel supply/injection system, the following "rules" regarding cleanliness should be carefully observed:

- Thoroughly clean connection points and their surroundings before loosening or removing them.
- Lay removed parts on a clean surface and cover. Use only lint-free cloths!
- Carefully cover or close opened parts if repairs cannot be carried out immediately.
- ♦ Only fit clean parts:

Do not remove spare parts from their packages until directly before installation.

Do not use parts which have been stored unpacked (e.g. stored in toolboxes etc.).

 When the system is opened: Avoid working with compressed air.

- In addition, also make sure that no Diesel fuel gets onto the coolant hoses. If necessary, the hoses must be cleaned again immediately. Damaged hoses must be renewed.
- Paint areas damaged on during removal and installation must be touched up immediately (danger of corrosion).



Servicing throttle controls

Note:

Only remove and install console together with retainer.

1 - 10 Nm

2 - Retainer

 Only remove and install together with console

3 - Console

Only remove and install together with retainer

4 - 6 Nm

5 - 10 Nm

6 - Accelerator lever

♦ Installing ⇒ page 20-19, Adjusting accelerator lever position sender



7 - Connecting plug

♦ Black, 6-pin

8 - Accelerator lever position sender (G79)

- The accelerator lever position sender passes the driver request on to the engine control unit
- To remove accelerator lever, unscrew Item 6
- ♦ Check ⇒ page 20-13
- ♦ Adjust ⇒ page 20-19

9 - 10 Nm

10 - Rubber bush

Rubber bushes may not twist during removal and installation



Checking accelerator lever position sender

Special tools, workshop equipment, test and measuring equipment and accessories required

- ♦ V.A.G 1526 A Hand multimeter
- ♦ V.A.G 1594 A Auxiliary test set
- Fault output device V.A.G 1552 with cable V.A.G 1551/3 or fault output device VAS 5052
- ♦ Current flow diagram

Rapid data transfer Select function XX	HELP
Read measuring value block	HELP

Enter display group number XXX

Function

The two accelerator position senders -G79 and -G185 are located in a housing and pass on the driver request to the engine completely independently of each other. The sender is secured on the console above the engine and can be mounted as desired (depending on the installation position of the throttle linkage).

Test procedure

- Connect the fault output device V.A.G 1552 (VAS 5052) and select the engine electronics control unit with the "Address word" 01. Here, the ignition must be on.

(Connecting fault output device and selecting engine control unit \Rightarrow page 01-4)

Display:

- Press keys 0 and 8 for "Read measuring value block" function and acknowledge entry with Q key.

Display:

- Press keys 0, 0 and 2 for "Display group number 2" and acknowledge entry with Q key.

Read measuring value block 2 \rightarrow						
rpm	0.0 %	0 0 1	18.4 °C			

Read measu	\rightarrow			
rpm	0.0 %	0 0 1	18.4 °C	

- Check display of accelerator position in display field 2. Accelerator must be in idling position. Setpoint value: 0.0 %
 - Also check the display for the idling switch in display field 3. The middle position must be at 1. Display: 010
 - Slowly depress the accelerator to the floor while watching the display fields 2 and 3.
 - Display field 2: The value for the accelerator position must increase continuously. Setpoint value in full-throttle position: 100 %
 - Display field 3: The middle position must jump to 0. Display: 000

If the setpoint values are not reached:

- Check the adjustment of the throttle linkage.
- Adjust the accelerator position sender
 ⇒ page 20-19.

If the display does not change or only changes irregularly:

- Press the \rightarrow -button.



- Press keys 0 and 6 for "End data transfer" function and acknowledge entry with Q key.
- Switch off the ignition.
- Check the wires of the accelerator lever position sender as follows:
- Open the cover -1- of the fuse box/relay plate.
 - To do this, unscrew the screws -arrows-.

- Pull the relay -1- out of the relay socket of the fuse box/relay plate.
 - Unlock the engine control unit -3- at socket -2- of the fuse box/relay plate and pull out the engine control unit.



- Separate the 6-pin connector for the accelerator position sender on the back of the fuse box/relay plate.
- Connect the hand multimeter V.A.G 1526 A with auxiliary wires from V.A.G 1594 A for resistance measurement:
- Check the wires at the contacts between the plug -A- and the socket -B- of the engine control unit for open circuits using the CFD. Plug -A- contact 2 + socket -B- contact 12 Plug -A- contact 3 + socket -B- contact 50 Plug -A- contact 4 + socket -B- contact 63 Plug -A- contact 6 + socket -B- contact 51 Wire resistance: max. 1.5 Ω
 - Also check the wires for short circuits to each other, to the vehicle earth and to the battery positive. Setpoint value: $\infty \Omega$

If no faults are determined in the wiring:



Measure the resistance of the sender between contacts 1+3 of the connector.
 Sotpoint value:

Setpoint value:

Accelerator lever in idling position: 0.9 - 1.1 k Ω Accelerator lever in full-throttle position: 1.6 - 1.8 k Ω

- Measure the resistance of the sender between contacts 2+3 of the connector. Setpoint value: Accelerator lever in idling position: 0.7 - 0.9 kΩ
- Check the idling switch (F60) in the accelerator position sender. To do this, measure the resistance between the plug contacts 4+6. Setpoint value:
 Accelerator lever in idling position:0.9 1.1 kΩ
 Accelerator lever in full-throttle position: ∞ Ω

If no faults are determined in the wiring:

- Renew the accelerator positions ender (G79) \Rightarrow page 20-12, item 8.
- Interrogate fault memory:
- \Rightarrow Repair group 01; Fault memory; Interrogating fault memory



Adjusting accelerator lever position sender

Special tools, workshop equipment, test and measuring equipment and accessories required

◆ VAS 5024 Fitting tool for spring clips



- Remove the engine cover.
- Unscrew throttle linkage from brake accelerator lever.
- Unclip the mounting clip -arrow- from the air filter.



- Unscrew the two upper mounting screws -1- of the fuse box/relay plate.
 - Pull off the fuse box/relay plate somewhat in -direction of arrow-.



- Unscrew the accelerator lever -1- from the accelerator position sender -2-.
 - Position the accelerator lever -1- on the accelerator position sender
 -2- so that there is a space of 3 mm between the console and the accelerator lever -arrow- (idling stop).
 Tightening torque: 10 Nm



- Tighten the mounting screws -arrows-of the fuse box/relay plate with
 10 Nm
 - Install throttle linkage.
 - After installation check the sender with the engine system tester V.A.G 1552 \Rightarrow page 20-13, Checking accelerator lever position sender.

- Secure mounting clip -arrow- on air filter.
- Install the engine cover.

Turbocharger with and without charge air system

Removing and installing turbocharger with attached parts

Parts of intercooling for engine code letters BCV, ANH \Rightarrow page 21-6

Observe rules for cleanliness \Rightarrow page 21-9.

Notes:

- ◆ All hose connections are secured with clips.
- Paint areas damaged on during removal and installation must be touched up immediately (danger of corrosion).
- ◆ Charge air system must be leak-free.
- Renew all self-locking nuts.
- ◆ The assembly tool VAS 5024 or the pliers V.A.G 1921 are recommended for mounting the spring clips.



- 1 To intake manifold
- 2 Charge air hose
- 3 20 Nm
- 4 30 Nm
- 5 Cover
- 6 40 Nm
- 7 Bracket for engine suspension
- 8 20 Nm
- 9 Mounted on engine block
- 10 Wastegate
 - Part of turbocharger and cannot be renewed
- 11 Connecting hose
- 12 Air hose
 - ◆ From air filter



13 - Turbocharger

- Removing and installing
- ⇒ page 21-10
- ♦ Check boost pressure
 - \Rightarrow page 21-21, Checking turbocharger

14 - Seal

♦ Renew

15 - Connection piece

16 - Coolant hose

- ◆ To connection piece on cylinder head ⇒ page 19-13, item 5
- 17 10 Nm
- 18 Oil return line

19 - To oil sump

- ◆ To flange cover on oil sump
 - \Rightarrow page 17-12, Item 23

20 - Gasket

♦ Renew



- 21 Gasket
 - ♦ Renew
 - Ensure proper installation position
 - ♦ Tabs face upward

22 - 40 Nm

- ◆ Do not interchange screws:
- ♦ Allen screws from above
- ♦ Hexagon bolts from below

23 - Hollow screw, 30 Nm

24 - Connecting hose

 ◆ To connection piece for housing-radiator package ⇒ page 21-3, Item 15

25 - Hollow screw, 15 Nm

26 - Oil supply line

 Fill turbocharger with engine oil at fitting of oil supply line before installing



27 - 10 Nm

28 - To connection on oil cooler bracket

• Connection \Rightarrow page 17-15, item 10

29 - Gasket

- ♦ Renew
- Ensure proper installation position

30 - Housing-radiator package

- ◆ Dismantling and assembling
 ⇒ page 19-16
- ◆ Install with assembly aid T 01902
 - \Rightarrow page 19-9, Fig. 3
- 31 Washer
- 32 20 Nm
- 33 20 Nm



Removing and installing parts of charge air cooling

Notes:

- ♦ All hose connections are secured with clips.
- Charge air system must be leak-free.

1 - Intake manifold

With integrated intercooler

2 - O-ring

- ♦ Renew if damaged
- 3 Intake manifold pressure sender (G71) with intake manifold temperature sender (G72)
 - ♦ With vent hole
 - Clean vent hole when dirty
 - ♦ Check:
- ⇒ page 23-49;Check intake manifold pressure sender



- 4 10 Nm
- 5 Sealing plug, 40 Nm
- 6 20 Nm
- 7 Closing cover
 - Mark installation position before removing
- 8 Intermediate flange
 - Mark installation position before removing
- 9 Locking ball
- 10 From hose connection of turbocharger
- 11 Gasket
 - ♦ Renew
 - Ensure proper installation position
- 12 To seawater pump



- 13 To housing-radiator package
- 14 Hose clamp

15 - Connecting piece

 Mark installation position before removing

16 - Intercooler

 Mark installation position before removing

17 - 20 Nm

Rules regarding cleanliness

Always carefully observe the following "5 rules" for cleanliness when working on the fuel supply/injection system:

- Thoroughly clean connection points and their surroundings before loosening or removing them.
- Lay removed parts on a clean surface and cover. Use only lint-free cloths!
- Carefully cover or close opened parts if repairs cannot be carried out immediately.
- Only fit clean parts: Do not remove spare parts from their packages until directly before installation. Do not use parts which have been stored unpacked (e.g. stored in

toolboxes etc.).

 When the system is opened: Avoid working with compressed air.



Removing and installing turbocharger

Special tools, workshop equipment, test and measuring equipment and accessories required

◆ V.A.G 1331 Torque spanner (5 - 50 Nm)







Removing

- Remove the engine cover.
- Unscrew the mounting bolts -arrows- for the cover -1-.



- Disconnect the connection line -2- from the turbocharger -1-.
 - Loosen the clamp -3- for the exhaust-pipe connection piece and remove the exhaust-pipe connection piece.



- Disconnect the air filter hose -arrow- from the turbocharger -1-.



- Remove the connection hose -3- between the intake manifold -2and the turbocharger -1-.



- Disconnect the oil return line -3- from the turbocharger -1-.
 - Unclip the coolant hose -2- on the connection piece of the turbocharger -1-.



Unscrew the oil supply line -arrow- from the turbocharger -1-.





- Unscrew the lower mounting bolts -arrows- on the turbocharger -1-.

- Unscrew the upper mounting bolts -arrows- between the housingradiator package and the turbocharger -1-.
 - Lift out the turbocharger with the gasket upward.



Fitting

Installation is carried out in reverse sequence. Here the following must be observed:

Position a new gasket -2- on the turbocharger -1- (tabs face toward turbocharger) and tighten the turbocharger with 40 Nm

Note:

Do not interchange the mounting bolts of the turbocharger (the hexagon bolts mount the turbocharger from below and the Allen screws from above).



 Position the oil return line -3- with new sealing rings and tighten with 10 Nm



 Position the oil supply line -arrow- with new sealing rings and tighten the banjo bolt with 30 Nm



- Position the connection line -2- with new sealing rings and tighten the banjo bolt with 15 Nm
 - Install the engine cover.

— 21-16 —



Dismantling and assembling intercooler

Engine code letters BCV, ANH

Special tools, workshop equipment, test and measuring equipment and accessories required

◆ Torque wrench (5 - 50 Nm) V.A.G 1331



Removing

- Remove the engine cover.
- Drain off the seawater at the drain screw -arrow-.

— 21-17 ——



- Disconnect the connection hoses between the seawater pump/ intercooler and the intercooler/housing-radiator package -arrows-.

Note:

Before removing the intercooler, mark the installation position of the connection piece and the end cover.

- Unscrew the mounting screws -arrows-from the flange -2- on the intake manifold -1-.
- Also remove the flange on the opposite side of the intake manifold.





- Unscrew the two locking screws -arrows- at the top on the intake manifold -1- until the intercooler can be moved easily in the intake manifold.

Note:

The intercooler must not become jammed when pulling out.

- Now carefully pull the intercooler out of the intake manifold in the -direction of the arrow-.

Note:

Clean the intercooler thoroughly before installing.

Pay particular attention to metal chips that may be located in the intake manifold and on the intercooler.


Fitting

Installation is carried out in reverse sequence. Here the following must be observed:

- Always renew the sealing rings.
- Tough-up paint defects.
- Tighten the locking screws with 40 Nm
 - Install the engine cover.



Checking boost pressure system

Checking turbocharger

Special tools, workshop equipment, test and measuring equipment and accessories required

 Fault output device V.A.G 1552 with cable V.A.G 1551/3 or fault output device VAS 5052

Test conditions

- No fault in fault memory
- \Rightarrow page 01-10; Fault memory; Interrogating fault memory
- No leaks on intake and exhaust side.
- No fault in engine/injection system, such as commencement of injection, injectors or compression pressure.
- Engine oil temperature at least 80 °C

Test procedure

If test and measuring devices are required during test drives, the following must be observed:

The test and measuring devices must be secured in the boat and operated there by a second person.

Rapid data transfer		HELP
Select f	unction XX	
·		
Read measuring value block HELP		HELP
Enter display group number XXX		

Read mea	\rightarrow		
780 rpm	XXX mbar	978 mbar	Χ%

Notes:

- ◆ The hoses must be connected absolutely leak-free.
- The boost pressure is measured using the fault output device V.A.G 1552 or VAS 5052 during a test drive.
- Connect the fault output device V.A.G 1552 or VAS 5052 and use the "Address word" 01 to select the control unit for engine electronics. The engine must be running at idle:

(Connecting fault output device and selecting engine control unit \Rightarrow page 01-4)

Display:

- Press keys 0 and 8 for "Read measuring value block" function and acknowledge entry with Q key.
- Display:
 - Press keys 0,1 and 1 for "Display group number 11" and acknowledge entry with Q key.
 - Display:
 - Accelerate the boat out of idle at full throttle.

Read measuring value block 11→2500 rpmXXXX mbar2150 mbarX %

Read measuring value block 11→3030 rpmXXXX mbar2150 mbarX %

- Read off the value in display field 3 at approx. 2500 rpm on the V.A.G 1552 or VAS 5052.
- Setpoint value on V.A.G 1552 or VAS 5052: 1950 2250 mbar (in display field 3)

Engine code letters ANH, BCV

- Read off the value in display field 3 at approx. 3000 rpm on the V.A.G 1552 or VAS 5052.
- Setpoint value on V.A.G 1551 or VAS 5052: 1950 2250 mbar (in display field 3)

Note:

The fault output device V.A.G 1552 or VAS 5052 is used to check whether the boost pressure is also detected in the control unit.

If the setpoint value is not reached:

 Check the function of the pressure unit for boost pressure control ⇒ page 21-24.

Check the function of the pressure unit for boost pressure control

The technical information on checking the pressure unit was not yet available at the editorial deadline.

Servicing diesel direct injection system

The control unit for the diesel direct injection system is equipped with a fault memory. Before repairs, adjustments and for trouble-shooting, the fault memory should be retrieved and the diagnosis of actuators carried out \Rightarrow page 01-10

Note:

During testing and adjustment, the control unit is able to detect and store faults.

After all the testing and adjustments have been completed, it is therefore essential that the fault memory is deleted \Rightarrow page 01-12.

Safety measures: \Rightarrow page 00-1; Safety precautions

Rules regarding cleanliness

Always carefully observe the following "6 rules" for cleanliness when working on the fuel supply/injection system:

- Thoroughly clean connection points and their surroundings before loosening or removing them.
- Lay removed parts on a clean surface and cover. Use only lint-free cloths!
- Carefully cover or close opened parts if repairs cannot be carried out immediately.
- Only fit clean parts: Do not remove spare parts from their packages until directly before installation. Do not use parts which have been stored unpacked (e.g. stored in

Do not use parts which have been stored unpacked (e.g. stored in toolboxes etc.).

- When the system is opened: Avoid working with compressed air.
- In addition, also make sure that no Diesel fuel gets onto the coolant hoses. If necessary, the hoses must be cleaned again immediately. Damaged hoses must be renewed.



Overview of Installation Points

- 1 Glow period warning lamp (K29)
- 2 Main panel
- **3** Diagnosis connection
- 4 Intake manifold temperature sender (G72)
 - With intake manifold pressure sender (G71), only on engines with turbocharger
- 5 Sender for accelerator position (G79)and idle switch (F60)
- ⇒ page 20-13; Checking accelerator lever position sender

6 - Injector

 Cylinder 5 with needle lift sender (G80)



7 - Glow plug

8 - Injection pump

- With quantity adjuster mechanism
- With quantity adjuster (N146)
- With modulating piston movement sender (G149)
- ♦ With fuel temperature sender (G81)
- ♦ With fuel shut-off valve (N109)
- With commencement of injection valve (N108)

9 - Fuse box/relay plate

- ♦ Components and connectors
 ⇒ page 23-6
- 10 Air cleaner

11 - Clutch switch (F36)

 ♦ With Z-drive MercruiserTM AlphaOneTM



12 - 4-pin connector

- For clutch switch (F36) or gearbox neutral switch (E352)
- With Z-drive (except Z-drive MercruiserTM AlphaOneTM) plug with two jumpers
- 13 Engine speed sender (G28)
- 14 Coolant temperature sender (G62)



Fuse box/relay plate

- 1 Emergency-Stop button
- 2 Control unit for diesel direct injection system (J248)

3 - Fuse box/relay plate

- ◆ Removing and installing:
- ⇒ page 97-1; Fuse box/relay plate; Removing and installing fuse box/relay plate

4 - 2-pin connector

• For needle lift sender (G80)

5 - 6-pin connector

 For accelerator lever position sender (G79) and idling switch (F60)



6 - 10-pin connector

- ◆ For fuel temperature sender (G81)
- ◆ For quantity adjuster (N146)
- For modulating piston movement sender (G149)
- ◆ For fuel shut-off valve (N109)
- For commencement of injection valve (N108)

7 - 5-pin connector

- ♦ For glow plugs
- 8 16-pin connector
- 9 37-pin connector
- 10 35-pin connector
- 11 Diagnosis connection
- 12 Fuse S125
 - For glowplugs



- 13 Glow plug relay (J52)
- 14 Water separator relay (J597)
- 15 Fuel shut-off activation relay (J593)
- 16 Coolant level relay (J597)
- 17 Engine stop relay fuse box/relay plate (J594)
- 18 Starter relay (J19)
- 19 Fuel pump relay (J17)
- 20 Fuse S190
 - For power supply Ter. 30
- 21 Fuse S81
 - ♦ For fuel pump



- 22 Oil extraction pump relay (J597)
- 23 Starting aid relay (J600)
- 24 Diode group (J79)
- 25 Voltage supply relay Terminal 30



Removing and installing toothed belt for injection pump

1 - Drive sprocket for injection pump

 Ensure proper position when installing toothed belt

 \Rightarrow page 23-18, Removing and installing, tensioning toothed belt for injection pump

2 - Mounting bolt for drive sprocket of injection pump

- ♦ 160 Nm
- Oil thread and contact surface
- ♦ Use brace 3036 to loosen and tighten

3 - Toothed belt for injection pump

- Mark running direction before removing
- Do not kink
- ♦ Removing and installing, tensioning
 ⇒ page 23-18



- 4 Tensioner
- 5 15 Nm
- 6 20 Nm
- 7 45 Nm

8 - Injection pump sprocket

♦ Removing ⇒ page 23-25, Removing injection pump

9 - Idler pulley

◆ Ensure proper installation position
 ⇒ page 23-18, Removing and installing, tensioning toothed belt for injection pump



Servicing injection pump

- ♦ Observe rules regarding cleanliness
 ⇒ page 23-2
- ♦ Removing and installing injection pump ⇒ page 23-25
- ♦ Check commencement of injection dynamically and adjust ⇒ page 23-31

1 - Injection lines

- ♦ Tighten with 25 Nm
- ♦ remove using 3035
- ◆ always remove complete set of lines

23-12 -

• Do not change shape of bends

2 - 25 Nm

- 3 Seal
 - ♦ Renew



4 - Return line

5 - Fuel shut-off valve(N109), 40 Nm

♦ Checking ⇒ page 01-33, Final control diagnosis

6 - O-ring

♦ Renew if damaged

7 - Connecting piece ♦ For return line

8 - Hollow screw, 25 Nm

9 - Supply line

10 - Injection pump

- With quantity adjuster mechanism
- ♦ With quantity adjuster (N146)
- With modulating piston movement sender (G149)
- ♦ With fuel temperature sender (G81)
- ♦ With fuel shut-off valve (N109)
- With commencement of injection valve (N108)



11 - Woodruff key

Check that securely seated

12 - Intermediate plate

13 - Blocking bolt

- 12 Nm with intermediate plate
 30 Nm without intermediate plate
- Blocking injection pump from delivery commencement

 \Rightarrow Removing and installing injection pump, page 23-25

14 - Sieve

15 - Commencement of injection valve (N108)

- ♦ Checking ⇒ page 01-33, Final control diagnosis
- 16 10 Nm
- 17 Retainer
- 18 Sleeve
- 19 12 Nm



- 20 Ball washer
- 21 25 Nm ♦ Renew
- 22 Bracket
- 23 45 Nm
- 24 25 Nm
 - ♦ tapered nut
- 25 Mounting bracket
- 26 Heat shield ♦ Renew
- 27 Clamp
- 28 Injector
 - for cylinder 5 with needle lift sender
 - Removing and installing
 - ⇒ page 23-35
 - Check \Rightarrow page 23-37



29 - 25 Nm

30 - 20 Nm

- 31 Connecting tube, 45 Nm
 - ♦ with pressure valve



Dismantling and assembling air filter

- 1 Spring clip
- 2 Filter insert

♦ Maintenance intervals and cleaning:
 ⇒ Operating Manual

- 3 Circlip
- 4 10 Nm
- 5 Air filter housing
- 6 Circlip
- 7 10 Nm
- 8 10 Nm
- 9 Retainer
- 10 Bolt

- 23-17 —



Removing and installing, tensioning toothed belt for injection pump

Special tools, workshop equipment, test and measuring equipment and accessories required

- 2068 A Adjustment device for TDC point (with engine removed)
- ♦ 3036 Brace
- ♦ 3313 Dial gauge adapter
- ◆ V.A.G 1331 Torque spanner (5 50 Nm)
- ◆ V.A.G 1332 Torque spanner (40 200 Nm)

Not shown:

- ♦ T 01901 TDC sender
- Dial gauge (measuring range 0 3 mm)





- Remove the engine cover.
- Remove the air filter and the intake manifold.
- Turn crankshaft in engine rotating direction to TDC position of cylinder 1:
- Check the TDC position:
- The markings of the vibration damper and the lower section of the toothed belt guard must be vertically aligned -arrow- .



- Engine installed:
 - The marking -A- on the injection pump pulley is to be located in the visible area of the injection pump marking -arrow-.

Notes:

- This state is only achieved in every 2nd TDC position and is used exclusively to check the TDC position.
- The marking -A- indicates that the injection pump is positioned on Cylinder 1.



- Screw the TDC sender T 01901 into the opening of the clutch bell.
 - The TDC sender must engage, otherwise the crankshaft must be turned until the TDC sender is heard and felt to engage.

Engine removed:

- Set adjustment device for TDC 2068 A to 96.9 mm -arrow A-, left notch of vernier gauge is reference point.
- Screw in adjustment device as shown. Turn crankshaft until TDC marking on flywheel aligns with edge of adjustment device -arrow B-.
- The marking -A- on the injection pump pulley is to be located in the area of the injection pump marking -arrow-.

23-20



Notes:

- This state is only achieved in every 2nd TDC position and is used exclusively to check the TDC position.
- The marking -A- indicates that the injection pump is positioned on Cylinder 1.
- Mark running direction of toothed belt.
- Hold injection-pump drive sprocket in place with brace 3036. Unscrew mounting bolt and remove toothed belt.
- Remove tensioner for toothed belt.

Installing, tensioning

- Block the injection pump from delivery commencement \Rightarrow page 23-30.

Engine installed:

- Check whether TDC sender T 01901 is screwed in and engaged.

Engine removed:

- Check whether TDC marking on flywheel and reference mark are aligned.



- Place the toothed belt on the injection pump sprocket.
- Watch running direction with used toothed belt.
- Insert the drive sprocket for the injection pump into the toothed belt and secure the sprocket on the camshaft in such a way that it can still be turned.
- Check installation position of idler pulley:
 - Turn the deflection roller until the pointer is flush with the flange contour of the cylinder head -arrow-.
 - Tighten the securing nuts -2- with 20 Nm.

- Fit the tensioner -1- in such a way that the tab of the tensioner is seated in the recess on the bracket -arrow B-.
- Tighten the securing screw by hand.
- To tension the toothed belt, turn the tensioning roller anti-clockwise until the two pointers are facing one another -arrow A-.
- Tighten the securing screw with 15 Nm.
- Tighten the securing nuts of the drive sprocket for the injection pump with 160 Nm. Use the retainer 3036.



Note:

Make sure when tightening the mounting bolt that no torque is transmitted to the injection pump shaft blocked at the point of injection.

- Slacken the blocking screw -2- on the injection pump.
 - Insert the intermediate plate -1- and tighten the blocking screw with 12 Nm.

Engine installed:

- Unscrew TDC sender T 01901 from gearbox bell.



- Turn crankshaft two rotations in engine rotating direction until crankshaft is positioned at TDC for cylinder 1 again.
- Check position of pointer -arrow A-. Pointers should be opposite each other. If pointers are not opposite each other, however front pointer is located within metal contour located behind it, then this is permissible.

Note:

If the front pointer is outside the metal contour located behind it, then the tensioning procedure must be repeated.

- Install the air filter and the intake manifold.
- Test the injection commencement dynamically and adjust if necessary \Rightarrow page 23-31.



Removing and installing injection pump

Special tools, workshop equipment, test and measuring equipment and accessories required

- 2068 A Adjustment device for TDC point (with engine removed)
- ♦ 3036 Brace
- ♦ 3313 Dial gauge adapter
- ♦ V.A.G 1331 Torque spanner (5 50 Nm)
- ◆ V.A.G 1332 Torque spanner (40 200 Nm)
- ♦ Extractor 3032



- ♦ 3035 Ring spanner
- ♦ T 01901 TDC sender
- Dial gauge (measuring range 0 3 mm)

Removing

- Remove the engine cover.
- Remove the air filter and the intake manifold.
- Remove the fuse box/relay plate:
- ⇒ page 97-1; Fuse box/relay plate; Removing and installing fuse box/ relay plate
- Remove the console with the accelerator lever position sender:
- \Rightarrow page 20-11; Servicing throttle controls
- Remove the injection lines using the open ring spanner 3035.

Note:

Always remove complete set of lines. Do not change the original shape

- Cover the openings with a clean cloth.
- Remove the toothed belt for the injection pump \Rightarrow page 23-18.



- Use retainer 3036 to slacken the securing nut for the injection pump sprocket by approx. 1 revolution.
 - Remove the tensioning roller and the deflection roller.



- Use extractor 3032 to pre-tension the injection pump sprocket.

Note:

In place of the extractor hook, screw two cheese head screws 3032/13 -1- into the threaded holes of the injection pump sprocket.

- Separate the injection pump sprocket from the taper of the injection pump by lightly tapping the spindle of the extractor -arrow-.
- Remove the injection pump sprocket.
- Separate the 10-pin connector for the injection pump. \Rightarrow Overview of installation locations, page 23-3.





- Unscrew the securing screws -1- and the tapered nut -2- from the console.
 - Remove the injection pump.

Fitting

Block the injection pump from delivery commencement
 ⇒ page 23-30.

Note:

New injection pumps are already blocked for delivery commencement.

- Place the injection pump in the console.
- Tighten the securing screws -1- and the tapered nut -2- with 25 Nm.

Note:

The commencement of injection is adjusted dynamically with V.A.G 1552/VAS 5052.

- Fit the injection pump sprocket. When aligning, ensure that the Woodruff keys are correctly aligned.

Note:

When tightening the securing nuts, make sure that none of the torque is transferred to the injection pump shaft which is blocked for delivery commencement.

- Tighten the securing nut with 45 Nm. Use the retainer 3036.



- Install the idler pulley and the toothed belt for the injection pump \Rightarrow page 23-18.
- At the connection for the return line, fill the injection pump with clean diesel fuel. Filling capacity for new pump is at least 180 ml
- Connect the injection lines, fuel lines.
- Install the console with the accelerator lever position sender:
- \Rightarrow page 20-11; Servicing throttle controls
- Install the fuse box/relay plate:
- ⇒ page 97-1; Fuse box/relay plate; Removing and installing fuse box/ relay plate
- Install the air filter and the intake manifold.
- Test the injection commencement dynamically and adjust if necessary \Rightarrow page 23-31.



Blocking injection pump from delivery commencement

- In place of the sealing bolt, screw in adapter 3313.
- Insert the meter (measurement range 0...3.0 mm) with approx. 2.0 mm initial tension in the adapter.



- Check whether the markings on the injection pump sprocket and the injection pump -arrows- match up.





- Slacken the blocking screw -2- on the injection pump.
 - Remove the underlying intermediate plate -1-.
 - Set the meter to "0".
 - To make sure that high-pressure piston of injection pump is at BDC, slowly turn injection pump sprocket somewhat opposite engine rotating direction (clockwise) with brace 3036. The pointer on the dial gauge must stop at "0"; if necessary, set the dial gauge to "0" after the BDC position has been reached.
 - Use retainer 3036 to turn the injection pump sprocket slowly in the direction of engine rotation (anti-clockwise) until the pointer of the dial gauge shows 0.55 mm stroke.
 - Tighten blocking bolt with 30 Nm.

Testing and adjusting injection commencement dynamically

Special tools, workshop equipment, test and measuring equipment and accessories required

 Fault output device V.A.G 1552 with cable V.A.G 1551/3 or fault output device VAS 5052
Notes:

- The dynamic test and correction of the injection commencement is only possible in function 04 "Basic Setting of the Engine".
- The injection commencement must always be checked and, if necessary, adjusted after replacement of the toothed belt or after removing the screwed connections on the injection pump or the toothed belt sprockets.

Test and adjustment conditions

- Basic mechanical setting of the engine OK
- Toothed belt tension OK. (Toothed belt camshaft drive)
- \Rightarrow page 15-9; Removing and installing toothed belt for camshaft
- The coolant temperature must be at least 70 °C.

Testing injection commencement

- Connect the fault output device V.A.G 1552 (VAS 5052) and select the engine electronics control unit with the "Address word" 01. Here, the engine should be idling.

(Connecting fault output device and selecting engine control unit \Rightarrow page 01-4)

IELP

Enter display group number XXX

System in basic setting 0

4

5

6

3

HFI P

 \rightarrow

10

8

9

7

Basic setting

2

Display:

- Press keys 0 and 4 for "Initiate basic setting" function and acknowledge entry with Q key.
- Display:
 - Press keys 0 three times for "Display group number 0" and acknow-ledge entry with Q key.
- Display:

(1...10 = display fields)

To read off commencement of injection in display field 2, the fuel temperature in display field 9 must be within the numerical range from 120 to 190.

- A Display field 2 "Commencement of injection"
 - B Display field 9 "Fuel temperature
 - C Setpoint value range for commencement of injection

Readout example:

Numerical value 140 in display field 9 (B) corresponds to a numerical value range of 38 - 67 in display field 2 (A).



Note:

 During the check, if the commencement of injection is within the setpoint value range -C-, no new setting is required. After repairs such as removing and fitting the injection pump, setting the control times, etc., set the commencement of injection to the mean value (dotted line) of the setpoint value range -C-.

Setting commencement of injection

- Remove the engine cover.
- Loosen the securing nut -2- of the idler pulley -1-.
 - Observe the value in display field 2 and, if necessary, repeat the setting until the displayed value remains at the mean value of the setpoint value range -C-.
 - Tighten the securing nuts -2- with 20 Nm.
 - Press the \rightarrow -button.
 - Press keys 0 and 6 for "End data transfer" function and acknowledge entry with Q key.
 - Install the engine cover.







Special tools, workshop equipment, test and measuring equipment and accessories required

◆ V.A.G 1331 Torque spanner (5 - 50 Nm)



♦ 3035 Ring spanner

Note:

Defective injectors cause the following faults:

- ♦ Ignition failure
- Knocking in one or more cylinders
- ♦ Engine overheats
- ◆ Drop in power/performance
- Excessive black exhaust smoke
- ◆ High fuel consumption
- ♦ Increased blue smoke at cold start

Defective nozzles can be detected by slackening the injection line union nuts one after the other while the engine is idling. If the engine speed remains constant after the union nut has been slackened, this indicates a defective nozzle.

Removing

- Remove the engine cover.

Note:

To remove the injectors on Cylinder 4 and 5 remove the console with the accelerator lever position sender: \Rightarrow page 20-11; Servicing throttle controls

- Remove the injection lines using the open ring spanner 3035.

Note:

Always remove complete set of lines. Do not change the original shape

- Slacken the securing screw, take off the clamping collar and remove the injector.

Fitting

Note:

Always replace the heat protection gasket between the cylinder head and the injectors.

- Insert the injectors.

- Ensure that the supports in the cylinder head are correctly seated.
- Insert the clamping collar.

Tightening torques: Injection lines = 25 Nm Screw for clamping collar = 25 Nm

- Install the console with the accelerator lever position sender:
- \Rightarrow page 20-11; Servicing throttle controls
- Install the engine cover.

Checking injectors

These engines are fitted with 2-spring injectors. Injection of the fuel quantity is in two stages.

If these injectors are damaged or defective, it is only possible to replace them; neither a pressure adjustment nor servicing are possible.

Special tools, workshop equipment, test and measuring equipment and accessories required

◆ Injector tester V.A.G 1322 with pressure line V.A.G 1322/2

Test condition

• Pressure gauge switched on





Important!

When checking the injectors, ensure that the jet of fuel does not strike your hands as the high pressure means that the fuel could penetrate the skin and cause serious injury.

- Connect injector to the injector testing device.
 - Slowly press down the pump lever. At the beginning of the injection, read off the injection pressure. If the injection pressure deviates from the setpoint value, replace the injectors. Setpoint values: (overpressure)

Engine code letters ANF, BCT New nozzles: 190 ... 200 bar Wear limit: 170 bar

Engine code letters ANG, ANH, BCU, BCV New nozzles: 220 ... 230 bar Wear limit: 200 bar



Checking for Leaks

- Slowly press down the pump lever and maintain the pressure at 150 bar for 10 seconds. In the process, no fuel should seep out of the nozzle opening.
- In the event of a leak, replace the injector.

Replacing O-ring on cover of injection timing device

- Remove the engine cover.
- Remove the fuse box/relay plate:
- ⇒ page 97-1; Fuse box/relay plate; Removing and installing fuse box/ relay plate
- Place a clean cloth underneath the injection pump.
- Use a standard angle screwdriver for Torx screws, e.g. Hazet 2115-T30, to unscrew the cover screws -1-.
 - Rake off the cover -2- and clean it.
 - Replace the O-ring -3- and refit the cover with the existing shims -4-.



- Install the fuse box/relay plate:
 ⇒ page 97-1; Fuse box/relay plate; Removing and installing fuse box/ relay plate
- Install the engine cover.





Checking components and functions

Checking the Power Supply for the Diesel Direct Injection System

Special tools, workshop equipment, test and measuring equipment and accessories required

♦ V.A.G 1526 A Hand multimeter

- ♦ V.A.G 1594 A Auxiliary test set
- ♦ Current flow diagram

Testing Requirement

• Battery voltage OK (at least 11.5 V)



Test procedure

- Open the cover -1- of the fuse box/relay plate.
- To do this, unscrew the screws -arrows-.

Check voltage supply relay -Terminal 30 (J317)

- Switch on the ignition. The voltage supply relay -Terminal 30 -1-must click once.

Note:

The relay can also be checked by touching.

The relay clicks:

- Check the voltage supply to Terminal $30 \Rightarrow$ page 23-45.

If the relay does not click:

- Switch off the ignition.
- Pull the voltage supply relay -Terminal 30 out of the fuse box/relay plate.
- Switch on the ignition.
- Measure the voltage with the multimeter between the contacts 85+86 of the fuse box/relay plate: Setpoint value: at least 11.5 V

If the setpoint value is reached:

- Check the voltage supply relay -Terminal 30 (J317).

If the setpoint value is not reached:

- Measure the voltage with the multimeter between contact 86 of the fuse box/relay plate and the engine earth: Setpoint value: at least 11.5 V

If the setpoint value is not reached:





- Check the cable connections to the fuse box/relay plate contact 86 for breaks, short-circuits and transition resistance at the contact points using the CFD.
- \Rightarrow Current Flow Diagrams binder

If the setpoint value is reached:

- Measure the voltage with the multimeter between contact 85 of the fuse box/relay plate and the battery (+): Setpoint value: at least 11.5 V

If the setpoint value is not reached:

- Switch off the ignition.
- Remove the engine control unit \Rightarrow page 23-88.
- Check the control line from socket -B- of the engine control unit contact 18 to the relay socket -A- contact 85 for breaks and short-circuits.

If no fault is detected in the cables and at the relay:

Replace the control unit for diesel direct injection system (J248)
 ⇒ page 23-88.





Check voltage supply to Terminal 30

- Switch off the ignition.
- Pull the voltage supply relay -Terminal 30 -1- out of the relay plate.
 - Unlock the engine control unit t -3- at socket -2- of the fuse box/relay plate and pull out the engine control unit.

- Bridge contacts 30+87 of the fuse box/relay plate -A- with auxiliary wires from V.A.G 1594.
 - Switch on the ignition.
 - Measure the supply voltage with the multimeter between contacts 1+4 and 2+5 of the socket -B- for the engine control unit: Setpoint value: at least 11.5 V

If the setpoint values are not reached:

- Check the cable connections for breaks, short-circuits and transition resistance at the contact points.

23-45



Check voltage supply to Terminal 15

- Remove the engine control unit \Rightarrow page 23-88.
- Switch on the ignition.
- Measure the supply voltage with the multimeter between contacts 4+34, 4+37 and 5+70 of the socket for the engine control unit: Setpoint value: at least 11.5 V

If the setpoint values are not reached:

- Check the cable connections for breaks, short-circuits and transition resistance at the contact points.





Checking the Engine Speed Sender

The engine speed sender is the speed and reference mark sender. In case of a failure, the engine will be switched off.

Special tools, workshop equipment, test and measuring equipment and accessories required

♦ V.A.G 1526 A Hand multimeter

- ♦ V.A.G 1594 A Auxiliary test set
- ♦ Current flow diagram



Test procedure

- Pull the plug off the engine speed sender (G28) -arrow-.

- Measure the resistance between contacts 1+2 on the sender. Setpoint value: 1,1 ... 1.6 $\mbox{k}\Omega$

If the setpoint value is not reached:

- Replace the engine speed sender (G28).
- \Rightarrow page 13-1; Dismantling and assembling engine

If the setpoint value is reached:

- Remove the engine control unit \Rightarrow page 23-88.



- Check the wires between plug -A- and socket -B- of the engine control unit for breaks using the CFD Wire resistance: max. 1.5 Ω

Plug for G28 contact	Control unit socket contact
1	102
2	110

- Check for short-circuits among the cables at the 2-pin connector in accordance with the current flow diagram. Setpoint value: $\propto \Omega$

If no faults are determined in the wiring:

Replace the control unit for diesel direct injection system (J248)
 ⇒ page 23-88.

Check intake manifold pressure sender

The intake manifold pressure sender is located together with the intake manifold temperature sender in a common housing on the intake manifold.

 \Rightarrow Overview of installation locations, page 23-3.



Special tools, workshop equipment, test and measuring equipment and accessories required

- ♦ V.A.G 1526 A Hand multimeter
- ♦ V.A.G 1594 A Auxiliary test set
- Fault output device V.A.G 1552 with cable V.A.G 1551/3 or fault output device VAS 5052
- ♦ Current flow diagram

Rapid data transfer	HELP	•
Select function XX		
[
Read measuring value block	HELP	
Enter display group number XXX		
Read measuring value block 10	\rightarrow	
780 rpm 1027 mbar 1013 mbar	0.0 %	

Test procedure

- Connect the fault output device V.A.G 1552 (VAS 5052) and select the engine electronics control unit with the "Address word" 01. Here, the ignition must be on.

(Connecting fault output device and selecting engine control unit \Rightarrow page 01-4)

Display:

- Press keys 0 and 8 for "Read measuring value block" function and acknowledge entry with Q key.

Display:

- Press keys 0,1 and 0 for "Display group number 10" and acknowledge entry with Q key.
- Compare the display in display field 3 (intake manifold pressure sender -G71) with the following table:

Altitude	Air pressure
0 m	998 mbar
500 m	954 mbar
1000 m	902 mbar
1500 m	853 mbar
2000 m	805 mbar

Note:

Depending on the weather, the air pressure may differ from the value specified in the table. Determine the actual air pressure if necessary (e.g. with a barometer or the weather report).

Setpoint value: The pressures must match up (Tolerance \pm 30 mbar)

If the value in display field 3 differs from the table value:

- Press the \rightarrow -button.
- Press keys 0 and 6 for "End data transfer" function and acknowledge entry with Q key.
- Switch off the ignition.
- Pull the plug off the intake manifold pressure sender (G71) -arrow-.
 - Remove the engine control unit \Rightarrow page 23-88.





- Check the wires between plug -A- and socket -B- of the engine control unit for breaks using the CFD Wire resistance: max. 1.5 Ω

Plug for G71 contact	Control unit socket contact
3	31
4	71

- Also check the wires for short circuits to each other, to the vehicle earth and to the battery positive. Setpoint value: $\propto \Omega$

If no fault is found in the wires:

- Replace the sender for intake manifold pressure with the sender for intake manifold temperature.



Checking the Coolant Temperature Sender

Special tools, workshop equipment, test and measuring equipment and accessories required

- ♦ V.A.G 1526 A Hand multimeter
- ♦ V.A.G 1594 A Auxiliary test set
- Fault output device V.A.G 1552 with cable V.A.G 1551/3 or fault output device VAS 5052
- ♦ Current flow diagram

Rapid data transfer		HELP
Select function XX		
Read measuring value	block	HELP
Enter display group nur	mber XXX	
Read measuring value	block 7	\rightarrow
15 / °C	15 Q °C	16 7 °C

Test procedure

- Connect the fault output device V.A.G 1552 (VAS 5052) and select the engine electronics control unit with the "Address word" 01. Here, the engine should be idling.

(Connecting fault output device and selecting engine control unit \Rightarrow page 01-4)

Display:

- Press keys 0 and 8 for "Read measuring value block" function and acknowledge entry with Q key.

Display:

- Press keys 0, 0 and 7 for "Display group number 7" and acknow-ledge entry with Q key.
- Display:
 - Check the coolant temperature value in display field 4. The temperature value must rise evenly without interruption.
- In the case of a fault, either the fuel temperature or the value 5.4 °C will be shown instead.



- If there is no realistic display in display field 4 or if the fuel temperature or - 5.4 °C is displayed instead, check the coolant temperature sender and the cable connections to the sender as follows:
- Press the \rightarrow -button.
- Press keys 0 and 6 for "End data transfer" function and acknowledge entry with Q key.
- Switch off the ignition.
- Pull the 4-pin connector off the coolant temperature sender (G62) -arrow-.



- Carry out a resistance measurement on the coolant temperature sender (G62) contact C (ground) and D (signal).



Setpoint value, see diagram

Area A shows you the resistance values for the temperature range 0 - 50 °C; area B shows the values for the temperature range 50 - 100 °C.

Readout examples:

- \blacklozenge 30 °C corresponds to a resistance of 1500 2000 Ω
- \blacklozenge 80 °Corresponds to a resistance of 275 375 Ω

If the setpoint value is not reached:

- Replace the coolant temperature sender (G62).

If the setpoint value is reached:

- Remove the engine control unit \Rightarrow page 23-88.



- Check the wires between plug -A- and socket -B- of the engine control unit for breaks using the CFD Wire resistance: max. 1.5 Ω

Plug for G62 contact	Control unit socket contact
3	104
4	112

- Also check the wires for short circuits to each other, to the vehicle earth and to the battery positive. Setpoint value: $\propto \Omega$

If no faults are determined in the wiring:

Replace the control unit for diesel direct injection system (J248)
 ⇒ page 23-88.

Checking the Intake Manifold Temperature Sender

The intake manifold temperature sender is located together with the intake manifold pressure sender in a common housing. ⇒ Overview of installation locations, page 23-3.



Special tools, workshop equipment, test and measuring equipment and accessories required

- ♦ V.A.G 1526 A Hand multimeter
- ♦ V.A.G 1594 A Auxiliary test set
- Fault output device V.A.G 1552 with cable V.A.G 1551/3 or fault output device VAS 5052
- ♦ Current flow diagram

Rapid data transfer	HELP
Select function XX	
Read measuring value block	HFLP
0	
Enter display group number XXX	11221

Read measuring value block 7 \rightarrow				
15,4 °C	%	15.9 °C	16.7 °C	

Test procedure

- Connect the fault output device V.A.G 1552 (VAS 5052) and select the engine electronics control unit with the "Address word" 01. Here, the engine should be idling.

(Connecting fault output device and selecting engine control unit \Rightarrow page 01-4)

Display:

- Press keys 0 and 8 for "Read measuring value block" function and acknowledge entry with Q key.

Display:

- Press keys 0, 0 and 7 for "Display group number 7" and acknow-ledge entry with Q key.

Display:

- If there is no realistic display in display field 3 or if a replacement temperature of 13 6.8 °C is displayed, check the intake manifold temperature sender and the cable connections to the sender as follows:
- Press the \rightarrow -button.
- Press keys 0 and 6 for "End data transfer" function and acknowledge entry with Q key.



- Switch off the ignition.
- Pull the plug off the intake manifold temperature sender (G72) -arrow-.

N23-0198	

- Carry out a resistance measurement on the intake manifold temperature sender contact 1+2.



Setpoint value, see diagram

Area A shows you the resistance values for the temperature range 0 - 50 °C; area B shows the values for the temperature range 50 - 100 °C.

Readout examples:

- \blacklozenge 30 °C corresponds to a resistance of 1500 2000 Ω
- \blacklozenge 80 °C corresponds to a resistance of 275 375 Ω

If the setpoint value is not reached:

- Replace the intake manifold temperature sender (G72).

If the setpoint value is reached:

- Remove the engine control unit \Rightarrow page 23-88.



- Check the wires between plug -A- and socket -B- of the engine control unit for breaks using the CFD Wire resistance: max. 1.5 Ω

Plug for G72 contact	Control unit socket contact
1	52
2	73

- Also check the wires for short circuits to each other, to the vehicle earth and to the battery positive. Setpoint value: $\propto \Omega$

If no faults are determined in the wiring:

Replace the control unit for diesel direct injection system (J248)
 ⇒ page 23-88.



Checking the Fuel Temperature Sender

Special tools, workshop equipment, test and measuring equipment and accessories required

- ♦ V.A.G 1526 A Hand multimeter
- ♦ V.A.G 1594 A Auxiliary test set
- Fault output device V.A.G 1552 with cable V.A.G 1551/3 or fault output device VAS 5052
- ♦ Current flow diagram

Rapid data transfer		HELP	
Select function XX			
Г			
Read measuring value	e block	HELP	
Enter display group n	umber XXX		
Г			
Read measuring value	e block 7	\rightarrow	
15,4 °C	15.9 °C	16.7 °C	

Test procedure

- Connect the fault output device V.A.G 1552 (VAS 5052) and select the engine electronics control unit with the "Address word" 01. Here, the engine should be idling.

(Connecting fault output device and selecting engine control unit \Rightarrow page 01-4)

Display:

- Press keys 0 and 8 for "Read measuring value block" function and acknowledge entry with Q key.

Display:

- Press keys 0, 0 and 7 for "Display group number 7" and acknowledge entry with Q key.
- Display:
 - If there is no realistic display in display field 1 or if a replacement temperature of -5.4 °C is displayed, check the fuel temperature sender and the cable connections to the sender as follows:
 - Press the \rightarrow button.
 - Press keys 0 and 6 for "End data transfer" function and acknowledge entry with Q key.



- Switch off the ignition.
- Separate the 10-pin connector for the injection pump -arrow-.

 Measure the resistance of the sender at contacts 4+7 of the connector.



Setpoint value, see diagram

Area A shows you the resistance values for the temperature range 0 - 50 °C; area B shows the values for the temperature range 50 - 100°C.

Readout examples:

- \blacklozenge 30 °C corresponds to a resistance of 1500 2000 Ω
- \blacklozenge 80 °Corresponds to a resistance of 275 375 Ω

If the setpoint value is not reached:

- Renew the injection pump \Rightarrow page 23-25.

If the setpoint value is reached:

- Remove the engine control unit \Rightarrow page 23-88.


- Check the wires between plug -A- and socket -B- of the engine control unit for breaks using the CFD Wire resistance: max. 1.5 Ω

10-pin connector contact	Control unit socket contact
4	103
7	111

- Also check the wires for short circuits to each other, to the vehicle earth and to the battery positive. Setpoint value: $\propto \Omega$

If no faults are determined in the wiring:

Replace the control unit for diesel direct injection system (J248)
 ⇒ page 23-88.

Checking the modulating piston movement sender and quantity adjuster

The quantity adjuster is an electro-magnetic rotary switch which is activated from the control unit by a targeted pulse duty factor. The eccentric shaft of the quantity adjuster moves the control sleeve on the high-pressure piston, thus determining the injection quantity.

The modulating piston movement sender supplies the control unit with the position of the quantity adjuster -N146, i.e. determines the injection quantity.



Special tools, workshop equipment, test and measuring equipment and accessories required

- ♦ V.A.G 1526 A Hand multimeter
- ♦ V.A.G 1594 A Auxiliary test set
- Fault output device V.A.G 1552 with cable V.A.G 1551/3 or fault output device VAS 5052
- ♦ Current flow diagram

Rapid data transfer	HELP
Select function XX	
5	
Read measuring value block	HELP
Enter display group number XXX	
Read measuring value block 1	Ļ
840 rpm 6.5 mg/stroke 1,480	V 87.3 °C
Read measuring value block 1	\rightarrow

87.3 °C

840 rpm6.5 mg/stroke 1,480 V

Test procedure

- Connect the fault output device V.A.G 1552 (VAS 5052) and select the engine electronics control unit with the "Address word" 01. Here, the engine should be idling.

(Connecting fault output device and selecting engine control unit \Rightarrow page 01-4)

Display:

- Press keys 0 and 8 for "Read measuring value block" function and acknowledge entry with Q key.
- Display:
 - Press keys 0, 0 and 1 for "Display group number 1" and acknowledge entry with Q key.
- Display:
 - Check the coolant temperature in display field 4.
 Setpoint value: at least 70 °C

Only continue the test when the coolant temperature has been reached.

- Check voltage from modulating piston movement sender in display field 3.
 - Setpoint value 1.25 2.0 V
 - If the setpoint value is not reached, check the modulating piston movement sender and the quantity adjuster in the following way:





Checking the Modulating Piston Movement Sender (G149)

- Press the \rightarrow -button.
- Press keys 0 and 6 for "End data transfer" function and acknowledge entry with Q key.
- Switch off the ignition.
- Separate the 10-pin connector for the injection pump -arrow-.



Measure the resistance between contacts 1 + 2 and 2 + 3 of the connector.
 Setpoint value: 5 - 7 Ω

If the setpoint value is not reached:

- Renew the injection pump \Rightarrow page 23-25.

If the setpoint value is reached:



- Remove the engine control unit \Rightarrow page 23-88.
- Check the wires between plug -A- and socket -B- of the engine control unit for breaks using the CFD Wire resistance: max. 1.5 Ω

10-pin connector contact	Control unit socket contact
1	108
2	106
3	99

- Also check the wires for short circuits to each other, to the vehicle earth and to the battery positive. Setpoint value: $\infty \ \Omega$

If no faults are determined in the wiring:

Replace the control unit for diesel direct injection system (J248)
 ⇒ page 23-88.

Checking the Quantity Adjuster (N146)

- Press the \rightarrow -button.
- Press keys 0 and 6 for "End data transfer" function and acknowledge entry with Q key.
- Switch off the ignition.





- Separate the 10-pin connector for the injection pump -arrow-.

- Measure the resistance between contacts 5+6 of the connector. Setpoint value: 0.5 - 2.5 Ω

If the setpoint value is not reached:

- Renew the injection pump \Rightarrow page 23-25.

If the setpoint value is reached:

- Remove the engine control unit \Rightarrow page 23-88.



- Check the wires between plug -A- and socket -B- of the engine control unit for breaks using the CFD Wire resistance: max. 1.5 Ω

10-pin connector contact	Control unit socket contact
5	1, 2
6	116, 121

- Also check the wires for short circuits to each other, to the vehicle earth and to the battery positive. Setpoint value: $\propto \Omega$

If no faults are determined in the wiring:

Replace the control unit for diesel direct injection system (J248)
 ⇒ page 23-88.



Checking the Needle Lift Sender

The needle lift sender signal is required to determine the injection commencement. In the event of a failure, the injection commencement is controlled (dependent on engine-speed and load); in normal operation, the injection commencement is regulated (dependent on enginespeed load and temperature).

Special tools, workshop equipment, test and measuring equipment and accessories required

♦ V.A.G 1526 A Hand multimeter



- ♦ V.A.G 1594 A Auxiliary test set
- ♦ Current flow diagram

Test procedure

- Switch off the ignition.
- Remove the air filter.



V96-1216

- Separate the connector for the needle lift sender -arrow-.

- Measure the resistance between contacts of the connector. Setpoint value: 80 - 120 Ω

If the setpoint value is not reached:

Replace the injector for cylinder 5 with the needle lift sender (G80)
 ⇒ page 23-35.

23-77 -

If the setpoint value is reached:

- Remove the engine control unit \Rightarrow page 23-88.



- Check the wires between plug -A- and socket -B- of the engine control unit for breaks using the CFD Wire resistance: max. 1.5 Ω

2-pin connector contact	Control unit socket contact
1	109
2	101

- Also check the wires for short circuits to each other, to the vehicle earth and to the battery positive. Setpoint value: $\propto \Omega$

If no faults are determined in the wiring:

Replace the control unit for diesel direct injection system (J248)
 ⇒ page 23-88.



Check injection timing device adjustment range

Special tools, workshop equipment, test and measuring equipment and accessories required

- ♦ V.A.G 1526 A Hand multimeter
- ♦ V.A.G 1594 A Auxiliary test set
- Fault output device V.A.G 1552 with cable V.A.G 1551/3 or fault output device VAS 5052
- ♦ Current flow diagram

Rapid data transfer	HELP	
Select function XX		
Basic setting	HELP	
Enter display group number XXX		

System in b	4 →		
780 rpm	advanced 7.4 ° bef. TDC	89%	

Test procedure

The injection timing-device control range is adjusted in Function 04 (basic setting). This procedure clocks the commencement of injection valve so that in measured value block 004 the extreme values for the advance and retard position of the injection timing device can be read off in display field 3.

- Connect the fault output device V.A.G 1552 (VAS 5052) and select the engine electronics control unit with the "Address word" 01. Here, the engine should be idling.

(Connecting fault output device and selecting engine control unit \Rightarrow page 01-4)

Display:

- Press keys 0 and 4 for "Initiate basic setting" function and acknowledge entry with Q key.
- Display:
 - Press keys 0, 0 and 4 for "Display group number 4" and acknowledge entry with Q key.

Display:

Specified value in display field 3: 7.0...9.0° bef. TDC

After approx. 10 seconds the injection distributor is moved into its retarded position.

System in b	4→		
780 rpm	retarded	3.3° bef. TDC	30%

Display:

Specified value in display field 3: 3.0...5.0° bef. TDC

If the setpoint values are not reached:

- Check commencement of injection valve as follows:

Checking commencement of injection valve (N108) electrically

- Press the \rightarrow -button.
- Press keys 0 and 6 for "End data transfer" function and acknowledge entry with Q key.
- Switch off the ignition.
- Separate the 10-pin connector for the injection pump -arrow-.







- Measure resistance between contacts 9+10 on connector. Setpoint value: 12 - 20 Ω

If the setpoint value is not reached:

Renew commencement of injection valve (N108)
 ⇒ page 23-14.

If the setpoint value is reached:

- Remove the engine control unit \Rightarrow page 23-88.
- Check the wires between plug -A- and socket -B- of the engine control unit for breaks using the CFD Wire resistance: max. 1.5 Ω

10-pin connector contact	Control unit socket contact
9	114
10	1, 2

- Also check the wires for short circuits to each other, to the vehicle earth and to the battery positive. Setpoint value: $\infty \Omega$

- 23-82 —

If no faults are determined in the wiring:

Replace the control unit for diesel direct injection system (J248)
 ⇒ page 23-88.



Checking additional signals

Checking clutch switch

Boats with Z-drive MercruiserTM AlphaOneTM

The clutch switch (F36) provides the control unit with the information as to whether or not the clutch is engaged.

Special tools, workshop equipment, test and measuring equipment and accessories required

- ♦ V.A.G 1526 A Hand multimeter
- ♦ V.A.G 1594 A Auxiliary test set
- Fault output device V.A.G 1552 with cable V.A.G 1551/3 or fault output device VAS 5052
- ♦ Current flow diagram

Select function XX	
Read measuring value block	HELP
Enter display group number XXX	
Read measuring value block 6	→

-

.

~

Read measuring value block 6 \rightarrow					\rightarrow
0 km/h	0	1	1	000000	255

Test procedure

- Connect the fault output device V.A.G 1552 (VAS 5052) and select the engine electronics control unit with the "Address word" 01. Here, the ignition must be on.

(Connecting fault output device and selecting engine control unit \Rightarrow page 01-4)

Display:

- Press keys 0 and 8 for "Read measuring value block" function and acknowledge entry with Q key.

Display:

- Press keys 0, 0 and 6 for "Display group number 6" and acknowledge entry with Q key.
- Note the display in display field 2.
- Setpoint value: 0 1 0
 - Actuate the clutch switch on the "shifting bracket". The right-hand side must jump to 1.
- Setpoint value: 0 1 1

If the setpoint values are not reached:



- Press the \rightarrow -button.
- Press keys 0 and 6 for "End data transfer" function and acknowledge entry with Q key.
- Switch off the ignition.
- Check the switch or the cable connections to the switch for breaks and short-circuits:
- \Rightarrow Current Flow Diagrams binder

Checking speed signal

The signal from the engine speed sender cannot be used further in its direct form, and is therefore prepared by the engine control unit for the following devices. The signal is required for the rev. counter in the panel.

Special tools, workshop equipment, test and measuring equipment and accessories required

♦ V.A.G 1526 A Hand multimeter



- ♦ V.A.G 1594 A Auxiliary test set
- ♦ Current flow diagram

Test procedure

- Switch off the ignition.
- Remove the engine control unit \Rightarrow page 23-88.



 Check cable connection from contact 20 of engine control unit socket to main panel breaks or short-circuits.
 ⇒ Current Flow Diagrams binder



065906018 T150-5	MDC 0000SG 3601 →
Coding 00001	WSC00000

Engine control unit

Renewing engine control unit

Special tools, workshop equipment, test and measuring equipment and accessories required

 Fault output device V.A.G 1552 with cable V.A.G 1551/3 or fault output device VAS 5052

Procedure

- First specify the control unit identification of the previous control unit as follows:
- Connect the fault output device V.A.G 1552 (VAS 5052) and select the engine electronics control unit with the "Address word" 01. Here, the ignition must be on.
 (Connecting fault output device and selecting engine control unit ⇒ page 01-4)
- The control unit identification appears on the display of the fault output device V.A.G 1552, e.g.:
 - Note the control unit identification.
 - Press \rightarrow key.
 - Press the keys 0 and 6 for the function "Quit output" and confirm the input using the Q key.

Rapid data transfer	HELP
Select function XX	



Display:

- Switch off the ignition.
- Open the cover -1- of the fuse box/relay plate.
 - To do this, unscrew the screws -arrows-.



- Pull the relay -1- out of the socket of the fuse box/relay plate.
 - Unlock the connection plug on the fuse box/relay plate -2- and pull out the control unit -3-.
 - Before installing the replacement engine control unit, note its part number.
 - Finally, interrogate the fault memory of the new engine control unit and erase the fault memory if necessary, Erase fault memory ⇒ page 01-12
 - Install the cover of the fuse box/relay plate and tighten the mounting screws with 10 Nm.

Checking terminating resistor for data bus

Function

The engine control unit communicates with other data-bus capable components.

The control units are interconnected with two twisted data bus cables (high and low) and exchange information (messages). Missing information on the data bus is detected by the engine control unit as a fault.

So that the data bus can function fault-free, it requires a terminating resistor. This central terminating resistor is located in the engine control unit.





• A data bus error has been detected by the self-diagnosis

Special tools, workshop equipment, test and measuring equipment and accessories required

♦ V.A.G 1526 A Hand multimeter

- ♦ V.A.G 1594 A Auxiliary test set
- ♦ Current flow diagram



Test procedure

- Remove the engine control unit \Rightarrow page 23-88.
- Check the central terminating resistor in the engine control unit:
- To do this, carry out a resistance measurement between contacts
 6 + 7 of the engine control unit: Setpoint value: 60...72 Ω

If the resistance value is outside the setpoint range:

- Renew the engine control unit \Rightarrow page 23-88.

If the resistance value is within the setpoint range:

- Eliminate the fault:
- \Rightarrow Current Flow Diagrams binder

Removing and installing parts of exhaust system

Notes:

- Following assembly work on the exhaust system, make sure that the exhaust system is not torqued and is a sufficient distance from the boat hull. If necessary, loosen the retaining and clamping clips and align the exhaust system so that it is a sufficient distance from the boat hull at all points.
- Paint areas damaged on during removal and installation must be touched up immediately (danger of corrosion).



Exhaust system without turbocharger

- **1 Exhaust pipe connection**
- 2 40 Nm
 - ♦ Allen screw
- 3 To exhaust hose
- 4 Gasket
 - ♦ Renew
 - Ensure proper installation position
 - ◆ Tabs face upward

5 - 40 Nm

♦ Hexagon bolt

6 - Housing-radiator package

◆ Dismantling and assembling
 ⇒ page 19-16



Exhaust system with turbocharger

1 - Retaining clip

◆ For hose connection, Item2

2 - Hose connection

 Secure connection Verbindung with 2 retaining clips each

3 - Exhaust pipe connection

 With hose connection on boats with reversing gear

4 - Hose clamp

5 - Turbocharger

- Removing and installing
 - ⇒ page 21-10
- ♦ Check boost pressure
 - \Rightarrow page 21-21, Checking turbocharger



6 - 40 Nm

♦ Allen screw

7 - Gasket

- ♦ Renew
- Ensure proper installation position
- ♦ Tabs face upward

8 - Housing-radiator package

◆ Dismantling and assembling
 ⇒ page 19-16

9 - 40 Nm

- ♦ Hexagon bolt
- 10 Exhaust pipe
 - ♦ For Z-drive

Starter

Important!

Disconnect the high-voltage connector from the engine before working on the electrical system.

Technical data of starter

♦ (12 V - 2.0 kW)





Removing and installing starter

Special tools, workshop equipment, test and measuring equipment and accessories required

◆ Torque wrench (5 - 50 Nm) V.A.G 1331

◆ V.A.G 1332 Torque spanner (40 - 200 Nm)



Removing:

- Disconnect the high-voltage connector from the engine.
- Unlock and pull off the plug-in housing of Terminal 50 -arrow-.



 Unscrew the hexagon nut (13 Nm) on the solenoid switch Terminal 30 -arrow- and pull off the wires.



- Unscrew the mounting screws -arrows-.
 - Remove the starter.



Installing:

- Fit the starter.

- Tighten he mounting screws -arrows- with 60 Nm.

The further installation is carried out in the opposite order.

Alternator

Important!

Disconnect the high-voltage connector from the engine before working on the electrical system.

Compact alternator with ribbed V-belt drive

Mounting B+ cable on alternator

The tightening torque for the mounting nut of the B+ cable -arrow- is 15 Nm.

Notes:

The screw connection for the B+ cable on the compact alternator is marked with B1+.

- Terminal designations on the connections
- \Rightarrow also see current flow diagram

If the B+ cable is not mounted with the specified tightening torque, the following dangers exist:

- The batters will not be completely charged.
- Complete failure of the boat electrical/electronic system (breakdowns).
- Danger of fire due to spark formation.
- Damage to electronic components and control units due to overvoltages.





Removing and installing voltage regulator

- Unscrew the mounting nuts -arrows A- and pull out the mounting bolt -arrow B- of the protective cap.
 - Remove the protective cap.



 Unscrew the mounting screws -arrows- of the voltage regulator and take off the voltage regulator.



Checking carbon brushes for alternator

Length of carbon brushes when new = 12 mm

Wear limit = 5 mm

Tolerance of carbon brushes to each other = +1 mm



Renewing ribbed V-belt pulley on alternator

Special tools, workshop equipment, test and measuring equipment and accessories required

◆ Torque wrench (40 - 200 Nm) V.A.G 1332


♦ 3310 Socket head



Removing and installing ribbed V-belt pulley on alternator

- Loosen or tighten the mounting nut of the ribbed V-belt pulley with the socket head 3310 while holding the alternator shaft in place with an Allen socket head.

Tightening torque: 65 Nm ± 5 Nm

Checking ribbed V-belt

Note:

If damage is determined, the ribbed V-belt must be renewed to prevent failures or malfunctions.

- Turn the engine by hand while checking the ribbed V-belt:
 - Base cracks (minor cracks, core breaks, cross-sectional breaks)
 - Layer separation (top layer, tensile strands)
 - ♦ Break-outs on base
 - ◆ Fraying of tensile strands
 - Side wear (material removal, frayed sides, side hardening -glassy sides-, surface cracks)
 - ◆ Traces of oil and grease





Special tools, workshop equipment, test and measuring equipment and accessories required

◆ Torque wrench (5 - 50 Nm) V.A.G 1331



◆ Torque wrench (40 - 200 Nm) V.A.G 1332



Note:

Test alternator:

- ⇒ Current Flow Diagrams, Electrical Fault Finding
 - 1 Alternator
 - 2 Hexagon bolt (M8 x 45) ♦ 40 Nm

3 - Retainer

 When installing the alternators, the plastic sleeves must always be inserted in the alternator bracket. Check sleeves for damage and wear, and renew if necessary.

4 - Hexagon bolts (M10 x 120)

- ♦ 40 Nm
- ♦ With washer



- 5 Hexagon bolts (M10 x 45)
 - ♦ 40 Nm
 - ♦ With washer
- 6 Cheese head bolt (M8 x 35) ♦ 20 Nm
- 7 Power steering pump
- 8 Cheese head bolts (M80 x 30) ♦ 20 Nm
- 9 Belt pulley for vane pump
- **10 Cheese head bolts (M8 x 12)** ♦ 20 Nm



- 11 Washers
- **12 Hexagon bolt (M8x85)** ♦ 25 Nm
- **13 Combi-bolt (M10 x 38)** ♦ 40 Nm

14 - Ribbed V-belt

- ♦ Removing and installing
 ⇒ page 27-17
- ♦ Ribbed V-belt drive
 - ⇒ page 27-14





Overview of ribbed V-belt drives

Fig. 4

- 1 Ribbed V-belt for seawater coolant pump
- 2 Tensioner
- 3 Belt pulley alternator
- 4 Idler pulley
- 5 Idler pulley
- 6 Ribbed V-belt for alternator
- 7 Belt pulley crankshaft
- 8 Tensioner for belt drive with seawater coolant pump
- 9 Belt pulley seawater coolant pump

Fig. 5

- 1 Tensioner
- 2 Belt pulley alternator
- 3 Idler pulley
- 4 Idler pulley
- 5 Belt pulley power steering pump
- 6 Ribbed V-belt for alternator and power steering pump



- 7 Belt pulley crankshaft
- 8 Tensioner for belt drive with seawater coolant pump
- 9 Ribbed V-belt for seawater coolant pump
- 10 Belt pulley seawater coolant pump

Fig. 6

- 1 Tensioner
- 2 Idler pulley
- 3 Belt pulley alternator
- 4 Idler pulley
- 5 Belt pulley second alternator
- 6 Ribbed V-belt for alternator and additional second alternator
- 7 Belt pulley crankshaft
- 8 Tensioner for belt drive with seawater coolant pump
- 9 Ribbed V-belt for seawater coolant pump
- 10 Belt pulley seawater coolant pump



Fig. 7

- 1 Tensioner
- 2 Idler pulley
- 3 Belt pulley alternator
- 4 Idler pulley
- 5 Belt pulley second alternator
- 6 Ribbed V-belt for alternator, power steering pump and additional second alternator
- 7 Belt pulley power steering pump
- 8 Belt pulley crankshaft
- 9 Tensioner for belt drive with seawater coolant pump
- 10 Ribbed V-belt for seawater coolant pump
- 11 Belt pulley seawater coolant pump

Removing and installing ribbed V-belt

Notes:

- Mark the running direction of the ribbed V-belt before removing and observe when installing. The opposite running direction lead to the belt being destroyed!
- If damage is determined, the ribbed V-belt must be renewed to prevent failures or malfunctions.
- It is not necessary to adjust the ribbed V-belt tension, as the best possible belt tension is ensured by a spring-loaded tensioning device.

Notes:

- When installing used ribbed V-belts, watch the previous running direction marked during removal.
- Ensure proper seating of the ribbed V-belt in the belt pulley when installing.



Removing ribbed V-belt of alternator

Note:

Mark the running direction before removing the ribbed V-belt. Ensure proper seating in the belt pulley when installing.

- Remove the ribbed V-belt for the seawater coolant pump, \Rightarrow page 27-21.
- Lift the tensioner with a 16 mm open-end spanner and remove the ribbed V-belt from the alternator belt pulley.
 - Remove ribbed V-belt.

Installing ribbed V-belt

Note:

Before installing the ribbed V-belt, make sure that all units (alternator and, if installed, additional alternator or power steering pump) are securely mounted.

- Lay ribbed V-belt on vibration damper with ribbed V-belt pulley.
- Lift the tensioner with a 16 mm open-end spanner and lay on the ribbed V-belt and tension.





Belt drive with alternator

Belt drive with alternator and power steering pump





Belt drive with alternator and additional 24 V or 230 V alternator

- Belt drive with alternator, power steering pump and additional 24 V or 230 V alternator
 - Reinstall the ribbed V-belt of the seawater cooling pump.
 - Start engine and check belt routing.





Remove the ribbed V-belt of the seawater coolant pump

Note:

Mark the running direction before removing the ribbed V-belt. Ensure proper seating in the belt pulley when installing.

- Lift the tensioner with a 16 mm open-end spanner and remove the ribbed V-belt from the pump belt pulley.
 - Remove ribbed V-belt.

Installing ribbed V-belt

Note:

Before installing the ribbed V-belt, make sure that the seawater coolant pump is securely mounted.

- Lay ribbed V-belt on vibration damper with ribbed V-belt pulley.
- Lift the tensioner with a 16 mm open-end spanner and lay on the ribbed V-belt and tension.
- Belt pulley with seawater coolant pump

Additional 230 V alternator

Important!

High voltage!

Work on the additional alternator and the related components and wiring connections may only be carried out by specially trained personnel.

The additional alternator supplies 230 V of alternating current with a sine wave of 50 Hertz.

The maximum current draw of 16 amperes (equivalent to 3.5 kVA) is possible at an engine speed of 1700 rpm. With the engine at idle, approx. 4 amperes (equivalent to 0.9kVA) are available.

In addition to the alternator, an On/Off switch with warning lamps and a control unit (power box) and the required wiring connections and components of the 230 V current circuit are also part of the system.

When the green LED in the switch lights up, 230 V alternating current is available and the system is ready for operation.



Exploded view of additional 230 V alternator

1 - Hexagon bolt (M8 x 100)

- ◆ Tightening torque **24 Nm**
- 2 Lock washer (8 mm)
- 3 Washers (8.4 mm x 16 mm)

4 - Retainer

- When installing the alternators, the plastic sleeves must always be inserted in the alternator bracket. Check sleeves for damage and wear, and renew if necessary.
- 5 Spacer sleeve (20 mm x 10 mm)
- 6 Idler pulley (80 mm diameter)



- 7 Washers (8 mm x 25 mm)
- 8 Hexagon bolt (M10 x 100) ♦ Tightening torque 47 Nm
- 9 Spacer sleeve (20 mm x 8mm)
- **10 Alternator fan impeller**

11 - Belt pulley

Tightening torque of mounting nut:
 50 Nm



Removing and installing additional 230 V alternator

Special tools, workshop equipment, test and measuring equipment and accessories required

◆ Torque wrench (5 - 50 Nm) V.A.G 1331



Removing:

- Remove ribbed V-belt, \Rightarrow page 27-18.
- Unscrew the two mounting screws -arrows-.
 - Disconnect the electrical connections and remove the alternator.



Installing:

Installation is carried out in the reverse order.

When installing, do not forget the spacer sleeves -arrow-.

When installing, the plastic sleeves must always be inserted in the alternator bracket. Check sleeves for damage and wear, and renew if necessary.



Removing bracket from additional alternator

Special tools, workshop equipment, test and measuring equipment and accessories required

◆ Torque wrench (5 - 50 Nm) V.A.G 1331



Removing:

- Remove ribbed V-belt, \Rightarrow page 27-18.
- Remove the belt pulley of the power steering pump -arrow- and the idler pulley -arrow-.



- Unscrew the two mounting screws -arrows-.
 - Disconnect the electrical connections and remove the alternator together with the bracket.

Installing:

Installation is carried out in the reverse order.

Fault displays on 230 V additional alternator

For safety reasons, the system is equipped with internal safety mechanisms. As soon as a fault occurs, the internal safety device is triggered and the red LED in the On/Off switch lights up.

If this is the case, the system should be switched off and not returned to operation until the cause has been found and the fault eliminated.

Important!

High voltage!

Work on the additional alternator and the related components and wiring connections may only be carried out by specially trained personnel.

The green LED lights up:

◆ The system is operating properly

The green LED does not light up:

- ◆ The alternator voltage is too low
- ◆ The alternator load is too high
- ◆ The alternator speed is too low

The red LED lights up:

- Undervoltage or overvoltage comes from the battery
- Overloading, e.g. due to switching the alternator on and off quickly with a load connected
- ◆ Too great a load is connected
- The switch connections are incorrectly mounted
- ◆ There is damage in the 230 V current circuit
- ◆ The temperature in the control unit (power box) is too high

Fault finding on 230 V additional alternator:

⇒ Chapter on fault finding, fault finding programme "Fault finding on 230 V additional alternator"





Checking glow plug system

Special tools, workshop equipment, test and measuring equipment and accessories required

♦ V.A.G 1526 A Hand multimeter

♦ V.A.G 1594 A Auxiliary test set

Test conditions

- Battery voltage at least 11.5 V
- Ignition switched off
- Control unit for diesel direct injection system (J248) OK
- Fuse for glow plugs (S125) OK.

Test procedure

- Remove the connector from the coolant temperature sender \Rightarrow Installation Point Overview, page 23-3.

Note:

Removing the connector from the sender simulates a "cold" engine state and when the ignition is switched on the corresponding preheating process takes place.

- Remove the plug connector from the glow plugs.
- Connect the multimeter for voltage measurement between a glow plug connector and the vehicle earth.
- Switch on the ignition. For approx. 20 seconds, the approx. battery voltage is displayed.
- If there is no voltage:
- ⇒ Current Flow Diagrams binder





Special tools, workshop equipment, test and measuring equipment and accessories required

♦ V.A.G 1594 A Auxiliary test set



- ♦ 3220 Flexible-head spanner
- ◆ Diode testing lamp V.A.G 1527

Test conditions

- Battery voltage at least 11.5 V
- Ignition switched off



Test procedure

- Remove the engine cover.

Note:

To check the glow plugs on Cylinder 4 and 5, remove the console with the accelerator lever position sender: \Rightarrow page 20-11; Servicing throttle controls

- Remove the plug connector from the glow plugs.
- Connect the cable of the diode testing lamp to the battery positive (+) terminal using clips from the measuring aids set.
- Place the testing tip of the diode testing lamp at one glow plug after another.

Diode lights up: Glow plug OK Diode does not light up: Replace glow plug

- Use the flexible-head wrench 3220 to remove and refit the glow plugs

Tightening torque: 15 Nm.

Exploded view: Power steering pump, reservoir, hydraulic lines

It is not possible to service the power steering pump. In case of complaints, determine the cause using the pressure test. If the component is defective, the power steering pump must be renewed.

- Pumps from the parts warehouse are not filled with oil. Therefore, be sure to fill the pump with hydraulic oil G 000 200 and rotate it by hand before installing, as otherwise noises or pump damage may occur during driving.
- ♦ Oil type: Hydraulic oil G 002 000
- Oil quantity in system: approx. 1 l
- Do not reuse drained hydraulic oil.
- ♦ Renew seals.



Function overview: Power steering pump, oil cooler, hydraulic lines, reservoir

1 - Power steering pump

- ♦ Removing and installing
 ⇒ page 48-9
- Check feed pressure
- ⇒ page 48-7
 ♦ Fill with oil before installing
 ⇒ note on page 48-1

2 - Z-drive

3 - Combination radiator

- ◆ For hydraulic oil/gear oil
- ♦ For fuel

4 - Reservoir

- Oil level: Between Min. and Max. marking
- Thick connection is for supply line to power steering pump
- Thin connection is for return line from oil cooler



- **5** Pressure line
 - ♦ With non-return valve
- 6 Pressure line between Z-drive and oil cooler

7 - Return line

◆ Make sure hose is laid kink-free

8 - Suction hose

◆ Make sure hose is laid kink-free



Exploded view: Power steering pump

- *Notes:* \Rightarrow *Page* 48-1
 - 1 Allen screw, 40 Nm
 - 2 Hexagon bolt, 40 Nm
 - 3 Hexagon bolt, 40 Nm
 - 4 Bracket
 - 5 Allen screw, 20 Nm



6 - Hexagon bolt, 40 Nm

Dowel screw

7 - Ribbed V-belt

- Removing and installing:
- ⇒ Electrical System; ⇒ page 27-17; Removing and installing alternator with ribbed V-belt; Removing and installing ribbed V-belt
 - ♦ Checking condition
- ⇒ Inspection service

8 - Allen screw, 20 Nm

- Loosening and tightening
 ⇒ page 48-9
- 9 Belt pulley
- 10 Hollow screw, 30 Nm



- 11 Seal
 - ♦ Renew
- **12 Screw clip** ♦ 4 Nm
- 13 Allen screw, 20 Nm

14 - Power steering pump

- ♦ Check feed pressure
 ⇒ page 48-7
- ♦ Removing and installing
 ⇒ page 48-9
- ◆ Fill with oil before installing
 - \Rightarrow note on page 48-1



Checking feed pressure of power steering pump

Special tools, workshop equipment, test and measuring equipment and accessories required

◆ V.A.G 1402 Power steering tester

The adapter V.A.G 1402/6 is required for the feed pressure test.

Testing Requirements

- V-belt/ribbed V-belt OK.
- System free of leaks
- Hoses/lines not kinked or constricted
- Unscrew pressure line from power steering gear (Z-drive).
- Connect pressure gauge V.A.G 1402 between power steering gear (Z-drive) and pressure line. Shut-off valve on pressure gauge open.
- Fill with hydraulic oil Part No. G 002 000.

- Start engine and top up oil level in reservoir if necessary. Check hose connections for leaks.
- With engine at idling speed, close shut-off valve (not longer than 5 seconds) and read off pressure.
- Setpoint value 95 110 bar gauge pressure
- If setpoint value is dropped below or exceeded by more than 5 bar, renew pump.
- Exploded view: Power steering pump \Rightarrow page 48-4.
- In case of leaks on the Z-drive, first check the lines/line connections for leaks, tighten if necessary and wipe dry.



Removing and installing power steering pump

Special tools, workshop equipment, test and measuring equipment and accessories required

♦ V.A.G 1590 Water pump spanner

Removing

- Remove ribbed V-belt, \Rightarrow page 27-17.
- Remove suction and pressure line and drain off hydraulic oil.



- Remove belt pulley.


- Unscrew bolts -1- and -2-.

Fitting

Installation is carried out in reverse sequence.



Assembly instructions for pressure line

The stop angle (arrow) must contact the power steering pump when tightening the banjo bolt on the housing.

The tightening torque for the banjo bolt of the hydraulic line is 30 Nm.

The tightening torque for the screw clip of the supply line from the reservoir is 4 Nm.

Instrument panel

Removing and installing instrument panel

Important!

Before working on the electrical system, disconnect highvoltage connector from the engine.

Removing instrument panel

- Unscrew mounting nuts -arrows- from instrument panel.
- Take out instrument panel.

Installing instrument panel

Installation is carried out in reverse sequence.



Removing and installing individual instruments

The individual instruments can be installed in the instrument panel or also in the individual cockpit of the boat as individual instruments.

To remove the instruments, remove the instrument panel (if installed). To remove the individual instruments, unscrew the nuts of the retaining tabs and take out the instrument.

The ignition/starter switch is screwed to the instrument panel from the outside.



Function overview of instrumentation

- 1 Instrument panel
- 2 Instrument panel of 2nd control stand ♦ If installed
- 3 2nd Accelerator-lever neutral switch
- 4 Switch-on unit/electrical box♦ If installed
- 5 Fuse box/relay plate
- 6 Switch-on unit/electrical box
- 7 1. Accelerator-lever neutral switch ♦ If installed

Fuse box/relay plate





Removing and installing fuse box/relay plate

Important!

Disconnect the high-voltage connector from the engine before working on the electrical system.

Special tools, workshop equipment, test and measuring equipment and accessories required

◆ Torque wrench (5 - 50 Nm) V.A.G 1331

Note:

 The fuse box/relay plate with fuse holder is located on the left-hand side of the engine.

Removing:

- Unlock and pull off the 3 multi-pin connectors below the fuse box/ relay plate.
- Unscrew the fuel filter -arrows- and lay it aside with the lines connected.



- Unscrew the two screws from the air filter -arrows-.



 Unscrew the air filter bracket from the housing of the fuse box/relay plate -arrows-.



- Unscrew the upper mounting screws -arrows-.



- Unscrew the lower mounting screws -arrows-.

- Pull the fuse box/relay plate forward somewhat.
- Unlock and pull off the connectors attached on the back of the fuse box/relay plate.
- Remove the fuse box/relay plate from the engine.

Installing:

Installation is carried out in the reverse order.

Connection assignment of fuse box/relay plate

Three multi-pin connectors are located on the underside of the fuse box/relay plate. They are named after the number of their contacts. The designations are T16, T35 and T 37. The individual contacts in the multi-pin connectors have letter designations. Here a distinction is also made between uppercase and lowercase letters.

Multi-pin connectors for the engine electrical system are located on the back of the fuse box/relay plate.



Multi-pin connection T16 on underside of fuse box/relay plate

- A K-wire
- B PWG 6
- C Earth Ter. 31
- D PWG 4
- E-PWG3
- F PWG 2
- G PWG 1
- H Start
- J Positive Ter. 30
- K Stop
- L-D+ direct
- M Positive Ter. 15
- N Supply voltage for glow plugs Ter. 30
- O Supply voltage for glow plugs Ter. 30
- P Supply voltage for glow plugs Ter. 30
- R Supply voltage for glow plugs Ter. 30



Multi-pin connection T35 on underside of fuse box/relay plate

- A Sender earth
- B Starter Ter. 50
- C EKP +
- D Switching positive Ter. 15
- E Raw water temperature
- F Positive Ter. 30
- G Positive Ter. 30
- H Earth Ter. 31
- J Earth Ter. 31
- K Oil temperature
- L-D+ direct
- M Water separator
- N Water level
- P Water temperature switch
- a Water temperature sender
- b Oil pressure switch
- c Neutral from gearbox
- d Oil pressure sender
- e Water temperature 1



- f Water temperature 3
- g Charge air 4
- h Charge air 2
- j Charge air 3
- k Engine speed 1
- I Engine speed 3
- m Engine speed 2
- n not in use
- p-not in use
- r Boost pressure controller
- s Air filter switch
- t Charge air 1
- u Oil extraction pump
- v not in use
- w Clutch switch
- x Earth relay



Multi-pin connection T37 on underside of fuse box/relay plate

- A Positive Ter. 30
- B Starter control Ter. 50a
- C CAN screen
- D Switching positive Ter. 15
- E Earth Ter. 31
- F Actuation EKP
- G Consumer signal
- H not in use
- J not in use
- K K-wire
- L D+ for split charge relay
- M Oil pressure sender
- N CAN High
- P Stop button
- R CAN Low
- S Buzzer
- T Acknowledgement
- U Oil temperature
- V PWG 2



- W not in use
- X PWG 4
- Z PWG 6
- a D+ charge monitoring
- b-PWG 1
- c Neutral from gearbox
- d Neutral to diode group
- e Raw water temperature
- f System lamp
- g Air filter lamp
- h Water separator lamp
- j Water level lamp
- k Engine speed signal
- m Oil pressure switch
- n Water temperature sender
- p Water temperature switch
- r Sender earth
- s-PWG 3



Multi-pin connections on back of fuse box/relay plate

- 1 Connection plug for needle movement sensor
- 2 Connection plug for pedal value sender (if installed)
- 3 Connection plug for distributor injection pump
- 4 Connection plug for glow plugs

Removing and installing earth switch-off relay

Important!

Before working on the electrical system, disconnect the highvoltage connector from the engine.

Note:

• The earth switch-off relay is located on the right-hand side of the engine behind the support on which the connector for the battery connection is mounted.



Removing:

- Separate the battery connection at the connector.
- Unscrew the positive cable from the starter.
- Unscrew the upper screws of the support -arrows-.



- Unscrew the lower screw of the support -arrows-.



- Remove the support -A- together with the earth switch-off relay -Band the cables.
 - Unlock and pull the connector -1- off the earth switch-off relay -B-.



- Unscrew the mounting screws -arrow- of the earth switch-off relay -B- and remove the relay from the support.
 - Unscrew the positive cable -2- and negative cable -3- from the contacts on the relay -B- or on the support -A-.

Installing:

Installation is carried out in the reverse order.

Wiring loom versions

Wiring loom between engine/instrument panel and instrument panel/2nd control stand

Various wiring loom lengths are available for installing the engine and instrument panel electrical system.

The wiring looms are prefabricated and technically identical. However, there are differences in the length.

- ◆ A wiring loom version with a length of 3 meters
- ◆ A wiring loom version with a length of 5 meters
- ◆ A wiring loom version with a length of 7 meters
- ◆ A wiring loom version with a length of 9 meters
- A wiring loom version with a length of 12 meters

These wiring looms are installed between the engine and the instrument panel. The same wiring loom is also installed between the instrument panel and the instrument panel of the 2nd control stand. The only difference is the wiring loom length.

Wiring loom between instrument panel and connection unit (electrical box)

This wiring loom is available in 2 versions:

- Prefabricated with connectors on both ends.
- Prefabricated with connectors on one end. The other end of the wiring loom is open, and therefore enables connection to individual instrumentation.

Note:

- For connection to individual instrumentation:
- ⇒ Chapter on current flow diagrams, current flow diagram "Wiring diagram for VW marine engines for individual instrumentation"



Wiring loom and connector repair

Wiring-loom repair set VAS 1978

Wiring loom and connector repairs on the electrical system of the boat engine may only be carried out with the Repair Set VAS 1978.

Operating instructions are included with the wiring-loom repair set VAS 1978 in which the procedure for repairs is described in detail.

For additional information, e.g. on installing and removing components, please see the respective Workshop Manual.

Please observe the following repair instructions. Repair instructions for wiring loom and connector repair

Important!

Disconnect the high-voltage connector from the engine before working on the electrical system.

Shielded cables may not be repaired. They must be completely renewed if damaged.

Before repairs are begun, first the cause of the damage must be eliminated, e.g. sharp-edged parts, defective electrical consumers, corrosion etc.

Wiring repairs may only be carried out with yellow wires.

Yellow wires and points on the wiring loom wrapped with yellow insulating tape mark previous repairs.

Following each repair, please conduct an operating test; if necessary, fault memories must be erased or systems must be brought into the basic setting.