

ENGINE**3.2 Liter VR6 4V Engine Mechanical, Fuel Injection Ignition, Engine Code(s): BJS****00 - GENERAL, TECHNICAL DATA****TECHNICAL DATA****Technical data**

Engine number, refer to Engine number

Engine data, refer to Engine data

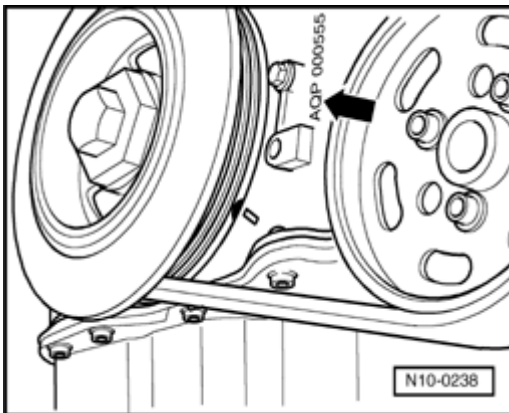
Engine number

Fig. 1: Identifying Engine Number

Courtesy of VOLKSWAGEN UNITED STATES, INC.

The engine number "engine code" and "serial number" is located next to vibration damper on cylinder block under coolant pump.

Additionally, a sticker is affixed to intake manifold with "engine code" and "serial number".

The engine code is also included on vehicle data plate.

Engine data

Engine code		BJS
Manufactured		10.03 -->
Emission values in accordance with		LEV2 Norm * See note
Cylinder arrangement		VR * See note
Cylinder angle		15.0 °
Displacement	ltr.	3.2
Output	kW at 1/rpm	177/6200

2004 Volkswagen R32

ENGINE 3.2 Liter VR6 4V Engine Mechanical, Fuel Injection Ignition, Engine Code(s): BJS

Torque	Nm at rpm	320/3200
Bore	dia. mm	84.0
Stroke	mm	95.9
Compression ratio		11.25
RON	min.	98 unleaded * See note

*LEV = Low Emission Vehicles

* VR = V-Arrangment in compact in-line design

* In exceptional circumstances min. 95 RON, however with reduced performance

Engine code	BJS
Fuel injection, ignition	Motronic ME7.1.1
Ignition sequence	1-5-3-6-2-4
Knock control	2 knock sensors
Oxygen sensor regulation	4 sensors
Self-Diagnosis	OBD II
Catalytic converter	yes
Exhaust gas recirculation	no
Charging	no
Secondary air injection (AIR) system	yes
Electronic Power Control (EPC)	yes
Variable intake manifold	yes
Variable valve timing	yes * See note
Leak diagnosis system	yes

* Two independently variable camshafts.

10 - ENGINE - ASSEMBLY

ENGINE, REMOVING AND INSTALLING

Engine, removing and installing

Notes on removing, refer to **Notes on removing**

Securing engine to assembly stand, refer to **Securing engine to assembly stand**

Notes on installing, refer to **Notes on installing**

Tightening torques, refer to **Torque specifications**

Aligning engine and transmission mounts, refer to *Engine and transmission mounts, aligning* under **Engine and**

transmission mounts, aligning

Assembly mounting, refer to **Assembly mounting**

Additional information and repair work on vehicles with air conditioning, refer to *Additional information and assembly work on vehicles with air conditioning* under **Additional information and assembly work on vehicles with air conditioning**

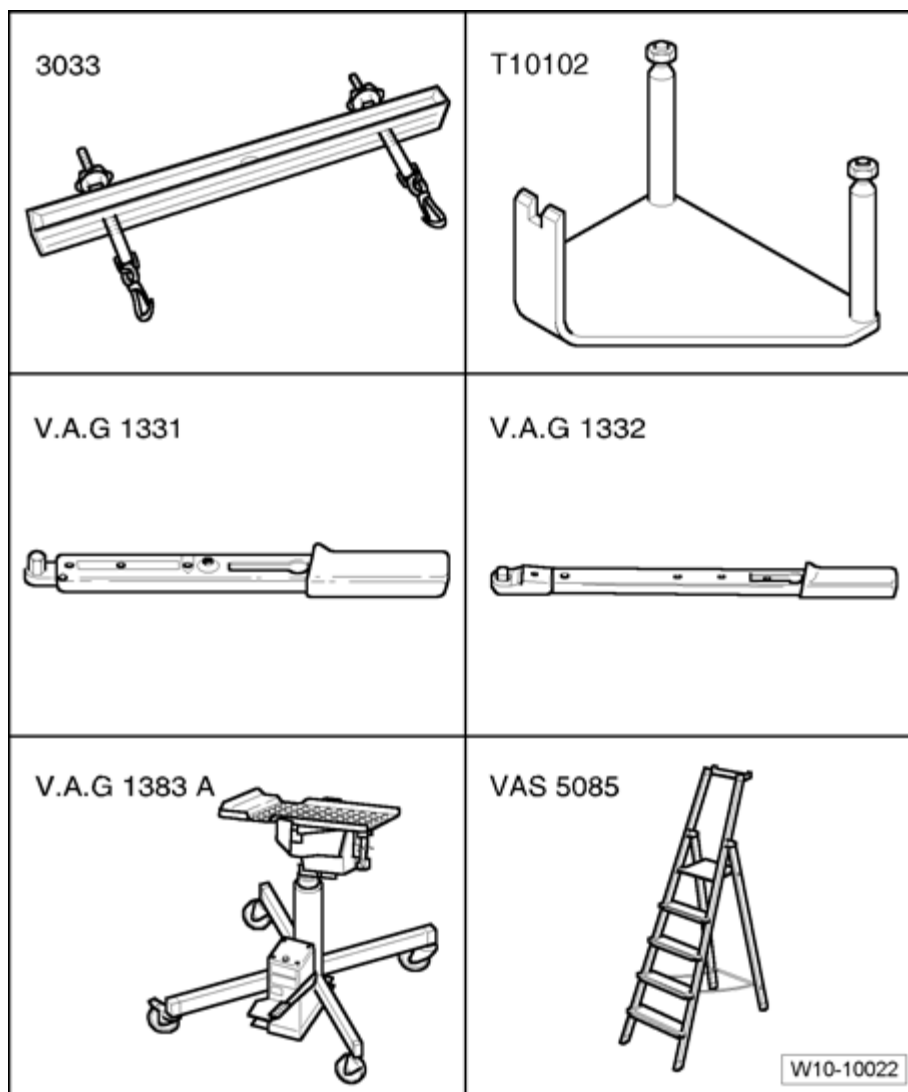


Fig. 2: Identifying Special Tools - Engine, Removing And Installing (1 Of 2)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Lifting tackle 3033
- Engine bracket T10102
- Torque wrench V.A.G 1331

- Torque wrench V.A.G 1332
- Engine/transmission jack V.A.G 1383 A
- Step ladder VAS 5085

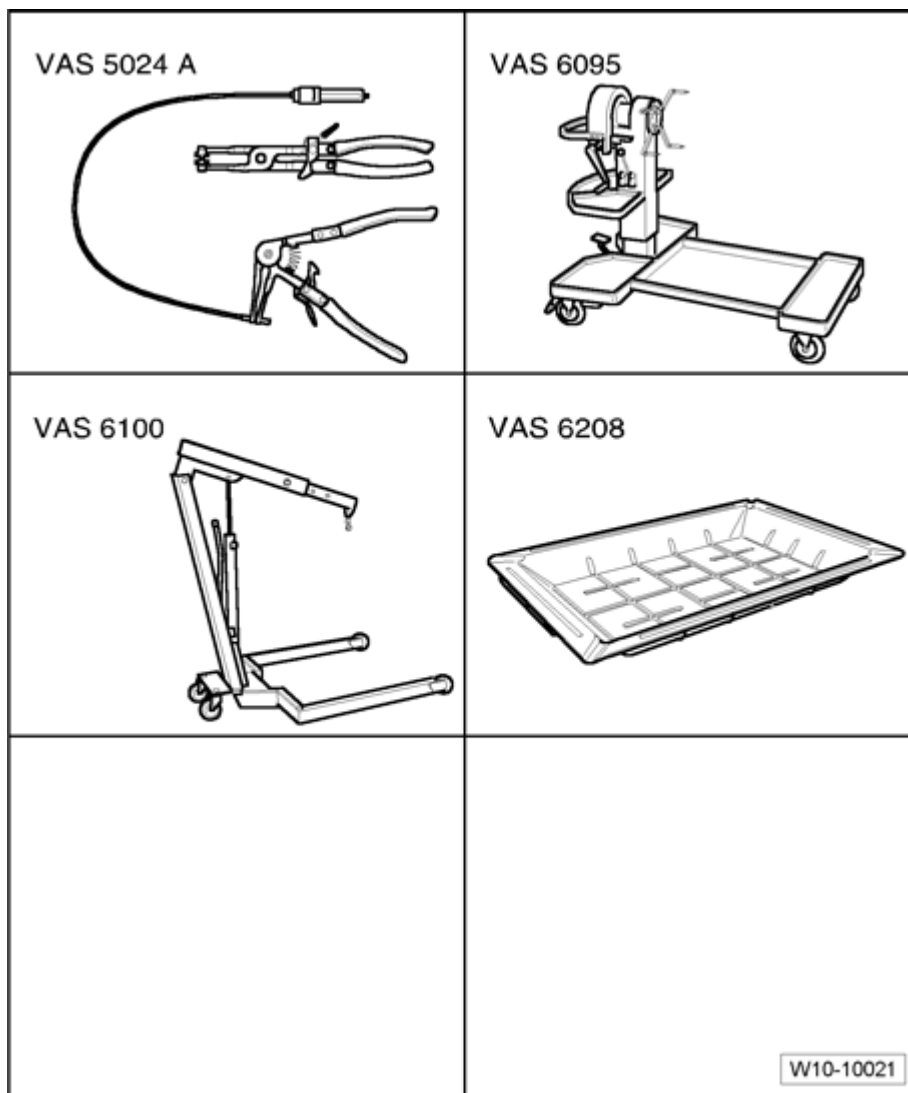


Fig. 3: Identifying Special Tools - Engine, Removing And Installing (2 Of 2)
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Spring-type clip pliers VAS 5024A
- Engine and transmission holder VAS 6095
- Shop crane VAS 6100
- Drip tray for workshop crane VAS 6208
- G 000 100 Grease (vehicles with manual transmission)

- Cable tie

Notes on removing**NOTE:**

- The engine is removed downward together with the transmission.
- All cable ties which are opened or cut open when removing engine, must be replaced in the same position when installing engine.
- To perform work sequence, the Ground (GND) cable must be disconnected from battery. Check whether a coded radio is installed. If so, obtain anti-theft coding beforehand.

- With ignition switched off disconnect battery Ground (GND) strap.
- Remove engine cover.
- Remove spark plug connectors and unclip spark plug wires.
- Remove battery and battery holder.
- Remove the air filter and intake tube, refer to **Air filter, assembly overview** .

CAUTION: Fuel supply lines are under pressure! Wear eye protection and protective gloves to avoid injuries and skin contact with fuel. Before removing from hose connection wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

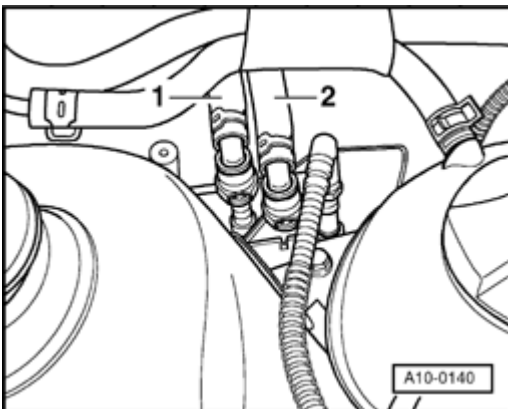


Fig. 4: Identifying Supply Line And Return Line

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull off supply line - 1 - (with white marking) and return line - 2 - (with blue marking) and catch any released fuel with a shop rag.

NOTE:

- Press buttons on hose couplings to do this.

- Seal lines so that the fuel system is not contaminated by dirt etc.
- Remove sound insulation pan, along with left and right sides: Refer to **BODY EXTERIOR**

- Remove ribbed belt, refer to *Ribbed belt, removing and installing* under **Ribbed belt, removing and installing**.
- Remove power steering pump on compact bracket and place to side; hoses remain connected: Refer to **48 STEERING**
- Remove securing clamps for power steering pressure line.

Vehicles with air conditioning

- Observe additional information and removal work, refer to *Additional information and assembly work on vehicles with air conditioning* under **Additional information and assembly work on vehicles with air conditioning**.

Continued for all vehicles

- Disconnect selector mechanism from transmission: Refer to **34 - MANUAL TRANSMISSION - CONTROLS, HOUSING**
- Separate hydraulic line to slave cylinder for hydraulic clutch: Refer to **30 - CLUTCH**
- Remove front bumper cover: Refer to **63 BUMPER**
- Bring lock carrier into service position: Refer to **50 BODY, FRONT**
- Remove intake manifold, refer to **Cylinder head cover, removing and installing**.
- Pull vacuum and vent hoses off from the engine.
- Separate the electrical connectors on the following components:

NOTE:

- **Before disconnecting harness connectors, mark allocation to component.**

- Engine Coolant Temperature (ECT) Sensor G62 with Engine Coolant Temperature (ECT) Gauge Sensor G2
- After-run coolant pump V51
- Valve 1 for camshaft adjustment N205
- Camshaft Adjustment Valve 1 (exhaust) N318
- Camshaft Position (CMP) sensor G40
- Camshaft position (CMP) sensor 2 G163
- Cylinder 1 Fuel Injector N30 to Cylinder 6 Fuel Injector N84
- Engine speed (RPM) sensor G28
- Knock sensor 1 G61
- Knock sensor 2 G66
- Oil level thermal sensor G266

Installed location: Refer to **Component locations, overview**

- Pull off/disconnect all electrical connections as necessary from engine and lay aside.
- Pull off/disconnect and lay aside all electrical harnesses from transmission, alternator, and starter.
- Drain the coolant, refer to *Cooling system, draining and filling* under **Cooling system, draining and filling**.
- Remove quick acting couplings of coolant hoses from radiator.
- Pull off coolant hoses from engine using spring type clip pliers VAS 5024A.
- Remove drive shafts: Refer to **40 FRONT SUSPENSION**

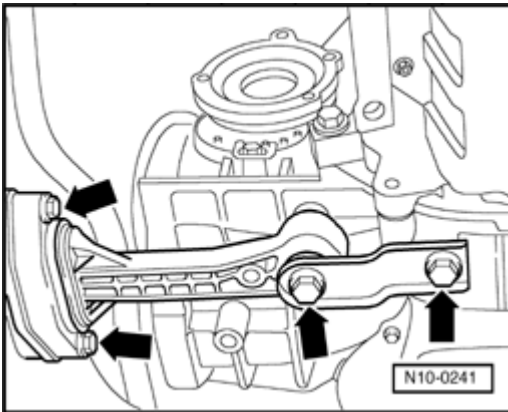


Fig. 5: Identifying Pendulum Supports

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove pendulum supports - **arrows** -.
- Remove double catalytic converter, refer to **Exhaust system components, removing and installing**.
- Remove front driveshaft tube: Refer to **39F - FINAL DRIVE, FRONT DIFFERENTIAL** or **39R - FINAL DRIVE, REAR DIFFERENTIAL**
- Remove front exhaust pipe, refer to **Exhaust system components, removing and installing**.
- Remove generator and compact holder: Refer to **27 BATTERY, STARTER, GENERATOR, CRUISE CONTROL**
- Remove holder for secondary air injection (AIR) pump motor V101 from oil pan.
- Set engine/transmission support T10102 onto engine/transmission jack V.A.G 1383 A.

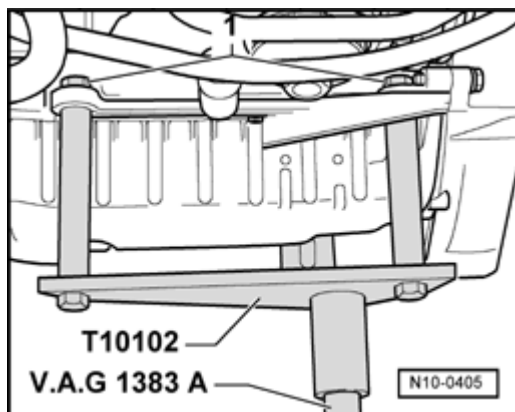


Fig. 6: Identifying Engine/Transmission Support T10102 And Engine/Transmission Jack V.A.G 1383 A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Set engine holder T10102 onto cylinder block and fasten with bolts - **1** -.
- Lift engine and transmission slightly using engine/transmission jack V.A.G 1383 A.

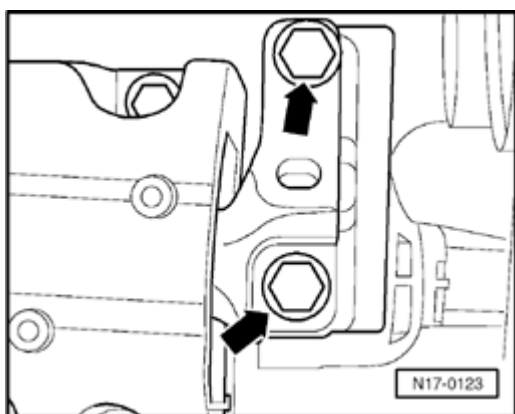


Fig. 7: Identifying Engine Side Of Assembly Mounting At Engine Bracket At Top
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unbolt engine side of assembly mounting from engine bracket at top - **arrows** -.

NOTE:

- Use step ladder VAS 5085 to remove bolts.

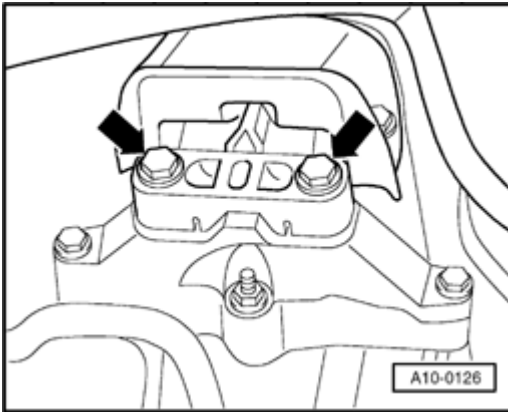


Fig. 8: Identifying Transmission Side Of Assembly Mounting At Top Of Transmission Carrier
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unbolt transmission side of assembly mounting from top of transmission carrier - **arrows** -.
- Carefully lower engine with transmission.

NOTE:

- **Carefully guided engine with transmission, when lowering, to prevent damage to bodywork.**

Securing engine to assembly stand

Secure engine in engine and transmission holder VAS 6095 when working on engine. Otherwise use engine and transmission holder VW 540 with supplementary set VW 540/1 B.

Work procedure

- Remove transmission.

Vehicles with automatic transmission

- Secure torque converter to prevent it from "falling out" after engine and transmission are separated.

Continued for all vehicles

- Attach lifting tackle 3033 as follows and lift engine with workshop crane VAS 6100 out from engine/transmission jack V.A.G 1383 A.

Vibration damper side: - **Position 3** -

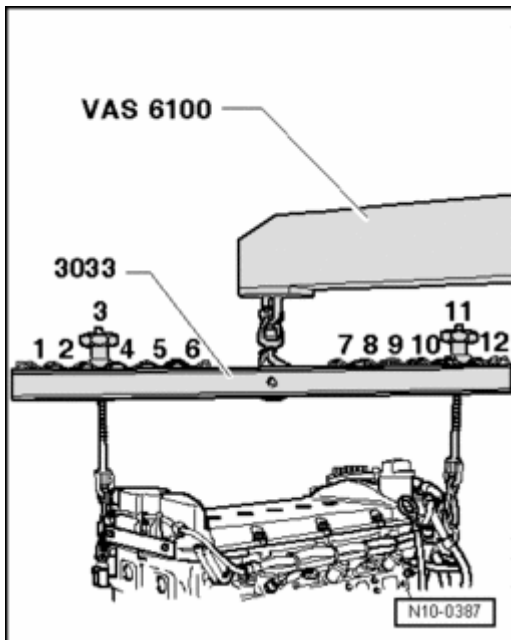


Fig. 9: Identifying Lifting Tackle 3033 & VAS 6100
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Flywheel side: - **Position 11** -

If using engine and transmission holder VAS 6095 :

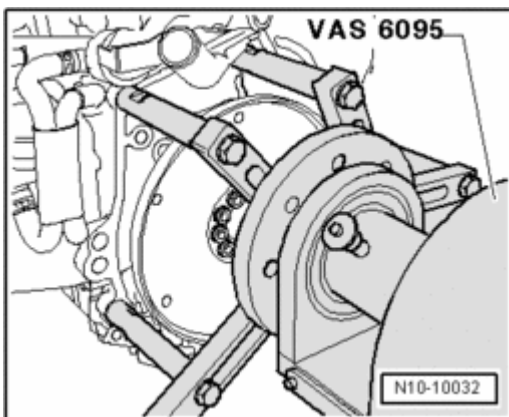


Fig. 10: Identifying Engine And Transmission Holder VAS 6095
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Secure engine to engine and transmission holder VAS 6095 as shown

If using holding fixture VW 540 :

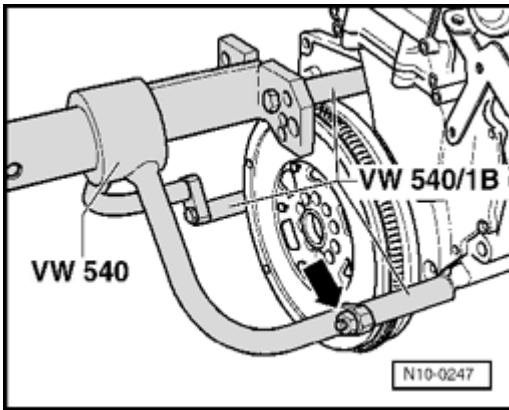


Fig. 11: Identifying Holding Fixture VW 540

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Bolt holding fixture VW 540 with three pieces from supplementary set VW 540/1 B to cylinder block. To fasten lower right - **arrow** -, use a commercially available Grade 8.8 bolt M12x160.

Notes on installing

Installation is performed in reverse order of removal. Note the following:

Work procedure

- Check 6 Spd. Manual Transmission 02Y All Wheel Drive clutch throw-out bearing, if necessary replace slave cylinder with throw-out bearing: Refer to **30 - CLUTCH**
- Clean drive shaft splines and lightly grease with "G 000 100".
- Check whether dowel sleeves for centralizing engine/transmission are in cylinder block, install if necessary.
- When installing engine/transmission assembly, ensure sufficient clearance to engine and transmission mountings and radiator.
- Align engine and transmission mountings, refer to *Engine and transmission mounts, aligning* under **Engine and transmission mounts, aligning** .

NOTE:

- **Torque settings for assembly mountings, refer to Assembly mounting .**

- Install compact bracket and generator: Refer to **27 BATTERY, STARTER, GENERATOR, CRUISE CONTROL**
- Install front exhaust pipe.
- Install front driveshaft tube: Refer to **39F - FINAL DRIVE, FRONT DIFFERENTIAL** or **39R - FINAL DRIVE, REAR DIFFERENTIAL**
- Install double catalytic converter, refer to **Exhaust system components, removing and installing** .
- Install drive axles: Refer to **40 FRONT SUSPENSION**
- Install hydraulic line to hydraulic clutch slave cylinder: Refer to **30 - CLUTCH**

- Bleed clutch system: Refer to **30 - CLUTCH**
- Install shift mechanism: Refer to **34 - MANUAL TRANSMISSION - CONTROLS, HOUSING**
- If necessary, adjust selector lever cable: Refer to **34 - MANUAL TRANSMISSION - CONTROLS, HOUSING**
- Install power steering pump: Refer to **30 - CLUTCH**
- Install ribbed belt, refer to *Ribbed belt, removing and installing* under **Ribbed belt, removing and installing** .
- Electrical connections and routing: Refer to Electrical Wiring Diagrams, Troubleshooting and Component Locations
- Install center sound insulation pan, along with left and right sides: Refer to **50 BODY, FRONT**
- Install intake manifold, refer to **Cylinder head cover, removing and installing** .
- Install the air filter with intake tube, refer to **Air filter, assembly overview** .
- Fill with coolant, refer to *Cooling system, draining and filling* under **Cooling system, draining and filling** .
- Adapt Engine Control Module (ECM) to throttle valve control module "Guided functions"
- Perform a test drive and check all Fault memories.
- Check headlight adjustment and adjust if necessary: Refer to Repair Manual, Maintenance

Torque specifications

Bolted connections		Torque specifications
Bolts, nuts	M6	10 Nm
	M7	15 Nm
	M8	25 Nm
	M10	40 Nm
	M12	60 Nm
Deviation from		
Connecting bolts, engine to transmission	M10	60 Nm
Connecting bolts, engine to transmission	M12	80 Nm
Starter to transmission		65 Nm

NOTE: • **Torque settings for assembly mountings, refer to Assembly mounting .**

Engine and transmission mounts, aligning

Special tools, testers and auxiliary items required

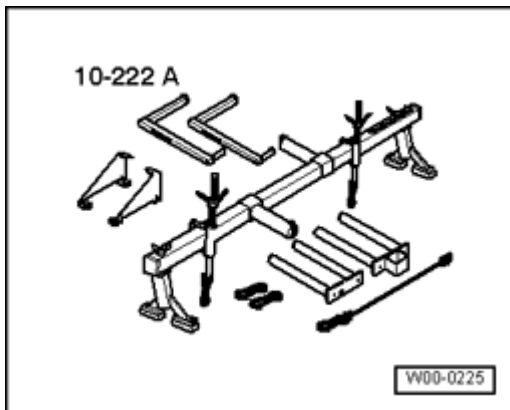


Fig. 12: Identifying Engine Support Bridge 10 - 222 A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Engine support bridge 10 - 222 A
- Frame 10 - 222 A /1
- Adapter 10 - 222 A /3

CAUTION: Before loosening bolts, secure assembly using engine support bridge 10 - 222 A.

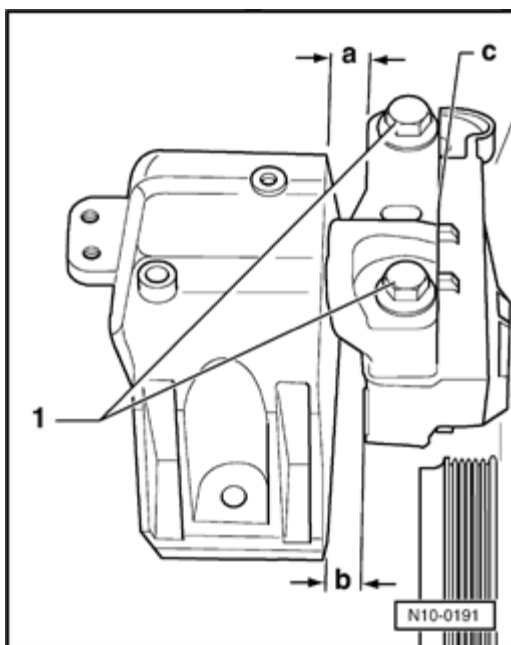


Fig. 13: Engine Mount Dimensions
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Engine mounting

Dimension - a - = 14.0 mm

Dimension - **b** - = minimum 10.0 mm

Both bolt heads - **1** - must be flush with edge - **c** -.

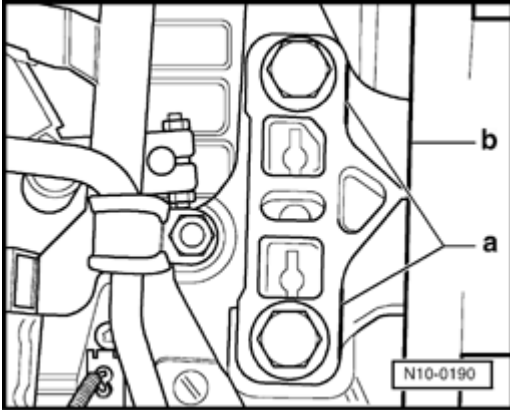


Fig. 14: Transmission Mount Dimensions
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Transmission assembly mounting

Edges - **a** - and - **b** - must be parallel to each other.

- Torque settings for assembly mountings, refer to Assembly mounting .

Assembly mounting

Torque specifications

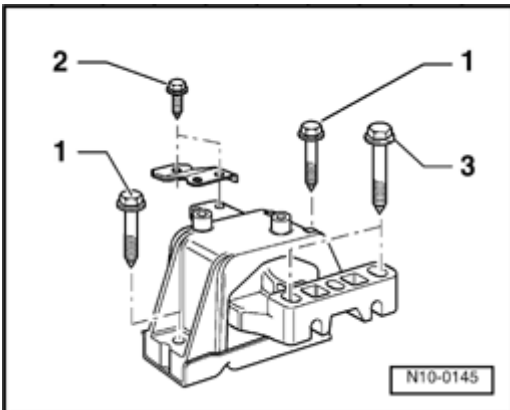


Fig. 15: Engine Mounting Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Engine mounting

1 -	Mounting to body * See note	40 Nm + 90 ° ($\frac{1}{4}$ turn)
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2004 Volkswagen R32

ENGINE 3.2 Liter VR6 4V Engine Mechanical, Fuel Injection Ignition, Engine Code(s): BJS

2 -	Support to mounting at body * See note	20 Nm + 90 ° ($\frac{1}{4}$ turn)
3 -	Mount to engine bracket	100 Nm

* Replace bolts

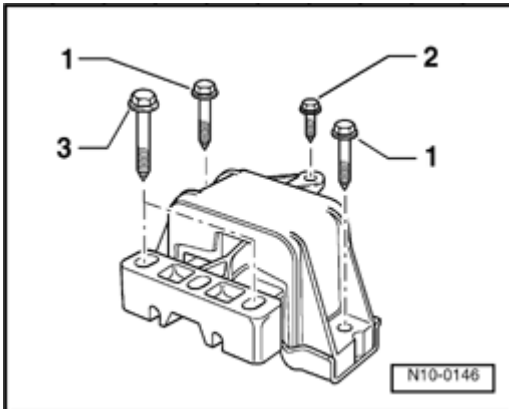


Fig. 16: Transmission Mounting Bolts

Courtesy of VOLKSWAGEN UNITED STATES, INC.

Transmission assembly mounting

1 -	Mounting to body * See note	40 Nm + 90 ° ($\frac{1}{4}$ turn)
2 -	Mounting to body * See note	20 Nm + 90 ° ($\frac{1}{4}$ turn)
3 -	Mounting to transmission console	100 Nm

* Replace bolts

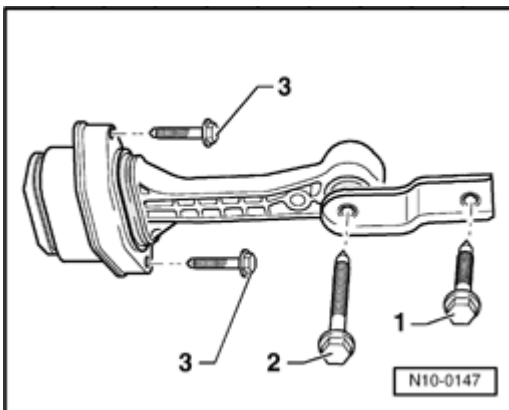


Fig. 17: Pendulum Supports Mounting Bolts

Courtesy of VOLKSWAGEN UNITED STATES, INC.

Pendulum supports

2004 Volkswagen R32

ENGINE 3.2 Liter VR6 4V Engine Mechanical, Fuel Injection Ignition, Engine Code(s): BJS

1 -	Pendulum supports to transmission	50 Nm
2 -	Pendulum supports to transmission	50 Nm
3 -	Pendulum supports to subframe	25 Nm

Additional information and assembly work on vehicles with air conditioning

CAUTION: The air conditioning refrigerant circuit must not be opened.

NOTE:

- The refrigerant circuit must only be opened in workshops with trained personnel and the necessary range of tools and workshop equipment.
- To prevent damage to condenser and also to the refrigerant lines/hoses, ensure that the pipes and hoses are not stretched, kinked or bent.

To facilitate removal and installation of the engine without having to open the refrigerant circuit:

- Remove retaining clamp(s) from refrigerant lines.
- Remove air conditioner compressor: Refer to **87 - AIR CONDITIONING**
- Secure A/C compressor to body so that the refrigerant lines/hoses are not under stress.

13 - ENGINE - CRANKSHAFT, CYLINDER BLOCK

ENGINE, DISASSEMBLING AND ASSEMBLING

Engine, disassembling and assembling

NOTE:

- When performing repair work, secure engine to engine and transmission holder VAS 6095 or holding fixture VW 540 with supplementary set VW 540/1 B.

Part I and II, assembly overview, refer to **Part I and II, assembly overview**

Part I: Chain drive, assembly overview, refer to **Part I: Chain drive, assembly overview**

Part II: Crank drive, assembly overview, refer to **part II: Crank drive, assembly overview**

Removing and installing ribbed belt, refer to *Ribbed belt, removing and installing* under **Ribbed belt, removing and installing**

NOTE:

- If large quantities of metal particles or abraded material are detected during engine repairs, it may be an indication for a damaged crankshaft or rod bearings. To prevent further damage, perform the following steps after the repair:

- Carefully clean oil passages
- Replace oil injection jets
- Replace oil cooler
- Replace oil filter

Part I and II, assembly overview

Part I: Chain drive, assembly overview, refer to **Part I: Chain drive, assembly overview**

Part II: Crank drive, assembly overview, refer to **part II: Crank drive, assembly overview**

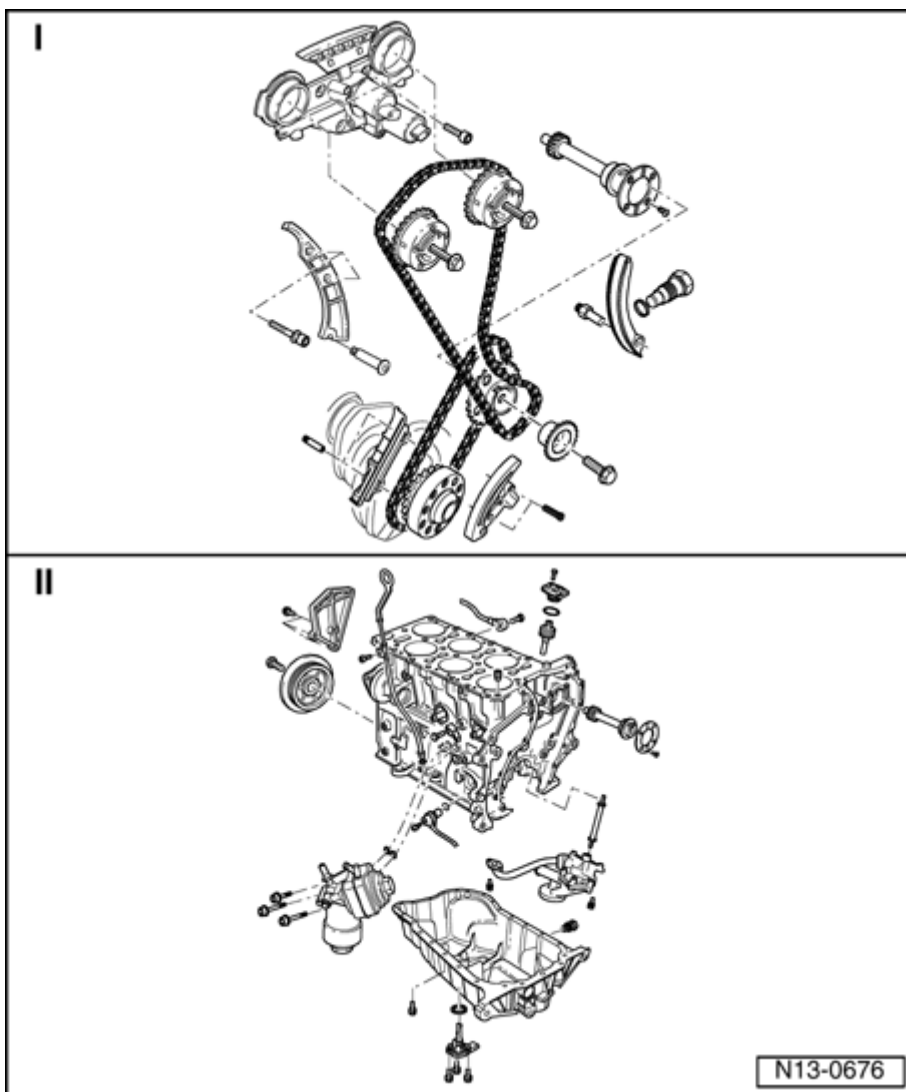


Fig. 18: Identifying Engine, Disassembling/Assembling Parts I & II
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Part I: Chain drive, assembly overview

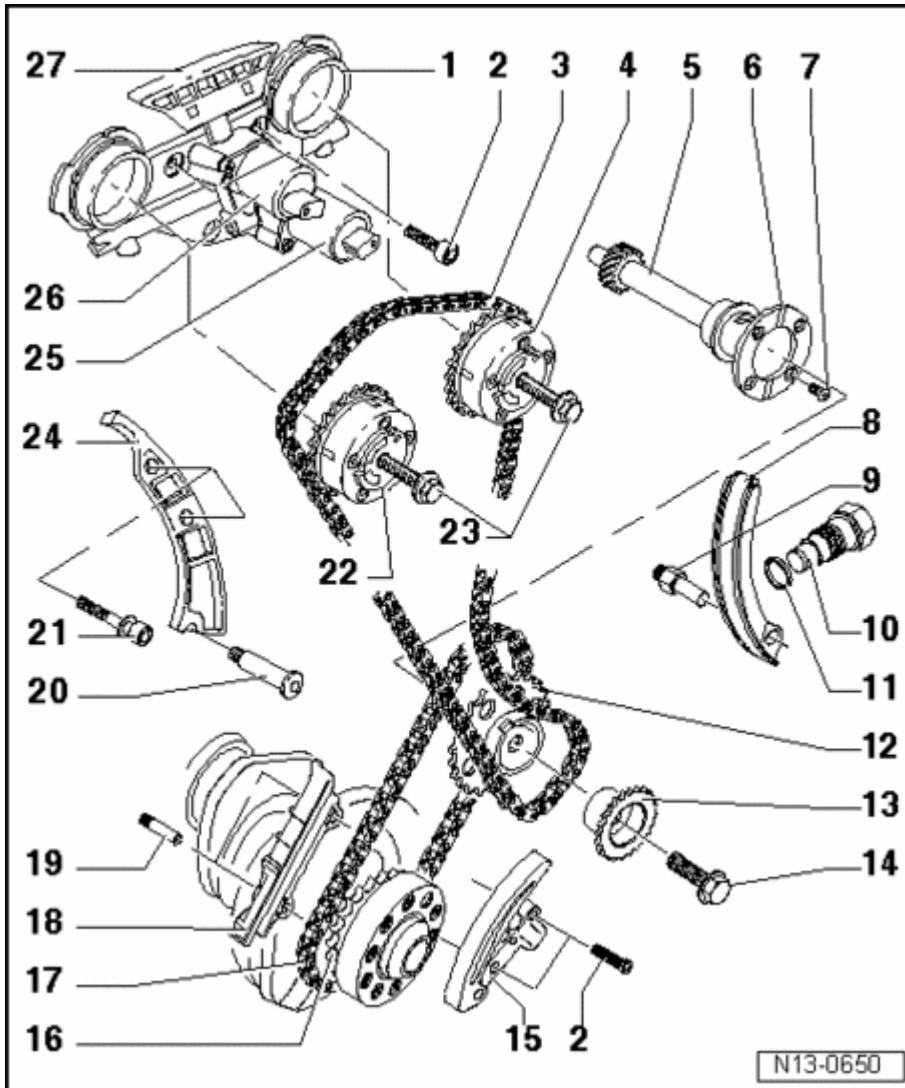


Fig. 19: Identifying Chain Drive, Assembly Overview - Part I
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Control housing

- Lightly lubricate contact surfaces of oil seals before installing
- Removing and installing, refer to **Camshafts, removing and installing**
- Disassembling and assembling *Disassembling and assembling control housing* under **Assembly overview**
- Before installing control housing strainer check for contamination *Check the control housing screen for contamination* under **Assembly overview**

2 - 8 Nm

- Replace

3 - Camshaft roller chain

- Mark direction of rotation before removing (installation position) **Marking roller chains**
- Installing, refer to **Valve timing, adjusting**

4 - Exhaust camshaft adjuster

- Identification: 32A
- Only rotate engine with camshaft adjuster installed
- Installing, refer to **Valve timing, adjusting**

5 - Intermediate shaft

6 - Thrust washer

7 - 8 Nm

- Insert with locking fluid "D 000 600 A2"

8 - Tensioning rail

9 - Pivot pin, 18 Nm

10 - Chain tensioner, 40 Nm

- Only rotate engine with chain tensioner installed

11 - Oil seal

- Replace if damaged or leaking

12 - Chain sprocket

- Installing, refer to **Valve timing, adjusting**

13 - Chain sprocket

- Installing, refer to **Valve timing, adjusting**

14 - 60 Nm + $\frac{1}{4}$ turn (90 °)

- Replace
- Use counter-holder tool T10069 to tighten and loosen, refer to **Valve timing, adjusting**

15 - Chain tensioner with tensioning rail

- Before installation release the locking device in the chain tensioner with a small screwdriver and press the

tensioning plate against the chain tensioner

- Only rotate engine with chain tensioner installed

16 - Drive gear

- Integral part of crankshaft
- Ground down tooth aligned with main bearing joint = TDC cyl. 1, refer to **Valve timing, adjusting**

17 - Roller chain

- Mark direction of rotation before removing (installation position) **Marking roller chains**
- Installing, refer to **Valve timing, adjusting**

18 - Guide rail

- Remove and install together with roller chain, refer to **Valve timing, adjusting**

19 - Locating pin without collar, 10 Nm

20 - 18 Nm

21 - 23 Nm

22 - Intake-camshaft adjuster

- Identification: 24E
- Only rotate engine with camshaft adjuster installed
- Installing, refer to **Valve timing, adjusting**

23 - 60 Nm + $\frac{1}{4}$ turn (90 °)

- Replace
- Contact surface of sender wheel must be dry around bolt head when assembling
- To remove and install, counter-hold at camshaft using an open-end wrench (32 mm), refer to **Camshafts, removing and installing**

24 - Guide rail

25 - Camshaft adjustment valve 1 (exhaust) N318

- For exhaust camshaft
- Before disconnecting, mark allocation of connector to component

26 - Valve 1 for camshaft adjustment N205

- For intake camshaft
- Before disconnecting, mark allocation of connector to component

27 - Guide rail

- For camshaft roller chain
- Clipped in at control housing

Marking roller chains

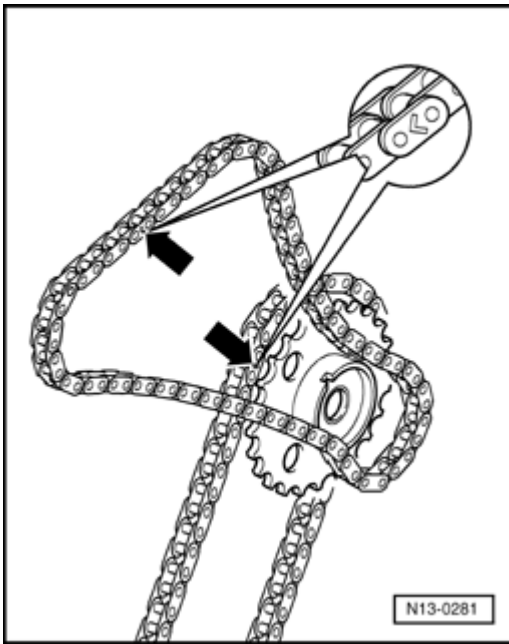


Fig. 20: Marking roller chains

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Mark roller chains before removing (e.g. with paint, arrow pointing in direction of rotation).

NOTE:

- **Do not mark chain with a center punch or similar means!**

Part II: Crank drive, assembly overview

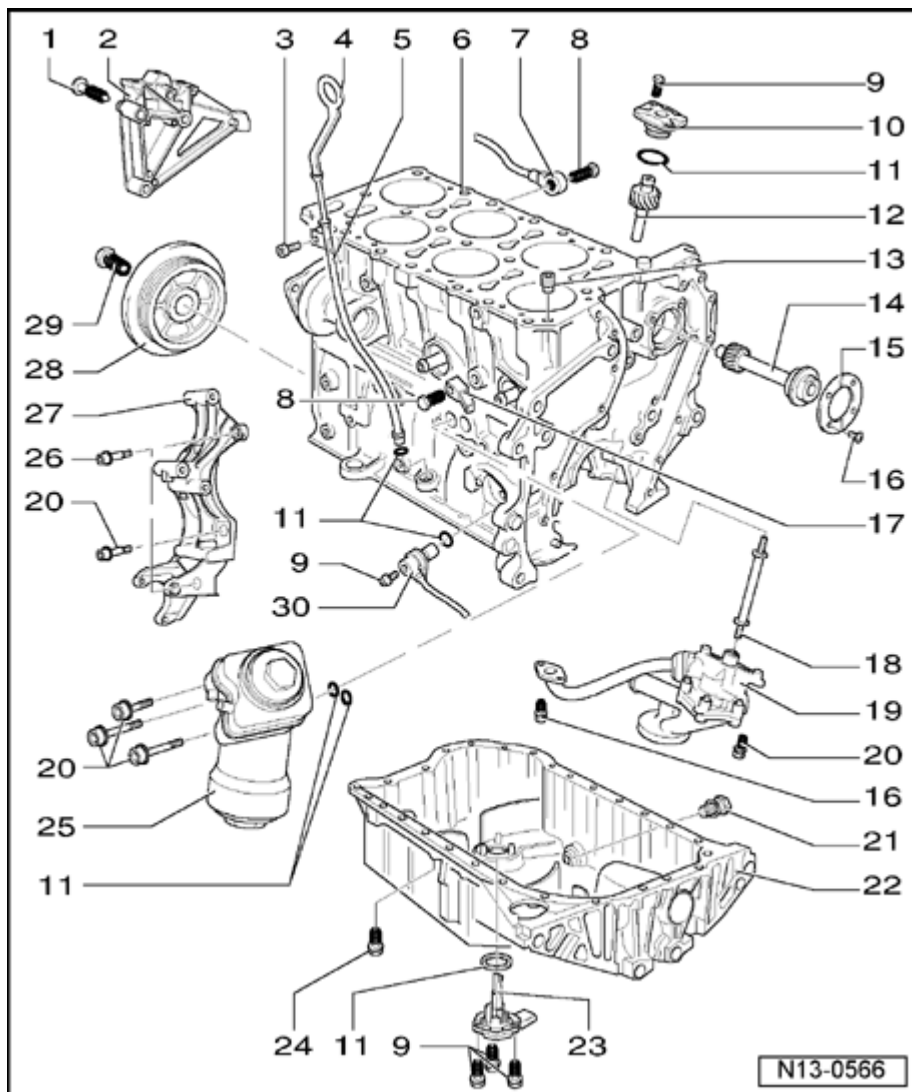


Fig. 21: Identifying Crank Drive, Assembly Overview - Part II
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 45 Nm

2 - Engine bracket

3 - 5 Nm

- Fastened to intake manifold

4 - Dipstick

- Oil level must not be above the max. mark!
- Marks **Markings on oil dipstick**

5 - Guide tube

- For dipstick
- Secured by a bolt to intake manifold

6 - Cylinder block

- Removing and installing sealing flange and dual-mass flywheel, refer to *Sealing flange and dual-mass flywheel, removing and installing* under **Sealing flange and dual-mass flywheel, removing and installing**
- Removing and installing crankshaft, refer to **Crankshaft, removing and installing**
- Piston and connecting rod, disassembling and assembling, refer to **Piston and connecting rod, disassembling and assembling**

7 - Knock sensor 1 G61

- Component location: Between cyl. 1 and cyl. 3

8 - 20 Nm

- Torque setting influences the function of knock sensor

9 - 10 Nm**10 - Oil pump drive cover****11 - O-ring**

- Replace
- Oil before assembling

12 - Oil pump drive**13 - Oil non-return valve, 5 Nm**

- Note installation position
- Clean if badly soiled
- See note, refer to **Engine, disassembling and assembling**

14 - Intermediate shaft**15 - Thrust washer****16 - 10 Nm**

- Install with locking fluid "D6"

17 - Knock sensor 2 G66

- Component location: Between cyl. 4 and cyl. 6

18 - Input shaft

- For oil pump drive

19 - Oil pump

- Disassembling and assembling, refer to **Oil pump, assembly overview**
- Coat oil pressure line at cylinder block and oil pump housing with sealing compound AMV 188 001 02

20 - 25 Nm

21 - Oil drain plug, 30 Nm

- Replace seal

22 - Oil pan

- Removing and installing, refer to **Oil pan, removing and installing**

23 - Oil level thermal sensor G266

24 - 12 Nm

25 - Oil filter housing

- Disassembling and assembling, refer to **Oil filter housing, assembly overview**
- Coolant hose connection diagram, refer to **Coolant hose connection diagram**

26 - Fitting bolt, 25 Nm

27 - Compact bracket

- For generator, air conditioning compressor, and power steering pump

28 - Vibration damper

- Removing and installing ribbed belt, refer to *Ribbed belt, removing and installing* under **Ribbed belt, removing and installing**

29 - 100 Nm + $\frac{1}{4}$ turn (90 °)

- Replace

- Use counter-holder T10069 to loosen and tighten **To loosen and tighten securing bolt, hold vibration damper with counter-holder T10069**
- Fasten with torque wrench V.A.G 1601

30 - Engine speed (RPM) sensor G28

To loosen and tighten securing bolt, hold vibration damper with counter-holder T10069

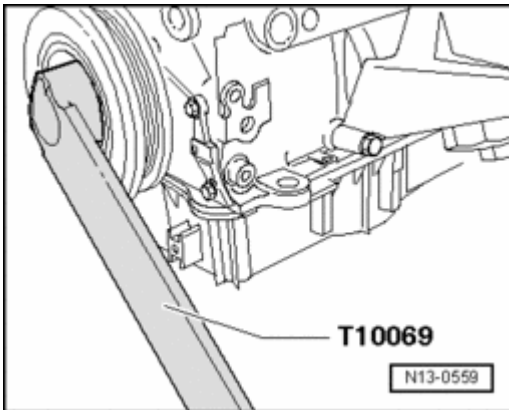


Fig. 22: Loosening/Tightening Securing Bolt, Using Counter-Holder T10069 To Hold Vibration Damper
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE:

- Vibration damper securing bolt must be replaced.
- Tighten securing bolt with torque wrench V.A.G 1601.

Ribbed belt, removing and installing

Special tools, testers and auxiliary items required

- Hex bolt M8x50

Removing

- Remove engine cover.
- Remove right insulation pan: Refer to **50 BODY, FRONT**
- Mark direction of rotation of ribbed belt.

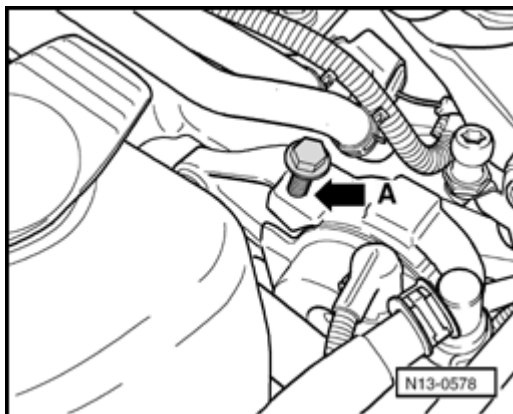


Fig. 23: Identifying Bolt M8X50 In Hole Of Ribbed Belt Tensioner Roller
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- To relieve tension on ribbed belt, screw a bolt M8x50 into hole - A - of ribbed belt tensioner roller.

NOTE:

- Only thread bolt in so far until the ribbed belt can be removed, otherwise the housing of the tensioning roller can be damaged.

- Remove ribbed belt.

Installing

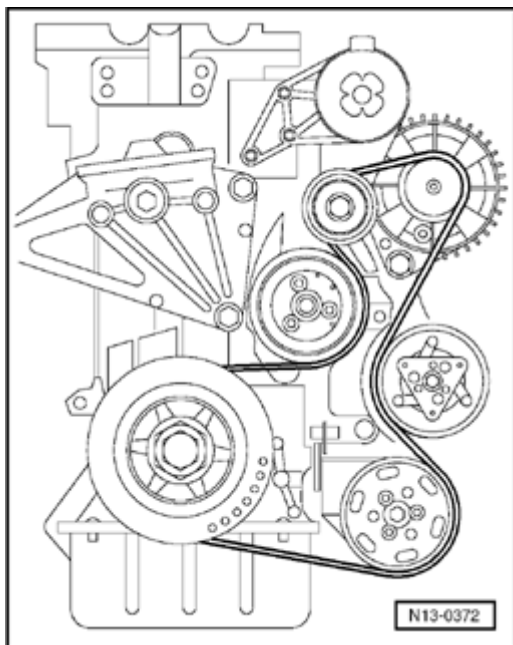


Fig. 24: Identifying Ribbed Belt Routing
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Set ribbed belt in place as shown.
- Remove bolt from tensioning roller.

NOTE:

- Ensure, before installing ribbed belt, that all ancillaries (generator, air conditioner compressor, power steering pump) are secured tightly.
- When installing the ribbed belt, be aware of the direction of rotation and ensure that the belt is seated correctly in the belt pulleys.

After completing repairs always:

- Start engine and check belt running.

SEALING FLANGE AND DUAL-MASS FLYWHEEL, REMOVING AND INSTALLING

Sealing flange and dual-mass flywheel, removing and installing

Assembly overview, refer to Assembly overview

Oil seal (flywheel side), removing and installing, refer to Oil seal (flywheel side), removing and installing

Drive plate, removing and installing, refer to Drive plate, removing and installing

Sealing ring for crankshaft - harmonic balancer side, replacing, refer to Crankshaft seal (vibration damper side), replacing

NOTE:

- When performing repair work, secure engine to engine and transmission holder VAS 6095 or holding fixture VW 540 with supplementary set VW 540/1 B.

Servicing clutch: Refer to 30 - CLUTCH

Assembly overview

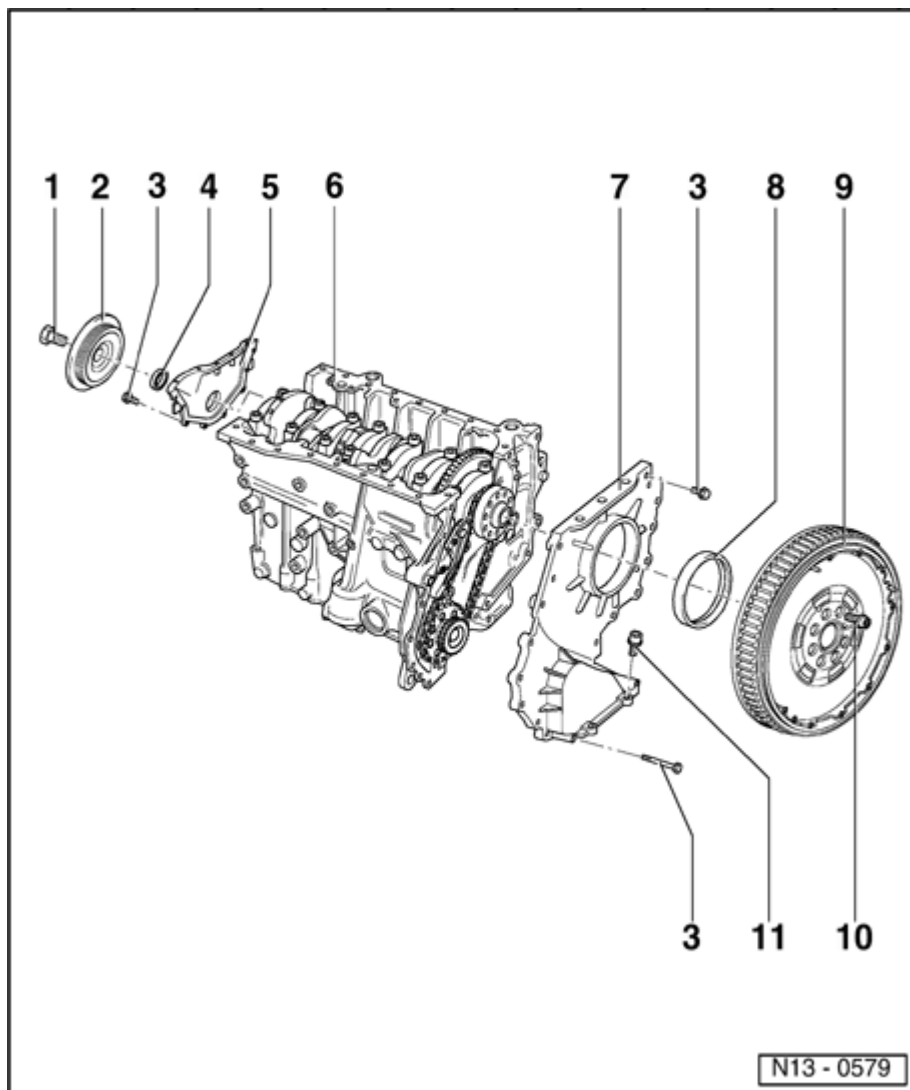


Fig. 25: Sealing Flange And Dual-Mass Flywheel Assembly Overview
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 100 Nm + $\frac{1}{4}$ turn (90 °)

- Replace
- Use counter-holder T10069 to loosen and tighten, refer to **Crankshaft seal (vibration damper side), replacing**
- Fasten with torque wrench V.A.G 1601

2 - Vibration damper

- Removing and installing ribbed belt, refer to *Ribbed belt, removing and installing* under **Ribbed belt, removing and installing**

3 - 10 Nm

4 - Oil seal

- Replace, refer to **Crankshaft seal (vibration damper side), replacing**

5 - Sealing flange

- Coat sealing surfaces with sealing compound AMV 176 501

6 - Cylinder block

- Removing and installing crankshaft, refer to **Crankshaft, removing and installing**
- Piston and connecting rod, disassembling and assembling, refer to **Piston and connecting rod, disassembling and assembling**

7 - Sealing flange

- Coat sealing surfaces with sealing compound AMV 176 501

8 - Oil seal

- Use extractor hook T20143/2 for removal
- PTFE version of oil seal
- Identification: no inner coil spring
- Do not additionally oil or grease sealing lip of sealing ring
- Before installing, remove oil remains from crankshaft journal with a clean cloth
- Removing and installing, refer to **Oil seal (flywheel side), removing and installing**

9 - Dual mass flywheel

10 - 60 Nm + $\frac{1}{4}$ turn (90 °)

- Replace
- To loosen or tighten, use counter-holder T10044 (with 5 mm spacers), or counter-holder tool T10069.

11 - 25 Nm

Oil seal (flywheel side), removing and installing

Special tools, testers and auxiliary items required

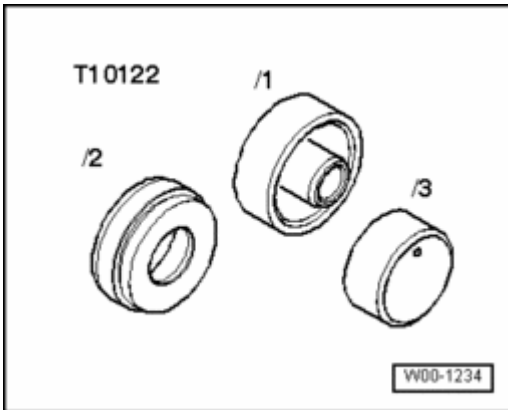


Fig. 26: Pulling Fixture T10122

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pulling fixture T10122

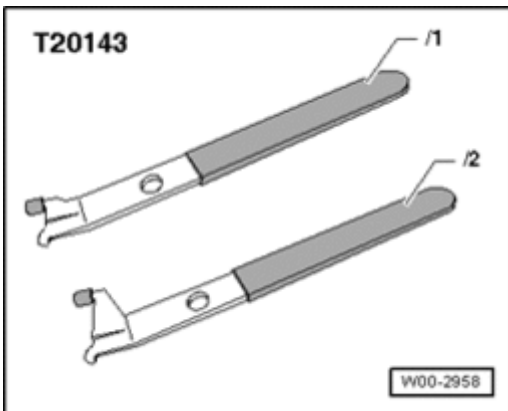


Fig. 27: Extractor Hook T20143

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Extractor hook T20143

Removing

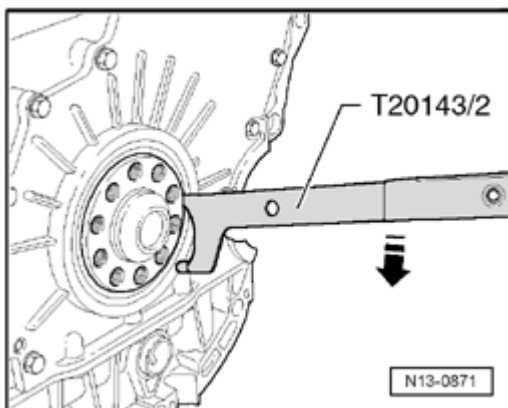


Fig. 28: Placing Removal Hook T20143/2 Behind Sealing Lip Of Oil Seal

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place removal hook T20143/2 behind sealing lip of oil seal as shown in the illustration.
- Support removal hook T20143/2 on sealing flange and pry out oil seal in - **direction of arrow** -.

Installing

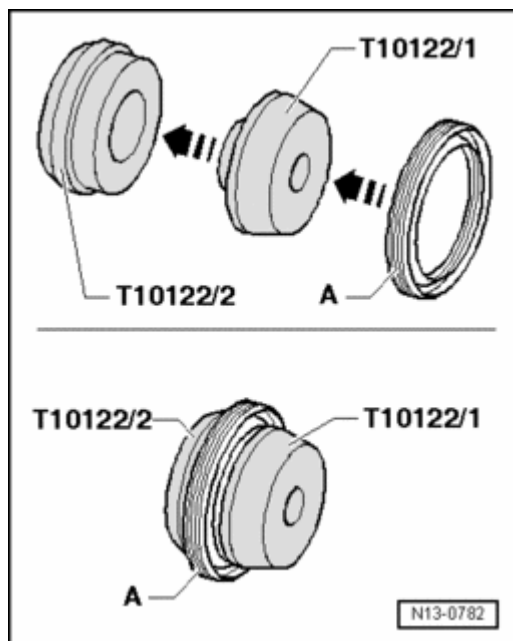


Fig. 29: Identifying Seal, Sleeve T10122/1 And Assembly Tool T10122/2

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull seal - A - with outer side over sleeve T10122/1 onto assembly tool T10122/2.
- Separate both assembly sleeves.
- Place assembly tool T10122/2 with dry seal onto crankshaft flange.

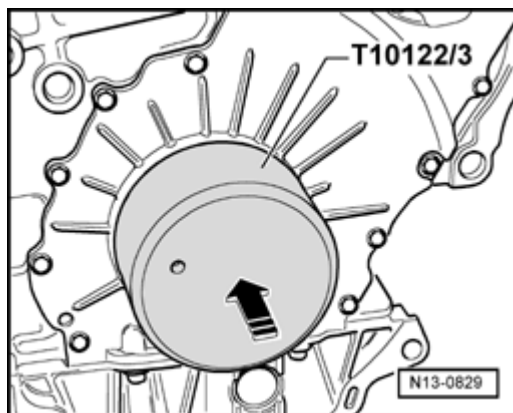


Fig. 30: Driving Seal Into Sealing Flange Until Stop Using Thrust Piece T10122/3

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Drive seal into sealing flange until stop using thrust piece T10122/3.

Drive plate, removing and installing

Special tools, testers and auxiliary items required

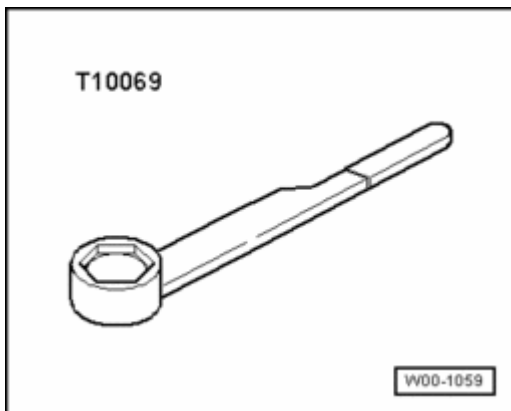


Fig. 31: Counter-Holder Tool T10069

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Counter-holder tool T10069

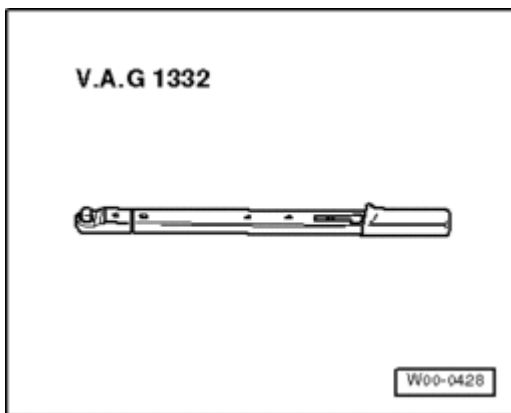


Fig. 32: Torque Wrench V.A.G. 1332 (40 To 200 Nm)

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Torque wrench V.A.G 1332
- Depth gauge
- Straight edge

Removing

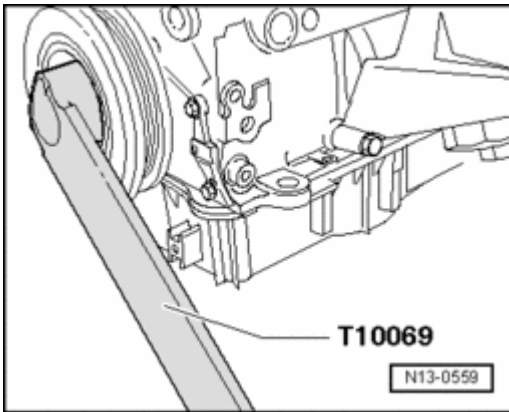


Fig. 33: Loosening/Tightening Securing Bolt, Using Counter-Holder T10069 To Hold Vibration Damper
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove drive plate. To do this, lock vibration damper with counter-holder T10069.
- Loosen drive plate securing bolts diagonally and remove.
- Remove drive plate.

Installing

- Install drive plate on crankshaft.
- Insert at least 3 old securing bolts and tighten to 30 Nm.

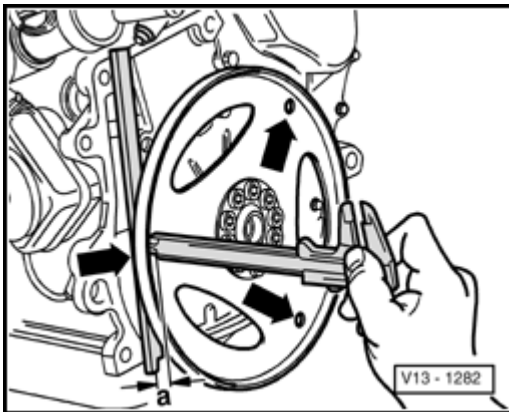


Fig. 34: Checking Dimension Through 3 Holes For Securing Torque Converter Using A Straight Edge And Depth Gauge And Calculate Average

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Check dimension - a - through 3 holes for securing torque converter using a straight edge and depth gauge and calculate average.
- Compare average (measured distance + thickness of straightedge) with specification. Specification: 15.7 to 16.5 mm

If specification is not attained:

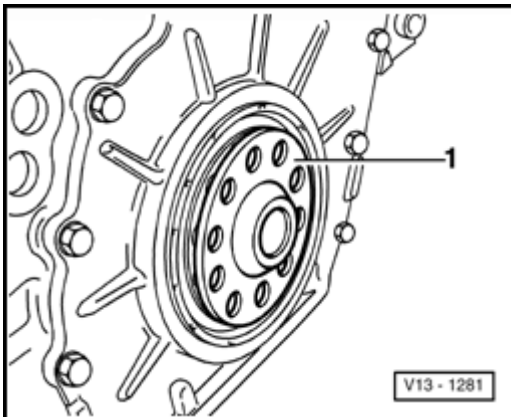


Fig. 35: Identifying Appropriate Shim

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove drive plate again and install appropriate shim - **1** -.

NOTE:

- **Only one shim of the appropriate thickness may be used.**

If specification is attained:

- Insert new securing bolts and tighten by hand.
- Tighten bolt to 60 Nm + 90 ° ($\frac{1}{4}$ turn)

Crankshaft seal (vibration damper side), replacing

Special tools, testers and auxiliary items required

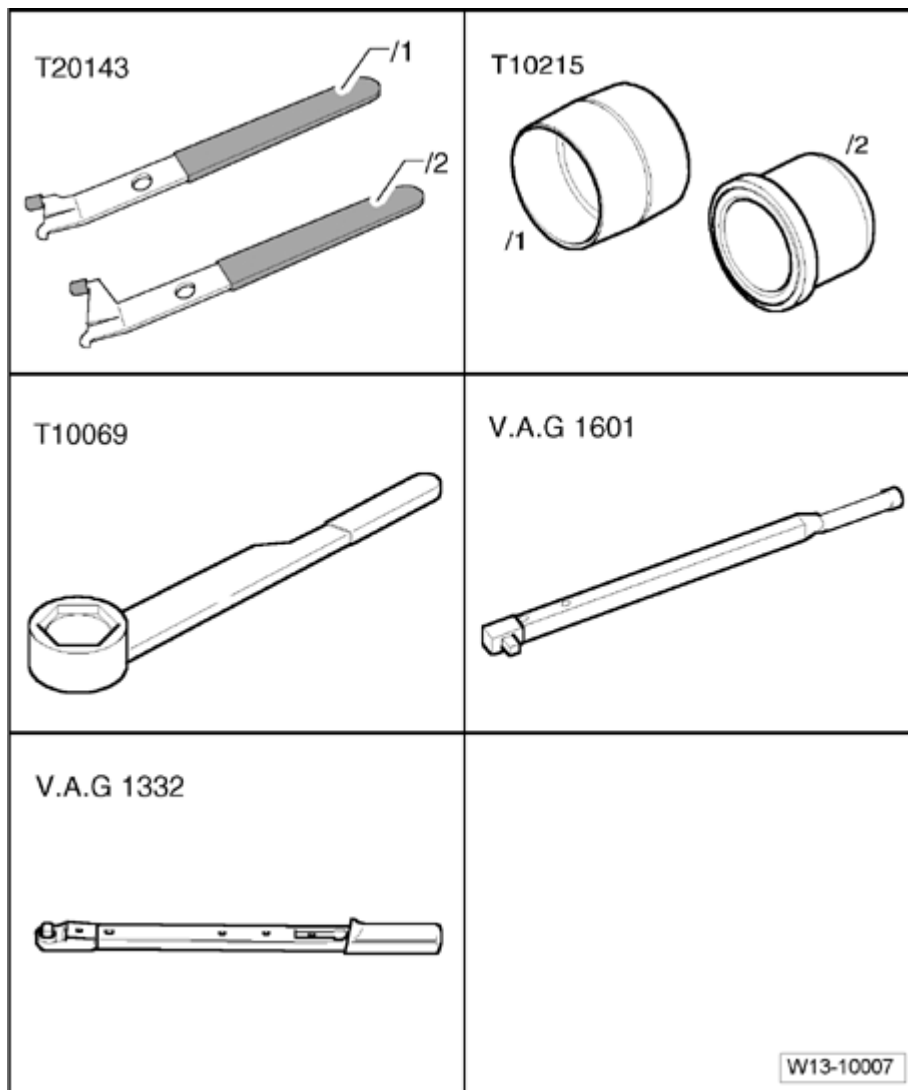


Fig. 36: Identifying Special Tools - Crankshaft Seal (Vibration Damper Side), Replacing
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Extractor hook T20143/1
- Assembly tool T10215
- Counter-holder tool T10069
- Torque wrench V.A.G 1601
- Torque wrench V.A.G 1332

Removing

- Remove ribbed belt, refer to *Ribbed belt, removing and installing* under **Ribbed belt, removing and installing** .

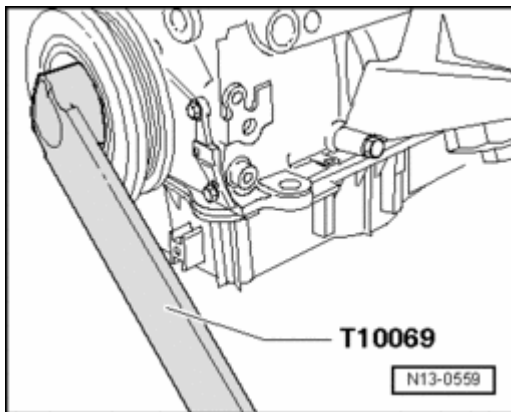


Fig. 37: Loosening/Tightening Securing Bolt, Using Counter-Holder T10069 To Hold Vibration Damper
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove vibration damper. To do this, lock vibration damper with counter-holder T10069.

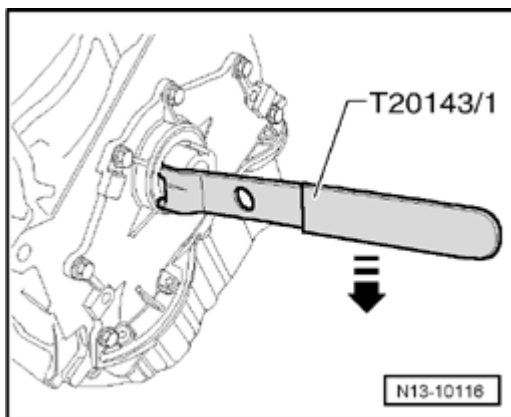


Fig. 38: Locking Vibration Damper With Counter-Holder T10069
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place removal hook T20143/1 behind sealing lip of oil seal as shown in the illustration.
- Support pulling hook T20143/1 on the sealing flange and pry out the oil seal in direction of - **arrow** -.

Installing

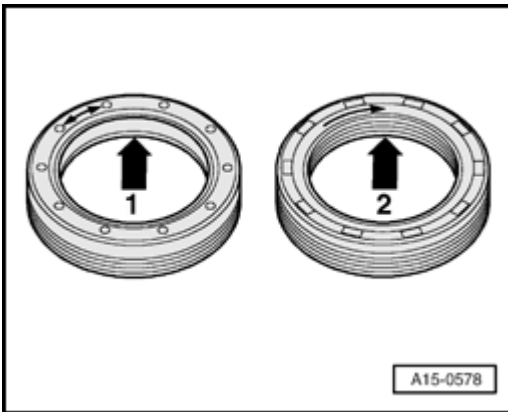


Fig. 39: Identifying A PTFE Seal (Teflon) & Inner Coil Spring Type Seal
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE:

- A PTFE seal (Teflon) - 2 - is gradually being introduced instead of the inner coil spring type seal - 1 -. This has a wider sealing lip. PTFE sealing rings are installed free of oil and grease. If a PTFE sealing ring was installed, only this type of sealing ring may be used as a replacement part!

- Before installing, remove oil remains from end of crankshaft with a clean cloth.

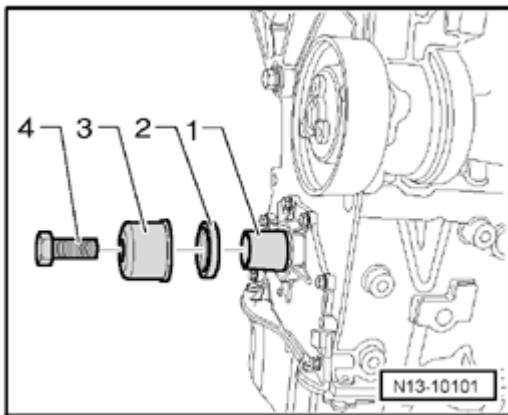


Fig. 40: Identifying Guide Sleeve T10215/1, Oil Seal, Thrust Sleeve T10215/2 And Old Vibration Damper Securing Bolt
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install guide sleeve T10215/1 - 1 - onto front of crankshaft journal.
- Carefully slide oil seal - 2 - onto guide sleeve as far as possible.
- Press in oil seal until stop using thrust sleeve T10215/2 - 3 -. To do this use an old vibration damper securing bolt - 4 -.

NOTE:

- Vibration damper securing bolt must be replaced.
- Tighten securing bolt with torque wrench V.A.G 1601.

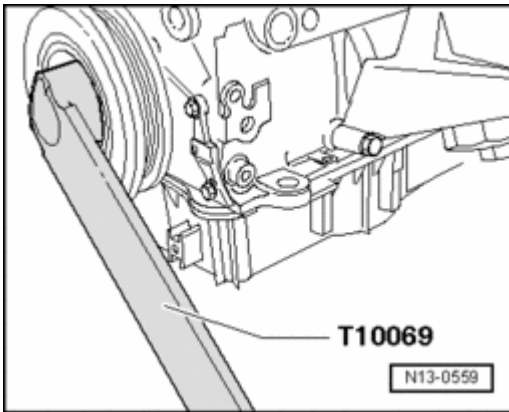


Fig. 41: Loosening/Tightening Securing Bolt, Using Counter-Holder T10069 To Hold Vibration Damper
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install vibration damper and lock with counterholder T10069.
- Fasten new bolt to 100 Nm plus additional $\frac{1}{4}$ (90 °) turn.
- Install ribbed belt, refer to *Ribbed belt, removing and installing* under **Ribbed belt, removing and installing** .

CRANKSHAFT, REMOVING AND INSTALLING

Crankshaft, removing and installing

Assembly overview, refer to **Assembly overview**

Sensor wheel to crankshaft, installing, refer to **Sensor wheel to crankshaft, installing**

NOTE:

- Before removing the crankshaft, prepare a suitable place to store the crankshaft to make sure that the sensor wheel (item - 6 -) does not make contact or become damaged.
- When performing repair work, secure engine to engine and transmission holder VAS 6095 or holding fixture VW 540 with supplementary set VW 540/1 B.
- When changing bearing shells ensure that only bearing shells with yellow color code are used.

Assembly overview

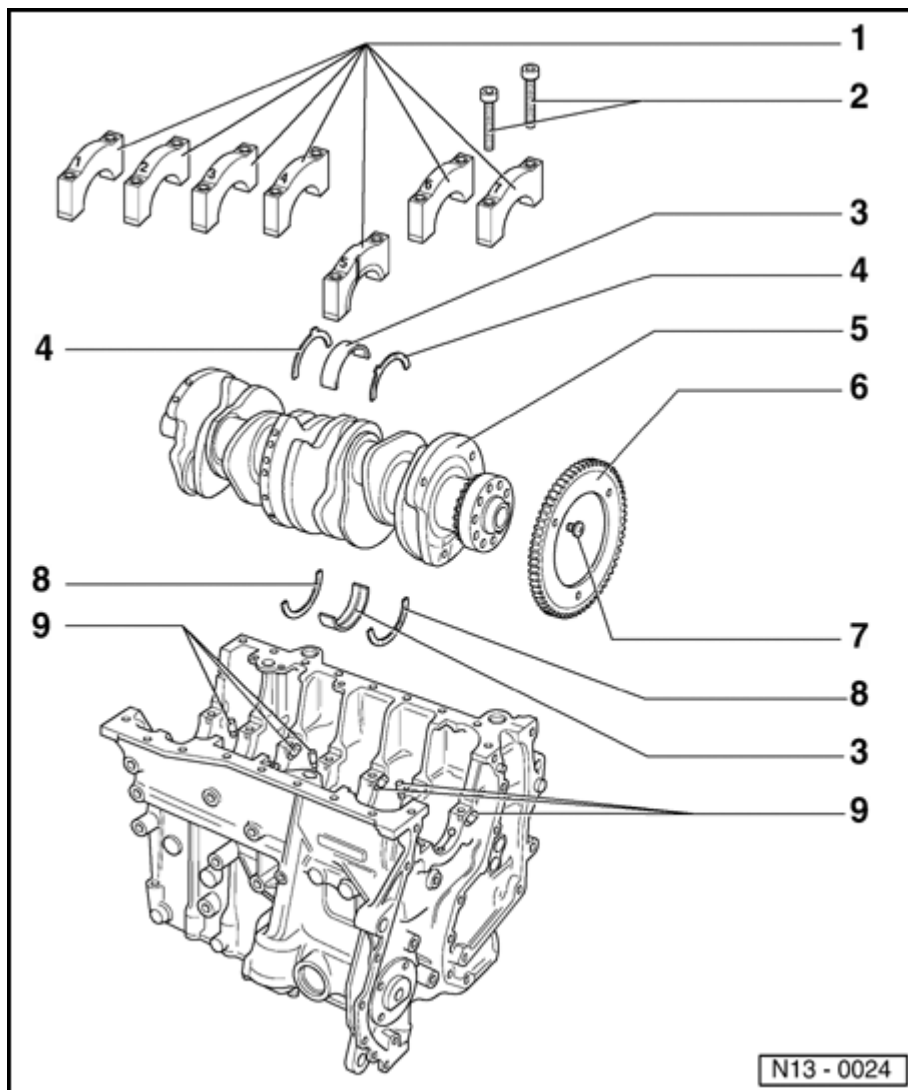


Fig. 42: Identifying Crankshaft Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Bearing cap

- Bearing cap 1: Vibration damper side
- Bearing cap 5 with notches for thrust washers
- Retaining tabs of bearing shells and cylinder block/bearing caps must lie above one another

2 - 30 Nm + $\frac{1}{2}$ turn (180 °)

- Replace
- 2 x 90 ° turns further is permissible

3 - Bearing shells 1 through 7

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

4 - Thrust washer

- For bearing cap 5
- Observe locating point

5 - Crankshaft

- Observe note before removing, refer to **Crankshaft, removing and installing**
- Axial clearance:
 - New: 0.07 to 0.23 mm
 - Wear limit: 0.30 mm
- Measure radial clearance with Plastigage:
 - New: 0.02 to 0.06 mm
 - Wear limit: 0.10 mm
- Do not turn crankshaft when measuring radial play
- Crankshaft dimensions:
 - Main bearing: 59.958 to 59.978 mm
 - Connecting rod bearing: 53.958 to 53.978 mm
 - Reworking is not permissible

6 - Sensor wheel

- For engine speed (RPM) sensor G28
- Replace
- Installing, refer to **Sensor wheel to crankshaft, installing**

7 - 10 Nm + $\frac{1}{4}$ turn (90 °)

- Replace

8 - Thrust washer

- Not on engine code BJS
- For cylinder block, bearing 5
- Observe locating point

9 - Oil spray jet

- For crankshaft bearing 2 through 7
- For piston cooling
- Opening pressure 2.0 bar pressure
- Removing and installing **Oil spray jet, removing and installing**
- See note, refer to **Engine, disassembling and assembling**

Sensor wheel to crankshaft, installing

Special tools, testers and auxiliary items required

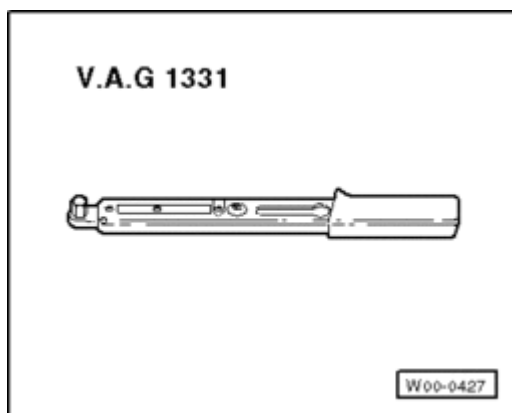


Fig. 43: Torque Wrench V.A.G. 1331 (5 To 50 Nm)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Torque wrench V.A.G 1331
- D 000 600 A2 Locking compound

Work procedure

Make sure crankshaft/sensor wheel contact surfaces are free of oil and grease.

- Apply a thin coat of locking compound "D 000 600 A2" to contact surfaces of crankshaft and sensor wheel for additional security.
- Check that when installing "VR6" - **arrow** - is marked at individual threaded holes.
- Tighten all new securing bolts lightly by hand.

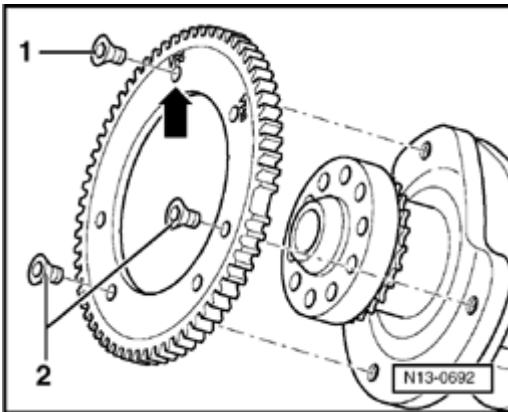


Fig. 44: Identifying VR6 And Bolts

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- First, tighten bolt - **1** - to 10 Nm plus additional 90 ° ($\frac{1}{4}$ turn).
- Tighten securing bolts - **2** - to 10 Nm plus additional 90 ° (1/4 turn).

PISTON AND CONNECTING ROD, DISASSEMBLING AND ASSEMBLING

Piston and connecting rod, disassembling and assembling

Assembly overview, refer to **Assembly overview**

Piston and cylinder dimensions, refer to **Piston and cylinder dimensions**

Assembly overview

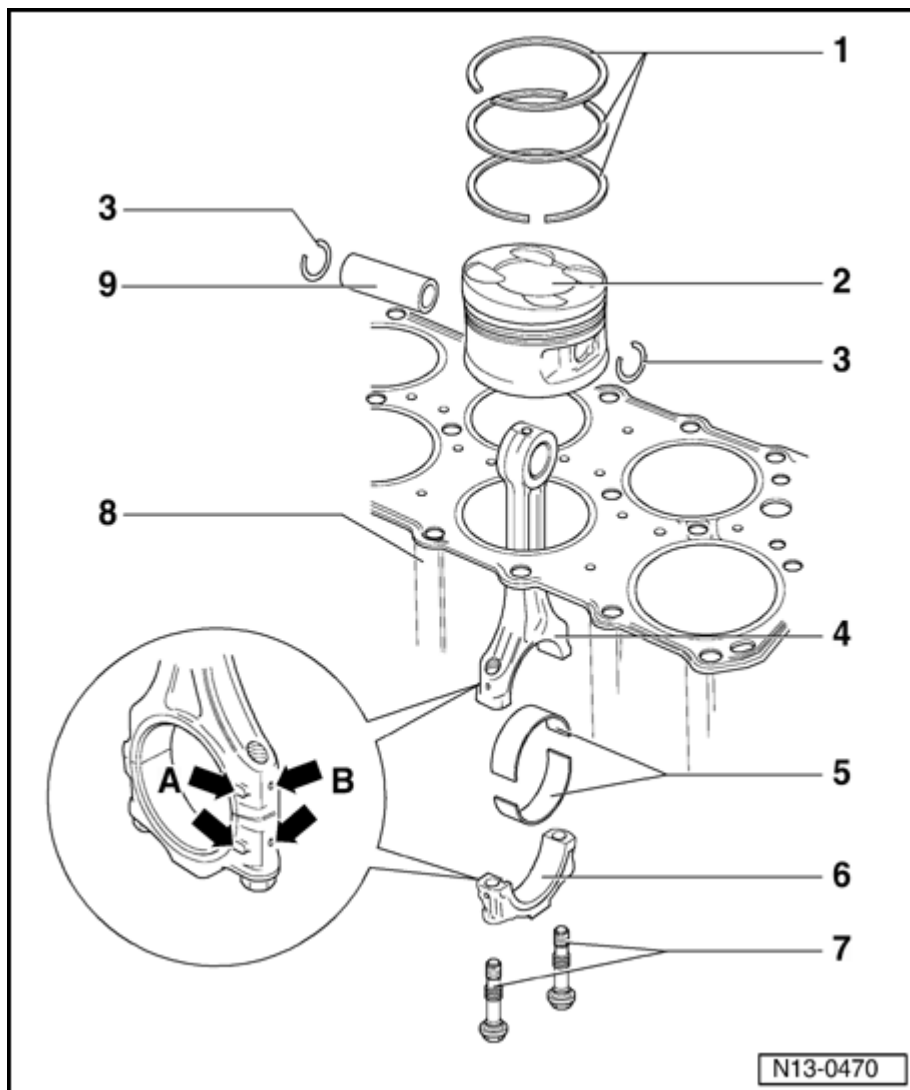


Fig. 45: Piston And Connecting Rod Assembly Overview
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Piston rings

- Offset gaps by 120 °
- Use piston ring pliers for removal and installation
- Identification "TOP" faces towards piston crown
- Checking ring gap *Checking piston ring gap* , under Assembly overview
- Check piston ring groove clearance *Checking ring to groove clearance* , under Assembly overview

2 - Piston

- Checking *Checking piston* under Assembly overview
- Mark installed location to connecting rod and affiliation to cylinder

- Flatter side of piston crown faces toward center of cylinder block
- Installing piston *Installing piston* , under **Assembly overview**

3 - Circlip

4 - Connecting rod

- Only replace as set
- Affiliation to the cylinder mark - **B** -
- Installed location: Markings - **A** - must lie above one another

5 - Bearing shell

- Note installation position
- Do not interchange used bearing shells
- Bearing shell retaining tabs must be firmly seated in the notches
- Axial clearance:
- New: 0.05 to 0.31 mm
- Wear limit: 0.40 mm
- Measure radial clearance with Plastigage:
- New: 0.02 to 0.07 mm
- Wear limit: 0.10 mm
- Do not turn crankshaft when checking radial clearance

6 - Connecting rod bearing cap

- Affiliation to the cylinder mark - **B** -
- Installed location: Markings - **A** - must lie above one another

7 - 30 Nm + $\frac{1}{4}$ turn (90 °)

- Replace
- Lubricate threads and contact surface
- Tighten to 30 Nm to measure radial play, do not turn further

8 - Cylinder block

- Cylinder bore, checking *Checking cylinder bores* under **Assembly overview**
- Removing and installing crankshaft, refer to **Crankshaft, removing and installing**
- Piston and cylinder dimensions, refer to **Piston and cylinder dimensions**

9 - Piston pin

- If difficult to move, heat piston to 60 ° C
- Removing and installing using a drift VW 222 A

Checking piston ring gap

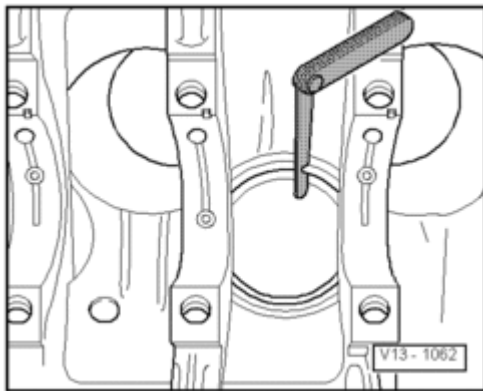


Fig. 46: Checking Piston Ring Gap

Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Feeler gauge

Test sequence

- Push ring squarely from above down to approx. 15 mm from bottom end of cylinder. To do this use a piston without rings.

Piston ring		Gap	
		New	Wear limit
Compression ring	mm	0.20 to 0.40	1.0
Tapered ring	mm	0.20 to 0.40	1.0
Oil scraping ring	mm	0.25 to 0.50	1.0

Checking ring to groove clearance

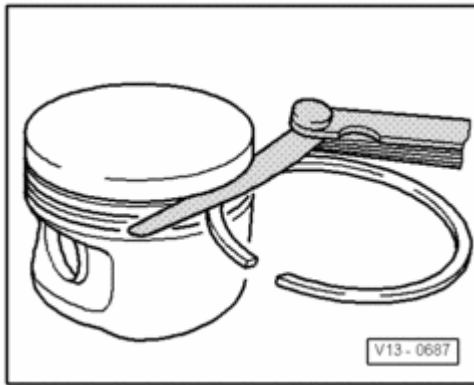


Fig. 47: Checking Ring To Groove Clearance
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Feeler gauge
- Clean ring groove before checking.

Piston ring		Ring to groove clearance	
		New	Wear limit
Compression ring	mm	0.04 to 0.09	0.15
Tapered ring	mm	0.03 to 0.06	0.15
Oil scraping ring	mm	0.02 to 0.06	0.15

Checking piston

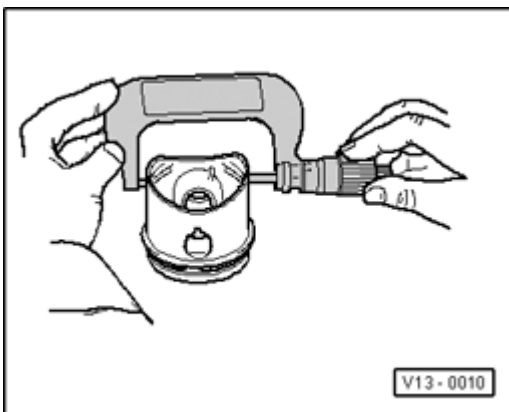


Fig. 48: Checking piston
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- External micrometer 75 to 100 mm

Take measurement approx. 6 mm from lower edge of piston skirt and offset 90 ° to piston axis.

Deviation from nominal dimension: max. 0.04 mm

Checking cylinder bores

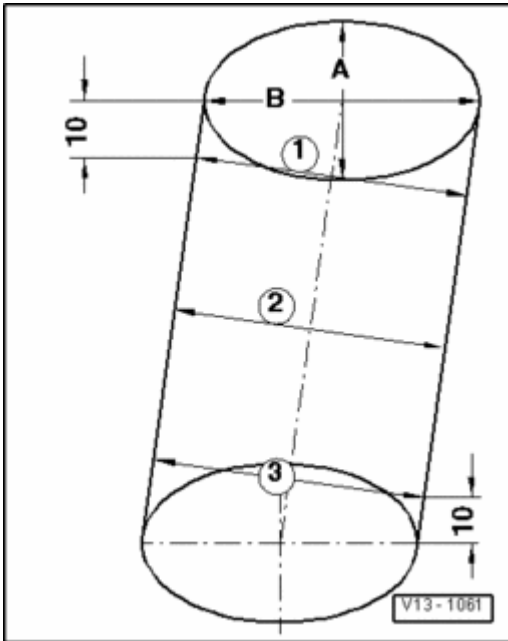


Fig. 49: Checking Cylinder Bores

Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Internal dial gauge 50 to 100 mm

Test sequence

Measure bores at 3 locations in both directions - **A** - across engine and - **B** - in line with crankshaft.

Deviation from nominal dimension: max. 0.08 mm

NOTE:

- Measurement of cylinder bore may not be performed when the cylinder block is mounted on engine and transmission holder VAS 6095 or holding fixture VW 540, false measurements are possible.

Installing piston

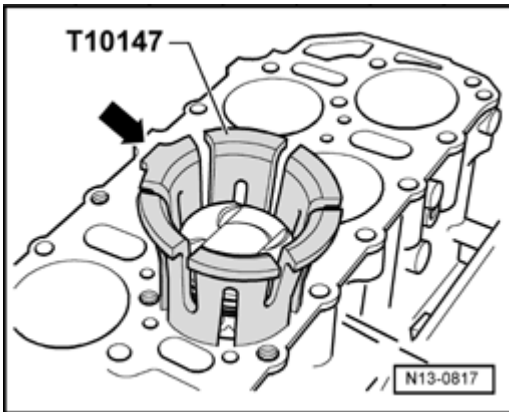


Fig. 50: Identifying Piston Installation Tool T10147
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Piston installation tool T10147
- Piston installation tool 3278

NOTE:

- For engine code BJS, install with Piston installation tool T10147
- If a new piston installation tool is used to install the pistons, first pass piston with oiled piston rings through the funnel twice and remove the resulting metal shavings if necessary. Only then install piston with piston rings.

Work procedure

- Push piston by hand into oiled piston installation tool. Flat side of piston crown must face toward tab on piston installation tool - **arrow** -.
- Hold piston installation tool (with piston inserted) on upper edge and press piston in with both thumbs.
- Push piston in until it protrudes approx. 15 mm from lower edge of piston installation tool.
- Insert piston into appropriate cylinder bore. Tab on piston installation tool - **arrow** - must face center of cylinder block.
- Press piston installation tool tightly against cylinder block and push piston in.

Piston and cylinder dimensions

For engine code BJS

Honing dimension		Piston dia.	Cylinder bore dia.
Basic dimension	mm	83.965	84.010

15 - ENGINE - CYLINDER HEAD, VALVETRAIN

CYLINDER HEAD**Cylinder head****NOTE:**

- If an exchange cylinder head is installed, all contact surfaces between bearing elements, roller rocker levers and cam running surfaces of camshaft must be oiled before installing cylinder head cover.
- The plastic protectors installed to protect the open valves must only be removed immediately before fitting the cylinder head.
- When replacing the cylinder head the complete amount of coolant must be replaced.
- Intake manifold, removing and installing, refer to Cylinder head cover, removing and installing .
- Dismantling and assembling intake manifold, refer to Intake manifold, assembly overview

Assembly overview, refer to Assembly overview

Cylinder head, removing and installing, refer to Cylinder head, removing and installing

Cover, assembly overview, refer to Cover, assembly overview

Valve timing, checking, refer to Valve timing, checking

Valve timing, adjusting, refer to Valve timing, adjusting

Checking compression pressure, refer to Compression pressures, checking

Assembly overview

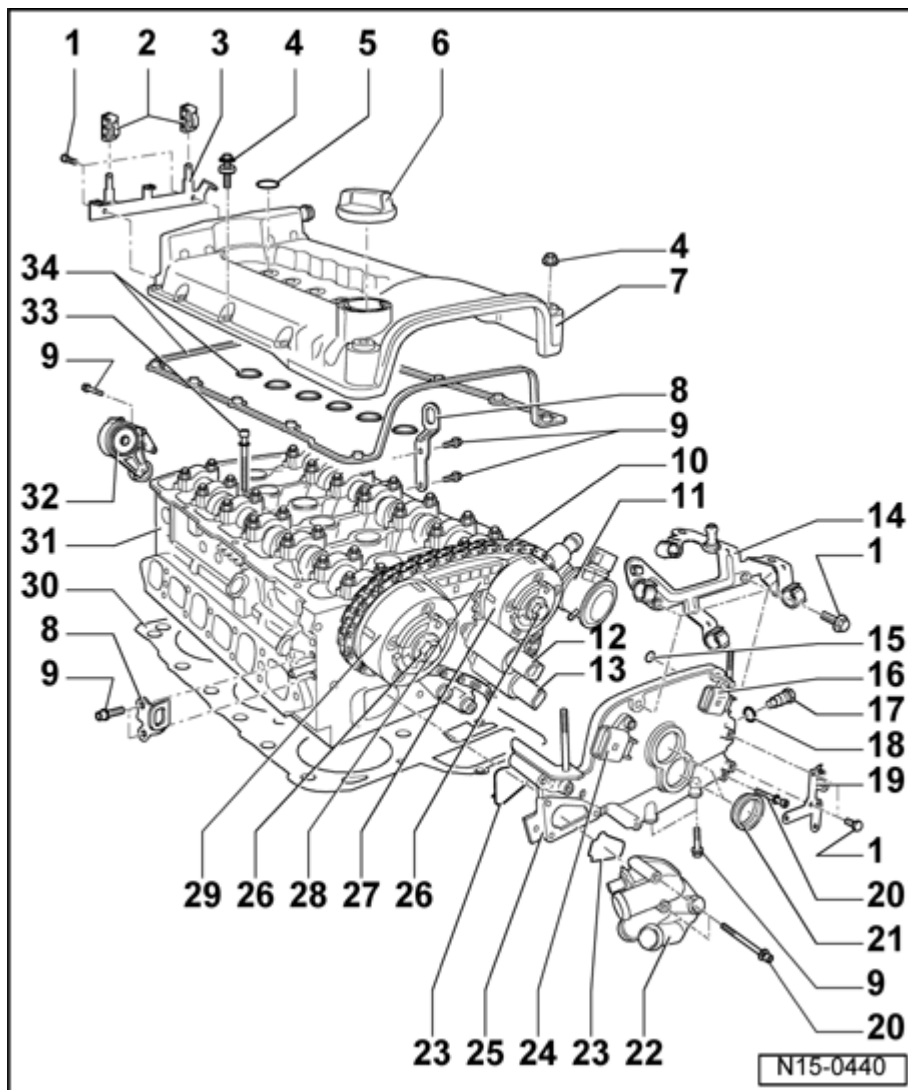


Fig. 51: Cylinder Head Assembly Overview

Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 10 Nm

2 - Bracket

- For fuel lines

3 - Mounting frame

4 - 10 Nm

- With spacer sleeve and seal
- Replace seal if damaged

5 - O-ring

- Replace if damaged
- Oil before assembling
- For ignition coil with power output stage

6 - Sealing cap

- Replace gaskets if damaged

7 - Cylinder head cover

- Removing and installing, refer to **Cylinder head cover, removing and installing**
- Replace if damaged

8 - Lifting eye**9 - 23 Nm****10 - Camshaft roller chain**

- Mark direction of rotation before removing (installation position) **Marking roller chains**
- Installing, refer to **Valve timing, adjusting**

11 - Combi-valve

- Removing and installing, refer to **Secondary air injection (AIR) system components, assembly overview**
- Checking, refer to **Combi-valve, checking**

12 - Valve 1 for camshaft adjustment N205

- For intake camshaft
- Before disconnecting, mark allocation of connector to component

13 - Camshaft adjustment valve 1 (exhaust) N318

- For exhaust camshaft
- Before disconnecting, mark allocation of connector to component

14 - Bracket

- For wiring harness

15 - O-ring

- For oil channel seal

- Replace
- Oil before assembling

16 - Camshaft position (CMP) sensor 2 G163

- For exhaust camshaft
- Before disconnecting, mark allocation of connector to component

17 - Chain tensioner, 40 Nm

- Only rotate engine with chain tensioner installed

18 - Oil seal

- Replace if damaged or leaking

19 - Bracket

- For wiring harness and ground connection

20 - 8 Nm**21 - Oil seal**

- Replace if damaged or leaking
- Installing *Oil seals for cover, installing under* **Cover, assembly overview**

22 - Coolant thermostat housing

- Disassembling and assembling, refer to **Coolant thermostat housing, assembly overview**
- Coolant hose connection diagram, refer to **Coolant hose connection diagram**

23 - Oil seal

- Replace

24 - Camshaft Position (CMP) sensor G40

- For intake camshaft
- Before disconnecting, mark allocation of connector to component

25 - Cover

- Can be removed and installed with engine installed
- Removing and installing, refer to **Cover, assembly overview**

- If only the cover has been removed, prepare cylinder head gasket for installation

26 - 60 Nm + $\frac{1}{4}$ turn (90 °)

- Replace
- Contact surface of sender wheel must be dry around bolt head when assembling
- To remove and install, counter-hold at camshaft using an open-end wrench (32 mm), refer to **Camshafts, removing and installing**

27 - Exhaust camshaft adjuster

- Identification: 32A
- Only rotate engine with camshaft adjuster installed
- Installing, refer to **Valve timing, adjusting**

28 - Guide rail

- Clipped in at control housing

29 - Intake-camshaft adjuster

- Identification: 24E
- Only rotate engine with camshaft adjuster installed
- Installing, refer to **Valve timing, adjusting**

30 - Cylinder head gasket

- Metal gasket
- Replace
- Prepare cylinder head gasket for installation
- After replacing replace entire amount of coolant

31 - Cylinder head

- Check for distortion *Checking cylinder head for distortion* under **Checking cylinder head for distortion**
- Removing and installing, refer to **Cylinder head, removing and installing**
- After replacing replace entire amount of coolant

32 - Tensioning element

- For ribbed belt
- Removing and installing ribbed belt, refer to *Ribbed belt, removing and installing* under **Ribbed belt, removing and installing**

33 - Cylinder head bolt

- Replace
- Observe installation instructions and sequence when loosening and tightening, refer to **Cylinder head, removing and installing**

34 - Seal for cylinder head cover

- Replace if damaged or leaking
- Note installation position

Cylinder head, removing and installing

Removing

Installing

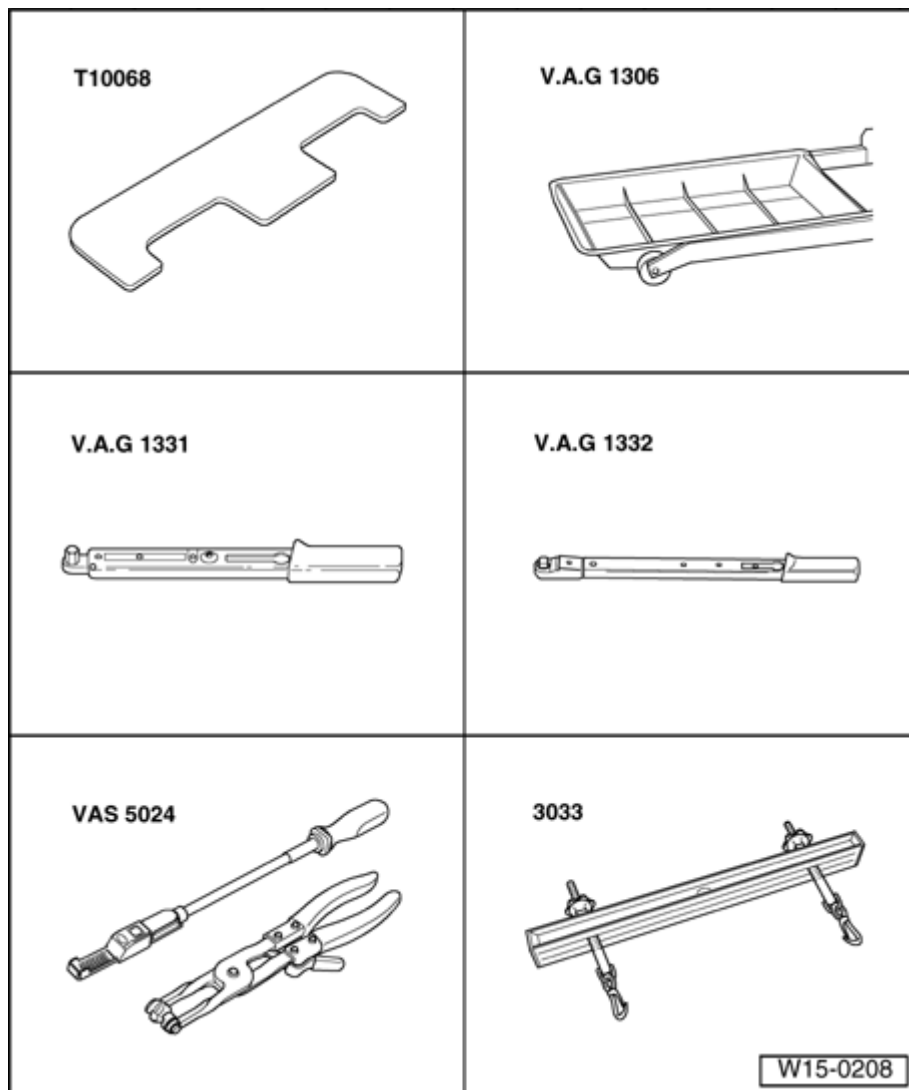


Fig. 52: Identifying Special Tools - Cylinder Head, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Camshaft bar T10068 A
- Drip tray V.A.G 1306
- Torque wrench V.A.G 1331
- Torque wrench V.A.G 1332
- Spring-type clip pliers VAS 5024A
- Lifting tackle 3033

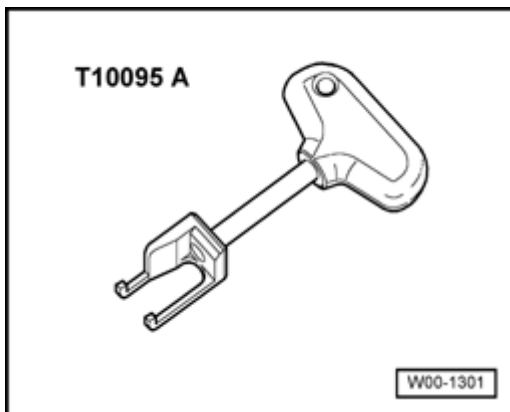


Fig. 53: Puller T10095 A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Puller T10095 A

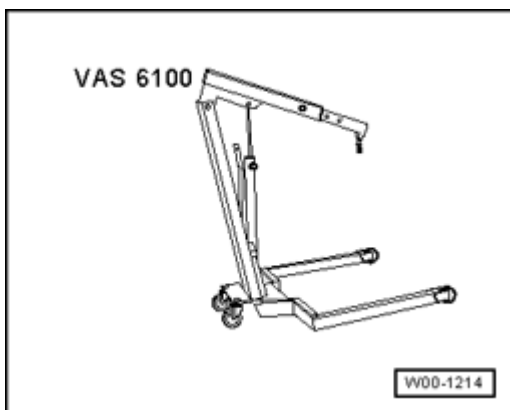


Fig. 54: Shop Crane VAS 6100
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Shop crane VAS 6100
- AMV 176 501 Sealing compound

- AMV 174 004 01 Sealing compound

Requirements

The engine must be no more than warm to touch.

Removing

CAUTION: When doing any repair work, especially in the engine compartment, pay attention to the following due to clearance issues:

- Route lines of all types (e.g. for fuel, hydraulic, EVAP system, coolant and refrigerant, brake fluid, vacuum) and electrical wiring so that the original path is followed.
 - To prevent damages to the lines, make sure there is sufficient clearance to all moving or hot components.
- Check whether a coded radio is installed. If necessary, obtain the anti-theft coding.
 - Disconnect battery Ground (GND) strap with the ignition switched off.

NOTE:

- All cable ties which are opened or cut open when removing, must be replaced in the same position when installing.

- Unbolt front exhaust pipe from exhaust manifold, refer to Exhaust system components, removing and installing.

NOTE:

- Before disconnecting harness connectors, mark allocation to component.

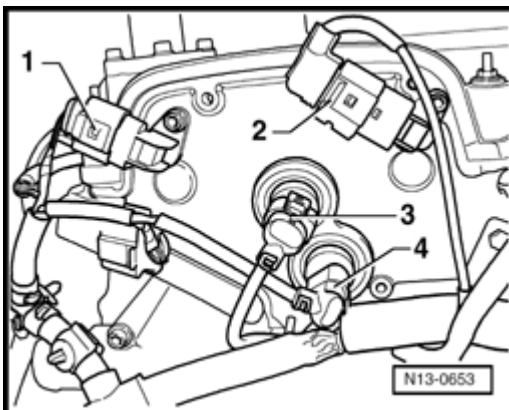


Fig. 55: Identifying CMP Sensor G40, CMP Sensor 2 G163 And Connectors
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Separate the connections from camshaft position (CMP) sensor G40 - 1 - and camshaft position (CMP) sensor 2 G163 - 2 -.

- Pull off the connectors - 3 - and - 4 -.
- Remove intake manifold, refer to Cylinder head cover, removing and installing .

CAUTION: Fuel supply lines are under pressure! Wear eye protection and protective gloves to avoid injuries and skin contact with fuel. Before removing from hose connection wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

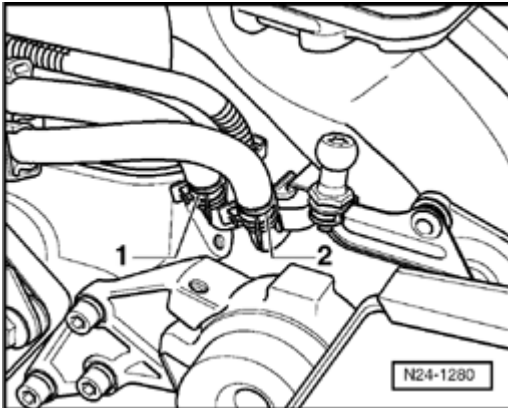


Fig. 56: Identifying Supply Line & Fuel Return Line
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull off fuel supply line - 1 - (with white marking) and fuel return line - 2 - (with blue marking) at fuel rail, and catch any released fuel with a shop rag.
- Seal lines so that the fuel system is not contaminated by dirt etc.
- Unclip fuel lines at cylinder head cover.

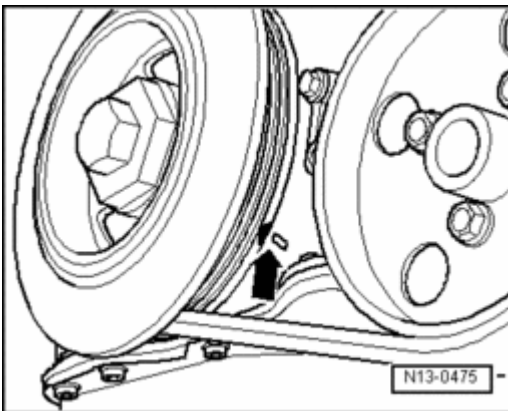


Fig. 57: Identifying Crankshaft At Vibration Damper Securing Bolt In Engine At TDC Cyl. 1
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Turn crankshaft at vibration damper securing bolt in engine direction of rotation to TDC cyl. 1 - **arrow** -.

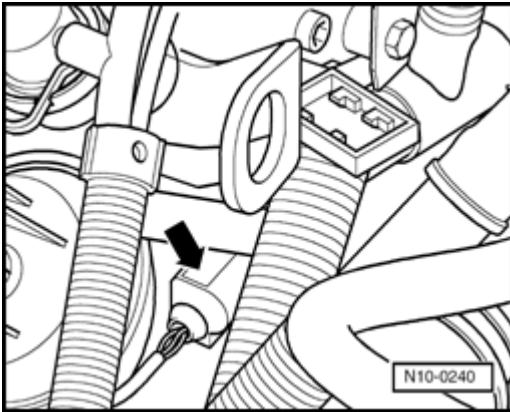


Fig. 58: Locating Engine Coolant Temperature Sensor G62
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect 2-pin connector from Engine Coolant Temperature (ECT) Sensor G62 - **arrow** -.
- Drain coolant, refer to *Cooling system, draining and filling* under **Cooling system, draining and filling** .
- Remove thermostat housing, refer to **Cooling system components (on engine), assembly overview** .
- Remove cylinder head cover, refer to **Cylinder head cover, removing and installing** .

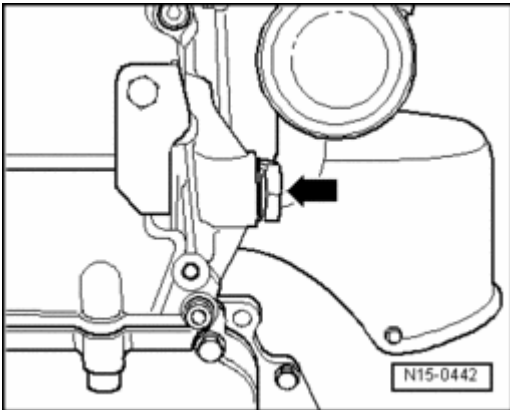


Fig. 59: Locating Camshaft Roller Chain Tensioner
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove camshaft roller chain tensioner - **arrow** -.

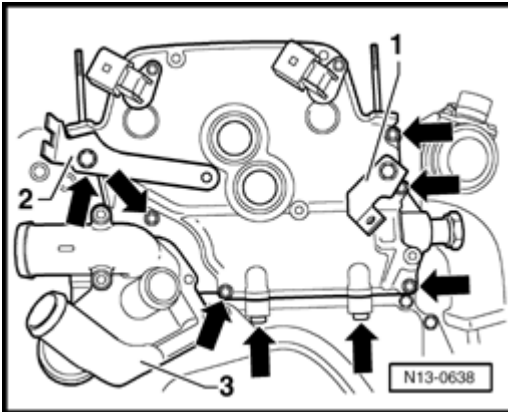


Fig. 60: Identifying Cover Bolts

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** - from cover and remove it.

NOTE:

- **Do not mark chain with a center punch or similar means!**

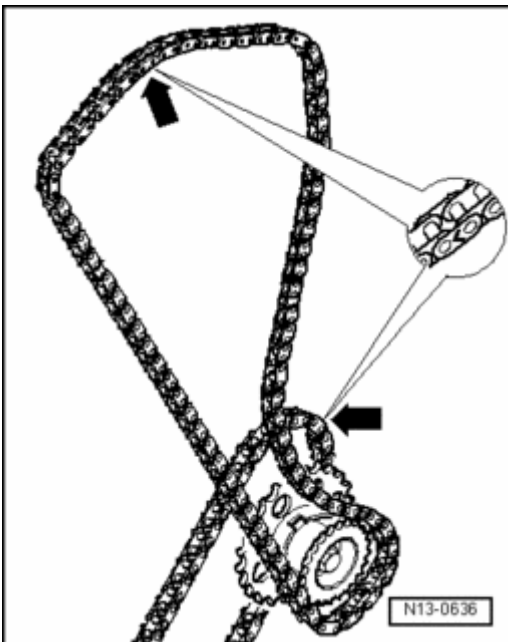


Fig. 61: Identifying Markings On Roller Chains

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Mark roller chains before removing (e.g. with paint, arrow pointing in direction of rotation).

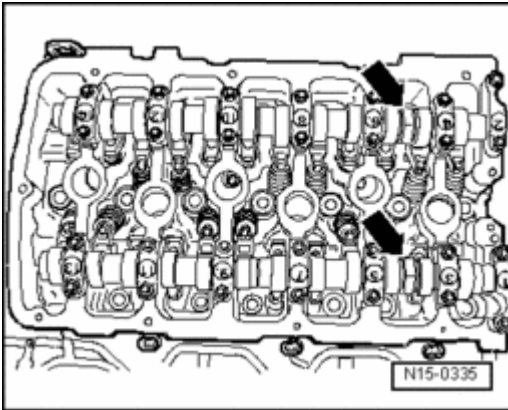


Fig. 62: Locating Counter-Hold Area On Camshaft

Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE:

- Counter-hold only with 32 mm open end wrench on camshaft - arrow -. Camshaft bar T10068 A must not be installed when camshaft adjuster is loosened or tightened.

- Remove exhaust camshaft adjuster.
- Remove camshaft adjuster with camshaft roller chain from intake camshaft.

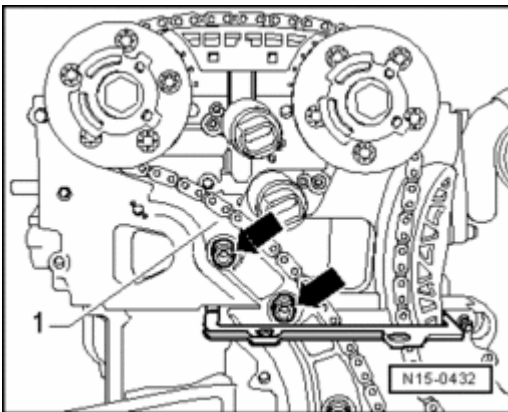


Fig. 63: Locating Guide Rail & Bolts

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** - for guide rail - **1** - and remove guide rail.
- Place camshaft roller chain aside.

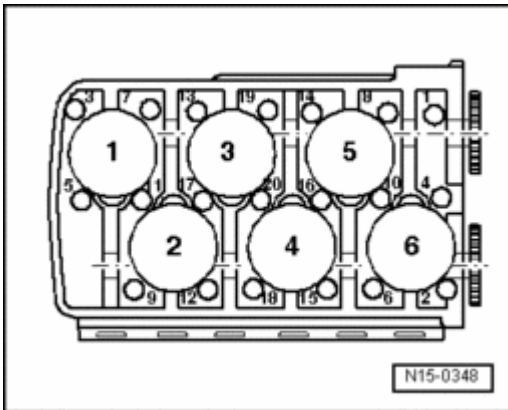


Fig. 64: Socket Head Bolts Removal Sequence

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen socket head bolts in the given sequence from outside to inside and then remove completely.

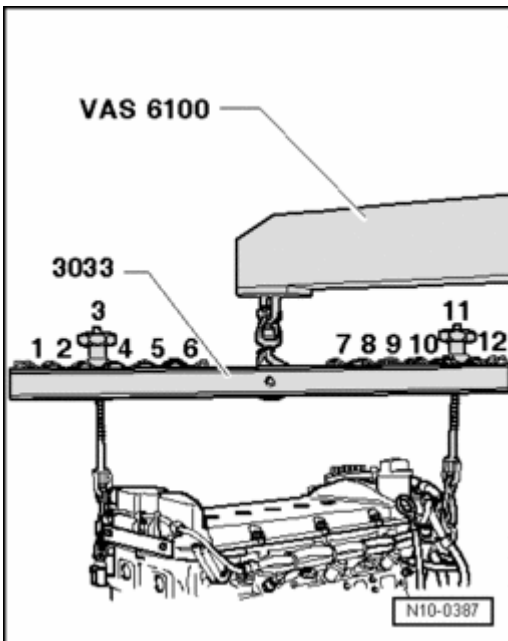


Fig. 65: Identifying Lifting Tackle 3033 & VAS 6100

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Hook in lifting tackle 3033 as follows and carefully lift cylinder head with workshop crane VAS 6100.
Vibration damper side: - **Position 3** - and flywheel side: - **Position 11** -

NOTE:

- With 1 to 12 marked positions, point the lifting tackle toward the flywheel side.
- The threaded spindles are adjusted to length as required.

- Carefully lift cylinder head off.
- Place a clean cloth in cylinders so that no dirt or emery cloth particles can get in between cylinder wall

and piston.

- Prevent dirt and emery cloth particles from getting into the coolant.
- Carefully clean cylinder head and cylinder block sealing surfaces. This ensures that no scoring or scratches are formed (when using abrasive paper the grade must not be less than 100).

Installing

- Carefully remove metal particles, emery remains and cloths.

If piston for No. 1 cylinder is not at TDC:

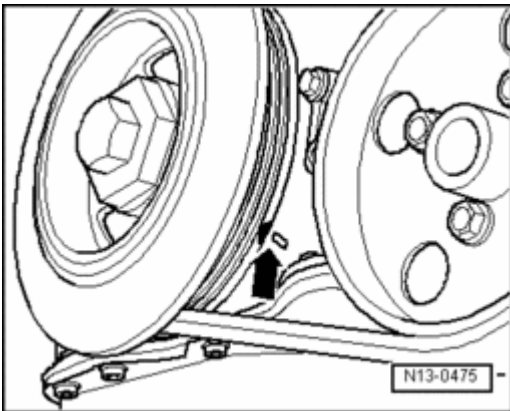


Fig. 66: Identifying Crankshaft At Vibration Damper Securing Bolt In Engine At TDC Cyl. 1
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Set crankshaft to TDC No. 1 Cyl. marks - **arrow** - by turning crankshaft on vibration damper securing bolt in engine direction of rotation. When doing this, guide camshaft roller chain by hand with aid of a 2nd technician.

NOTE:

- Only remove the new cylinder head gasket from its packing immediately before installing.
 - Handle the new gasket with extreme care. Damaging will lead to leaks.
- Install new cylinder head gasket. Install new cylinder head gasket. Inscription (Part No.) must be legible.

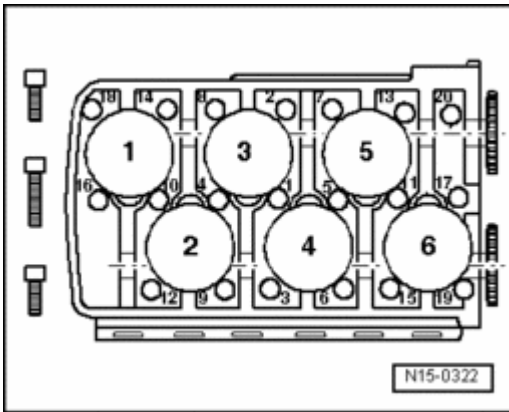


Fig. 67: Cylinder Head Tightening Sequence

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Ensure that alignment bushings are inserted into cylinder block holes 12 and 20 and that cylinder head gasket is seated.
- Position camshafts in cylinder head to TDC No. 1 cylinder.

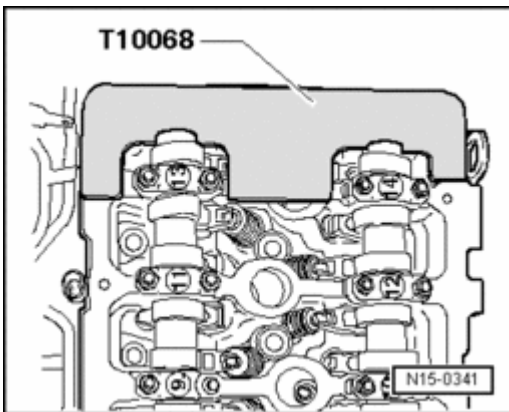


Fig. 68: Identifying Camshaft Bar T10068 Engage In Both Shaft Grooves

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- The camshaft bar T10068 A must engage in both shaft grooves.
- Prepare cylinder head gasket for installation *Preparing cylinder head gasket for installation* , under **Preparing cylinder head gasket for installation**
- Install cylinder head, insert new cylinder head bolts and hand tighten.

NOTE:

- **The longer cylinder head bolts must be inserted in the middle holes of cylinder head.**

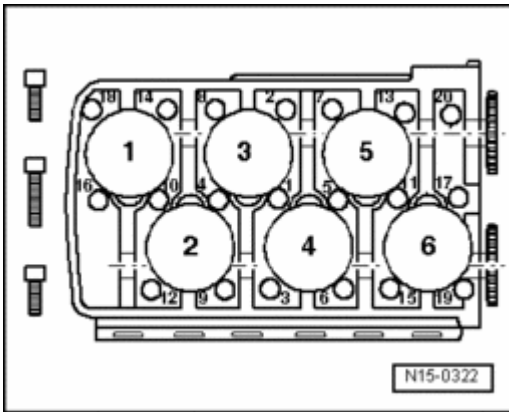


Fig. 69: Cylinder Head Tightening Sequence

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tighten cylinder head in tightening sequence as follows from inside to outside:
- Pretighten all bolts to 30 Nm.
- Then tighten all bolts to 50 Nm.
- Tighten all bolts ($\frac{1}{4}$ turn) (90 °) further using a rigid wrench.
- Afterwards, tighten all bolts again $\frac{1}{4}$ turn (90 °) further

The rest of assembly is basically a reverse of disassembling sequence.

NOTE:

- **Make sure that the O-ring for sealing the oil channel and the seal in the cover are installed.**

How to adjust valve timing, refer to Valve timing, adjusting .

- Install cylinder head cover and intake manifold, refer to Cylinder head cover, removing and installing .

Fill with new coolant, refer to *Cooling system, draining and filling* under Cooling system, draining and filling .

NOTE:

- **There is no requirement to retighten the cylinder head bolts after repairs.**

Checking cylinder head for distortion

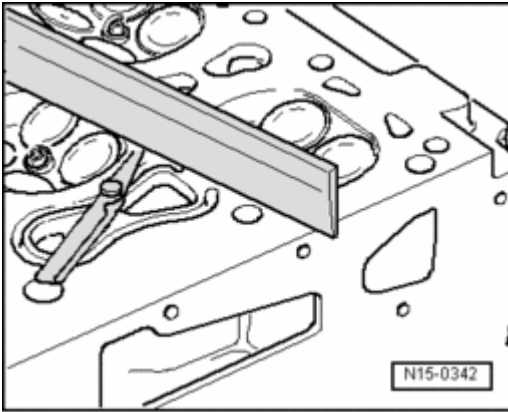


Fig. 70: Checking Cylinder Head For Distortion

Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Straight edge
- Feeler gauge
- Max. permissible distortion: 0.05 mm

Preparing cylinder head gasket for installation

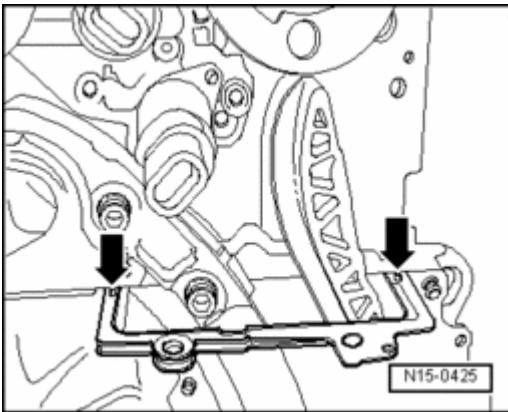


Fig. 71: Locating 3 mm Holes In The Cylinder Head Gasket

Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Sealing compound AMV 174 004 01
- Sealing compound AMV 176 501
- Clean old sealing compound from the 3 mm holes in the cylinder head gasket - **arrows** -.
- Fill 3 mm holes in cylinder head gasket with sealing compound 174 004 01 and coat sealing surfaces of cover and sealing flange with sealing compound AMV 176 501. Install the cover immediately!

NOTE:

- With the cylinder head installed only half of the holes in the cylinder head gasket are visible.

Cover, assembly overview

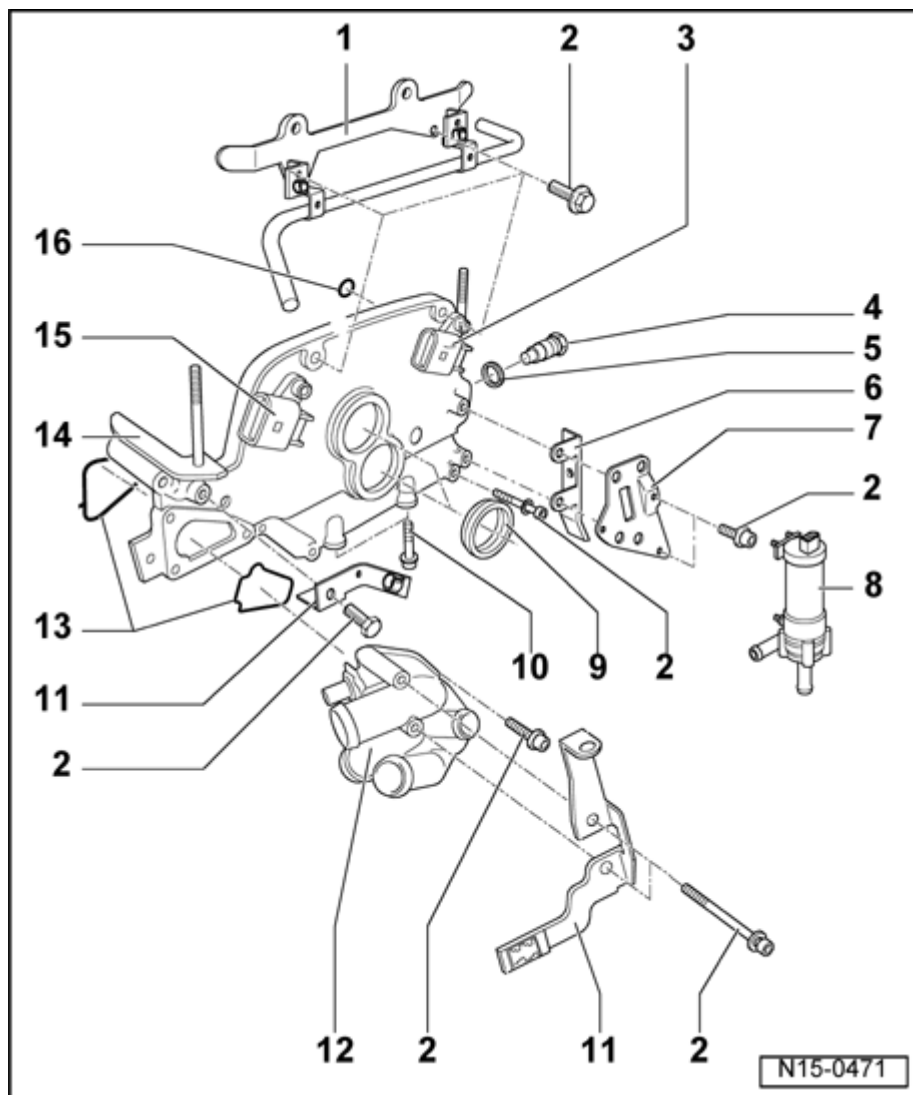


Fig. 72: Cylinder Cover Assembly Overview

Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Wiring router

- For coolant hoses and wiring harness
- Coolant hose connection diagram, refer to Coolant hose connection diagram

2 - 8 Nm

3 - Camshaft position (CMP) sensor 2 G163

- For exhaust camshaft
- Before disconnecting, mark allocation of connector to component

4 - Chain tensioner, 40 Nm

- Only rotate engine with chain tensioner installed

5 - Oil seal

- Replace if damaged or leaking

6 - Bracket

- For wiring harness and ground connection

7 - Bracket

- For after-run coolant pump V51

8 - After-run coolant pump V51

- Coolant hose connection diagram, refer to **Coolant hose connection diagram**
- Checking, refer to **After-run coolant pump, checking**

9 - Oil seal

- Replace if damaged or leaking
- Installing *Oil seals for cover, installing* under **Cover, assembly overview**

10 - 23 Nm**11 - Bracket**

- For wiring harness

12 - Coolant thermostat housing

- Disassembling and assembling, refer to **Coolant thermostat housing, assembly overview**
- Coolant hose connection diagram, refer to **Coolant hose connection diagram**

13 - Oil seal

- Replace

14 - Cover

- Coat sealing surfaces with sealing compound "AMV 176 501"
- Prepare cylinder head gasket for installation *Preparing cylinder head gasket for installation* , under **Preparing cylinder head gasket for installation**

15 - Camshaft Position (CMP) sensor G40

- For intake camshaft
- Before disconnecting, mark allocation of connector to component

16 - O-ring

- For oil channel seal
- Replace
- Oil before assembling

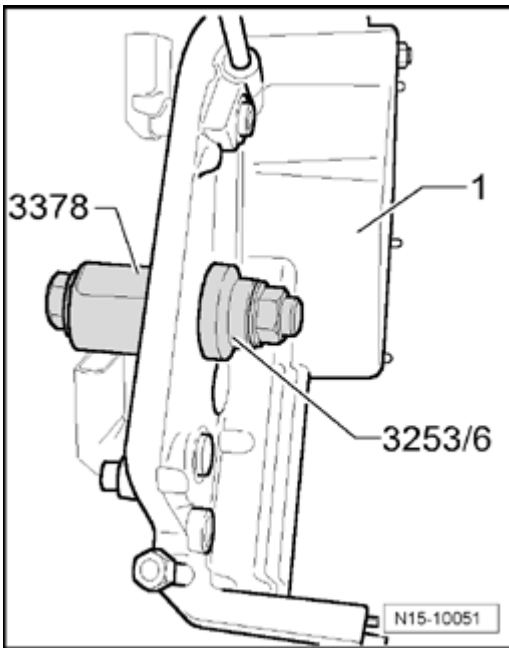
Oil seals for cover, installing

Fig. 73: Identifying Fitting Sleeve 3378, Fitting Sleeve 3253/6 And Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Fitting sleeve 3378
- Fitting sleeve 3253/6
- Do not lubricate seal.
- Install seal with fitting sleeve 3378 into the cover - **1** - and pull in flush with fitting sleeve 3253/6.

Valve timing, checking

Special tools, testers and auxiliary items required

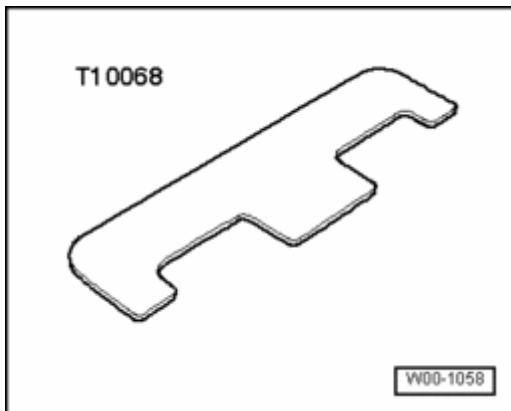


Fig. 74: Camshaft Bar T10068 A

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Camshaft bar T10068 A

Test sequence

- Remove cylinder head cover and intake manifold, refer to **Cylinder head cover, removing and installing**.

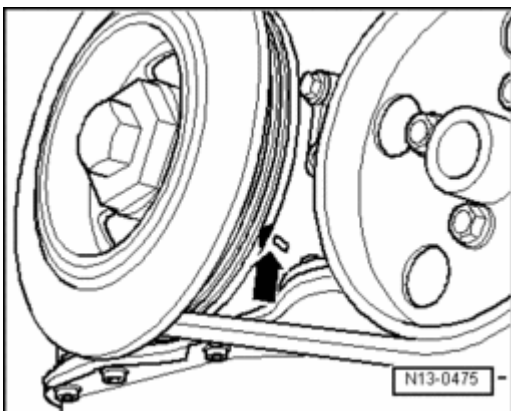


Fig. 75: Identifying Crankshaft At Vibration Damper Securing Bolt In Engine At TDC Cyl. 1

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Turn crankshaft at vibration damper securing bolt in engine direction of rotation to TDC cyl. 1 - **arrow** -.

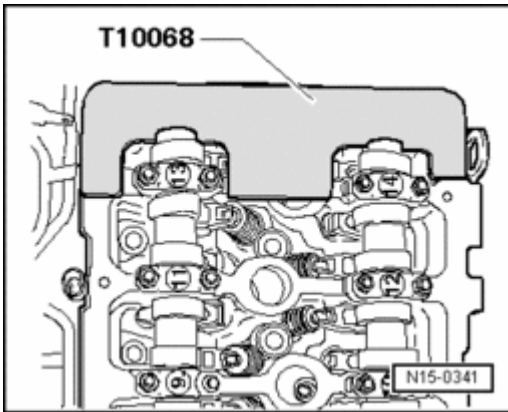


Fig. 76: Identifying Camshaft Bar T10068 Engage In Both Shaft Grooves
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- The camshaft bar T10068 A must engage in both shaft grooves.

If camshaft bar cannot be engaged:

- Turn crankshaft over in direction of rotation one time.

NOTE:

- If the camshaft bar cannot be installed, turn the crankshaft in engine direction of rotation until approx. 5 mm past the TDC setting for No. 1 cyl. (dependent on drive chain tolerances).

Verify installation markings of camshaft adjuster with markings on control housing:

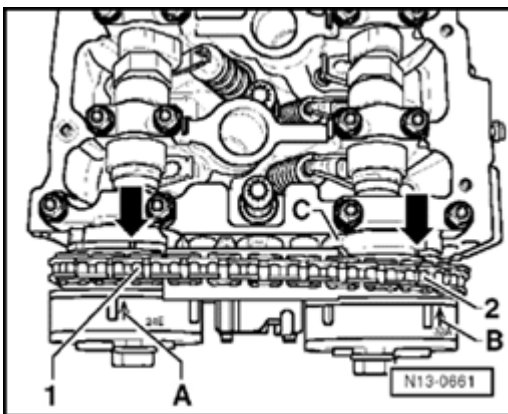


Fig. 77: Identifying Marks And Camshaft Adjusters Aligned With Notches On Control Housing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Marks - A - and - B - on camshaft adjusters must align with notches - arrows - on control housing - C -.
- Distance between tooth - 1 - and tooth - 2 - of camshaft adjuster must be exactly 16 rollers of camshaft roller chain.

NOTE:

- Illustration shows a cover which has been removed.

If marks do not align:

- Adjust valve timing, refer to **Valve timing, adjusting** .

If marks align:

- Install cylinder head cover and intake manifold, refer to **Cylinder head cover, removing and installing** .

Valve timing, adjusting

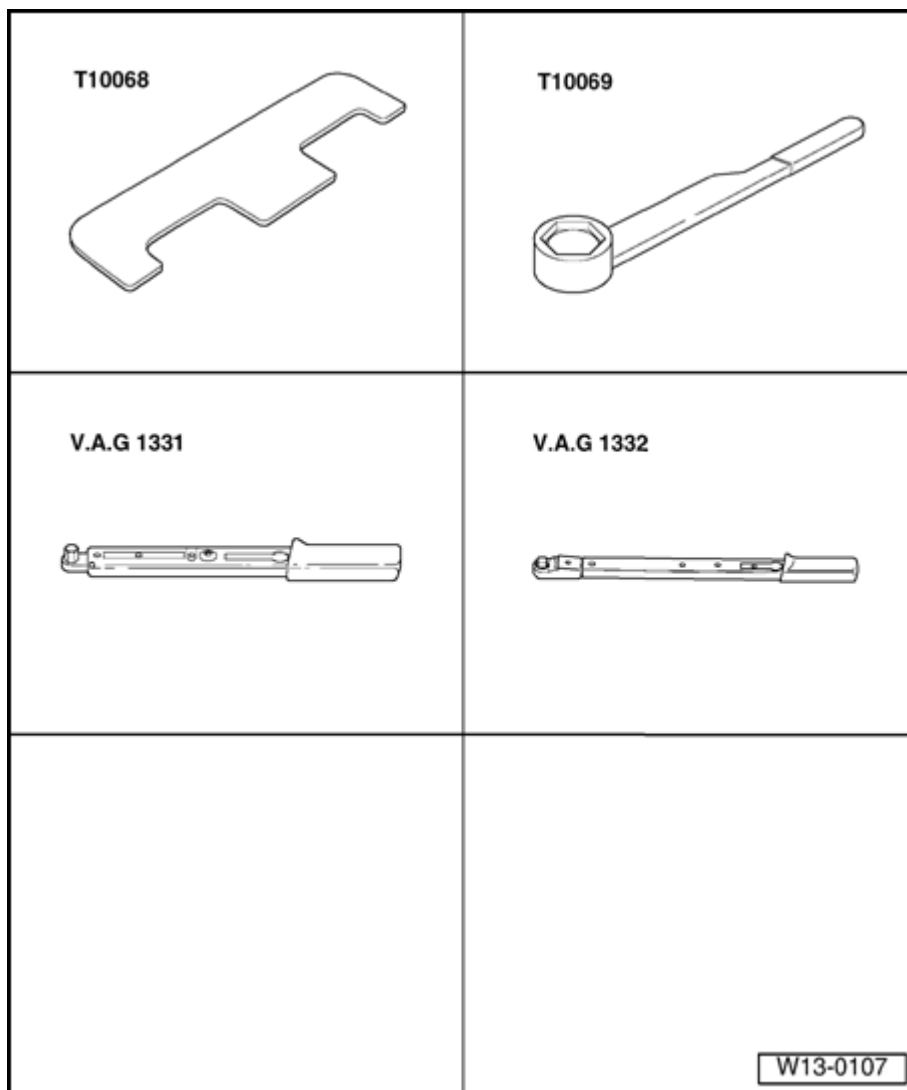


Fig. 78: Identifying Special Tools - Valve Timing, Adjusting
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Camshaft bar T10068 A
- Counter-holder tool T10069

- Torque wrench V.A.G 1331
- Torque wrench V.A.G 1332
- Sealing compound AMV 176 501

Work procedure

CAUTION: When doing any repair work, especially in the engine compartment, pay attention to the following due to clearance issues:

- Route lines of all types (e.g. for fuel, hydraulic, EVAP system, coolant and refrigerant, brake fluid, vacuum) and electrical wiring so that the original path is followed.
- To prevent damages to the lines, make sure there is sufficient clearance to all moving or hot components.

NOTE:

- The following work sequence is described with engine removed. The adjustments required depend on how far the engine has been disassembled. The oil pan is removed and may only be installed after the sealing flange has been installed.

Install roller chain and chain tensioner with tensioning plate for intermediate shaft drive:

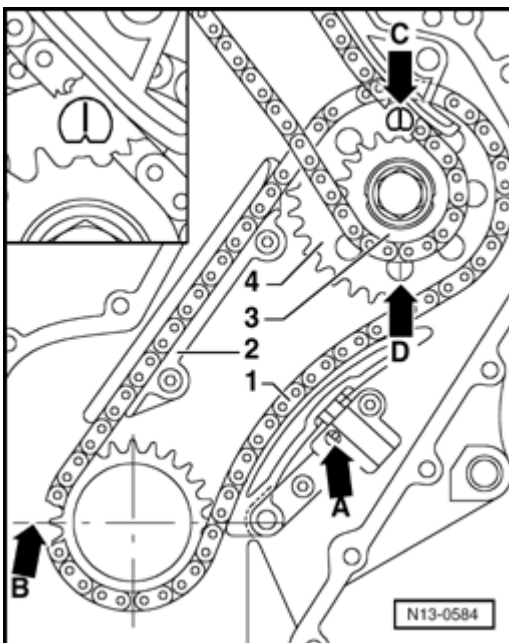


Fig. 79: Identifying Guide Rail, Roller Chain, Both Chain Sprockets, And Marking On Roller Chain Sprocket Aligned With Notch On Thrust Washer Of Intermediate Shaft
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Adjust position of crankshaft relative to intermediate shaft. To position: Align ground-down tooth of

drive chain sprocket - **B** - with bearing joint (TDC cyl. 1).

- Install both bolts without collar for guide rail - **2** - and tighten to 10 Nm.

NOTE:

- **Note direction of rotation of used chains Marking roller chains**

- Install guide rail - **2** - with roller chain - **1** - and both chain sprockets - **3** - and - **4** -. Marking on roller chain sprocket - **4** - must align with notch - **C** - or - **D** - on thrust washer of intermediate shaft.

During installation make sure that the roller chain runs completely straight in the guide rail from the crankshaft to the intermediate shaft.

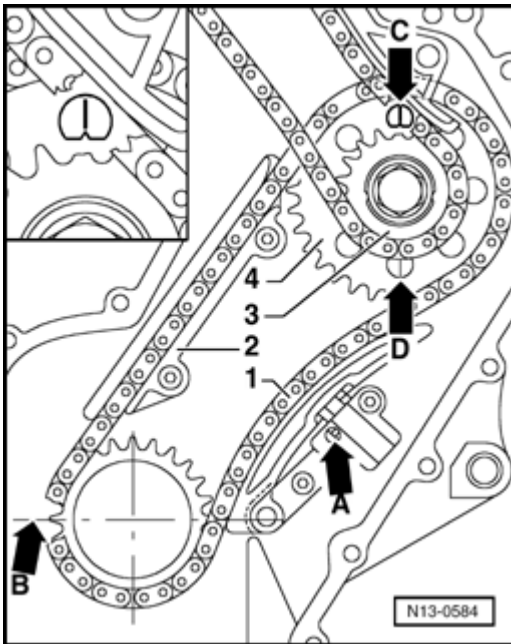


Fig. 80: Identifying Guide Rail, Roller Chain, Both Chain Sprockets, And Marking On Roller Chain Sprocket Aligned With Notch On Thrust Washer Of Intermediate Shaft
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tighten chain sprockets - **3** - and - **4** - on the intermediate shaft by hand.

NOTE:

- **Be aware that all chain sprocket securing screws/bolts must be replaced.**

- Install chain tensioner on opposite side.
- Release locking splines of chain tensioner - **A** - with a small screwdriver and tensioning rail pressed against chain tensioner.
- Install chain tensioner in this position and tighten to 8 Nm.

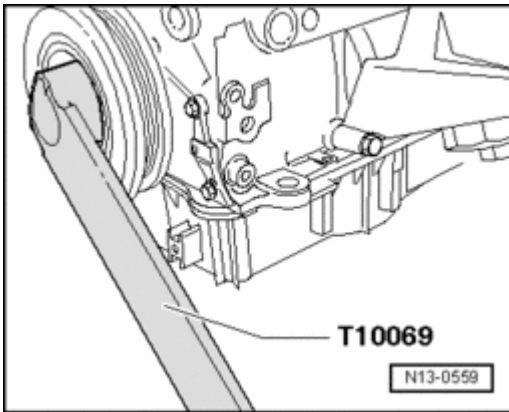


Fig. 81: Loosening/Tightening Securing Bolt, Using Counter-Holder T10069 To Hold Vibration Damper
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Lock vibration damper with counter-holder T10069.

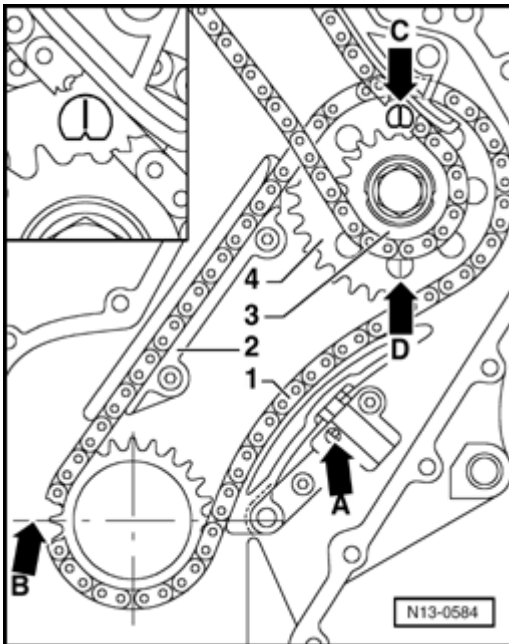


Fig. 82: Identifying Guide Rail, Roller Chain, Both Chain Sprockets, And Marking On Roller Chain Sprocket Aligned With Notch On Thrust Washer Of Intermediate Shaft
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tighten new securing bolt for intermediate shaft chain sprockets - 3 - and - 4 - to 60 Nm + 90 ° (1/4 turn). (The additional turn may be performed in several steps.)
- Remove counter-holder T10069.
- Check position of crankshaft - B - to intermediate shaft - C - or - D - again.
- Set engine again to TDC cyl. 1.

Install roller chain for camshaft drive:

- Position camshafts in cylinder head to TDC No. 1 cylinder.

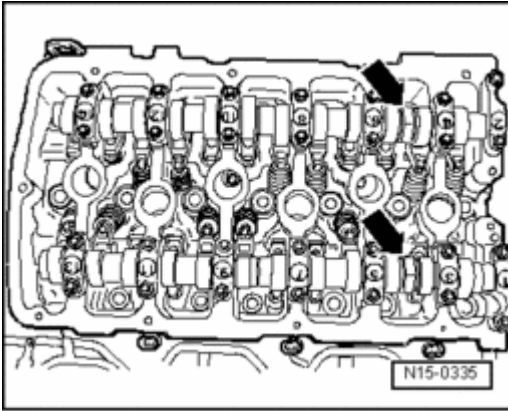


Fig. 83: Locating Counter-Hold Area On Camshaft
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE:

- If necessary use 32 mm open end wrench to turn camshafts - arrow - to the correct position. Camshaft bar T10068 A must not be installed during this process.

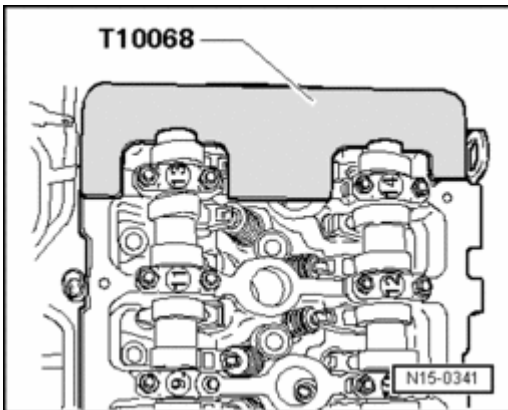


Fig. 84: Identifying Camshaft Bar T10068 Engage In Both Shaft Grooves
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- The camshaft bar T10068 A must engage in both shaft grooves.

NOTE:

- If the cylinder head is removed:
- Install cylinder head, refer to Cylinder head, removing and installing .

- Place camshaft roller chain on intermediate shaft chain sprocket.
- Route chain between tensioning rail and guide rail toward control housing.

NOTE:

- The camshaft bar T10068 A remains installed.

- For this version of camshaft adjustment, the exhaust and intake camshaft adjusters can be turned in two directions. When installing, make sure both camshaft adjusters are turned in direction of - arrow - until limit stop.
- The distance between the intake and exhaust camshaft adjuster markings "24E" to "32A" amounts to exactly 16 rollers of the camshaft roller chain.

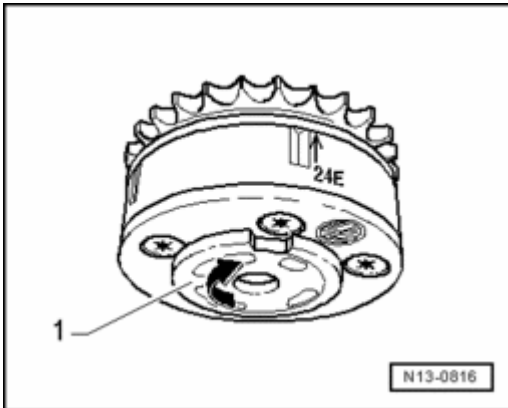


Fig. 85: Turning Sensor Wheel At Intake Camshaft Adjuster To The Right
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Turn sensor wheel - 1 - at intake camshaft adjuster to the right - **arrow** - until limit stop, and fasten adjuster hand-tight in this position to intake camshaft with camshaft roller chain installed.

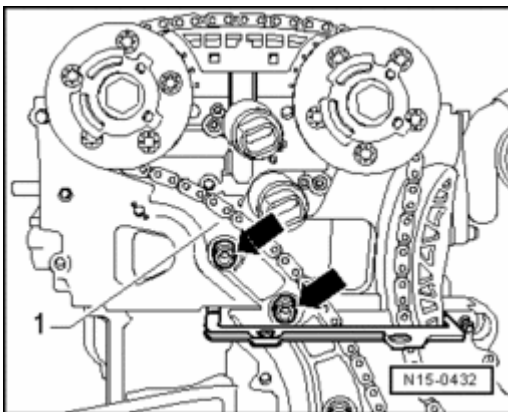


Fig. 86: Locating Guide Rail & Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Make sure that the camshaft roller chain rests against the guide rail - 1 - tightly and does not hang through.

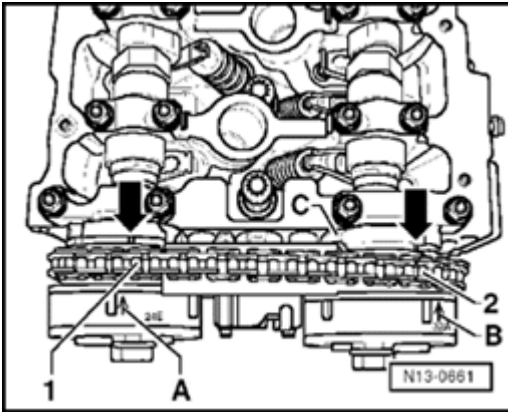


Fig. 87: Identifying Marks And Camshaft Adjusters Aligned With Notches On Control Housing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- The marking "24E" - A - on the camshaft adjuster must be aligned with the notch - **arrow** - of control housing - C -.
- From the marking "24E" on adjuster count exactly 16 rollers on control chain toward right and mark the roller with a colored marker.

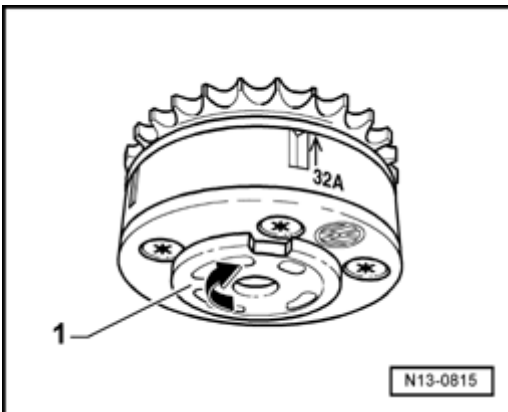


Fig. 88: Turning Sensor Wheel Of Exhaust Camshaft Adjuster To Right
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Turn sensor wheel - 1 - of exhaust camshaft adjuster to right - **arrow** - until limit stop and hold adjuster with sensor wheel in this position.

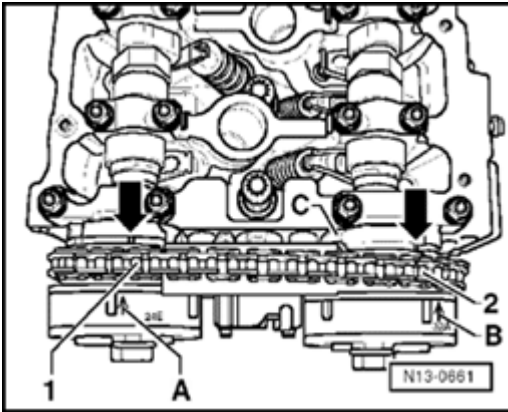


Fig. 89: Identifying Marks And Camshaft Adjusters Aligned With Notches On Control Housing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place exhaust camshaft adjuster with marking "32A" into camshaft roller chain, positioned exactly so that the 16 pre-counted rollers rest between markings "24E" and "32A" - 1 - and - 2 -.
- Fasten exhaust camshaft adjuster to camshaft hand-tight.

Continued for engine codes BJS

- Remove camshaft bar T10068 A.
- Turn over crankshaft twice in direction of engine rotation and check valve timing, refer to **Valve timing, checking**.

NOTE:

- **When turning the crankshaft, the tensioning rail must be pressed by hand against the camshaft roller chain at the chain tensioner, so that the camshaft roller chain does not jump over!**

If marks do not align:

- Repeat valve timing adjustment procedure.

If marks align:

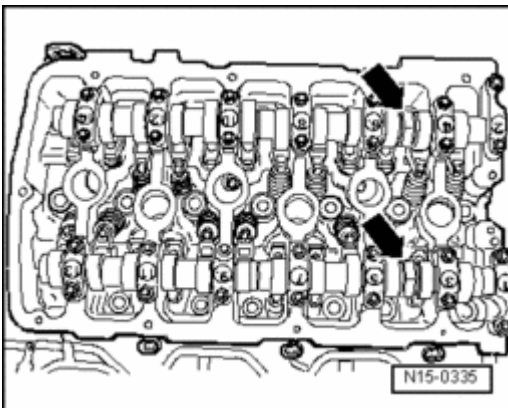


Fig. 90: Locating Counter-Hold Area On Camshaft
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Hold respective fastening camshaft tightly with an open-end wrench 32 mm - **arrow** -.

NOTE:

- **Camshaft bar T10068 A must not be installed during this process.**

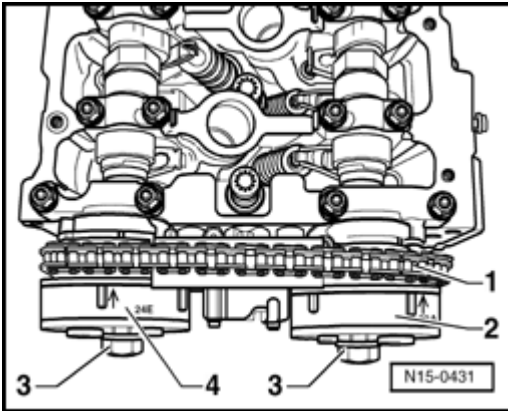


Fig. 91: Identifying Intake And Exhaust Camshaft Adjusters And Securing Bolt
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tighten new securing bolt - **3** - for intake and exhaust camshaft adjusters - **4** - and - **2** - to 60 Nm + 90 ° (1/4 turn). (The additional turn may be performed in several steps.)
- Coat sealing surface of sealing flange with sealing compound "AMV 176 501" and install. Tighten bolts to 8 Nm.
- Prepare cylinder head gasket for installation *Preparing cylinder head gasket for installation* , under **Preparing cylinder head gasket for installation**
- Coat sealing surface of cover with sealing compound "AMV 176 501".
- Lubricate O-ring for oil channel seal and install with oil seal into cover.
- Install cover, insert all fastening bolts and lightly tighten.
- First fasten bolts M8 to 23 Nm, then fasten bolts M6 to 8 Nm.
- Install camshaft roller chain tensioner and fasten to 40 Nm.
- Turn over crankshaft twice in direction of engine rotation and check valve timing again.
- Install cylinder head cover and intake manifold, refer to **Cylinder head cover, removing and installing** .

Cylinder head cover, removing and installing

Special tools, testers and auxiliary items required

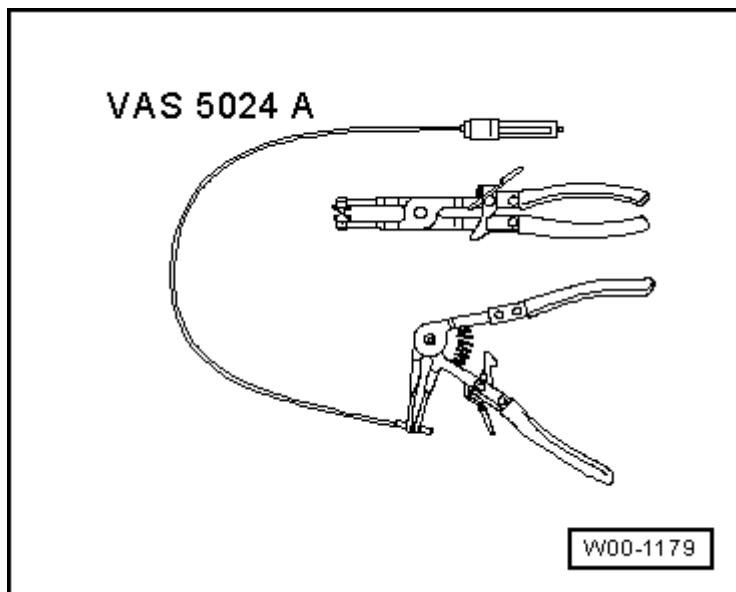


Fig. 92: Spring-Type Clip Pliers VAS 5024A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Spring-type clip pliers VAS 5024A

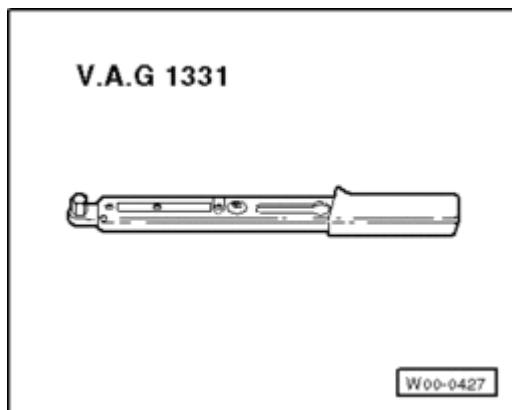


Fig. 93: Torque Wrench V.A.G. 1331 (5 To 50 Nm)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Torque wrench V.A.G 1331

Removing

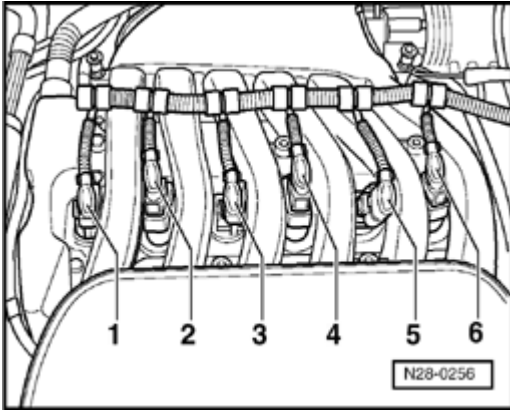
NOTE:

- To perform work sequence, the Ground (GND) cable must be disconnected from battery. Check whether a coded radio is installed. If so, obtain anti-theft coding beforehand.
- With ignition switched off disconnect battery Ground (GND) strap.

NOTE:

- All cable ties which are opened or cut open when removing, must be replaced in the same position when installing.

- Remove engine cover.

**Fig. 94: Identifying Ignition Coils**

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- On engine codes BJS remove the ignition coils with power output stages for cylinders 1 through 6 using the puller for ignition coil T10095 A, refer to **Ignition coils with power output stage, removing and installing**.
- Remove intake manifold, refer to **Intake manifold, removing and installing**.
- Remove cylinder head cover.

Installing

Installation is performed in reverse order of removal. Note the following:

NOTE:

- Replace cylinder head cover and/or seal if damaged or leaking.
- First, bolt the intake manifold to the cylinder head. Then, fasten bolts for shield and intake manifold support.
- Ensure fuel hoses are seated securely.

Torque specifications

Bolted connections	Torque specifications
Cylinder head cover to cylinder head	10 Nm
Intake manifold to cylinder head	15 Nm
Intake manifold to support	20 Nm
Shield to exhaust manifold	23 Nm
Oil dip stick guide tube to intake manifold	5 Nm

Compression pressures, checking

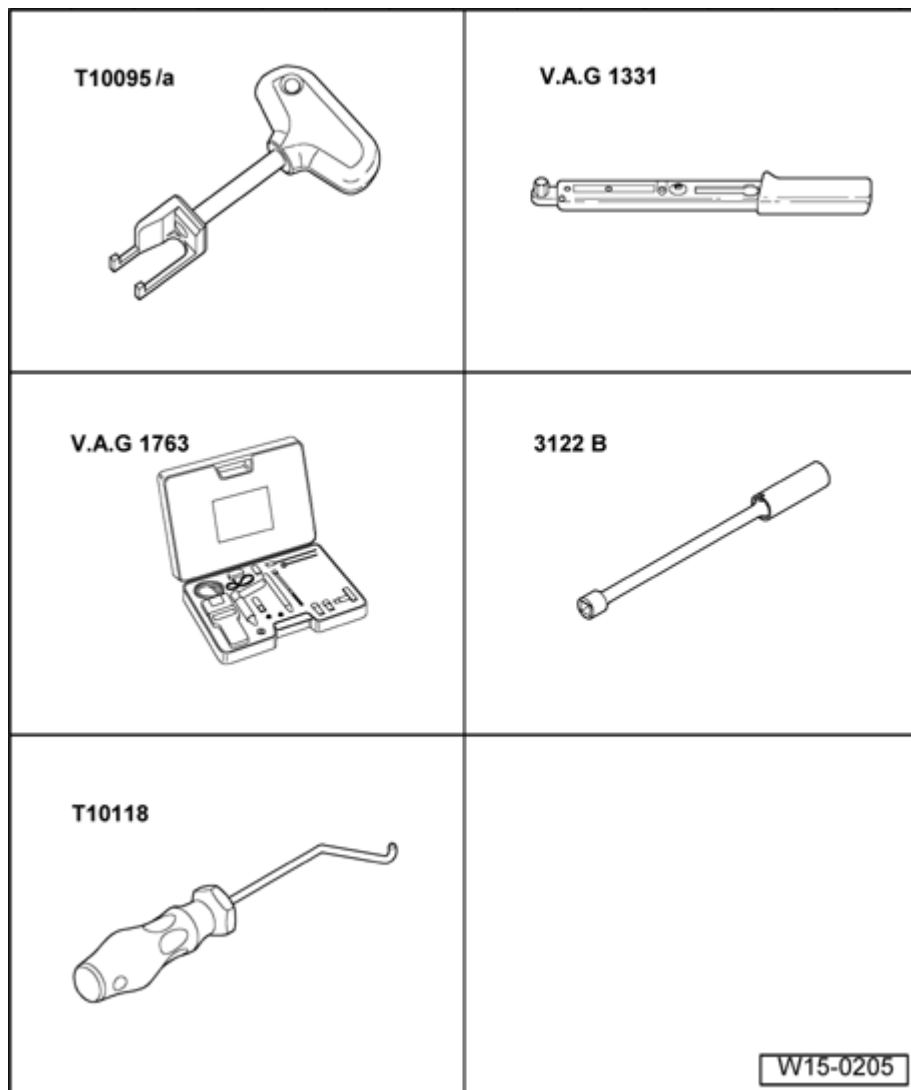


Fig. 95: Identifying Special Tools - Compression Pressures, Checking
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Puller T10095 A
- Torque wrench V.A.G 1331
- Compression tester V.A.G 1763
- Spark plug removal tool 3122 B
- Assembly tool T10118

Test conditions

- Engine oil temperature at least 30 ° C
- Battery voltage must be at least 11.5 V.

Test sequence

- Remove engine cover.

For engine codes BJS

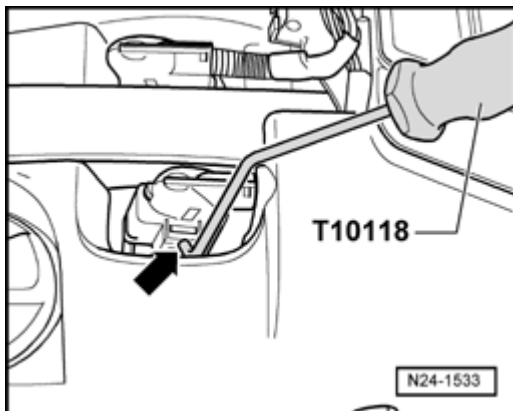


Fig. 96: Identifying Assembly Tool T10118 On Release Button
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place assembly tool T10118 on release button - **arrow** -, release connector retainers, and carefully pull off connectors from ignition coils 1 to 6.

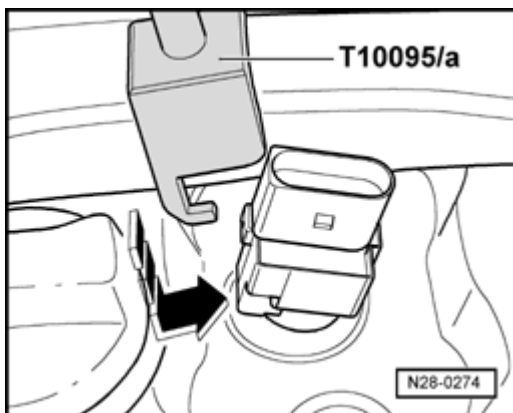


Fig. 97: Pushing The Remover T10095/A From The Straight Connector Side
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- From straight side of connector, push puller for ignition coil T10095 A on in direction of - **arrow** -, and pull out the ignition coil with power output stage.

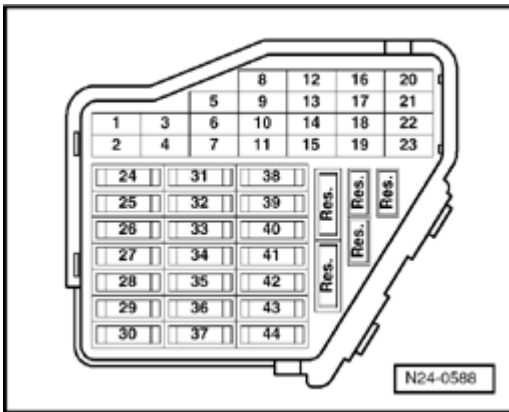


Fig. 98: Identifying Main Fuse Panel

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove fuse No. 29 from fuse holder.

Removing fuse No. 29 interrupts the voltage supply to the injectors.

- The spark plugs are removed from all engines using spark plug removal tool 3122 B.
- Check compression pressure using compression tester V.A.G 1763.

NOTE:

- Using tester, refer to **Operating instructions**.

- Operate starter until tester shows no further pressure increase.

Compression pressure:

New: 10 to 13 bar pressure

Wear limit: 7.5 bar pressure

Permissible difference between all cylinders: 3 bar

- Thereafter, reinstall spark plugs and ignition coils with power output stages, refer to **Ignition coils with power output stage, removing and installing**

VALVETRAIN, SERVICING

Valvetrain, servicing

Assembly overview, refer to **Assembly overview**

Camshafts, removing and installing, refer to **Camshafts, removing and installing**

Replace valve stem seals for all engine codes, refer to **Valve stem seals, replacing**

Check valve guides, refer to [Valve guides, checking](#)

Rework valve seats, refer to [Valve seats, reworking](#)

Assembly overview

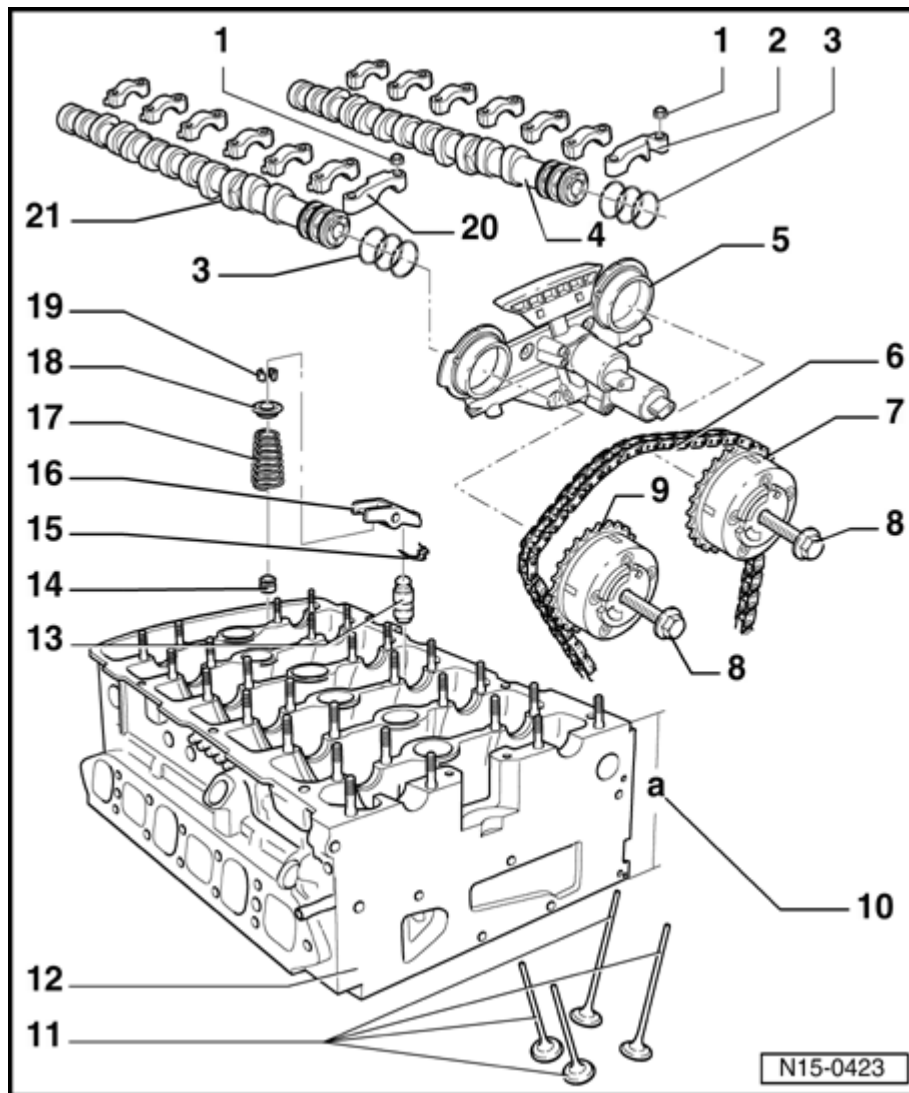


Fig. 99: Valvetrain Assembly Overview

Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 5 Nm + $\frac{1}{8}$ turn (45 °)

2 - Exhaust camshaft bearing cap

- Installation order, refer to [Camshafts, removing and installing](#)

3 - Oil seal

- If seal is leaking, replace completely
- When installing control housing, lightly lubricate contact surfaces of seal
- When replacing seals, do not spread too widely

4 - Exhaust camshaft

- Checking radial clearance with Plastigage, Wear limit: 0.1 mm
- Run-out: max. 0.01 mm
- Checking axial play *Camshafts, checking axial clearance* under **Valve stem seals, replacing**
- Identification and timing *Camshaft identification, valve timing* under **Valve stem seals, replacing**
- Removing and installing, refer to **Camshafts, removing and installing**

5 - Control housing

- Lightly lubricate contact surfaces of oil seals before installing
- Disassembling and assembling *Disassembling and assembling control housing* under **Assembly overview**
- Before installing control housing strainer check for contamination *Check the control housing screen for contamination* under **Assembly overview**
- Removing and installing, refer to **Camshafts, removing and installing**

6 - Camshaft roller chain

- Mark direction of rotation before removing (installation position) **Marking roller chains**
- Installing, refer to **Valve timing, adjusting**

7 - Exhaust camshaft adjuster

- Identification: 32A
- Only turn over engine with camshaft adjusters and chain installed
- Installing, refer to **Valve timing, adjusting**

8 - 60 Nm + ¹ / 4 turn (90 °)

- Replace
- Contact surface of sender wheel must be dry around bolt head when assembling
- To remove and install, counter-hold at camshaft using an open-end wrench (32 mm), refer to **Camshafts, removing and installing**

9 - Intake-camshaft adjuster

- Identification: 24E
- Only turn over engine with camshaft adjusters and chain installed

- Installing, refer to **Valve timing, adjusting**

10 - Cylinder head height

- Minimum height: a = 139.9 mm

11 - Valves

- Do not rework, only grinding is permitted
- Valve dimensions *Valve dimensions* under **Valve stem seals, replacing**

12 - Cylinder head

- Check for distortion *Checking cylinder head for distortion* under **Checking cylinder head for distortion**
- Removing and installing, refer to **Cylinder head, removing and installing**
- Rework valve seats, refer to **Valve seats, reworking**
- After replacing replace entire amount of coolant

13 - Support element

- Before installing check camshaft axial play *Camshafts, checking axial clearance* under **Valve stem seals, replacing**
- Do not interchange
- With hydraulic valve clearance compensation

14 - Valve stem seal

- Replace, refer to **Valve stem seals, replacing**

15 - Securing clip

- Check for secure seat

16 - Roller rocker lever

- Before installing check camshaft axial play *Camshafts, checking axial clearance* under **Valve stem seals, replacing**
- Do not interchange
- Check roller for easy movement
- Lubricate contact surface
- Use securing clip to clip onto support element when installing

17 - Valve spring

- Note installation position
- Removing and installing, refer to **Valve stem seals, replacing**

18 - Valve spring plate

19 - Valve keepers

20 - Intake camshaft bearing cap

- Installation order, refer to **Camshafts, removing and installing**

21 - Intake camshaft

- Checking radial clearance with Plastigage, Wear limit: 0.1 mm
- Run-out: max. 0.01 mm
- Checking axial play *Camshafts, checking axial clearance* under **Valve stem seals, replacing**
- Identification and timing *Camshaft identification, valve timing* under **Valve stem seals, replacing**
- Removing and installing, refer to **Camshafts, removing and installing**

Disassembling and assembling control housing

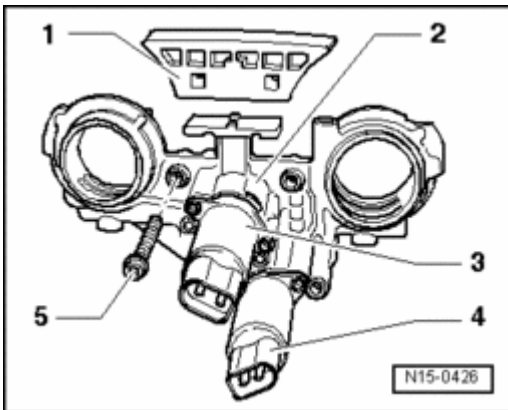


Fig. 100: Disassembling And Assembling Control Housing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- 1 - Glide track: clipped in at control housing
- 2 - Control housing
- 3 - Valve 1 for camshaft adjustment N205
- 4 - Camshaft adjustment valve 1 (exhaust) N318
- 5 - 8 Nm

Check the control housing screen for contamination

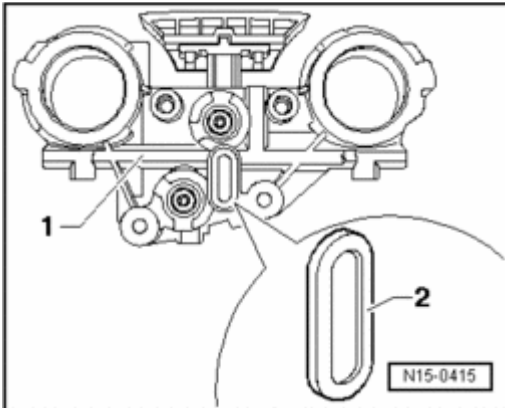


Fig. 101: Checking The Control Housing Screen For Contamination

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unclip the screen - 2 - from the backside of the control housing - 1 - and remove any contaminants.

Camshafts, removing and installing

Removing

Installing

(with cylinder head installed)

2004 Volkswagen R32

ENGINE 3.2 Liter VR6 4V Engine Mechanical, Fuel Injection Ignition, Engine Code(s): BJS

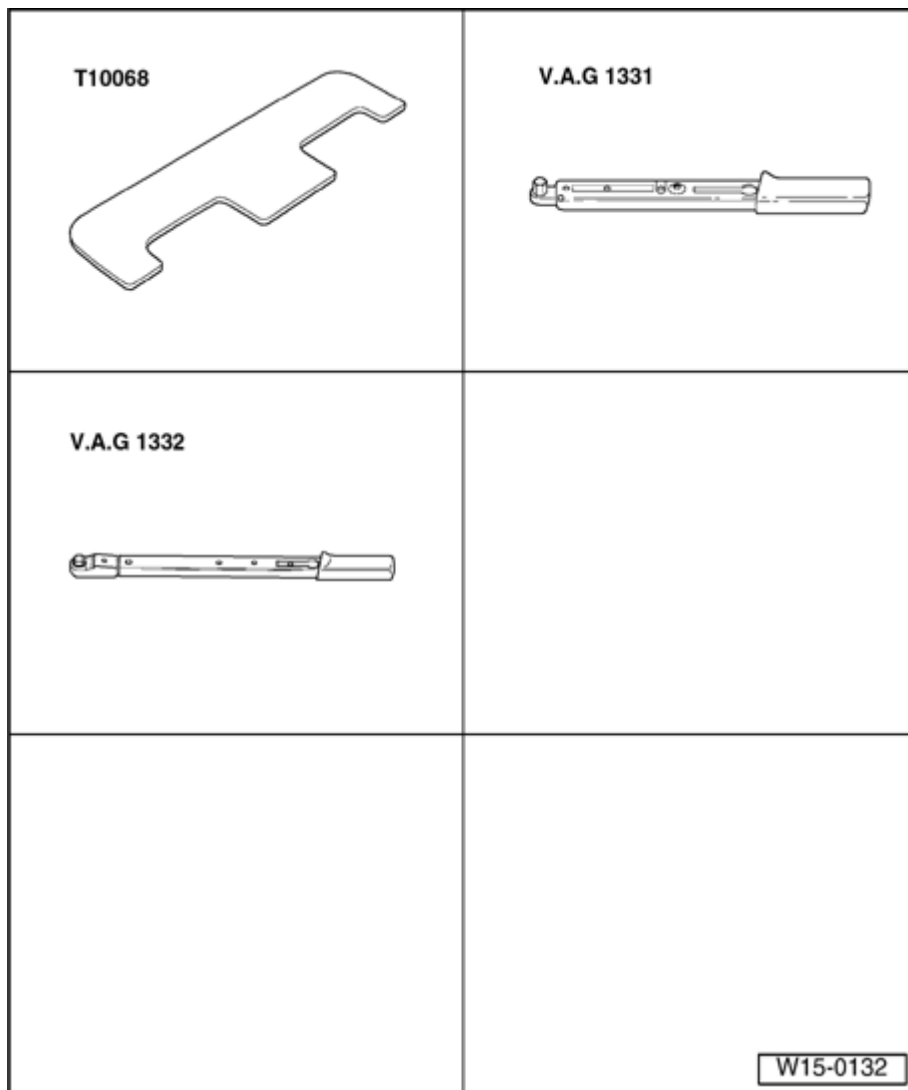


Fig. 102: Identifying Special Tools - Camshafts, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Camshaft bar T10068 A
- Torque wrench V.A.G 1331
- Torque wrench V.A.G 1332
- Sealing compound AMV 174 004 01
- Sealing compound AMV 176 501
- Grease G 052 723 A2

Removing

CAUTION: When doing any repair work, especially in the engine compartment, pay

attention to the following due to clearance issues:

- Route lines of all types (e.g. for fuel, hydraulic, EVAP system, coolant and refrigerant, brake fluid, vacuum) and electrical wiring so that the original path is followed.
 - To prevent damages to the lines, make sure there is sufficient clearance to all moving or hot components.
- Check whether a coded radio is installed. If necessary, obtain the anti-theft coding.
 - Disconnect battery Ground (GND) strap with ignition switched off.
 - All cable ties which are opened or cut open when removing, must be replaced in same position when installing.
 - Remove intake manifold, refer to Cylinder head cover, removing and installing .

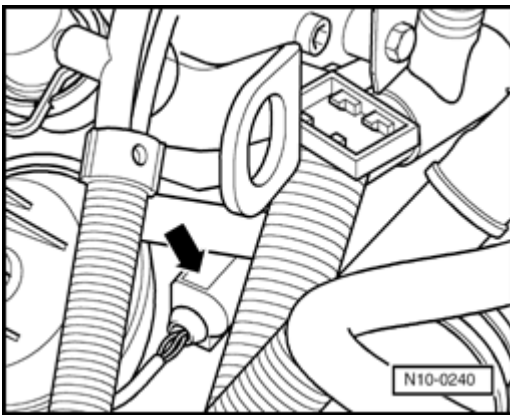


Fig. 103: Locating Engine Coolant Temperature Sensor G62

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect 2-pin connector from Engine Coolant Temperature (ECT) Sensor G62 - **arrow** -.
- Drain coolant, refer to *Cooling system, draining and filling* under Cooling system, draining and filling .
- Remove thermostat housing, refer to Cooling system components (on engine), assembly overview .

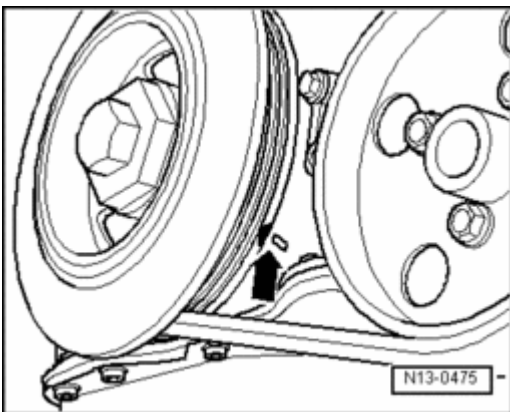


Fig. 104: Identifying Crankshaft At Vibration Damper Securing Bolt In Engine At TDC Cyl. 1

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Turn crankshaft at vibration damper securing bolt in engine direction of rotation to TDC cyl. 1 - **arrow** -.
- Remove cylinder head cover, refer to **Cylinder head cover, removing and installing** .

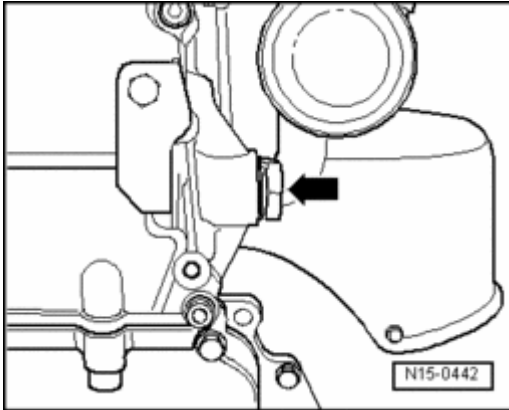


Fig. 105: Locating Camshaft Roller Chain Tensioner

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove camshaft roller chain tensioner - **arrow** -.
- On the following components, pull off the covers for the connectors:
 - Valve 1 for camshaft adjustment N205
 - Camshaft adjustment valve 1 (exhaust) N318
 - Camshaft Position (CMP) sensor G40
 - Camshaft position (CMP) sensor 2 G163

NOTE: ● **Before disconnecting harness connectors, mark allocation to component.**

- Free up wiring harness.
- Remove camshaft cover.
- Remove exhaust camshaft adjuster.
- Remove camshaft adjuster together with camshaft roller chain from intake camshaft.

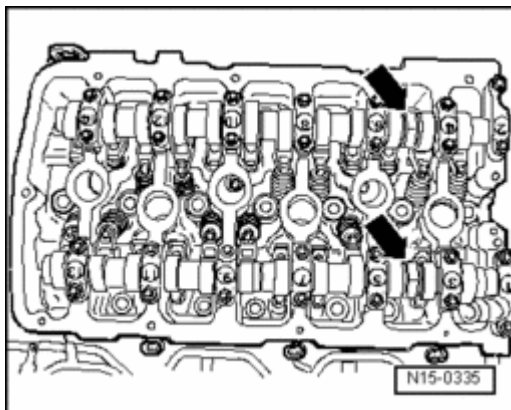


Fig. 106: Locating Counter-Hold Area On Camshaft

Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE:

- Counter-hold only with 32 mm open end wrench on camshaft - arrow -. Camshaft bar T10068 A must not be installed when camshaft adjuster is loosened or tightened.

- Place camshaft roller chain aside.

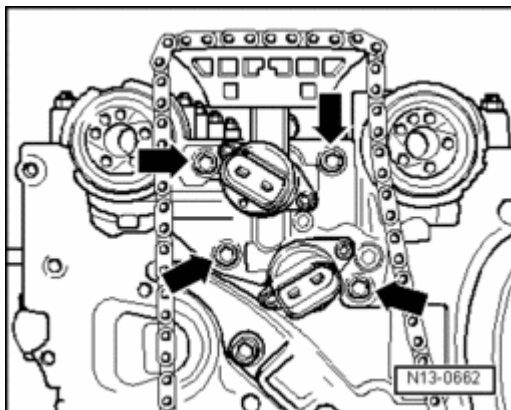


Fig. 107: Locating Control Housing-To-Cylinder Head Bolts

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove control housing from cylinder head - **arrows** -.
- Pull control housing carefully off camshaft seals.

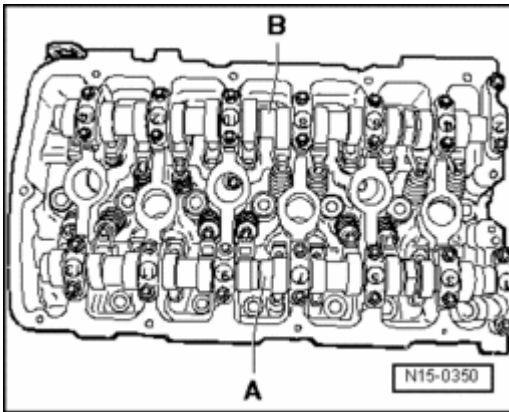


Fig. 108: Identifying Intake Camshaft And Exhaust Camshaft
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

A - Intake camshaft

- First remove bearing caps 1 and 13.
- Remove bearing caps 3 and 11.
- Remove bearing cap 7.
- Loosen bearing caps 5 and 9 alternately and diagonally, and remove.

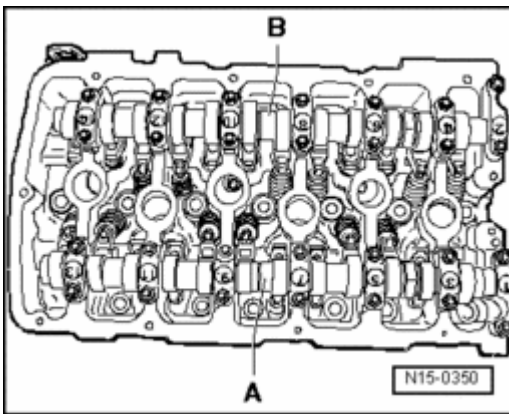


Fig. 109: Identifying Intake Camshaft And Exhaust Camshaft
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

B - Exhaust camshaft

- First remove bearing caps 2 and 14.
- Remove bearing caps 4 and 12.
- Remove bearing cap 8.
- Loosen bearing caps 6 and 10 alternately and diagonally and remove.
- Carefully remove camshafts and place on a clean surface.
- Remove roller rocker lever together with support elements and place on a clean surface.

- Ensure the roller rocker levers and the support elements are not interchanged.

Installing

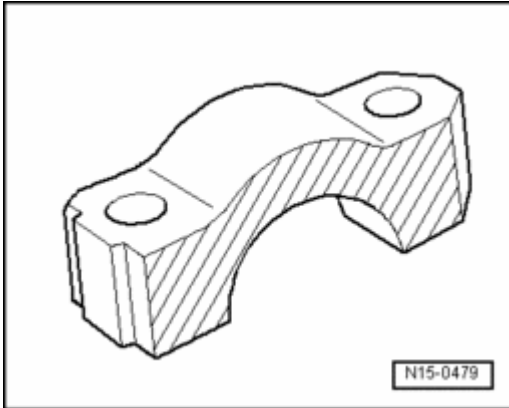


Fig. 110: Identifying Contact Surfaces Of Bearing Caps 7 And 8
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Before installing, lightly coat contact surfaces of bearing caps 7 and 8 with grease "G 052 723 A2".

Requirements

- When installing the camshafts, the cam lobes for cylinder 1 must point upward.
- Insert support element in cylinder head and install roller rocker lever onto respective valve stem end and support element.

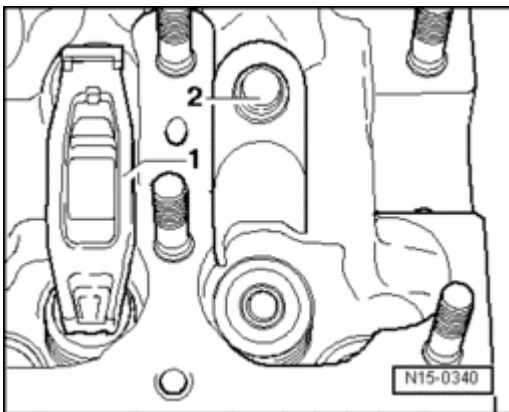


Fig. 111: Identifying Valve Stem Ends & Support Elements
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Ensure that all roller rocker levers seat properly on valve stem ends - **1** - and are clipped onto respective support elements - **2** -.
- Oil running surfaces of both camshafts.
- Place respective camshaft carefully in camshaft bearings of cylinder head. Observe camshaft identification *Camshaft identification, valve timing* under **Valve stem seals, replacing**.

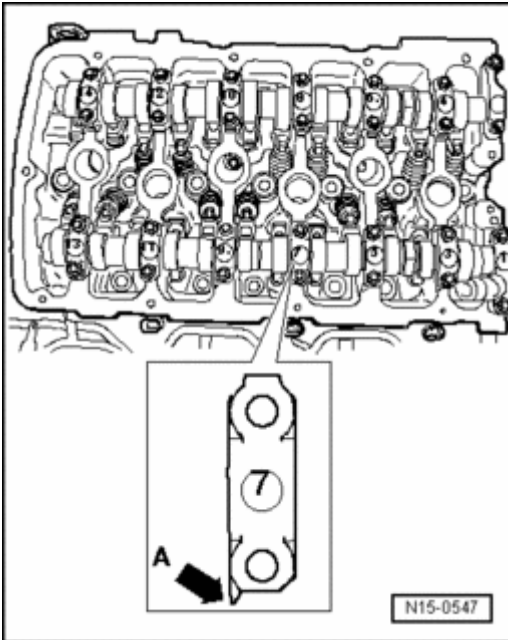


Fig. 112: Points Of Intake And Exhaust Camshaft Bearing Cap
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE:

- Observe installed position of bearing caps:
- Points of intake and exhaust camshaft bearing caps - arrow A - face outwards.
- Identification on bearing caps is legible when read from intake side.

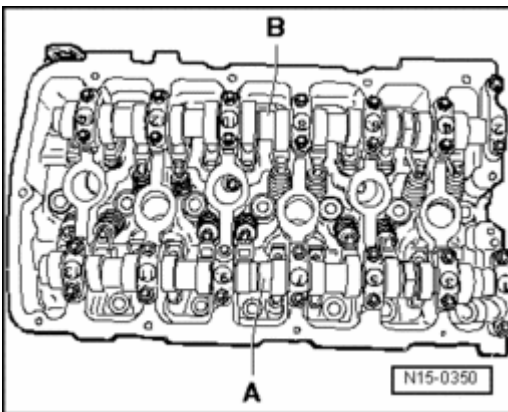


Fig. 113: Identifying Intake Camshaft And Exhaust Camshaft
Courtesy of VOLKSWAGEN UNITED STATES, INC.

A - Intake camshaft

- Tighten bearing caps 5 and 9 alternately and diagonally to 5 Nm and 1/8 turn (45 °) further.
- Install bearing caps 1 and 13 and tighten to 5 Nm and 1/8 turn (45 °) further.
- Install bearing cap 7 and tighten to 5 Nm and 1/8 turn (45 °) further.

- Install bearing caps 3 and 11 and also tighten to 5 Nm and 1/8 turn (45 °) further.

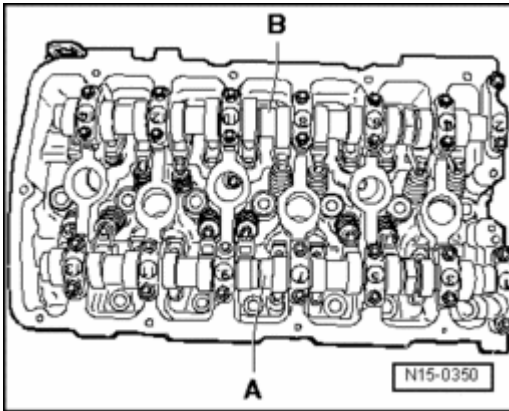


Fig. 114: Identifying Intake Camshaft And Exhaust Camshaft
Courtesy of VOLKSWAGEN UNITED STATES, INC.

B - Exhaust camshaft

- Tighten bearing caps 6 and 10 alternately and diagonally to 5 Nm and 1/8 turn (45 °) further.
- Install bearing caps 2 and 14 and tighten to 5 Nm and 1/8 turn (45 °) further.
- Install bearing cap 8 and tighten to 5 Nm and 1/8 turn (45 °) further.
- Install bearing caps 4 and 12 and also tighten to 5 Nm and 1/8 turn (45 °) further.
- Position the camshafts in cylinder head to TDC No. 1 cylinder.

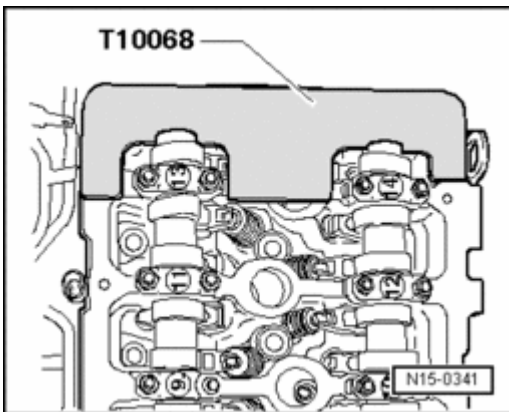


Fig. 115: Identifying Camshaft Bar T10068 Engage In Both Shaft Grooves
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- The camshaft bar T10068 A must engage in both shaft grooves.
- Before installing, check the control housing screen for contamination *Check the control housing screen for contamination* under **Assembly overview** .
- Before installing control housing, lightly lubricate surfaces in control housing contacting camshaft seals.
- Lightly lubricate camshaft seals and slowly push control housing over camshaft seals.

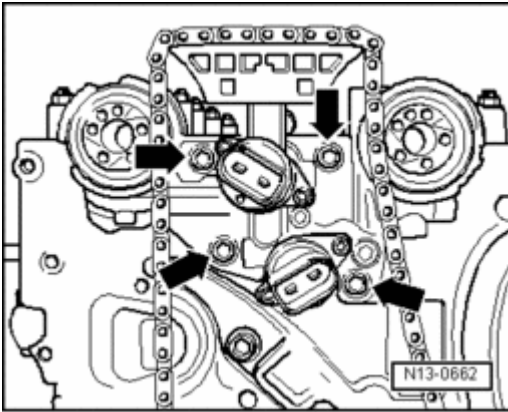


Fig. 116: Locating Control Housing-To-Cylinder Head Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install control housing - **arrows** - and fasten with 8 Nm.

How to adjust valve timing, refer to **Valve timing, adjusting** .

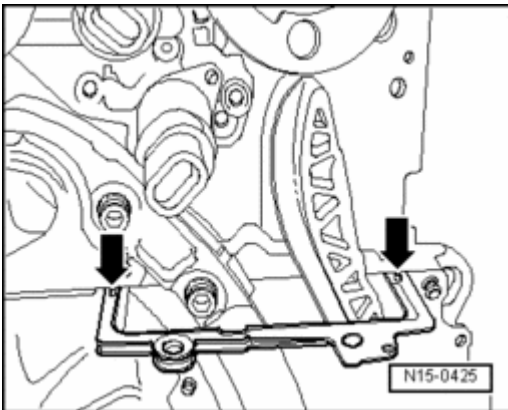


Fig. 117: Locating 3 mm Holes In The Cylinder Head Gasket
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Clean old sealing compound from the 3 mm holes in cylinder head gasket - **arrows** -.

NOTE:

- **With the cylinder head installed only half of the holes in the cylinder head gasket are visible.**

- Fill the 3 mm holes in the cylinder head gasket with sealing compound 174 004 01 and apply an elevated level of sealing compound to these respective areas.

NOTE:

- **Sealing compound AMV 174 004 01 hardens quickly.**

- Lubricate O-ring for oil channel seal and install with oil seal into cover.
- Coat sealing surface of cover with sealing compound "AMV 176 501" and install immediately.

- First insert all fastening bolts and lightly tighten.
- Thereafter fasten the bolts M8 to 23 Nm, and then fasten bolts M6 to 8 Nm.
- Install camshaft roller chain tensioner and fasten to 40 Nm.
- Install cylinder head cover and intake manifold, refer to **Cylinder head cover, removing and installing** .

Valve stem seals, replacing

Removing

Installing

(with cylinder head installed)

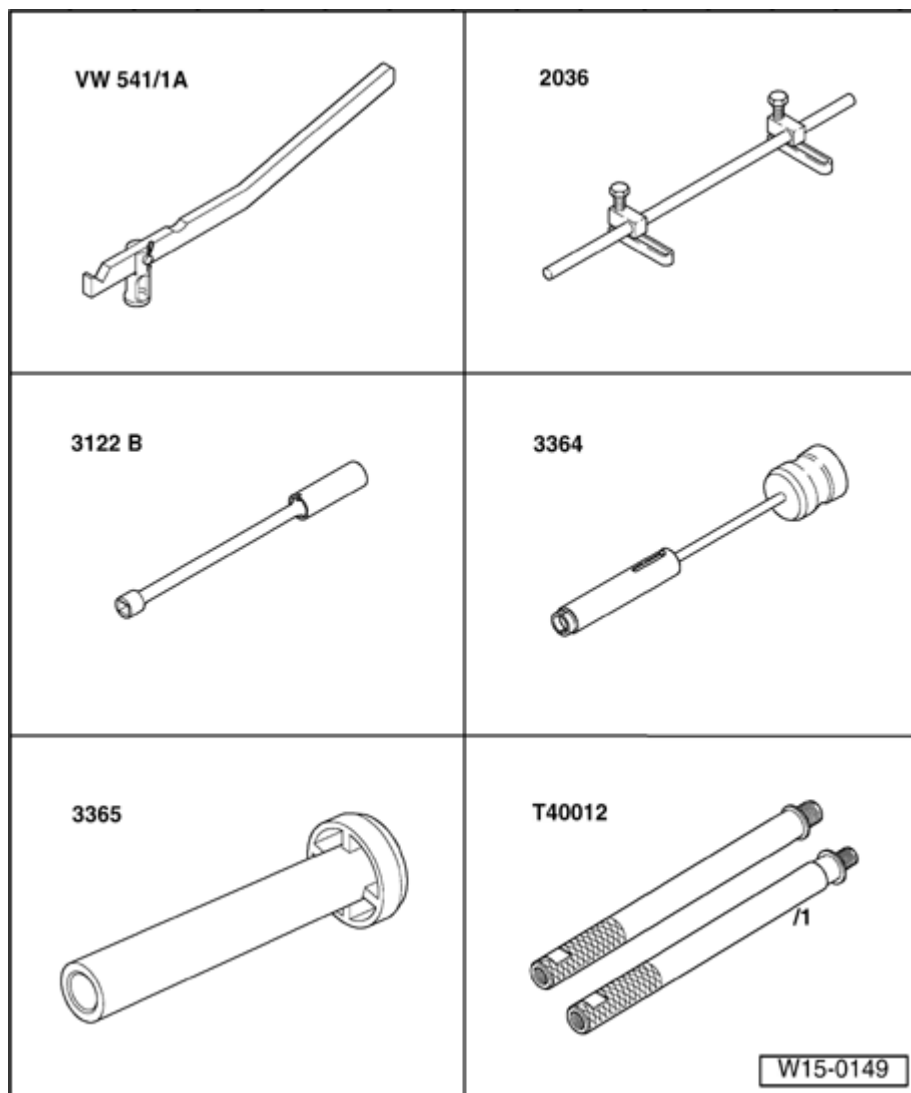


Fig. 118: Identifying Special Tools - Valve Stem Seals, Replacing
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Valve lever VW 541/1 A with pressure piece for VW 541 / 1 A and 2037 VW 541/6
- Valve assembly tool 2036 with adapter plate 2036/1
- Spark plug removal tool 3122 B
- Valve seal removal tool 3364
- Valve stem seal driver 3365
- Adapter T40012 and adapter T40012/1

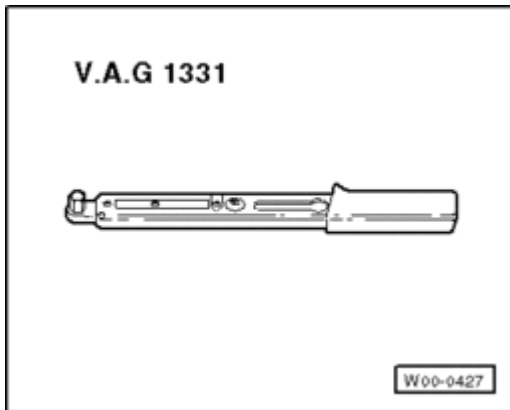


Fig. 119: Torque Wrench V.A.G. 1331 (5 To 50 Nm)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Torque wrench V.A.G 1331

Removing**For engine codes BJS:**

- Remove camshafts, refer to **Camshafts, removing and installing** .
- Remove roller rocker lever together with support elements and place on a clean surface.
- Remove spark plugs with spark plug removal tool 3122 B.
- Set piston of appropriate cylinder to "bottom dead center".

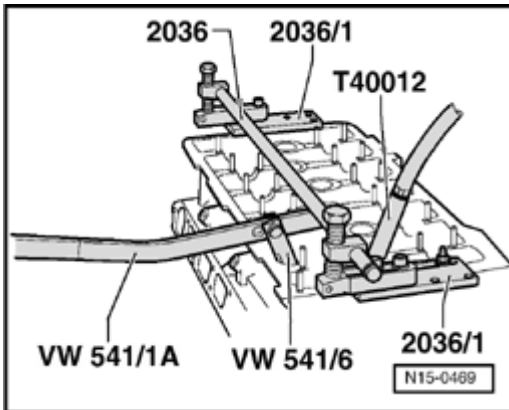


Fig. 120: Identifying Adjustable Rod 2036, Adapter T40012 And Valve Lever VW 541/1 A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install adjustable rod 2036 with adapter plates 2036/1 and adjust mountings.
- Screw adapter T40012 and adapter T40012/1 into spark plug threads.
- Connect a commercially available adapter to the compressed air line and maintain a steady pressure of at least 6 bar.
- Remove valve springs using valve lever VW 541/1 A and pressure piece for VW 541 / 1 A and 2037 VW 541/6.

NOTE:

- Tight keepers can be loosened by tapping lightly on the lever.

- Pull off valve stem seals with valve stem removal tool 3364.

Installing

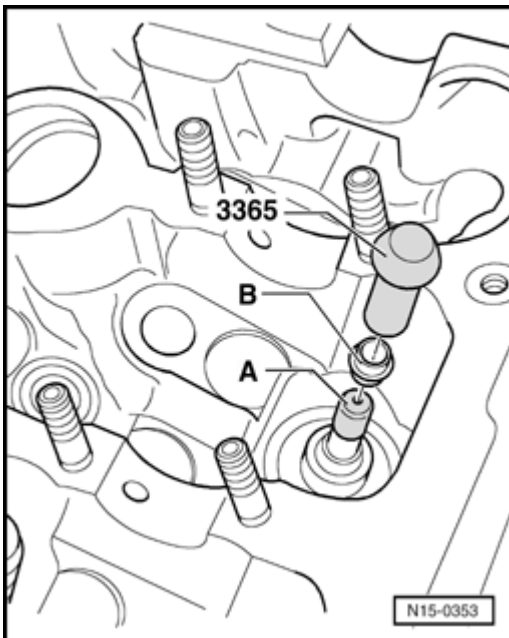


Fig. 121: Plastic Sleeve, Valve Stem Seal And Valve Stem Seal Driver 3365

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- To prevent damage to new valve stem seals, place plastic sleeve - **A** - on valve stem.
- Lubricate sealing lip of valve stem seal - **B** -, insert in valve stem seal driver 3365, and carefully push onto valve guide.
- Installing camshafts: Refer to Camshafts, removing and installing .

Camshafts, checking axial clearance

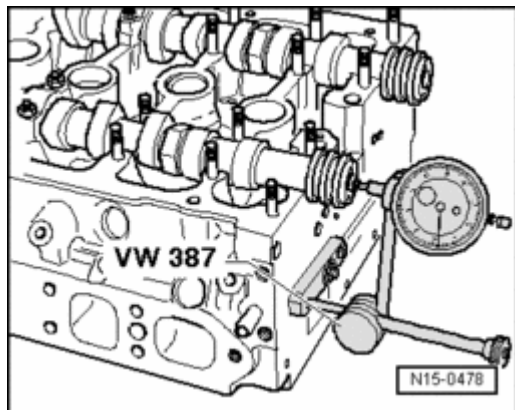


Fig. 122: Checking Camshafts Axial Clearance

Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Dial gauge holder VW 387
- Dial gauge

Test sequence

Perform measurements with support elements and roller rocker levers removed.

Center bearing cap of respective camshaft installed.

Wear limit: max. 0.10 mm

Camshaft identification, valve timing

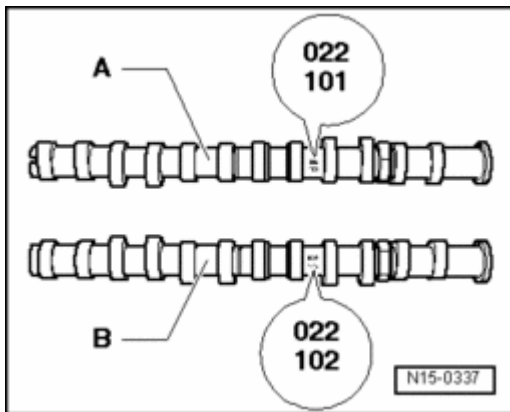


Fig. 123: Camshaft Identification, Valve Timing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Camshaft identification

Identification between No. 4 cyl. and No. 5 cyl. cam pair of respective camshaft.

Camshaft	Identification
A - Exhaust camshaft	022 101 Index
B - Intake camshaft	022 102 Index

Valve timing at 1 mm valve lift

	Intake valve	Exhaust valve
Opens before TDC	---	211.5 °
Closes before TDC	---	6.5 °
Opens after TDC	18.50 °	---
Closes after TDC	223.5 °	---

Valve dimensions

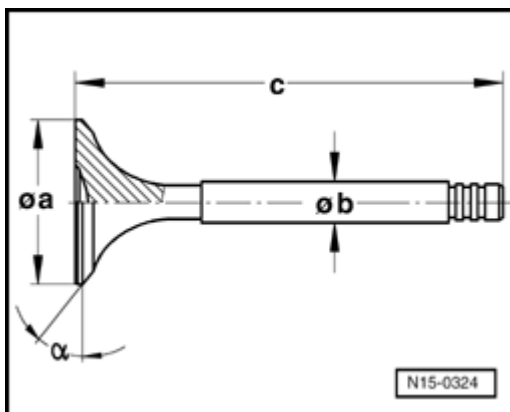


Fig. 124: Valve Dimensions
Courtesy of VOLKSWAGEN UNITED STATES, INC.

2004 Volkswagen R32

ENGINE 3.2 Liter VR6 4V Engine Mechanical, Fuel Injection Ignition, Engine Code(s): BJS

NOTE:

- Valves must not be reworked. Only grinding is permitted.

Valve dimensions for intake valves

Dimension		Short intake valve	Long intake valve
Dia. a	mm	31.00	31.00
Dia. b	mm	5.96	5.96
c	mm	102.20	136.10
a	Angle °	45	45

Valve dimensions for exhaust valves

Dimension		Short exhaust valve	Long exhaust valve
Dia. a	mm	27.00	27.00
Dia. b	mm	5.94	5.94
c	mm	102.50	136.40
a	Angle °	45	45

Valve guides, checking

Special tools, testers and auxiliary items required

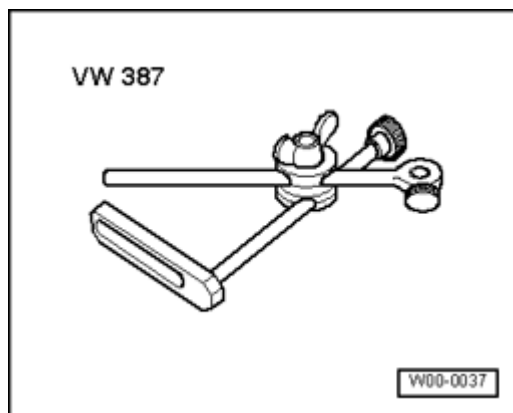


Fig. 125: Dial Gauge Holder VW 387

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Dial gauge holder VW 387
- Dial gauge

Test sequence

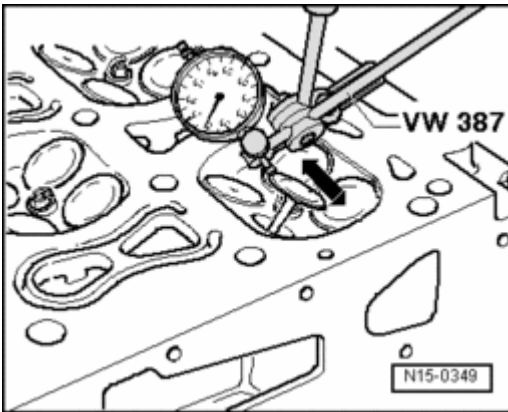


Fig. 126: Checking Valve Guides

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert new valve into guide. The end of the valve stem must be flush with the guide. Due to the slight difference in stem diameters, ensure that only an intake valve is used in the intake guide and an exhaust valve in the exhaust guide.
- Determine tilt clearance. Wear limit: 0.8 mm

If tilt clearance is exceeded:

- Replace cylinder head.

Valve seats, reworking

Special tools, testers and auxiliary items required

- Depth gauge
- Valve seat refacing tool

Work procedure

NOTE:

- When repairing engines with leaking valves, it is not sufficient to rework or replace valve seats and valves. It is also necessary to check the valve guides for wear. This is particularly important on high mileage engines, refer to Valve guides, checking .
- The valve seats should only be reworked just enough to produce a perfect seating pattern. The maximum permissible reworking dimension must be calculated before work is carried out. If the reworking dimension is exceeded, the function of the hydraulic lifters can no longer be guaranteed and therefore the cylinder head should be replaced.

- Removing camshafts, refer to Camshafts, removing and installing .

Maximum permitted refacing dimension is calculated as follows:

- Insert valve and press firmly against seat.

NOTE:

- If the valve is to be replaced as part of a repair, use a new valve for the calculation.

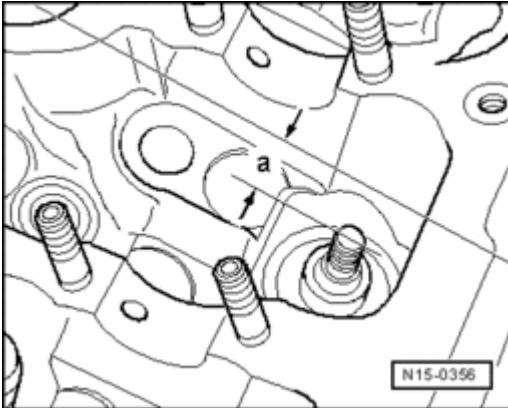


Fig. 127: Identifying Distance Between End Of Valve Stem And Upper Edge Of Cylinder Head
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

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

Minimum dimensions:

Short intake valve	mm	31.8
Long intake valve	mm	10.2
Short exhaust valve	mm	31.8
Long exhaust valve	mm	10.2

Measured distance - **a** - minus minimum dimension = max. permissible refaced dimension.

Example:

	Measured distance	10.6 mm
	Minimum dimension	10.2 mm
=	Max. permissible reworking dimension*	0.4 mm

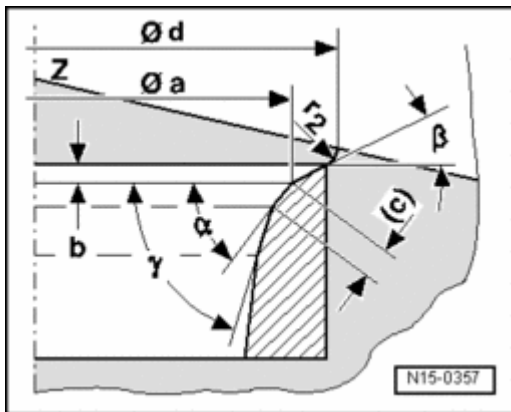


Fig. 128: Reworking Intake Valve Seat

Courtesy of VOLKSWAGEN UNITED STATES, INC.

Reworking intake valve seat

a - = 30.6 mm

b - = Max. permissible reworking dimension*

c - = 0.9 to 1.5 mm

d - = max. dia. 35.0 mm

r2 - = Radius 2.0 mm

Z - = Cylinder head lower edge

a - 45 ° valve seat angle

β - 30 ° upper correction angle

gamma - 60 ° lower correction angle

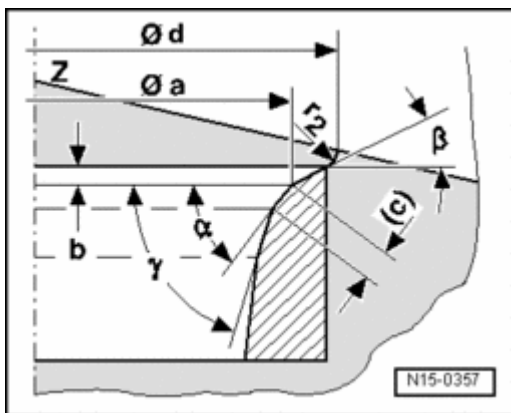


Fig. 129: Reworking Exhaust Valve Seat

Courtesy of VOLKSWAGEN UNITED STATES, INC.

Reworking exhaust valve seat

a - = Dia. 26.7mm

b - = Max. permissible reworking dimension*

c - = 1.2 to 10.7 mm

d - = max. dia. 29.0 mm

r2 - = Radius 2.0 mm

Z - = Cylinder head lower edge

a - 45 ° valve seat angle

β - 30 ° upper correction angle

gamma - 60 ° lower correction angle

17 - ENGINE - LUBRICATION**LUBRICATION SYSTEM COMPONENTS, REMOVING AND INSTALLING**

Lubrication system components, removing and installing

NOTE:

- When performing repair work, secure engine to engine and transmission holder VAS 6095 or holding fixture VW 540 with supplementary set VW 540/1 B.
- The oil level must not be above the max. mark - danger of damage to catalytic converter!
- If large quantities of metal particles or abraded material are detected during engine repairs, it may be an indication for a damaged crankshaft or rod bearings. To prevent further damage, perform the following steps after the repair:
 - Carefully clean oil passages
 - Replace oil non-return valve
 - Replace oil injection jets
 - Replace oil cooler
 - Replace oil filter

Engine oil, refer to Engine oil

Assembly overview, refer to **Assembly overview**

Oil filter housing, assembly overview, refer to **Oil filter housing, assembly overview**

Oil pump, assembly overview, refer to **Oil pump, assembly overview**

Oil pan, removing and installing, refer to **Oil pan, removing and installing**

Oil pressure and oil pressure switch, checking, refer to **Oil pressure and oil pressure switch, checking**

Engine oil

Oil system capacity:

With oil filter 5.5 ltr.

Engine oil specifications:

Use "long life engine oils" in compliance with VW standard 503 00.

NOTE:

- **The engine is filled at the factory with engine oil complying to VW standard 503 00.**
- **Engine oil conforming to VW standard 500 00, 501 01, or 502 00 may continue to be used. The oils must be changed every 12 months or every 10,000 miles (15,000 km). The service interval display must be programmed correspondingly. Procedure: Refer to Repair Manual, Maintenance**
- **For changing, engine oil "ILSAC GF3 with viscosity rating SAE 5W-40" can be used.**

Assembly overview

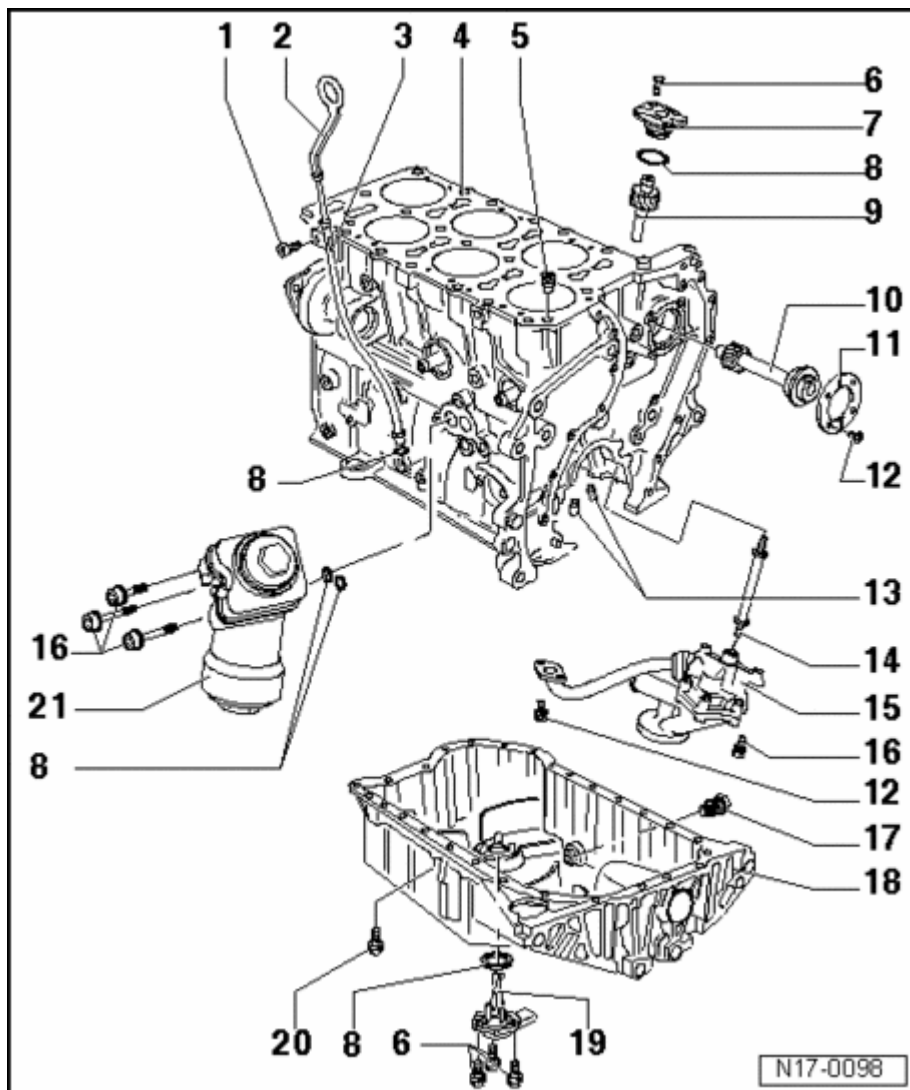


Fig. 130: Lubrication System Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 8 Nm

- Fastened to intake manifold

2 - Dipstick

- Oil level must not be above the max. mark!
- Marks **Markings on oil dipstick**

3 - Guide tube

- For dipstick
- Secured by a bolt to intake manifold

4 - Cylinder block

- Removing and installing sealing flange and dual-mass flywheel, refer to *Sealing flange and dual-mass flywheel, removing and installing* under **Sealing flange and dual-mass flywheel, removing and installing**
- Removing and installing crankshaft, refer to **Crankshaft, removing and installing**
- Piston and connecting rod, disassembling and assembling, refer to **Piston and connecting rod, disassembling and assembling**

5 - Oil non-return valve

- Removing and installing
- Note installation position
- Clean if badly soiled

6 - 8 Nm**7 - Oil pump drive cover****8 - O-ring**

- Replace
- Oil before assembling

9 - Oil pump drive**10 - Intermediate shaft****11 - Thrust washer****12 - 10 Nm**

- Install with locking fluid "D6"

13 - Oil spray jet

- For crankshaft bearing 2 to 7
- For piston cooling
- Opening pressure 2.0 bar pressure
- Removing and installing **Oil spray jet, removing and installing**
- See note, refer to *Lubrication system components, removing and installing* under **Lubrication system components, removing and installing**

14 - Input shaft

- For oil pump drive

15 - Oil pump

- Disassembling and assembling, refer to **Oil pump, assembly overview**
- Coat oil pressure line at cylinder block and oil pump housing with sealing compound AMV 188 001 02

16 - 23 Nm**17 - Oil drain plug, 30 Nm**

- Replace if washer is permanent

18 - Oil pan

- Removing and installing, refer to **Oil pan, removing and installing**

19 - Oil level thermal sensor G266**20 - 12 Nm****21 - Oil filter housing**

- Disassembling and assembling, refer to **Oil filter housing, assembly overview**
- Coolant hose connection diagram, refer to **Coolant hose connection diagram**

Oil spray jet, removing and installing**Special tools, testers and auxiliary items required**

- Drift dia. 4 mm
- Drift dia. 6 mm

NOTE:

- **Oil spray jets are built into the crankshaft bearings 2 to 7.**

Removing

- Using a drift dia. 4 mm, press the oil spray jet toward the engine bearing and out.

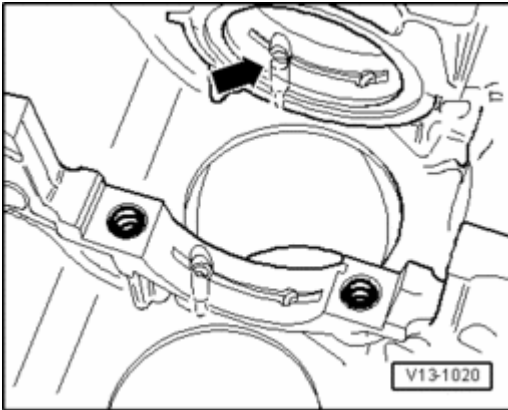


Fig. 131: Identifying Oil Spray Jet Application Area
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Installing

- To install, press oil spray jet in by hand using a drift dia. 6 mm - **arrow** -.

Markings on oil dipstick

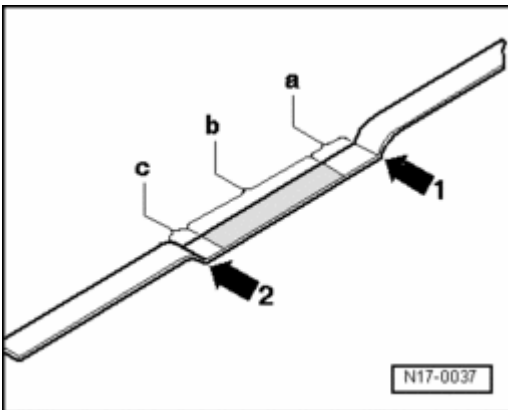


Fig. 132: Markings On Oil Dipstick
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Max. mark

2 - Min. mark

a - Area above hatched field up to Max. mark: Do not top off with engine oil!

b - Oil level within hatched field: Can be topped off with engine oil

c - Area from Min. mark up to hatched field: Top off with max. 0.5 ltr. of engine oil!

Oil non-return valve, removing and installing

Removing

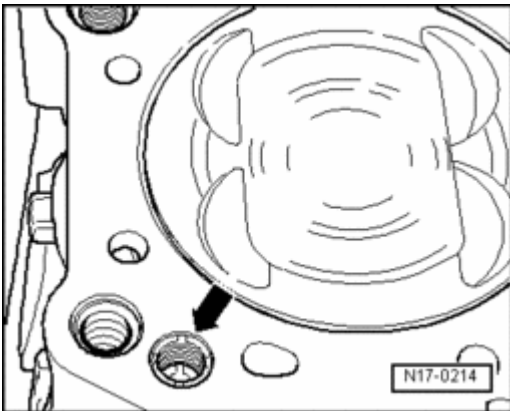


Fig. 133: Oil Non-Return Valve Bolt Hole

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Screw approx. 4 threads of a commercially available bolt M8x1.5 into the valve - **arrow** - and pull it from the bore.

Installing

- Before installing, moisten O-Ring with engine oil. Press the valve into the oil channel by hand.

Installation of oil cooler gasket

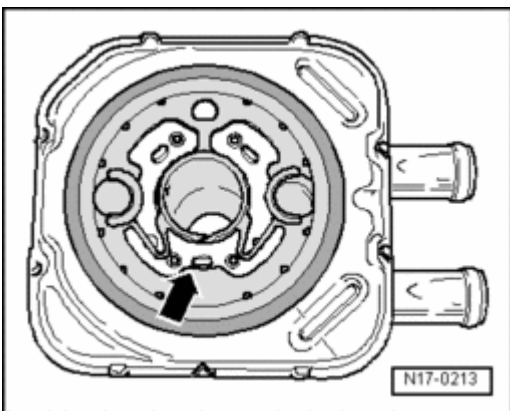


Fig. 134: Installation Position Of Oil Cooler Gasket

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install oil-soaked gasket in the oil cooler as illustrated. Observe installed location - **arrow** -.

Oil filter housing, assembly overview

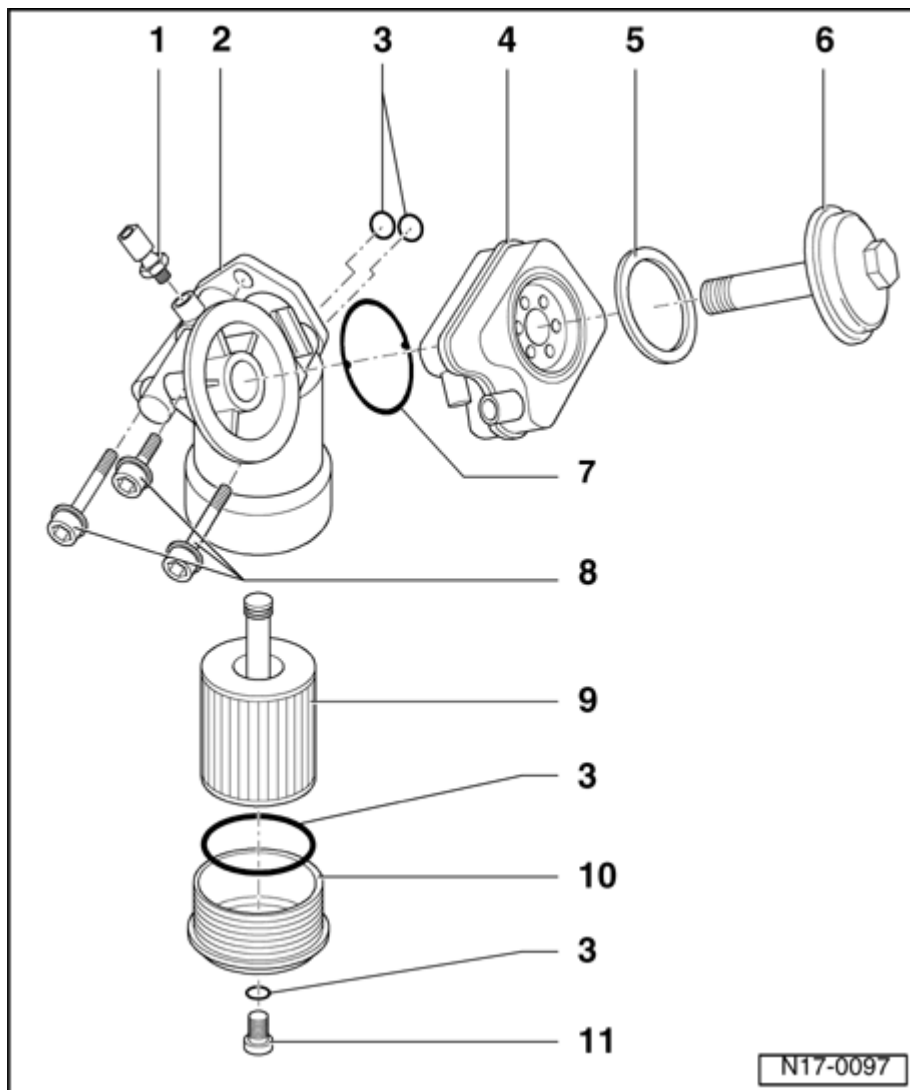


Fig. 135: Oil Filter Housing, Assembly Overview
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 1.4 bar Oil Pressure Switch F1, 20 Nm

- Black
- If sealing ring is leaking cut open and replace.
- Checking, refer to **Oil pressure and oil pressure switch, checking**

2 - Oil filter housing

- With check valve
- Opening pressure 0.05 bar pressure

3 - O-ring

- Replace
- Oil before assembling

4 - Oil cooler

- Ensure sufficient clearance to surrounding components
- Coat all contact surfaces outside of the oil seal with sealing compound AMV 188 001 02
- See note, refer to *Lubrication system components, removing and installing* under **Lubrication system components, removing and installing**
- Coolant hose connection diagram, refer to **Coolant hose connection diagram**

5 - Oil seal

- Replace
- Oil before assembling

6 - Oil cooler cover, 25 Nm**7 - O-ring**

- Insert into oil cooler before installing *Installation of oil cooler gasket* under **Assembly overview**
- Replace
- Oil before assembling

8 - 23 Nm**9 - Oil filter element**

- Observe change intervals
- See note, refer to *Lubrication system components, removing and installing* under **Lubrication system components, removing and installing**

10 - Oil filter lower part, 25 Nm

- Drain before removing
- With bypass valve opening pressure: 2.50 bar pressure

11 - Oil drain plug, 10 Nm**Oil pump, assembly overview**

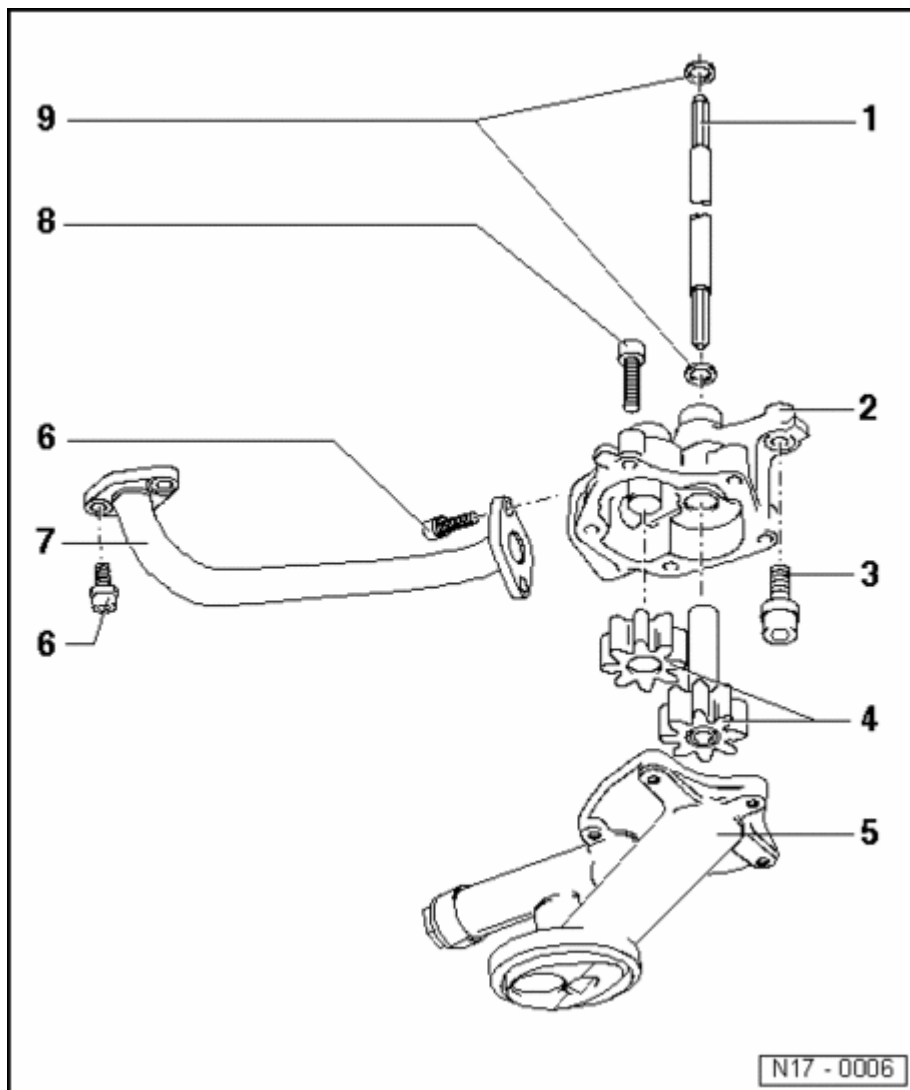


Fig. 136: Oil Pump, Assembly Overview

Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Input shaft

- For oil pump drive

2 - Oil pump housing

3 - 23 Nm

4 - Gears

- Checking backlash *Checking oil pump backlash* under **Oil pump, assembly overview**
- Checking axial play *Checking oil pump axial clearance* under **Oil pump, assembly overview**

5 - Oil pump cover with pressure relief valve

- Opening pressure 5.3 to 5.7 bar pressure
- Clean strainer if soiled

6 - 8 Nm

- Install with locking fluid "D6"

7 - Oil pressure line

- Coat at cylinder block and at oil pump housing with sealing compound AMV 188 001 02
- Fasten with new "micro-encapsulated" bolts.

8 - 10 Nm

9 - Oil seal

- Replace if damaged

Checking oil pump backlash

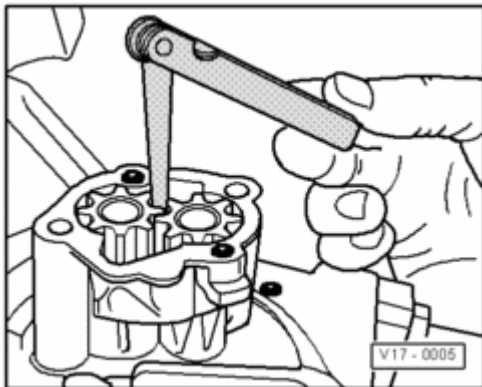


Fig. 137: Checking Oil Pump Backlash

Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Feeler gauge

Wear limit: 0.20 mm

Checking oil pump axial clearance

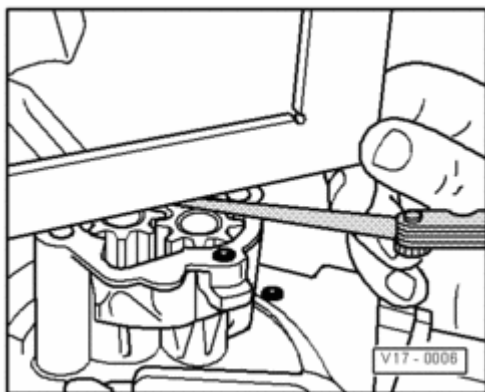


Fig. 138: Checking Oil Pump Axial Clearance
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Straight edge
- Feeler gauge

Wear limit: 0.10 mm

Oil pan, removing and installing

Special tools, testers and auxiliary items required

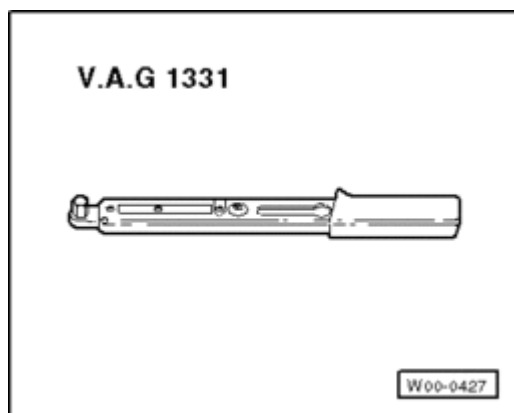


Fig. 139: Torque Wrench V.A.G. 1331 (5 To 50 Nm)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Torque wrench V.A.G 1331
- Hand drill with plastic brush attachment
- Flat scraper
- Protective glasses
- Silicone sealing compound D 176 404 A2

Removing

- Remove sound insulation pan, along with left and right sides: Refer to **50 BODY, FRONT**
- Disconnect 3-pin connector from oil level thermal sensor G266.
- Remove the holder for the secondary air injection (AIR) pump motor V101 from the oil pan.
- Drain engine oil.

NOTE: • **Observe disposal regulations!**

- Remove the oil pan.
- Loosen oil pan with light blows of a rubber headed hammer if necessary.
- Remove sealant residue from cylinder block with a flat scraper.

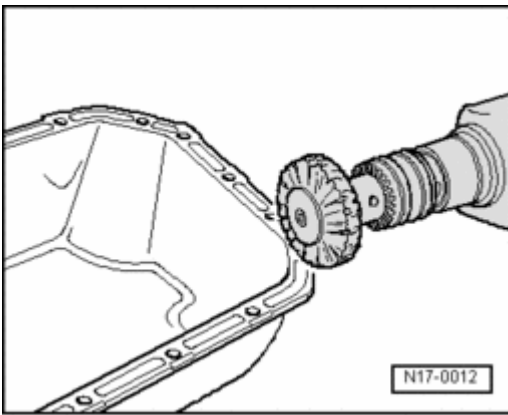


Fig. 140: Removing Sealant Residue From Oil Pan With A Rotating Brush
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove sealant residue from pan with a rotating brush, e.g. a hand drill with a plastic brush attachment (wear eye protection).
- Clean sealing surfaces, they must be free of oil and grease.

Installing

NOTE:

- **Note the expiration date of the sealing compound.**
- **Oil pan must be installed within 5 minutes of applying silicone sealing compound.**

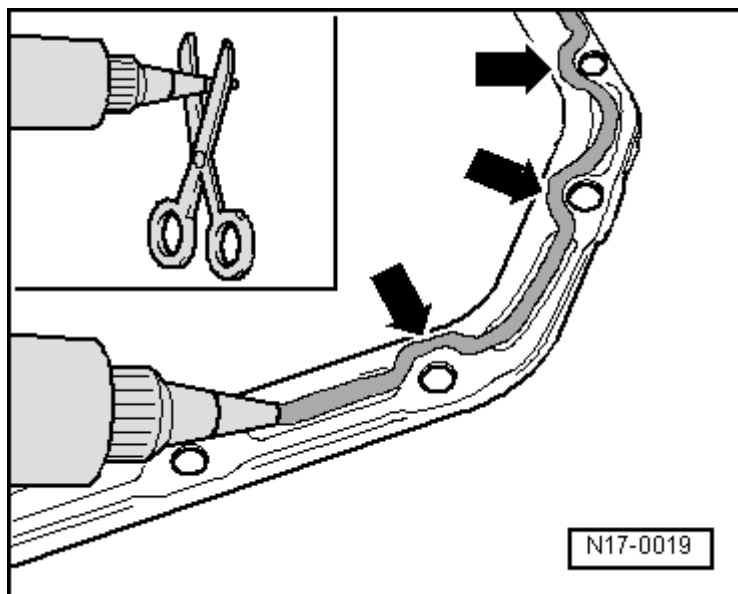


Fig. 141: Cutting Off Tube Nozzle & Applying Silicone Sealing Compound To Oil Pan Sealing Surface
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Cut off nozzle on tube of sealant at front mark (dia. of nozzle approx. 3 mm).
- Apply silicone sealing compound, as shown, to clean oil pan sealing surface. Sealing compound bead must be:
 - 2...3 mm thick
 - And run on inside of bolt holes - **arrows** -

NOTE:

- The sealing compound bead must not be thicker, otherwise excess sealing compound will enter the oil pan and may block the oil suction pipe strainer.

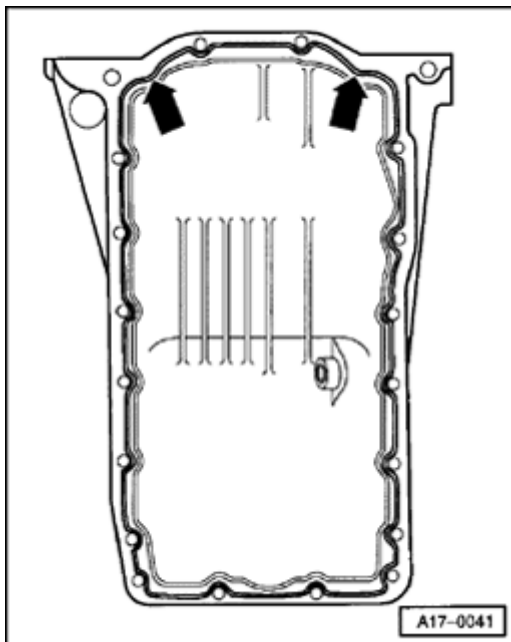


Fig. 142: Identifying Silicone Sealing Compound Application Area
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Apply silicone sealing compound bead as illustrated to clean sealing surface of oil pan.
- Install oil pan immediately and tighten all oil pan bolts lightly.
- Tighten oil pan bolts to 12 Nm.
- Tighten oil pan/transmission bolts to 45 Nm.

NOTE:

- **After installing the oil pan the sealant must be allowed to dry for approx. 30 minutes. Only after then may the engine oil be replenished.**

The rest of assembly is basically a reverse of disassembling.

Oil pressure and oil pressure switch, checking

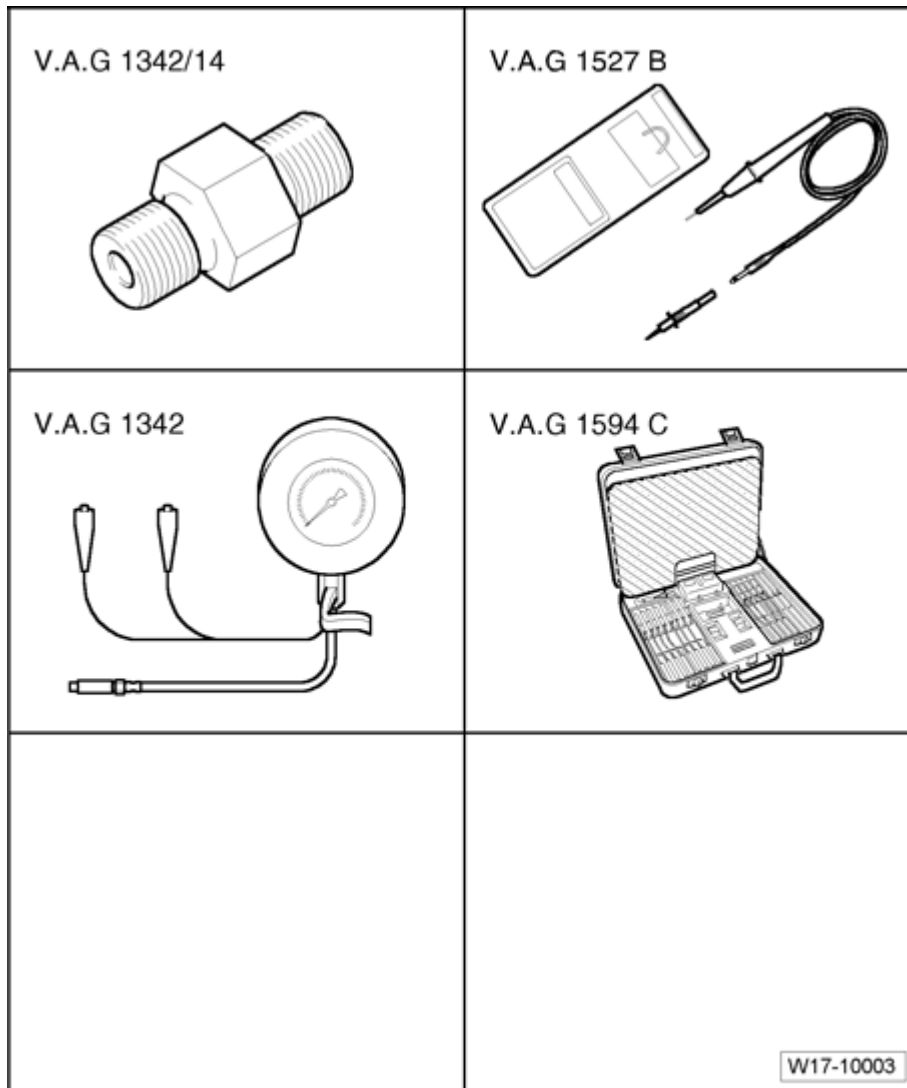


Fig. 143: Identifying Special Tools - Oil Pressure And Oil Pressure Switch, Checking
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Adapter V.A.G 1342/14
- Oil pressure gauge V.A.G 1342
- Voltage tester V.A.G 1527B
- Connector test set V.A.G 1594C

Function of the dynamic oil pressure warning indicator

When not under pressure, the oil pressure switch is open and will close when the operating pressure is attained.

The oil pressure warning is activated approx. 10 seconds after turning on the ignition.

Switch-on delay of oil pressure warning is approx. 3 seconds.

Switch-off delay of oil pressure warning is approx. 5 seconds.

NOTE:

- **Function test and servicing the optical and acoustic oil pressure indicator: Refer to Electrical Wiring Diagrams, Troubleshooting and Component Locations**

Checking warning lamp

After switching on ignition without starting engine, the oil pressure warning lamp in the instrument cluster insert must illuminate for approx. 3 seconds and then extinguish. The test will be discontinued when the engine is running.

Criteria for warning

The optical oil pressure warning switches on (oil pressure warning lamp lights up continuously) and the buzzer sounds three times for the acoustical warning under one of the following conditions.

- "Ignition on", engine stationary, oil pressure switch closed
- Engine speed above 1500 rpm, oil pressure switch open

NOTE:

- **If the oil pressure switch is closed, the warning lamp will remain switched on if the engine speed is above 5000 rpm. The warning lamp will be switched off again if the engine speed is below 5000 rpm.**
- **If the oil pressure switch is open for 0.3 to 3.0 seconds when the engine speed is above 1500 rpm, it will be stored in the combi-processor in the instrument panel insert. If this condition occurs three times when the engine is running, the oil pressure warning will be activated and will not be cancelled even below 1500 rpm. The oil pressure warning will be cancelled when the oil pressure switch is closed for longer than 5 seconds at an engine speed above 1500 rpm or when the ignition is switched off.**

Oil pressure switch, checking

Test conditions

- Engine oil level OK, checking **Markings on oil dipstick** .
- Oil pressure warning lamp K3 must light up for approx. 3 seconds when ignition is switched on
- Engine oil temperature at least 80 ° C (radiator fan must have run once)

Test sequence

- Remove sound insulation pan, along with left and right sides: Refer to **50 BODY, FRONT**

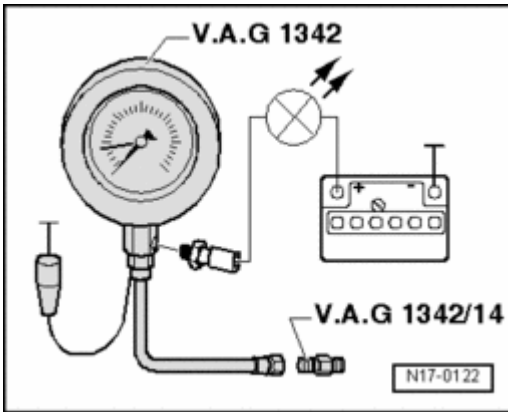


Fig. 144: Identifying V.A.G 1342 With Adapter V.A.G 1342/14
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove oil pressure switch F1 and screw it into oil pressure gauge V.A.G 1342.
- Screw oil pressure gauge V.A.G 1342 with adapter V.A.G 1342/14 into oil filter housing in place of oil pressure switch.

NOTE:

- **Note installation position of adapter: The conical connecting neck of the adapter is screwed to the pressure hose of the tester.**

- Connect brown wire of tester to ground (-).
- Connect voltage tester V.A.G 1527B using adapter cables from connector test kit V.A.G 1594C to B+ and oil pressure switch. LED must not light up.

If LED lights up:

- Replace oil pressure switch F1.

If the LED does not light up:

- Start engine and run at idle speed. At 1.2 to 1.6 bar pressure LED must light up; otherwise replace oil pressure switch F1.

Oil pressure, checking

Test conditions

- Engine oil temperature at least 80 ° C (radiator fan must have run once)

Test sequence

- Check oil pressure at different speeds:

1500 RPM: 1.7 bar

2000 RPM: 3.0 to 5.5 bar pressure

Above 2000 RPM: maximum 7.0 bar

If the specifications are not obtained:

- Correct mechanical damage, e.g. bearing damage.

At higher engine speeds oil pressure must not exceed 7.0 bar

If specification is exceeded:

- Check oil channels.
- If necessary, replace oil pump, refer to Oil pump, assembly overview .

19 - ENGINE - COOLING SYSTEM

COOLING SYSTEM COMPONENTS, REMOVING AND INSTALLING

Cooling system components, removing and installing

NOTE:

- **When the engine is warm the cooling system is under pressure. If necessary release pressure before commencing repair work.**
- **Hoses are secured with spring-type clips. In cases of repair only use spring-type clips.**
- **The spring-type clip pliers VAS 5024A are recommended for installing spring-type clips.**
- **When installing coolant hoses route stress-free, so that they do not come into contact with other components (observe markings on coolant connection and hose).**

Perform leak test of cooling system using cooling system tester V.A.G 1274, adapter V.A.G 1274/8 and adapter V.A.G 1274/9.

Cooling system components (on body), assembly overview, refer to Cooling system components (on body), assembly overview

Cooling system components (on engine), assembly overview, refer to Cooling system components (on engine), assembly overview

Coolant hose connection diagram, refer to Coolant hose connection diagram

Coolant thermostat housing, assembly overview, refer to Coolant thermostat housing, assembly overview

Cooling system, draining and filling, refer to *Cooling system, draining and filling* under Cooling system,

Cooling system components (on body), assembly overview

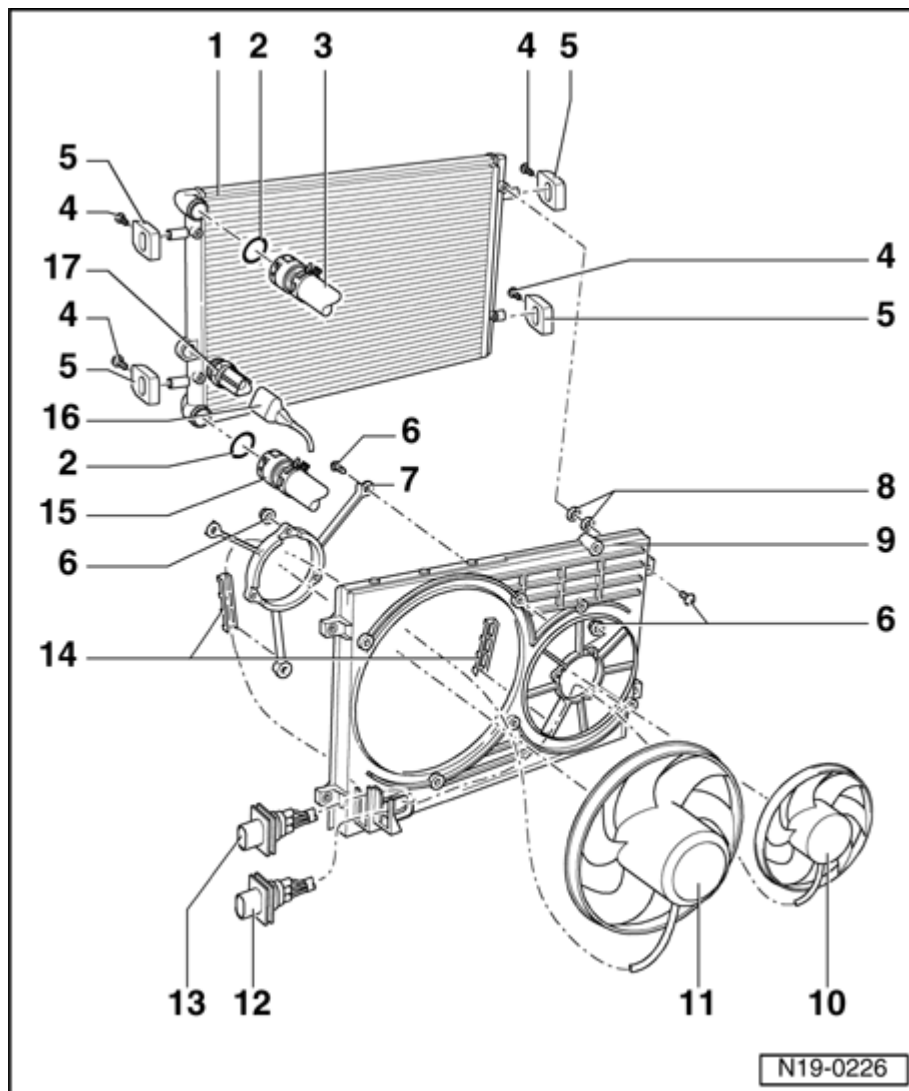


Fig. 145: Cooling System Components (On Body), Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Radiator

- Removing and installing, refer to **Radiator, removing and installing**
- After replacing replace entire amount of coolant

2 - O-ring

- Replace if damaged

3 - Upper coolant hose

- Secured to radiator with a quick coupling
- Ensure seated tightly
- Coolant hose connection diagram, refer to **Coolant hose connection diagram**

4 - 15 Nm**5 - Bracket**

- For radiator
- Note installation position

6 - 10 Nm**7 - Fan support****8 - Washer****9 - Air shroud****10 - Right Coolant Fan V35**

- Checking, refer to **Coolant fan, checking**

11 - Coolant fan V7

- Checking, refer to **Coolant fan, checking**

12 - Connector

- For Right Coolant Fan V35

13 - Connector

- For Coolant Fan V7

14 - Retaining clip

- Check for secure seat

15 - Lower coolant hose

- Secured to radiator with a quick coupling
- Ensure seated tightly
- Coolant hose connection diagram, refer to **Coolant hose connection diagram**

16 - Connector

- For Coolant Fan Control (FC) Thermal Switch F18

17 - Coolant fan control (FC) thermal switch F18, 35 Nm

- For electric fan
- Switch temperatures:
 - 1st stage on: 92 to 97 ° C off: 84 to 91 ° C
 - 2nd stage on: 99 to 105 ° C; off: 91 to 98 ° C

Cooling system components (on engine), assembly overview

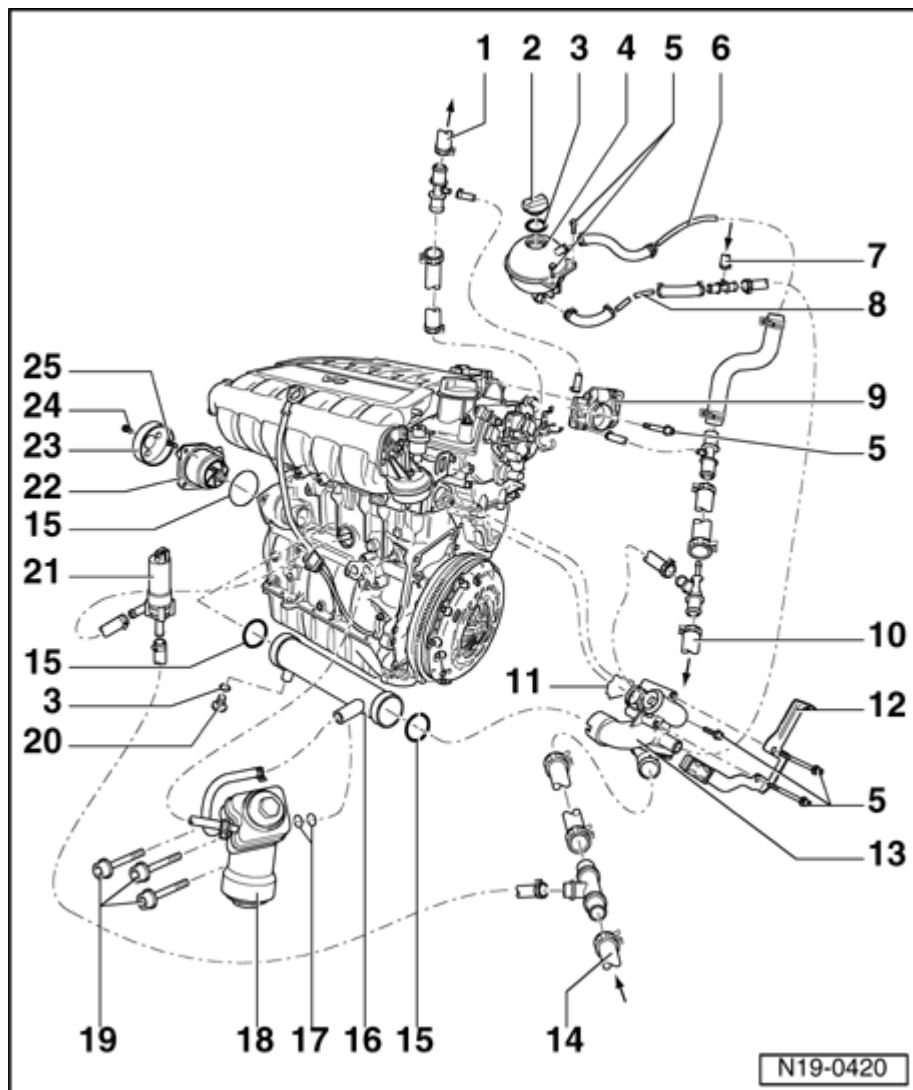


Fig. 146: Cooling System Components (On Engine), Assembly Overview
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - To heat exchanger

- Coolant hose connection diagram, refer to **Coolant hose connection diagram**

2 - Sealing cap

- Check using cooling system tester V.A.G 1274 and adapter V.A.G 1274/9
- Pressure release valve must open at a pressure of 1.4 to 1.6 bar.

3 - O-ring

- Replace if damaged

4 - Reservoir

- Perform cooling system leakage test with cooling system tester V.A.G 1274 and adapter V.A.G 1274/8
- Test pressure 1.4 to 1.6 bar

5 - 10 Nm

6 - Upper coolant line

- Clipped to bulkhead

7 - From heat exchanger

- Coolant hose connection diagram, refer to **Coolant hose connection diagram**

8 - Lower coolant line

- Fastened at the intake manifold support and shield

9 - Throttle valve control module J338

- Coolant heated

10 - To upper radiator

- Coolant hose connection diagram, refer to **Coolant hose connection diagram**

11 - Oil seal

- Replace

12 - Bracket

13 - Coolant thermostat housing

- Disassembling and assembling, refer to **Coolant thermostat housing, assembly overview**

14 - From lower radiator

- Coolant hose connection diagram, refer to **Coolant hose connection diagram**

15 - O-ring

- Replace

16 - Coolant line

17 - O-ring

- Replace
- Oil before assembling

18 - Oil filter housing

- With oil cooler
- Disassembling and assembling, refer to **Oil filter housing, assembly overview**

19 - 25 Nm

20 - Sealing plug, 3 Nm

21 - After-run coolant pump V51

- Fastened to cylinder block with bracket
- Checking, refer to **After-run coolant pump, checking**

22 - Coolant pump

- Note installation position
- Check for ease of movement
- If damaged or leaking replace completely
- Removing and installing, refer to **Coolant pump, removing and installing**

23 - Pulley

- For coolant pump
- Removing and installing ribbed belt, refer to *Ribbed belt, removing and installing* under **Ribbed belt, removing and installing**

24 - 20 Nm

- Use water pump wrench V.A.G 1590 to loosen and tighten, refer to **Coolant pump, removing and installing**

25 - 8 Nm

Coolant hose connection diagram

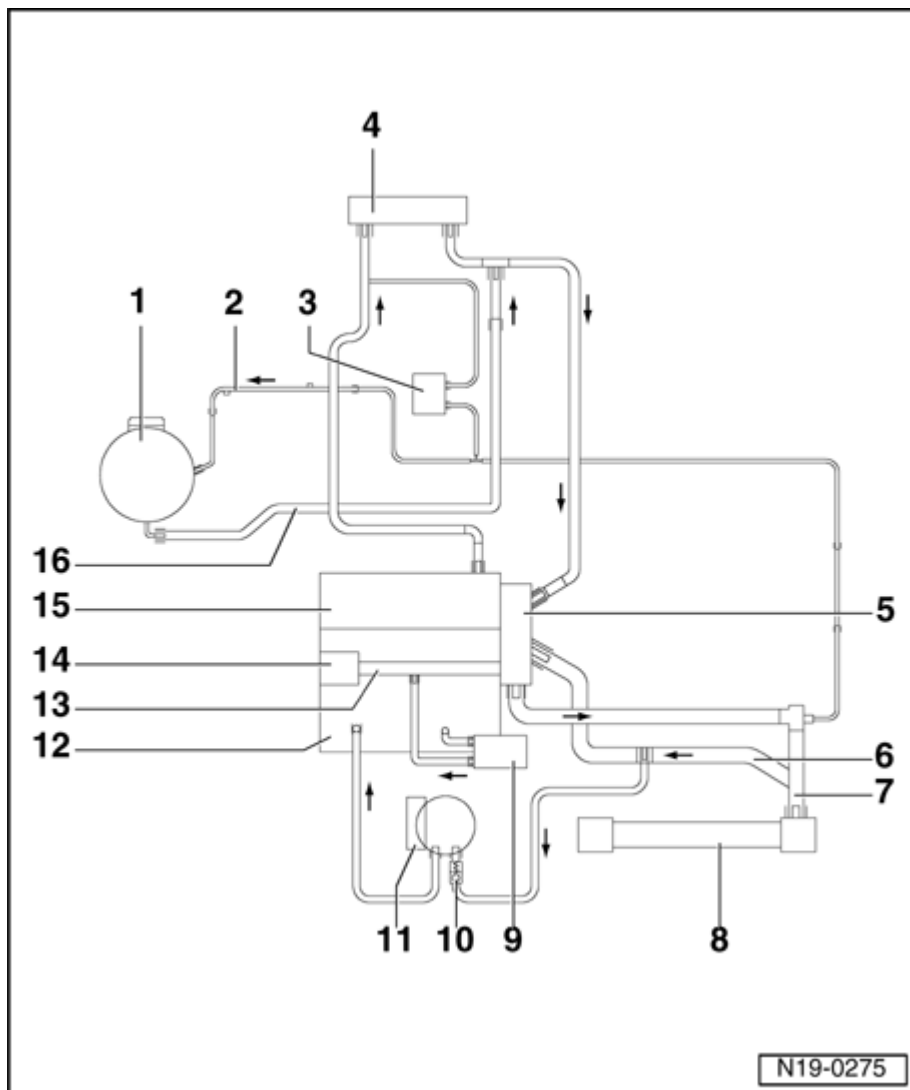


Fig. 147: Coolant Hose Connection Diagram

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- 1 - Reservoir
- 2 - Upper coolant line
- 3 - Throttle valve control module J338
- 4 - Heater unit heat exchanger
- 5 - Coolant thermostat housing
- 6 - Lower coolant hose
- 7 - Upper coolant hose

8 - Radiator

9 - Oil cooler

10 - Non-return valve

11 - After-run coolant pump V51

12 - Cylinder block

13 - Coolant line

- Between coolant pump and thermostat housing

14 - Coolant pump

15 - Cylinder head

16 - Lower coolant line

Coolant thermostat housing, assembly overview

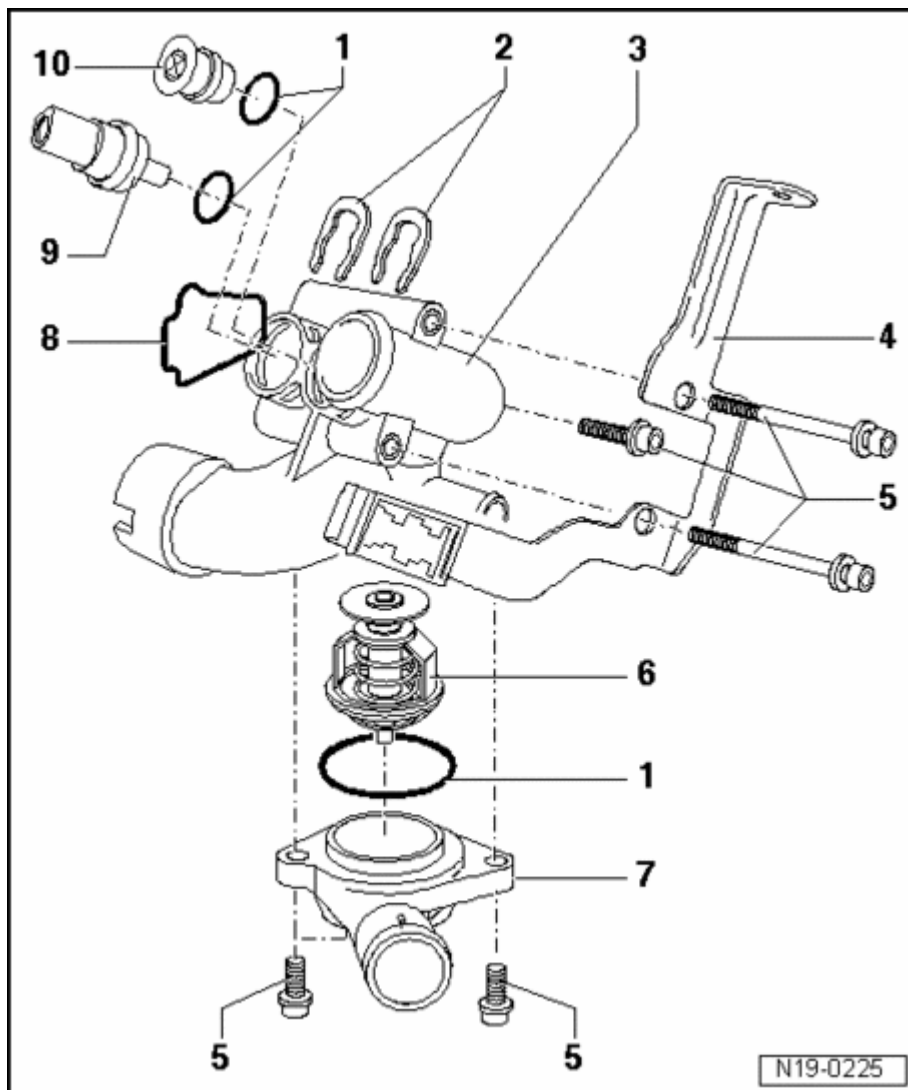


Fig. 148: Coolant Thermostat Housing, Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - O-ring

- Replace if damaged

2 - Retaining clip

- Check for secure seat

3 - Coolant thermostat housing

4 - Bracket

5 - 10 Nm

6 - Coolant thermostat

- Note installation position
- Checking: Heat up thermostat in water
- Opening begins approx. 80 ° C
- Ends approx. 105 ° C
- Opening lift min. 7 mm

7 - Connection**8 - Oil seal**

- Replace

9 - Engine coolant temperature (ECT) sensor G62

- With engine coolant temperature (ECT) sensor G2
- For Engine Control Module (ECM)
- If necessary release pressure in cooling system before removing

10 - Plug

- If necessary release pressure in cooling system before removing

NOTE:

- **Routing of coolant hoses to thermostat housing, refer to Cooling system components (on engine), assembly overview .**

Cooling system, draining and filling

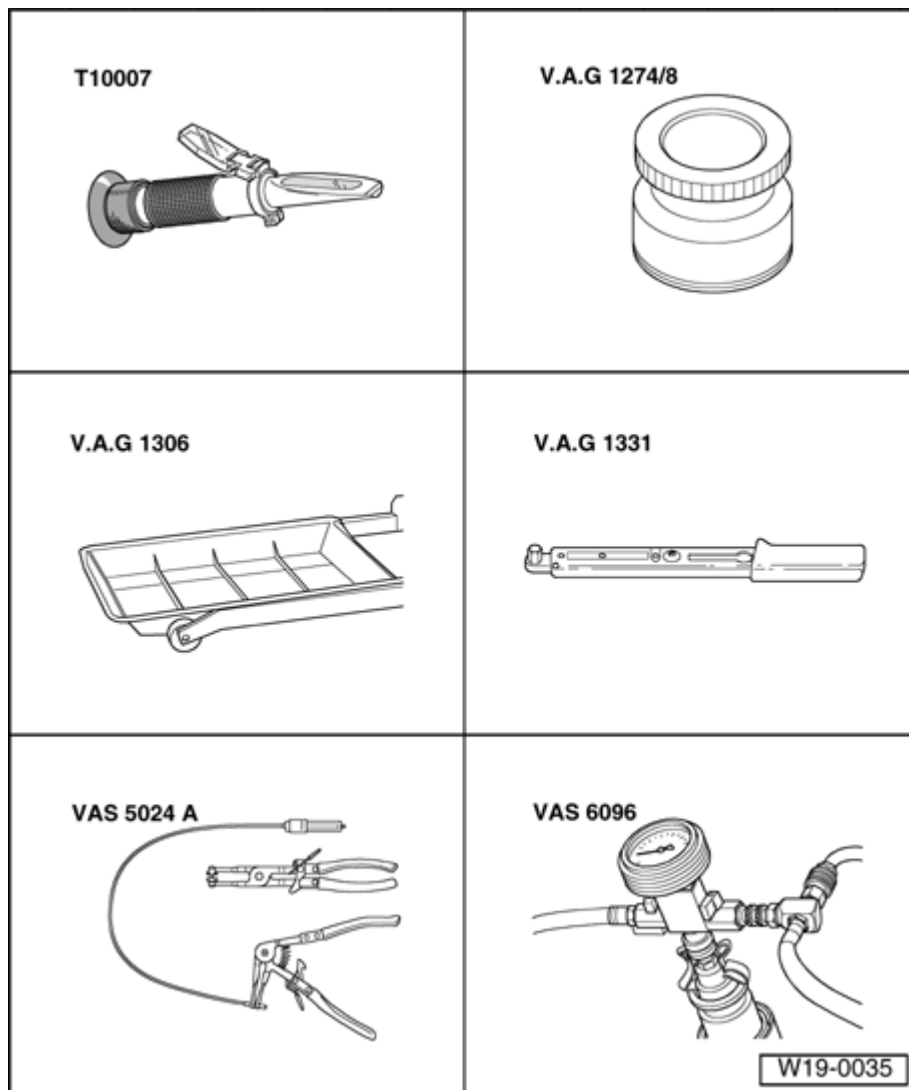


Fig. 149: Identifying Special Tools - Cooling System, Draining And Filling
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Refractometer T10007
- Adapter V.A.G 1274/8
- Drip tray V.A.G 1306
- Torque wrench V.A.G 1331
- Spring-type clip pliers VAS 5024A
- Cooling system charge unit VAS 6096

Draining

CAUTION: Hot steam may escape when opening expansion tank. Wear protective

**goggles and protective clothing to prevent damage to eyes and scalding.
Cover cap with a rag and open carefully.**

- Open cap on coolant expansion tank.
- Remove sound insulation pan, along with left and right sides: Refer to **50 BODY, FRONT**

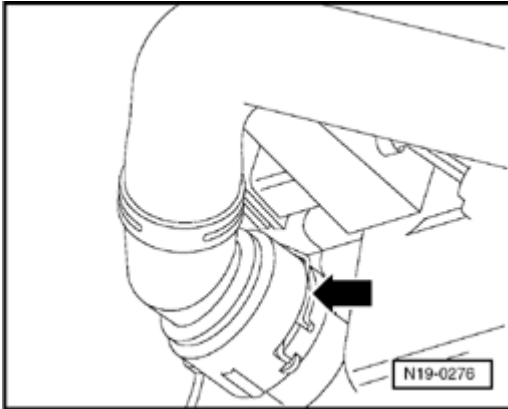


Fig. 150: Locating Coolant Hose Retaining Clip
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull coolant hose retaining clip - **arrow** - off downward and remove coolant hose from radiator.

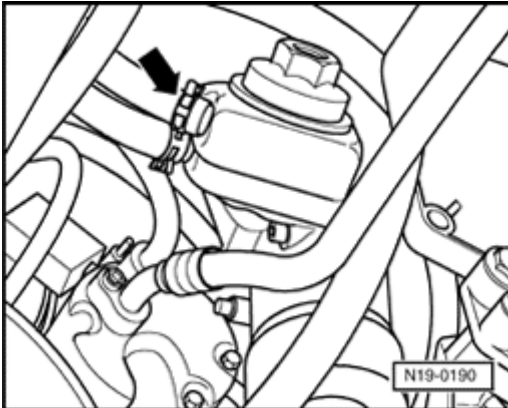


Fig. 151: Locating Coolant Hose At Oil Cooler
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- In addition, to drain coolant from engine, disconnect coolant hose at oil cooler - **arrow** -.

NOTE: • **Observe disposal regulations!**

Filling

NOTE: • **Only use coolant additive G 12 according to "TL VW 774 F". Distinguishing feature: colored violet**

- "G 12" and coolant additives marked in accordance with "TL VW 774 F" prevent frost and corrosion damage, scaling and also raise the boiling point of the coolant. For this reason the system must be filled all year round with frost and corrosion protection additives.
- G 12 purple (according to TL VW 774 F) may be mixed with previous coolant additive G 12 red!
- Because of its high boiling point, the coolant improves engine reliability under heavy loads, particularly in countries with tropical climates.
- Protection against frost must be assured to about -25 ° C (in arctic climatic countries to about -35 ° C).
- The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. The anti-freeze ratio must be at least 40%.
- Use only clean drinking water for mixing.
- If for climatic reasons a greater frost protection is required, the amount of G 12 can be increased, but only up to 60% (frost protection to about -40 ° C), as otherwise frost protection is reduced again and cooling effectiveness is also reduced.
- If radiator, heat exchanger, cylinder head or cylinder head gasket is replaced, do not reuse old coolant.
- To fill the coolant circuit, use of the cooling system charge unit VAS 6096 recommended.

Recommended mixture ratios:

Frost protection to	Anti-freeze portion	G 12 * See note	Clean water * See note
-25 ° C -35 ° C	40% 50%	3.7 l 4.6 l	5.5 l 4.6 l

* The quantity of coolant can vary depending upon the vehicle equipment.

Work procedure

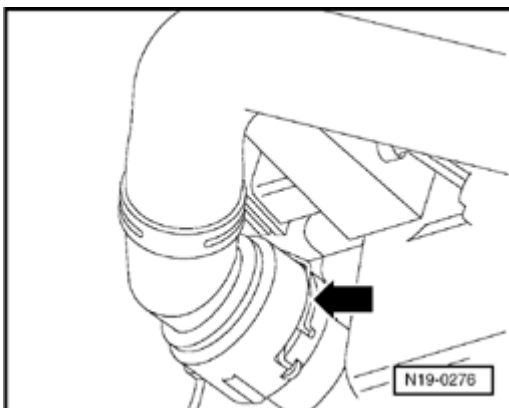


Fig. 152: Locating Coolant Hose Retaining Clip

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install lower coolant hose and secure with retaining clamp - **arrow** -.

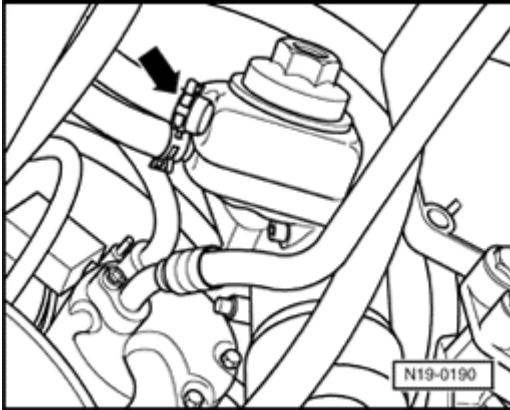


Fig. 153: Locating Coolant Hose At Oil Cooler

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Push coolant hose onto oil cooler connection and fasten with spring-type clip.

With cooling system charge unit VAS 6096

- Thread adapter V.A.G 1274/8 on expansion tank.
- Fill coolant circuit using cooling system charge unit VAS 6096. Operating instructions for cooling system charge unit VAS 6096

Without cooling system charge unit VAS 6096

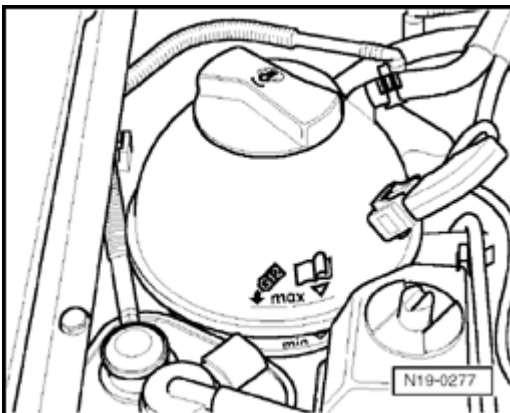


Fig. 154: Markings On Coolant Expansion Tank

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Fill coolant to Max marking on expansion tank.
- Close expansion tank.
- Turn off the heater and air conditioning.

- Start engine and maintain an engine speed of about 2000 rpm for approx. 3 minutes.
- Allow engine to run at idle speed until the lower hose on radiator becomes hot.
- Check coolant level and top off as necessary. When the engine is at normal operating temperature, the coolant level must be on the Max. mark, and when the engine is cold, between the Min. and Max. marks.

Radiator, removing and installing

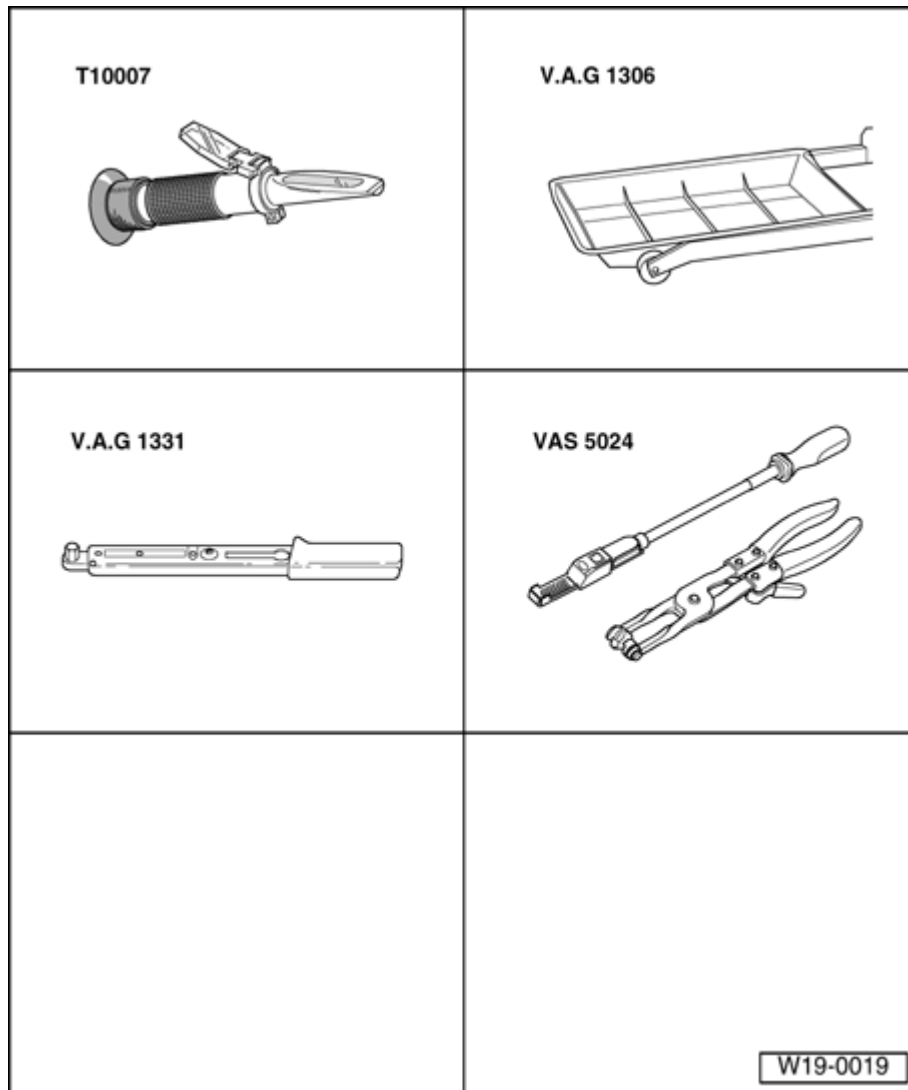


Fig. 155: Identifying Special Tools - Radiator, Removing And Installing
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Refractometer T10007
- Drip tray V.A.G 1306
- Torque wrench V.A.G 1331

- Spring-type clip pliers VAS 5024A

Removing

- Remove sound insulation pan, along with left and right sides: Refer to **50 BODY, FRONT**
- Remove front bumper cover: Refer to **63 BUMPER**
- Bring lock carrier into service position: Refer to **50 BODY, FRONT**
- Drain coolant, refer to *Cooling system, draining and filling* under **Cooling system, draining and filling** .
- Remove quick acting couplings of coolant hoses from radiator.
- Remove connectors from thermal switch and radiator fans.
- Remove fastening bolts from radiator and remove radiator with fans downward.

Additional information and assembly work on vehicles with air conditioning

CAUTION: The air conditioning refrigerant circuit must not be opened.

NOTE:

- To prevent damage to condenser and also to the refrigerant lines/hoses, ensure that the pipes and hoses are not stretched, kinked or bent.
- Remove retaining clamp(s) from refrigerant lines.
- Remove condenser from radiator and fasten to lock carrier.

Installing

Installation is performed in reverse order of removal. Note the following:

Fill with new coolant, refer to *Cooling system, draining and filling* under **Cooling system, draining and filling** .

After-run coolant pump, checking

Special tools, testers and auxiliary items required

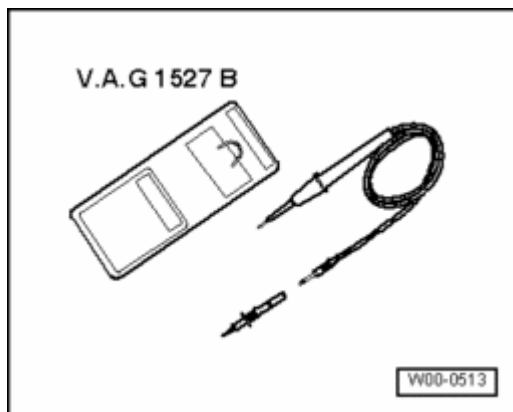


Fig. 156: Voltage Tester V.A.G 1527B

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Voltage tester V.A.G 1527B



Fig. 157: Connector Test Set V.A.G 1594C

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connector test set V.A.G 1594C
- Wiring diagram

Test conditions

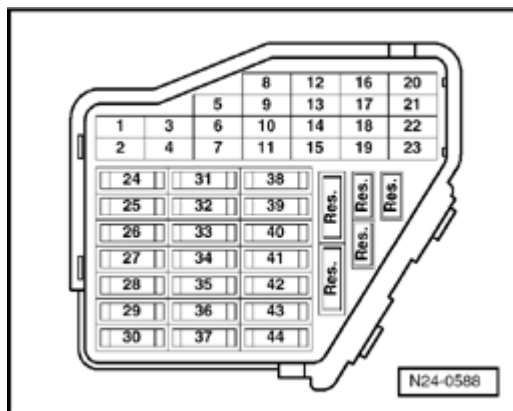


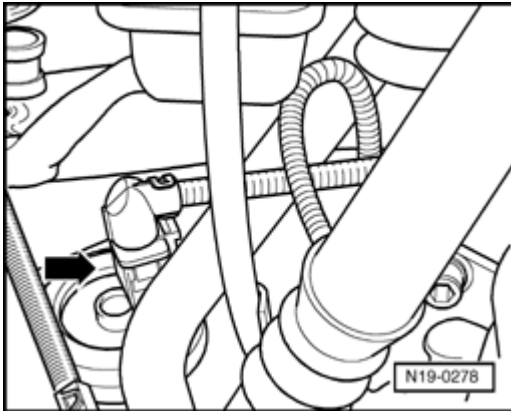
Fig. 158: Identifying Main Fuse Panel

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Fuse 16 must be OK.

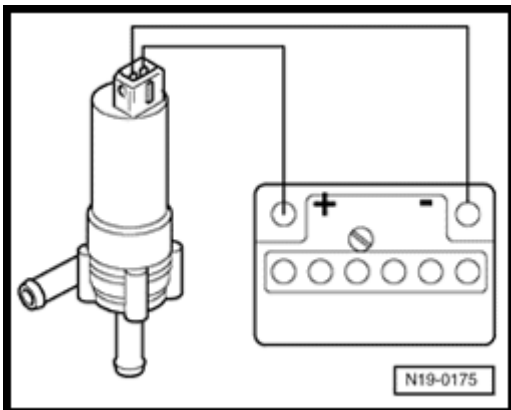
Test sequence

- Remove sound insulation pan, along with left and right sides: Refer to **50 BODY, FRONT**

**Fig. 159: Locating After-Run Coolant Pump V51**

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect the 2-pin connector from the After-Run Coolant Pump V51 - **arrow** -.

**Fig. 160: Contacts Of After-Run Coolant Pump V51 Connected To Battery**

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect contacts of after-run coolant pump V51 to battery, using adapter cables from connector test set V.A.G 1594C. After-run coolant pump must start running.

If after-run coolant pump V51 does not start running:

- Replace after-run coolant pump V51.

If after-run coolant pump V51 does starts running:

- Turn the ignition off and then on again.

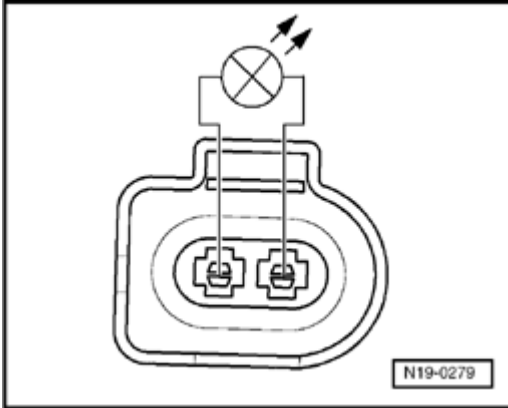


Fig. 161: After-Run Coolant Pump V51 Connector
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect voltage tester V.A.G 1527B to disconnected connector of after-run coolant pump V51, using adapter cables from connector test set V.A.G 1594C. LED must light up.

NOTE:

- **This test must be performed inside of 10 min. after the ignition has been switched off.**

If LED does not light up:

- Determine and eliminate open circuit according to electrical schematics: Refer to Electrical Wiring Diagrams, Troubleshooting and Component Locations

Coolant fan, checking

Special tools, testers and auxiliary items required



Fig. 162: Connector Test Set V.A.G 1594C
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connector test set V.A.G 1594C
- Wiring diagram

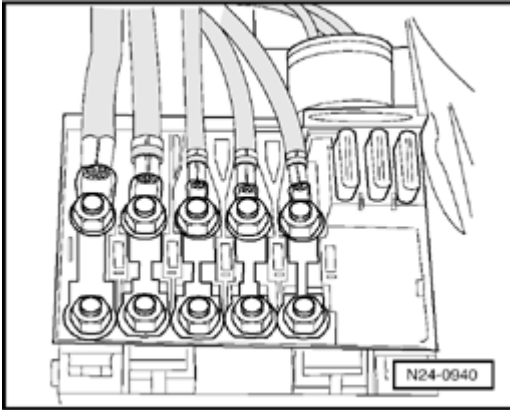
Test conditions

Fig. 163: Locating Coolant Fan Control Thermal Switch
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Main fuses must be OK.
- Coolant Fan Control (FC) Thermal Switch F18 OK

Test sequence

- Disconnect 3-pin connector from coolant fan control (FC) thermal switch F18.

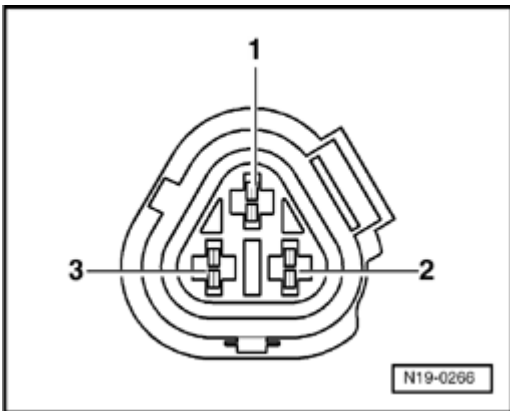


Fig. 164: Coolant Fan Control Thermal Switch 3-Pin Connector
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Bridge terminal - 1 - and terminal - 2 - of the connector using adapter wires from connector test set V.A.G 1594C. Stage 1 of Coolant Fan V7 and Right Coolant Fan V35 must start running.
- Switch ignition on.
- Bridge terminal - 2 - and terminal - 3 - of connector using adapter wires from connector test set V.A.G 1594C. The Coolant Fan V7 and Right Coolant Fan V35 must start running.

If 1st or 2nd speeds of fans do not run:

- Determine and eliminate open circuit according to electrical schematics: Refer to Electrical Wiring Diagrams, Troubleshooting and Component Locations

If no fault is detected in the wiring:

- Replace Coolant Fan V7 or Right Coolant Fan V35.

Coolant pump, removing and installing

With engine installed

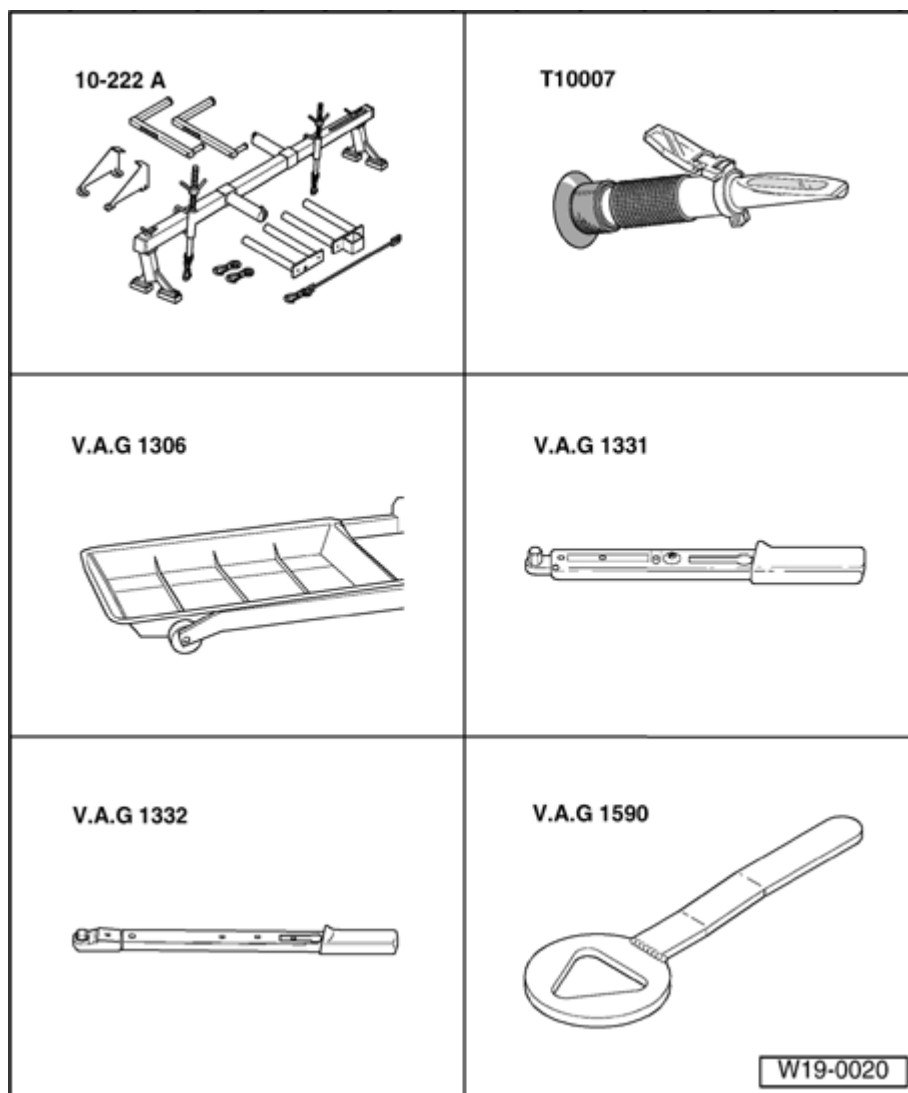


Fig. 165: Identifying Special Tools - Coolant Pump, Removing And Installing
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Engine support bridge 10 - 222 A with bracket for engine 10 - 222 A /1
- Refractometer T10007
- Drip tray V.A.G 1306
- Torque wrench V.A.G 1331
- Torque wrench V.A.G 1332
- Water pump wrench V.A.G 1590

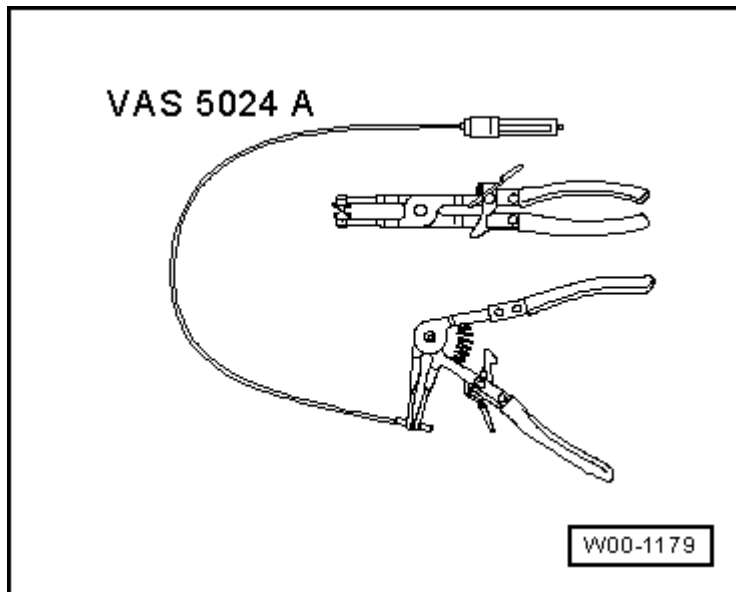


Fig. 166: Spring-Type Clip Pliers VAS 5024A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Spring-type clip pliers VAS 5024A



Fig. 167: Step Ladder VAS 5085
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Step ladder VAS 5085

Removing

- Remove engine cover.
- Remove sound insulation pan, along with left and right sides: Refer to **50 BODY, FRONT**
- Remove ribbed belt, refer to *Ribbed belt, removing and installing* under **Ribbed belt, removing and installing** .
- Pull off crankcase breather connecting hose between cylinder head cover and intake hose on cylinder head cover.

NOTE:

- **Press buttons on hose couplings to do this.**

- Drain coolant, refer to *Cooling system, draining and filling* under **Cooling system, draining and filling** .

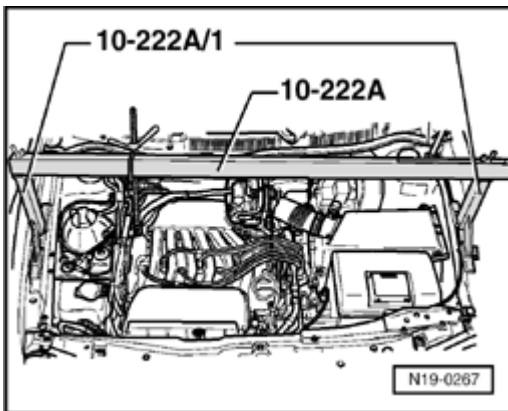


Fig. 168: Engine Support Bridge 10 - 222 A With Bracket For Engine 10 - 222 A /1 Installed
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install engine support bridge 10 - 222 A with bracket for engine 10 - 222 A /1.
- Insert securing hook of engine support bridge 10 - 222 A in right lifting eye of cylinder block and put engine under slight tension.

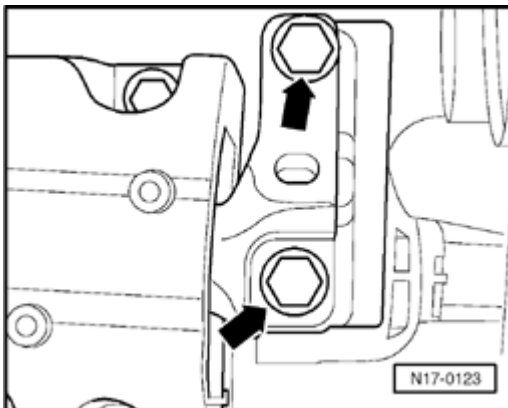


Fig. 169: Identifying Engine Side Of Assembly Mounting At Engine Bracket At Top
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unbolt engine side of assembly mounting from engine bracket at top - **arrows** -.

NOTE:

- **Use step ladder VAS 5085 to remove bolts.**

- Lower engine on support bridge only as far as necessary to remove coolant pump.

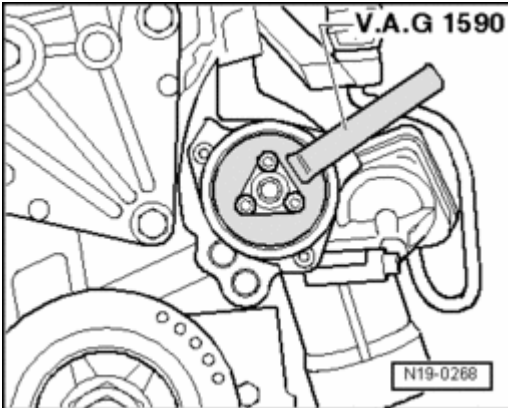


Fig. 170: Holding Belt Pulley With Water Pump Wrench V.A.G 1590
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove belt pulley. Hold belt pulley with water pump wrench V.A.G 1590 when doing this.

NOTE:

- **If engine has been removed, it is not necessary to remove belt pulley. The coolant pump securing bolts can be unscrewed through the holes in the belt pulley.**

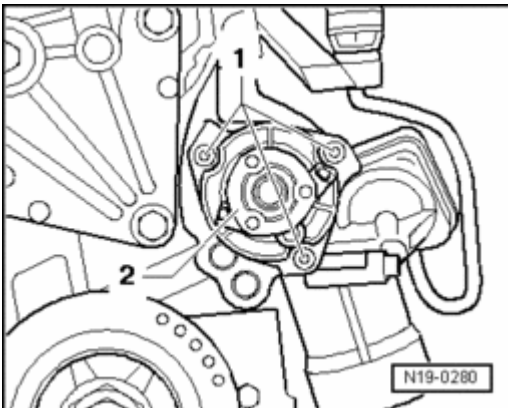


Fig. 171: Coolant Pump Securing & Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unscrew coolant pump securing bolts - **1** - and remove coolant pump - **2** -.

Installing

Installation is performed in reverse order of removal. Note the following:

- Moisten new O-ring with coolant.
- Insert coolant pump into cylinder block and tighten securing bolts. Torque specification: 8 Nm
- Install belt pulley and tighten securing bolts. Torque specification: 20 Nm
- Align engine subframe, refer to *Engine and transmission mounts, aligning* under **Engine and transmission mounts, aligning** .

NOTE: • **Torque settings for assembly mountings, refer to Assembly mounting .**

- Install ribbed belt, refer to *Ribbed belt, removing and installing* under **Ribbed belt, removing and installing** .

Fill with new coolant, refer to *Cooling system, draining and filling* under **Cooling system, draining and filling** .

20 - FUEL SUPPLY

FUEL SUPPLY SYSTEM COMPONENTS, REMOVING AND INSTALLING

Fuel supply system components, removing and installing

- NOTE:**
- **Hose connections are secured with either spring-type or clamp-type clips.**
 - **Always replace clamp-type clips with spring-type clips.**
 - **Fuel hoses at engine must only be secured with spring-type clips. The use of clamp or screw type clips is not permissible.**
 - **The spring-type clip pliers VAS 5024A are recommended for installing spring-type clips.**

Fuel tank with attachments and fuel filter - assembly overview, refer to **Fuel tank with attachments and fuel filter, assembly overview**

Observe safety precautions, refer to **Safety precautions when working on fuel supply system** .

Note rules of cleanliness, refer to **Rules for cleanliness**

Suction jet pump, removing and installing, refer to **Suction jet pump, removing and installing**

Fuel delivery unit, removing and installing, refer to **Fuel delivery unit, removing and installing**

Fuel level sensor, removing and installing, refer to **Fuel level sensor, removing and installing**

Fuel tank, removing and installing, refer to **Fuel tank, removing and installing**

Observe crash fuel shut-off, refer to **Crash fuel shut-off**

Check fuel pump, refer to [Fuel pump, checking](#)

Checking fuel delivery

Checking fuel pump non-return valve

Fuel tank with attachments and fuel filter, assembly overview

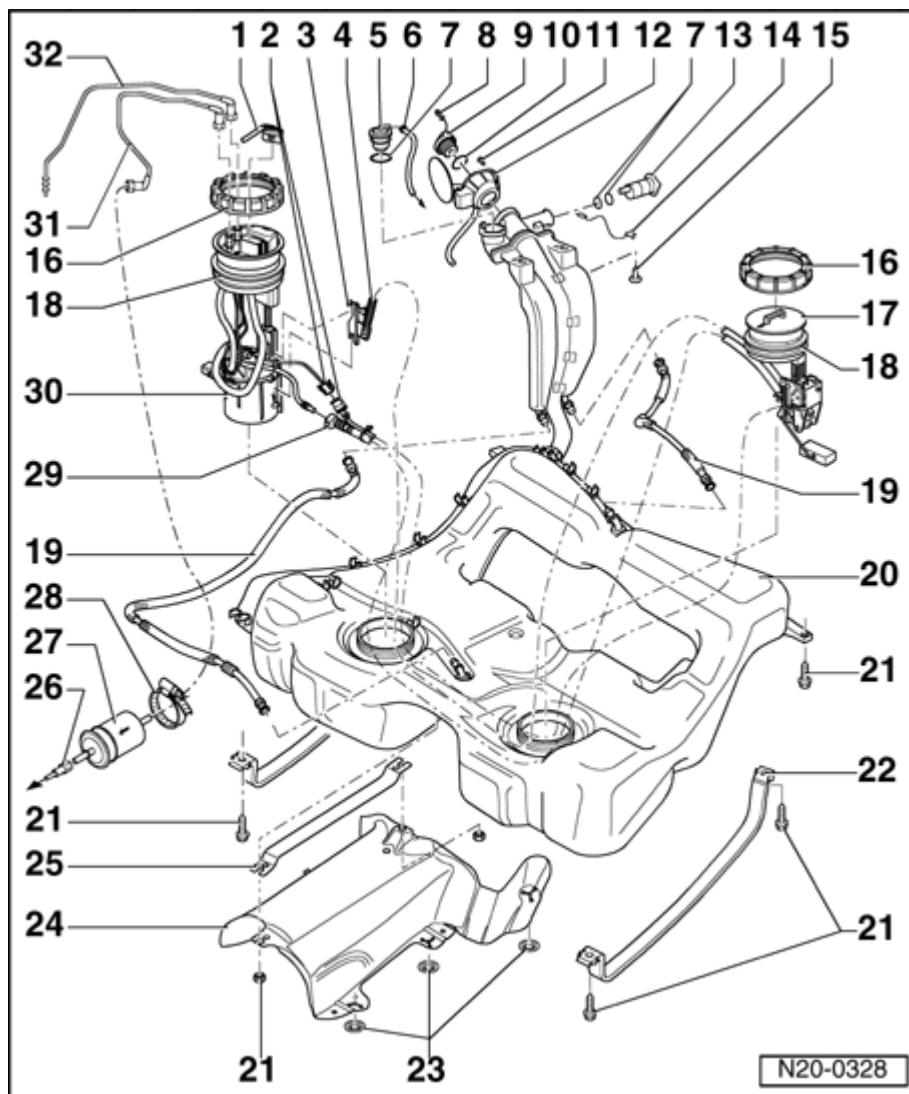


Fig. 172: Fuel Tank With Attachments And Fuel Filter, Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Connector

- Black, 4-pin
- For Fuel Level Sensor G and Transfer Fuel Pump G6

2 - Connector

- Black, 2-pin

3 - Bracket for return line

- Clipped to side of fuel delivery unit

4 - Return line

5 - Gravity/expansion valve

- To remove valve unclip upward out of support
- Test valve for through-flow
- Valve vertical: Open
- Valve angled at 45 ° : Closed

6 - Vent line

- Ensure seated tightly
- Secure with spring-type clips

7 - O-ring

- Replace if damaged

8 - Securing clip

9 - Cap

10 - Oil seal

- Replace if damaged

11 - Bolt

12 - Tank flap unit

- With rubber cup

13 - Breather valve

- To remove valve unclip sideways out of support
- Checking *Checking breather valve* under **Fuel tank with attachments and fuel filter, assembly overview**

14 - Ground connection

- Ensure seated tightly

15 - 10 Nm

16 - Union nut, 80 Nm

- Use ring nut wrench 3217 for removal and installation

17 - Fuel supply sensor 2 G169

- Note installed position on fuel tank *Installation position of fuel delivery unit flange* under **Fuel tank with attachments and fuel filter, assembly overview**
- Checking: Refer to Electrical Wiring Diagrams, Troubleshooting and Component Locations

18 - Oil seal

- To install, place into opening of fuel tank dry
- Replace if damaged
- Moisten with fuel only when installing flange

19 - Vent line

- Ensure seated tightly

20 - Fuel tank

- Support with engine/transmission jack V.A.G 1383 A when removing
- Removing and installing, refer to **Fuel tank, removing and installing**

21 - 25 Nm

22 - Securing strap

- Note installation position

23 - Lock washer

24 - Heat shield

25 - Support brace

26 - Supply line

- Black
- Ensure seated tightly

- Secure with spring-type clips
- To fuel supply line at fuel rail

27 - Fuel filter

- Installed location: Arrow points in direction of flow

28 - Screw clamp**29 - Supply line****30 - Fuel delivery unit**

- With sender for fuel gauge G
- Removing and installing, refer to **Fuel delivery unit, removing and installing**
- Check fuel pump, refer to **Fuel pump, checking**
- Clean strainer if soiled

31 - Supply line

- Ensure seated tightly
- Black
- Clipped to side of fuel tank

32 - Return line

- Blue or with blue marking
- Ensure seated tightly
- Secure with spring-type clips
- To fuel supply line at fuel rail

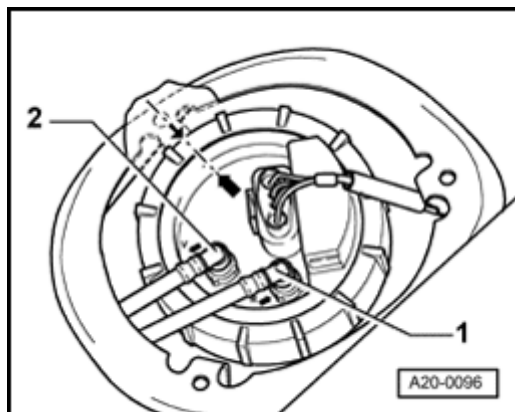
Installation position of fuel delivery unit flange

Fig. 173: Installed Position Of Flange Of Fuel Delivery Unit
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Marking on sender must align with marking on fuel tank - **arrow** -.

Blue or blue-marked return line - **1** - to connection with identification - **R** -.

Black supply line - **2** - to connection with identification - **V** -.

NOTE:

- After installing Fuel Pump (FP) flange, check whether supply, return and ventilation lines are still clipped in at fuel tank.

Checking breather valve

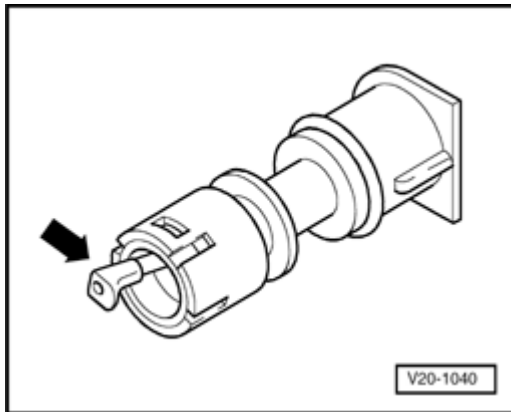


Fig. 174: Checking Breather Valve
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Lever in rest position: Closed

Lever pushed in direction of - **arrow** - : Open

NOTE:

- Before installing bleeder valve, unscrew cap from fuel tank.

Safety precautions when working on fuel supply system

- For safety reasons, fuse No. 28 must be removed from fuse holder before opening fuel system as fuel pump can be activated by door contact switch in drivers door.

CAUTION: Fuel system is under pressure! Wear eye protection and protective gloves to avoid injuries and skin contact with fuel. Before removing from hose connection wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

Always observe the following when removing and installing the sender for fuel gauge or the fuel pump (fuel

delivery unit) from full or partially filled fuel tanks:

- Already before starting work, switch on exhaust extraction system and place an extraction hose close to the sensor installation opening of fuel tank to extract escaping fuel fumes. If no exhaust extraction system is available, a radial fan (as long as motor is not in air flow) with a displacement greater than 15 m³/h can be used.
- Prevent fuel from contacting skin! Wear fuel-resistant gloves!

Rules for cleanliness

When working on the fuel supply/injection system, pay careful attention to the following "5 rules" :

- Thoroughly clean all connections and the surrounding area before disconnecting.
- Place parts that have been removed on a clean surface and cover them. Do not use fluffy cloths!
- Carefully cover over opened components or seal, if repairs are not performed immediately.
- Only install clean components: Only unpack replacement parts immediately prior to installation. Do not use parts that have been stored loose (e.g. in tool boxes etc.).
- When the system is open: Avoid working with compressed air if possible. Do not move vehicle unless absolutely necessary.

Suction jet pump, removing and installing

On vehicles with all-wheel drive, the shape of the fuel tank dictates that a suction jet pump unit is required to pump fuel to the fuel delivery unit from the area of the fuel level sensor 2 G169,. The suction jet pump works based on physical principles. It is driven via the fuel supply through an additional fuel pump connection.

NOTE:

- **A test is only to be performed when the engine shuts off through lack of fuel, even though the fuel level indicator still indicates the fuel tank is filled above the reserve level.**

Special tools, testers and auxiliary items required

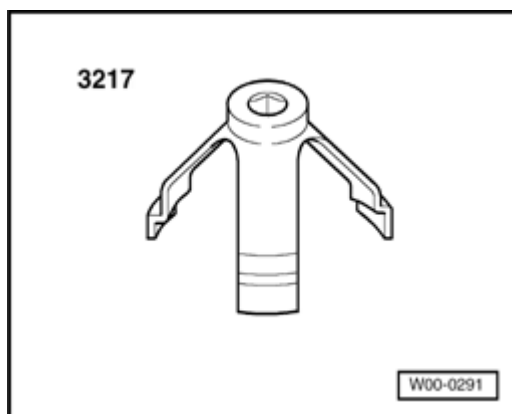


Fig. 175: 3217 Ring Nut Spanner

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Ring nut wrench 3217

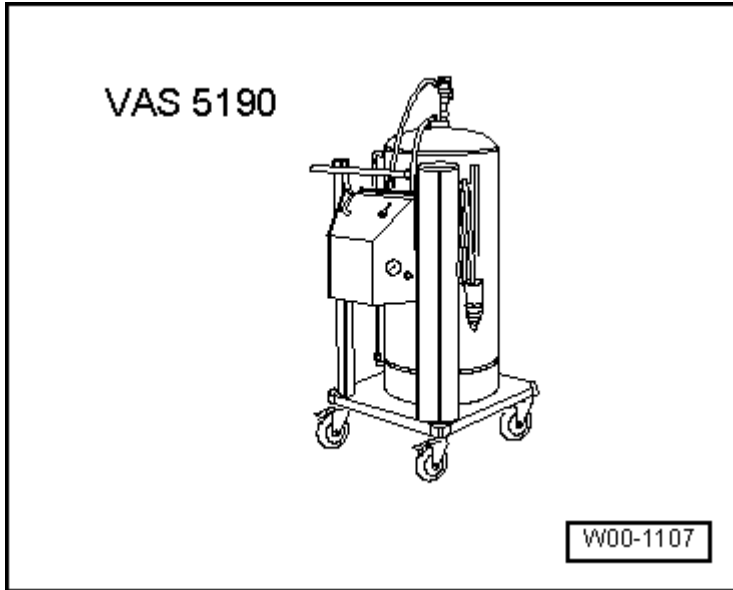


Fig. 176: Fuel Siphoning Unit VAS 5190

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Fuel siphoning unit VAS 5190
- Torque wrench V.A.G 1332

Requirements

- Fuel tank must be drained
- Both fuel level sensors must be checked with guided fault finding and be OK: Refer to Electrical Wiring Diagrams, Troubleshooting and Component Locations

Work procedure

- Observe safety precautions before performing repair work, refer to **Safety precautions when working on fuel supply system** .

NOTE:

- **To perform work sequence, the Ground (GND) cable must be disconnected from battery. Check whether a coded radio is installed. If so, obtain anti-theft coding beforehand.**
- With the ignition switched off disconnect battery Ground (GND) strap.
- Remove cover under the bench seat.

CAUTION: Fuel system is under pressure! Wear eye protection and protective gloves

to avoid injuries and skin contact with fuel. Before removing from hose connection wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

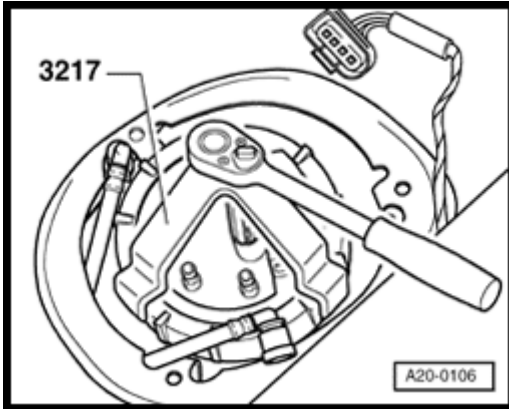


Fig. 177: Removing/Installing Union Nut With Wrench 3217
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull off 4-pin connector and fuel hoses from fuel delivery unit (right side of vehicle), and remove the fuel delivery unit, refer to **Fuel delivery unit, removing and installing** .

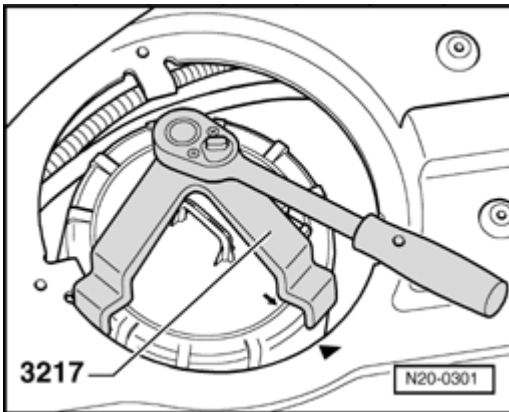


Fig. 178: Removing/Installing Fuel Level Sensor 2 G169 Union Nut On Left Side Of Vehicle
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove fuel level sensor 2 G169 union nut on left side of vehicle.
- Lift fuel level sensor 2 upward as far as possible.

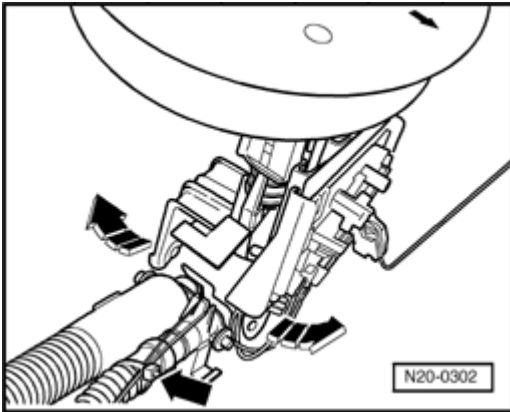


Fig. 179: Separating Cable Ties From Fuel Lines & Spreading Apart The Mount For Suction Jet Pump On Fuel Level Sensor 2

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Separate cable ties from fuel lines - **arrow** - and carefully spread apart the mount for suction jet pump on fuel level sensor 2 directional - **arrow** -.
- Unclip and remove suction jet pump with supply and return lines on fuel level sensor 2.
- Check that the fuel hoses/lines on suction jet pump are installed securely and are not damaged.
- Additionally check suction jet pump for contamination/dirt if necessary.

If no malfunctions are found:

- Install suction jet pump and fuel level sensor 2 in reverse order.
- If seals are swollen with fuel, always replace.

Fuel delivery unit, removing and installing

Special tools, testers and auxiliary items required

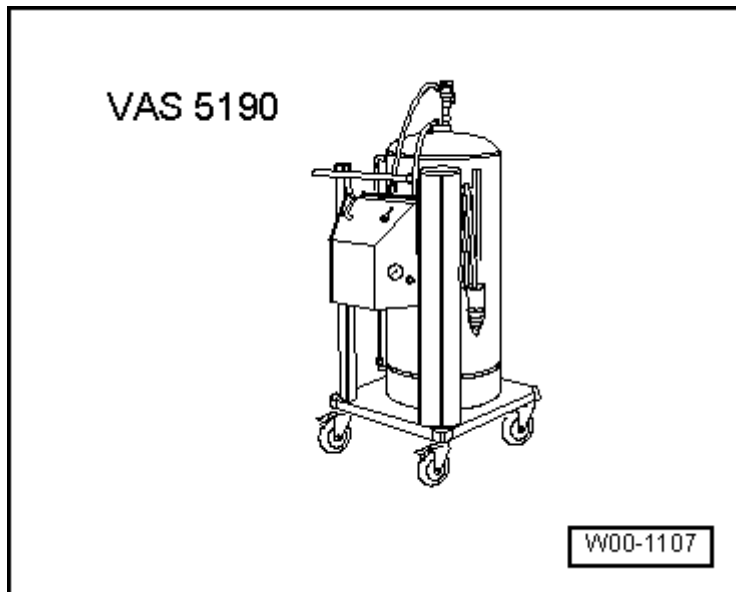


Fig. 180: Fuel Siphoning Unit VAS 5190
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Fuel siphoning unit VAS 5190

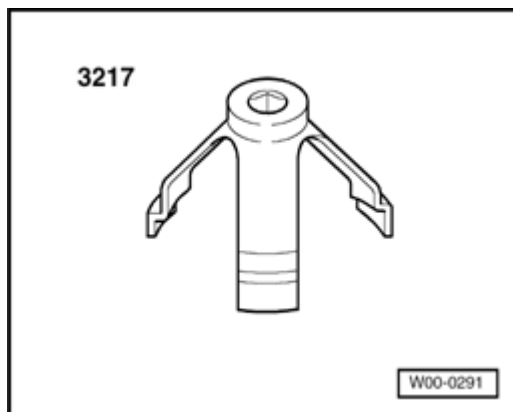


Fig. 181: 3217 Ring Nut Spanner
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Ring nut wrench 3217
- Torque wrench V.A.G 1332

Removing

NOTE:

- Empty fuel tank using fuel siphoning unit VAS 5190.
- Observe safety precautions before performing repair work, refer to **Safety precautions when working on fuel supply system** .

NOTE:

- To perform work sequence, the Ground (GND) cable must be disconnected from battery. Check whether a coded radio is installed. If so, obtain anti-theft coding beforehand.

- With the ignition switched off disconnect battery ground strap.
- Remove right cover under the bench seat.

CAUTION: Fuel system is under pressure! Wear eye protection and protective gloves to avoid injuries and skin contact with fuel. Before removing from hose connection wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

- Pull off 4-pin connector such as supply and return lines from flange.

NOTE:

- Press buttons on hose couplings to do this.

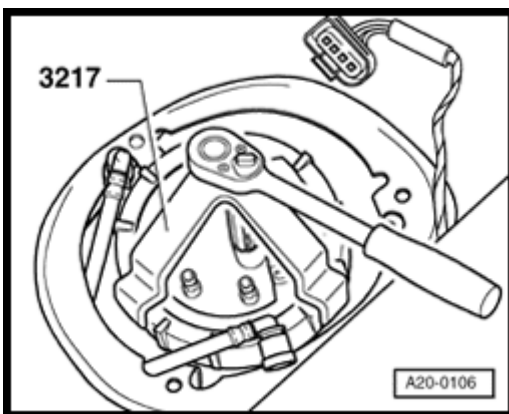


Fig. 182: Removing/Installing Union Nut With Wrench 3217
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Use ring nut spanner 3217 to remove union nut.

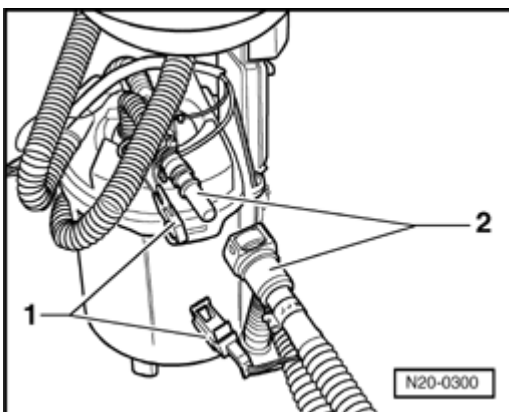


Fig. 183: Identifying 2-Pin Connection, Such As Supply Line Hose Connection To Suction Jet Pump

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect 2-pin connection - **1** -, such as supply line hose connection - **2** - to suction jet pump.

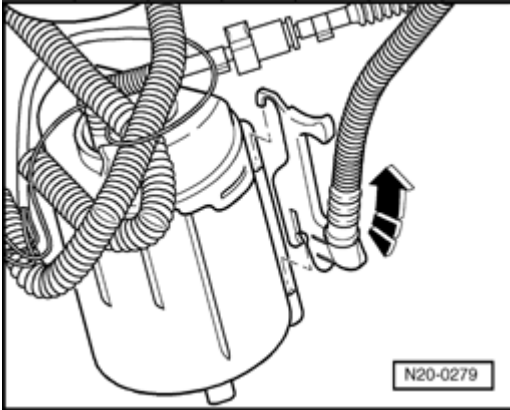


Fig. 184: Lifting The Fuel Delivery Unit Slightly And Pulling Bracket With Return Line
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Lift the fuel delivery unit slightly and pull the bracket with return line - **arrow** - off upward.
- Pull fuel delivery unit and seal out of opening in fuel tank.

NOTE:

- If the delivery unit is to be replaced then drain old delivery unit before disposal.

Installing

- Installation of the fuel delivery unit is performed in the reverse order.

NOTE:

- If seals are swollen with fuel, always replace.
 - Do not bend lever arm of fuel sender when installing.
 - Insert seal for fuel delivery unit and fuel level sensor 2 dry into opening of fuel tank.
 - Ensure fuel hoses are seated securely.
-
- After installing fuel delivery unit, check that the supply, return and breather lines are still clipped onto the fuel tank.

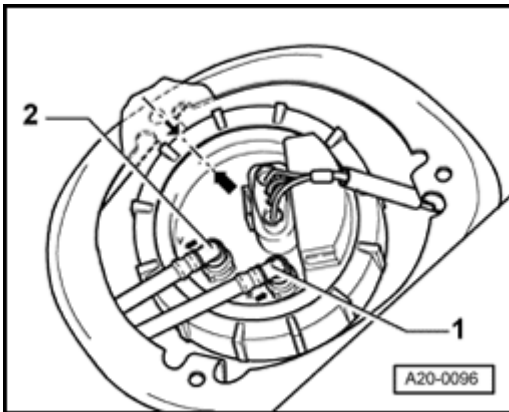


Fig. 185: Installed Position Of Flange Of Fuel Delivery Unit
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Note installation position of fuel delivery unit flange! Marking on flange must align with marking on fuel tank - **arrow** -.

Fuel level sensor, removing and installing

NOTE:

- Vehicles with all-wheel drive have two fuel level sensors. How to remove the Fuel Level Sensor 2 G169, refer to Suction jet pump, removing and installing .
- Empty fuel tank using fuel siphoning unit VAS 5190.

Removing

CAUTION: Fuel system is under pressure! Wear eye protection and protective gloves to avoid injuries and skin contact with fuel. Before removing from hose connection wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

- Remove fuel delivery unit, refer to Fuel delivery unit, removing and installing .

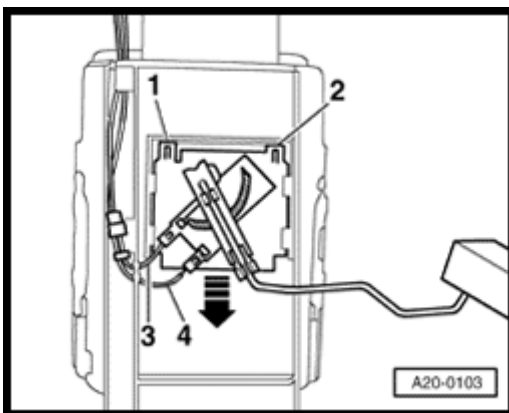


Fig. 186: Fuel Gauge Sender Connectors & Retaining Tabs

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Release and pull off terminals for wires - **3** - and - **4** -.
- Lift retaining tabs - **1** - and - **2** - with a screwdriver and pull fuel level sensor G downward and off - **arrow** -.

Installing

- Insert fuel gauge sender G into the guides on the fuel delivery unit and push up until it engages.
- When installing, verify that the seals for the sensor flange are correctly seated.

NOTE:

- If seals are swollen with fuel, always replace.
- Moisten seal with fuel only when installing fuel delivery unit and fuel level sensor 2.

Fuel tank, removing and installing

Special tools, testers and auxiliary items required

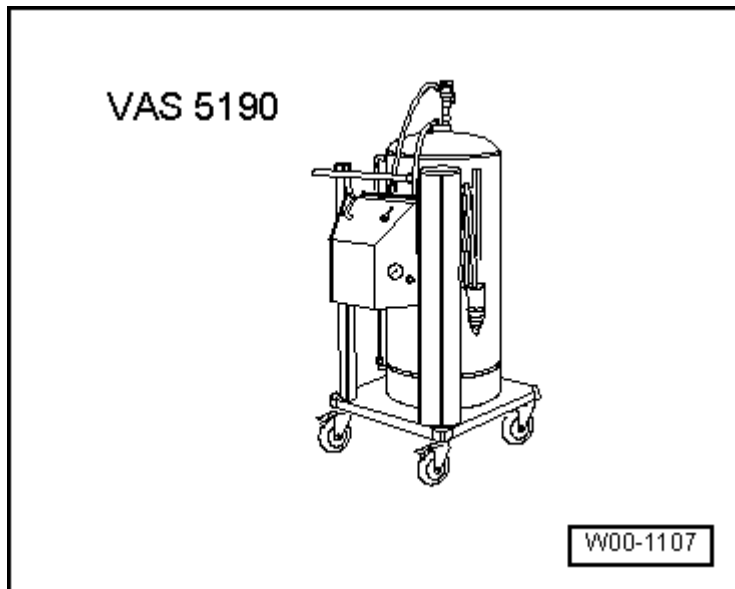


Fig. 187: Fuel Siphoning Unit VAS 5190

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Fuel siphoning unit VAS 5190

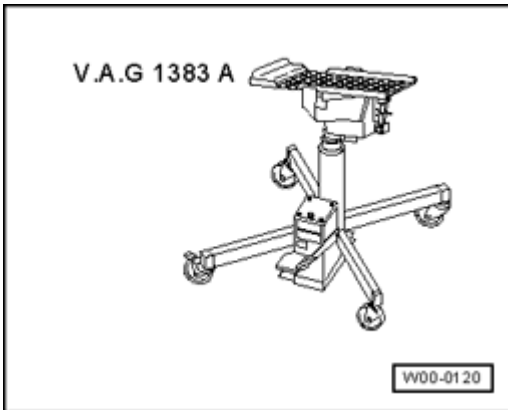


Fig. 188: Engine/Transmission Jack V.A.G 1383 A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Engine/transmission jack V.A.G 1383 A
- Torque wrench V.A.G 1331

Removing

- Observe safety precautions before performing repair work, refer to **Safety precautions when working on fuel supply system** .

NOTE:

- To perform work sequence, the Ground cable must be disconnected from battery. Check whether a coded radio is installed. If so, obtain anti-theft coding beforehand.

- With ignition switched off disconnect battery Ground (GND) strap.
- Open fuel tank flap.

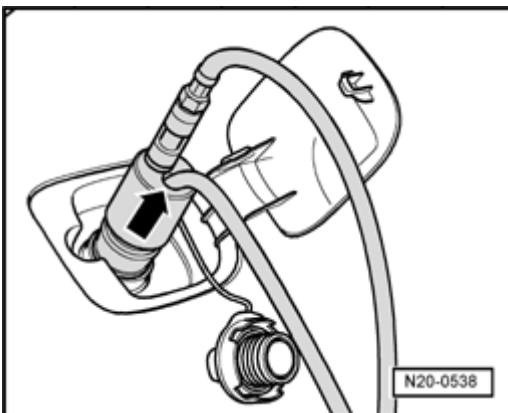


Fig. 189: Fuel Siphoning Unit VAS 5190 Suction Hose In Fuel Filler Neck
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Push suction hose - **arrow** - of fuel siphoning unit VAS 5190 about 100 to 120 cm into fuel filler neck and extract fuel.

- Unscrew securing bolts and remove tank flap unit with rubber cup.
- Remove securing bolts on filler neck.
- Remove rear right wheel housing liner: Refer to **66 EXTERIOR EQUIPMENT**
- Clean area surrounding fuel filler tube.
- Fold rear seat bench forward.
- Remove right and left cover under the bench seat.
- Remove heat shield under the fuel tank
- Remove rear axle: Refer to **42 REAR SUSPENSION**

CAUTION: Fuel supply lines are under pressure! Wear eye protection and protective gloves to avoid injuries and skin contact with fuel. Before removing from hose connection wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

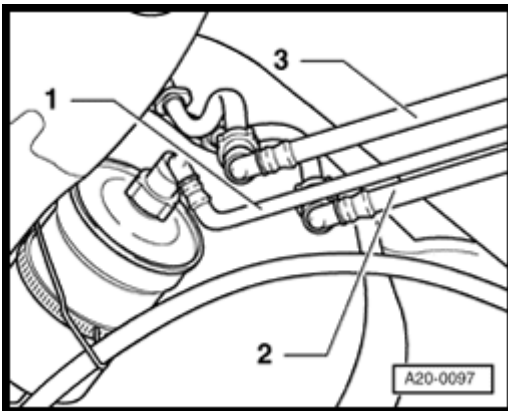


Fig. 190: Identifying Return Line, Supply Line And Breather Line
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Separate return line - 2 - (blue), supply line - 1 - (black) and breather line - 3 - (white) at their connection points.

NOTE:

- Press buttons on hose couplings to do this.

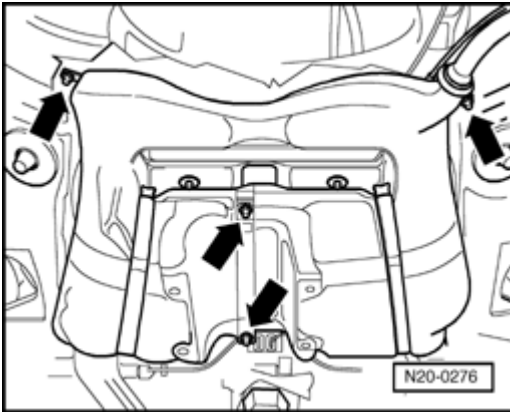


Fig. 191: Fuel Tank Bolts/Nuts

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove securing bolts/nuts - **arrows** -.
- Remove tensioning strap. Support fuel tank using engine/transmission jack V.A.G 1383 A while doing so
- Lower fuel tank.

Installing

Installation is performed in reverse order of removal. Note the following:

- Make sure ventilation and fuel lines are not kinked when installed.
- Secure fuel hoses with spring-type clamps.
- Route fuel hoses kink-free.
- Ensure fuel hoses are seated securely.
- Do not interchange supply and return hose (return hose blue or blue markings, supply hose black).

NOTE:

- **After installing fuel tank, check that the supply, return and breather lines are still clipped onto the fuel tank.**

Crash fuel shut-off

Function

Vehicles with an airbag are equipped with a crash fuel shut-off system. It reduces the danger of a fire in a crash as the fuel pump is switched off via the fuel pump relay. At the same time, with this set-up, an improvement in the comfort of engine startability is also attained. When opening the door, the fuel pump is activated for 2 seconds to build pressure in the fuel system.

When opening the fuel system:

Observe safety precautions, refer to **Safety precautions when working on fuel supply system** .

- Check fuel pump relay: Refer to Electrical Wiring Diagrams, Troubleshooting and Component Locations

Fuel pump, checking

Function and voltage supply, checking

Checking fuel delivery

Checking fuel pump non-return valve

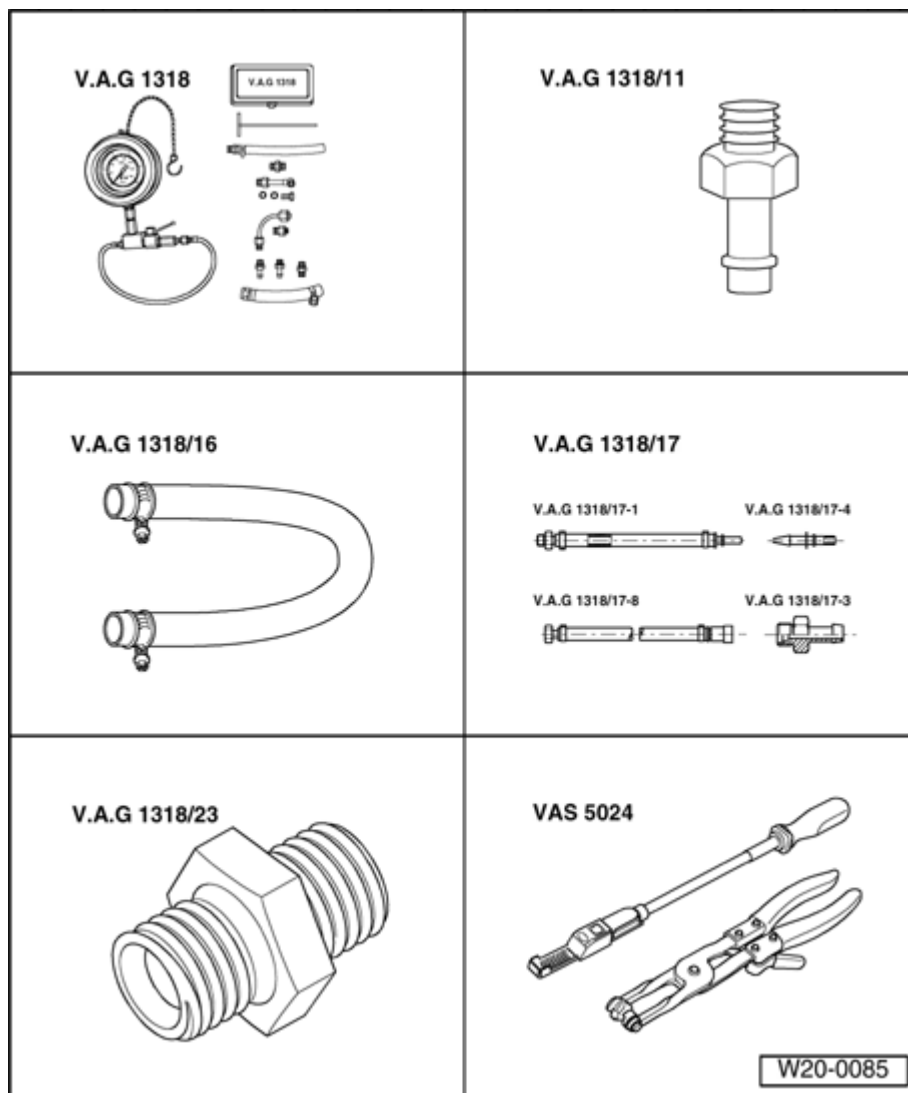


Fig. 192: Identifying Special Tools - Fuel Pump, Checking (1 Of 2)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Pressure gauge V.A.G 1318

- Adapter V.A.G 1318/11
- Hose adapter V.A.G 1318/16
- Pressure gauge adapter V.A.G 1318/17
- Fuel line feed adapter V.A.G 1318/23
- Spring-type clip pliers VAS 5024A

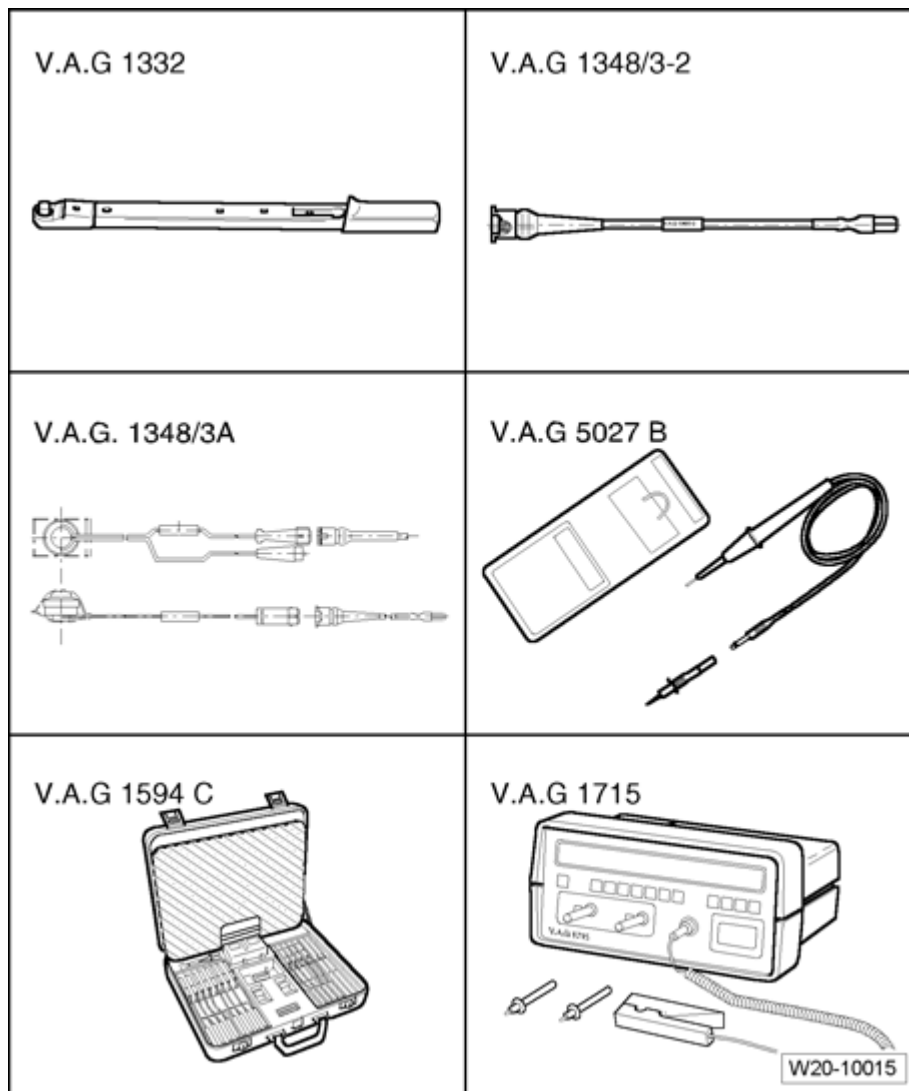


Fig. 193: Identifying Special Tools - Fuel Pump, Checking (1 Of 2)
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Torque wrench V.A.G 1332
- Adapter cable V.A.G 1348/3-2
- Remote control connection V.A.G 1348/3A
- Voltage tester V.A.G 1527B

- Connector test set V.A.G 1594C
- Multimeter V.A.G 1715

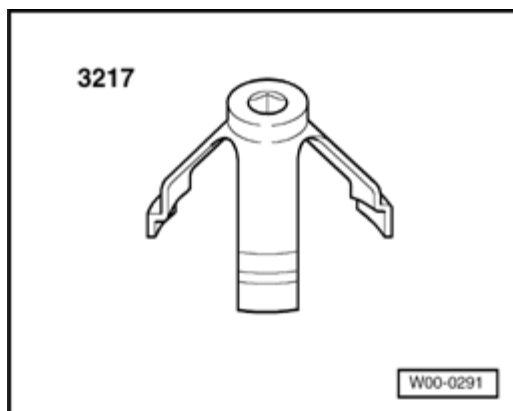


Fig. 194: 3217 Ring Nut Spanner

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Ring nut wrench 3217
- Measuring container
- Wiring diagram

Function and voltage supply, checking

Test conditions

- Battery voltage at least 11.5 V

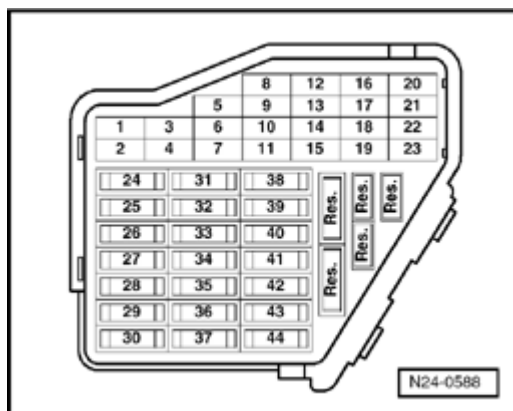


Fig. 195: Identifying Main Fuse Panel

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Fuse No. 28 is OK

NOTE:

- Observe the description of crash fuel shut-off function, refer to Crash fuel shut-off .

- Remove cover from fuel delivery unit.
- Briefly operate the starter. Fuel pump must activate audibly.
- Switch off ignition.

If fuel pump does not activate:

- Remove cover in front of fuse holder.
- Pull fuse No. 28 from the fuse holder.

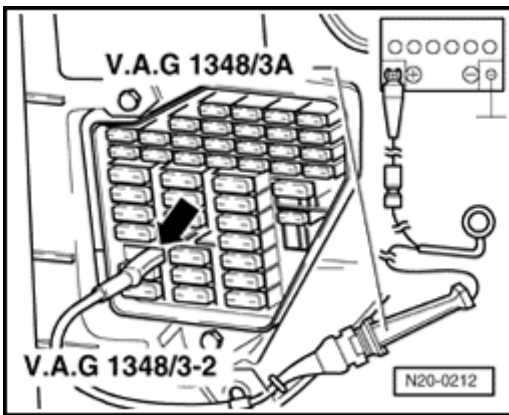


Fig. 196: Connecting VAG 1348/3A With Adapter Cable VAG 1348/3-2 To Contact And Battery Positive
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect remote control V.A.G 1348/3A with adapter cable V.A.G 1348/3-2 to contact 28a to fuel pump and battery positive (+).
- Operate remote control.

If fuel pump is activated:

- Check activation of fuel pump relay according to electrical schematics using the connector test set V.A.G 1594C : Refer to Electrical Wiring Diagrams, Troubleshooting and Component Locations

If fuel pump is not activated:

- Disconnect 4-pin connector from flange on fuel delivery unit.

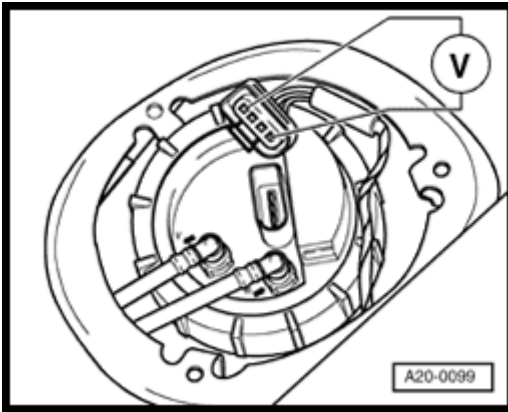


Fig. 197: Connecting Voltage Tester V.A.G 1527B Using Adapter Cables From Connector Test Kit V.A.G 1594C To Outer Terminals Of Connector

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect voltage tester V.A.G 1527B using adapter cables from connector test kit V.A.G 1594C to outer terminals of connector.
- Operate remote control. LED must light up

LED does not light up:

- Determine and eliminate open circuit according to electrical schematics: Refer to Electrical Wiring Diagrams, Troubleshooting and Component Locations

LED lights up (voltage supply OK):

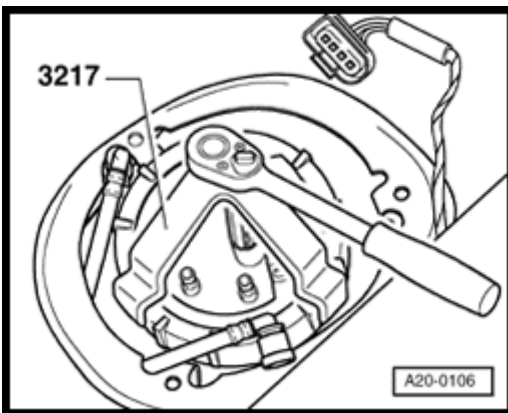


Fig. 198: Removing/Installing Union Nut With Wrench 3217

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Use ring nut spanner 3217 to remove union nut.
- Check if electrical wiring between flange and fuel pump is connected.

If no open circuits are found:

- Fuel Pump (FP) faulty, replace fuel delivery unit, refer to **Fuel delivery unit, removing and installing** .

Checking delivery rate**Test conditions**

- Voltage supply OK.
- Remote control V.A.G 1348/3A connected

Test sequence

- Remove fuel filler cap from fuel filler tube.

CAUTION: Fuel supply lines are under pressure! Wear eye protection and protective gloves to avoid injuries and skin contact with fuel. Before removing from hose connection wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

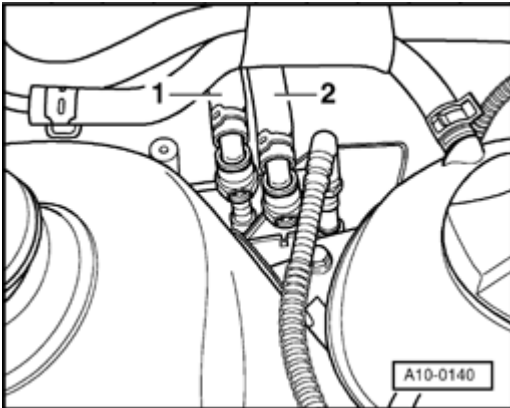


Fig. 199: Identifying Supply Line And Return Line
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect supply hose - 3 - (with white marking) and collect fuel that may leak out with a cloth.

NOTE:

- Press buttons on hose couplings to do this.

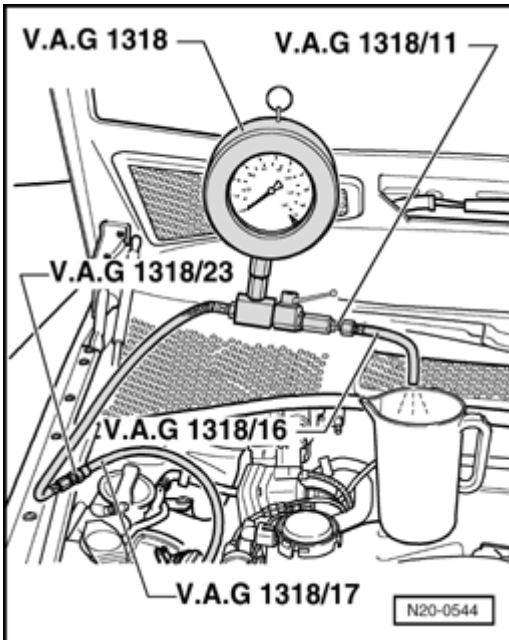


Fig. 200: Pressure Gauge V.A.G 1318 Connected To Fuel Supply Line Using Fuel Line Feed Adapter V.A.G 1318/23 And Adapter V.A.G 1318/17

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect pressure gauge V.A.G 1318 to fuel supply line using fuel line feed adapter V.A.G 1318/23 and adapter V.A.G 1318/17.
- Install hose adapter V.A.G 1318/16 onto adapter V.A.G 1318/11 on pressure gauge V.A.G 1318 and hold hose in a measuring container.
- Open shut-off tap on pressure gauge V.A.G 1318. The lever then points in direction of flow.
- Operate remote control V.A.G 1348/3A. Slowly close shut-off tap, until pressure gauge shows 3 bar. From this point on do not move position of shut-off tap.
- Empty the measuring container.
- Delivery rate of Fuel Pump (FP) is dependent on battery voltage. Therefore, connect multimeter V.A.G 1715 to vehicle battery using adapter cables from connector test kit V.A.G 1594C.
- Operate remote control for 30 seconds and measure battery voltage.

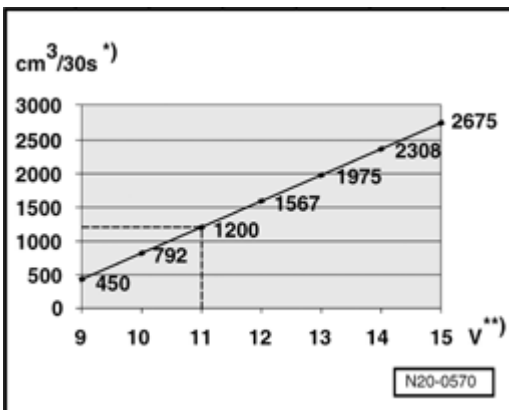


Fig. 201: Fuel Delivery Chart

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Compare the quantity of fuel delivered with specification.

- *) - Minimum delivery rate $\text{cm}^3 / 30 \text{ seconds}$

- **) - Voltage at fuel pump with engine stopped and pump running (approx. 2 volts less than battery voltage).

Example:

During the test, a voltage of 13 volts is measured at the battery. As the voltage at the pump is approx. 2 volts less than the battery voltage then this will equate to a minimum delivery of $1,100 \text{ cm}^3 / 30 \text{ s}$.

If minimum delivery rates are not obtained:

- Check fuel lines for possible restrictions (kinks) or blockages.

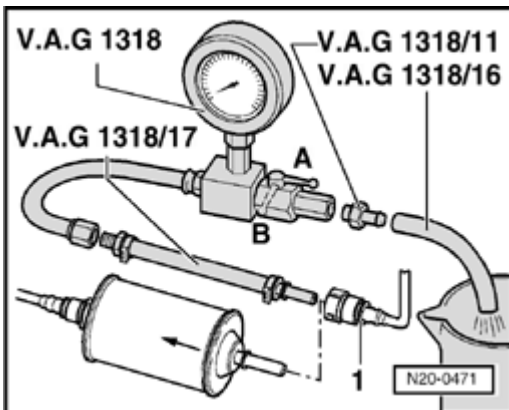


Fig. 202: Connecting Pressure Gauge VAG 1318 To Hose With Adapter VAG 1318/17 To Fuel Filter

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull off supply hose - **1** - from fuel filter inlet.
- Connect pressure gauge V.A.G 1318 to the hose using adapter V.A.G 1318/17.
- Resume testing the delivery quantity.

If minimum delivery rate is now obtained:

- Replace the fuel filter:

If minimum delivery rate is again not obtained:

- Remove fuel delivery unit and check fuel strainer for soiling.

Only when up to now no malfunction has been detected:

- Replace fuel delivery unit.

If delivery rate has been attained but nevertheless you suspect a fuel supply system malfunction (e.g. intermittent failure of fuel supply system):

- Check current draw of fuel pump as follows:
- Reconnect all disconnected fuel lines.

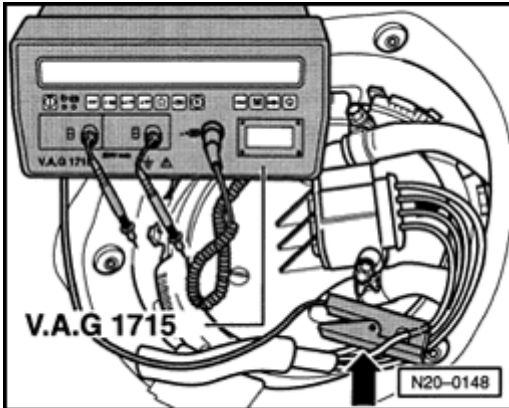


Fig. 203: Multimeter V.A.G 1715 Connected To Wire For Contact 1 Of 4-Pin Connector Using Current Pick-Up Clamp.

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect multimeter V.A.G 1715 to wire (arrow) for contact 1 of 4-pin connector using current pick-up clamp.
- Start engine and run at idle speed.
- Measure current draw of fuel pump. Specification: max. 8 amps.

NOTE:

- If malfunction in fuel system is sporadic, test can also be performed during a road test, but a second person is required.

If current draw is exceeded:

- Fuel Pump (FP) faulty, replace fuel delivery unit, refer to Fuel delivery unit, removing and installing .

Fuel Pump (FP) check-valve, checking

Test conditions

Remote control for VAG 1348 V.A.G 1348/3A is still connected.

Pressure gauge V.A.G 1318 is still connected.

Test sequence

NOTE:

- This test also checks the connections of the fuel supply line from fuel delivery unit to connection point of pressure gauge V.A.G 1318 for proper seal.

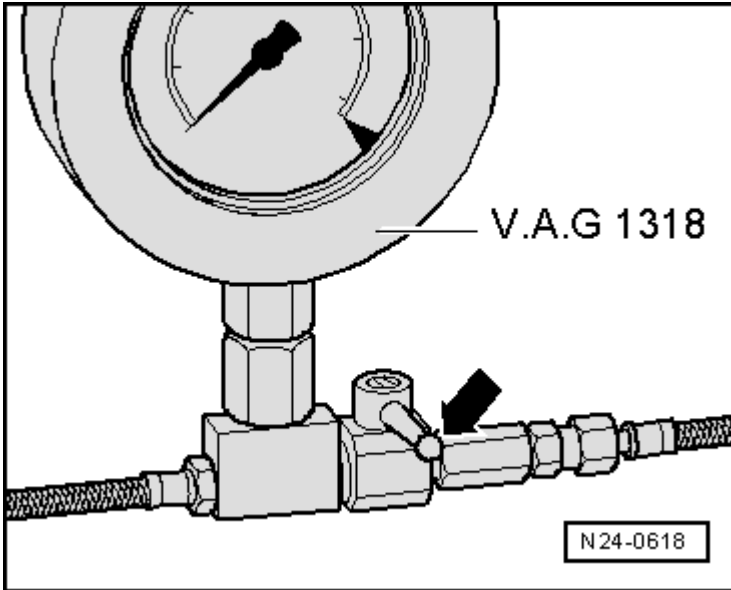


Fig. 204: Locating V.A.G 1318 Shut-Off Tap
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Close pressure gauge V.A.G 1318 shut-off tap (lever at right angle to direction of flow).
- Operate remote control V.A.G 1348/3A at short intervals, until a pressure of approx. 3 bar has built up.

CAUTION: Danger of fuel spray when opening shut-off tap; Wear protective eyewear and clothing to prevent injuries and skin contact with fuel. Hold a container in front of the open connection of the pressure gauge.

- If pressure builds up too high, lower excess pressure by carefully opening the shut-off tap.
- Watch pressure drop on gauge. After 10 minutes the pressure must not drop below a 2.5 bar decrease.

If pressure drops further:

- Check line connections for leaks.

If no fault is detected in wiring:

- Fuel Pump (FP) faulty, replace fuel delivery unit, refer to **Fuel delivery unit, removing and installing** .

EVAPORATIVE EMISSIONS (EVAP) SYSTEM

Evaporative emissions (EVAP) system

Function, refer to **Function**

EVAP canister system components, assembly overview, refer to **EVAP canister system, assembly overview**

Leak detection pump (LDP) components - assembly overview, refer to **Leak detection pump (LDP) components, assembly overview**

Leak detection pump and EVAP canister, removing and installing, refer to **Leak detection pump and EVAP canister, removing and installing**

Function

Depending upon air pressure and ambient temperature - more or less fuel vapors form in the fuel tank.

The evaporative emissions system prevents these HC-emissions from dispersing into the environment.

Fuel vapors disperse from the highest point of the fuel tank (at the filler neck) through the gravity valve (which closes at an inclination by 45 °) into the EVAP canister.

The activated charcoal in the canister stores these gases like a sponge.

When driving with active Oxygen sensor regulation (engine warm), the evaporative emission (EVAP) canister purge regulator valve N80 is activated based on load and speed. The open duration is dependent on the input signals.

Without electricity (e.g. open circuit) the evaporative emission (EVAP) canister purge regulator valve remains closed. The EVAP canister is not purged.

Function description of leak diagnosis

The EVAP system (including fuel tank) is equipped with leak diagnosis. The leak diagnosis will detect whether the system is leaking.

The diagnosis operates by pressurizing the system and should detect leaks where the damage exceeds 1 mm in diameter.

Before every leak diagnosis the Evaporative Emission (EVAP) Canister Purge Solenoid Valve 2 N115 is briefly opened to relieve any possible pressure.

During the diagnostic, the Leak Detection Pump (LDP) V144 generates a positive pressure of approx. 30 mbar in EVAP canister system. The pump will switch off when pressure is attained. When pressure falls to below a certain figure, the pump will switch on again. On Board Diagnostic monitors the switch intervals and stores a Fault in Fault memory if the intervals are too short.

NOTE:

- **Hose connections are secured with either spring-type or clamp-type clips.**
- **Always replace clamp-type clips with spring-type clips.**

- Fuel hoses in engine compartment must only be secured with spring-type clips. The use of clamp or screw type clips is not permissible.

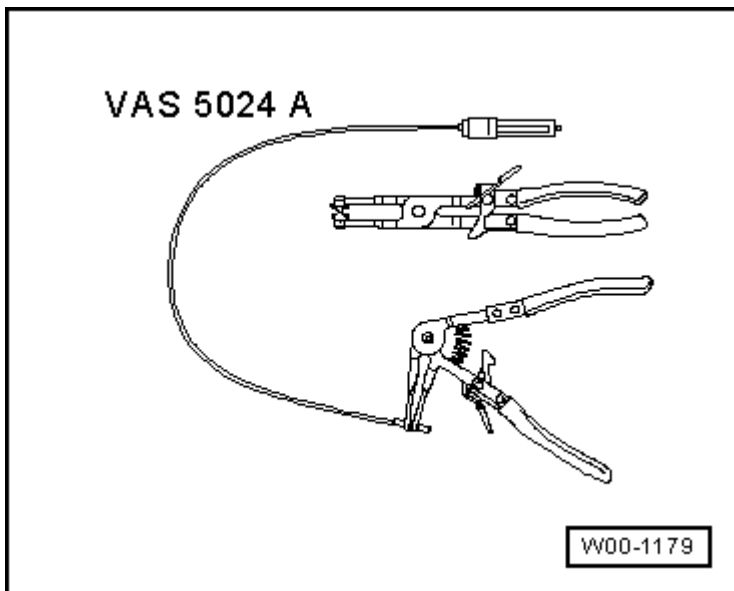


Fig. 205: Spring-Type Clip Pliers VAS 5024A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- The spring-type clip pliers VAS 5024A are recommended for installing spring-type clips.

Observe safety precautions, refer to **Safety precautions when working on fuel supply system** .

Observe rules for cleanliness, refer to **Rules for cleanliness** .

EVAP canister system, assembly overview

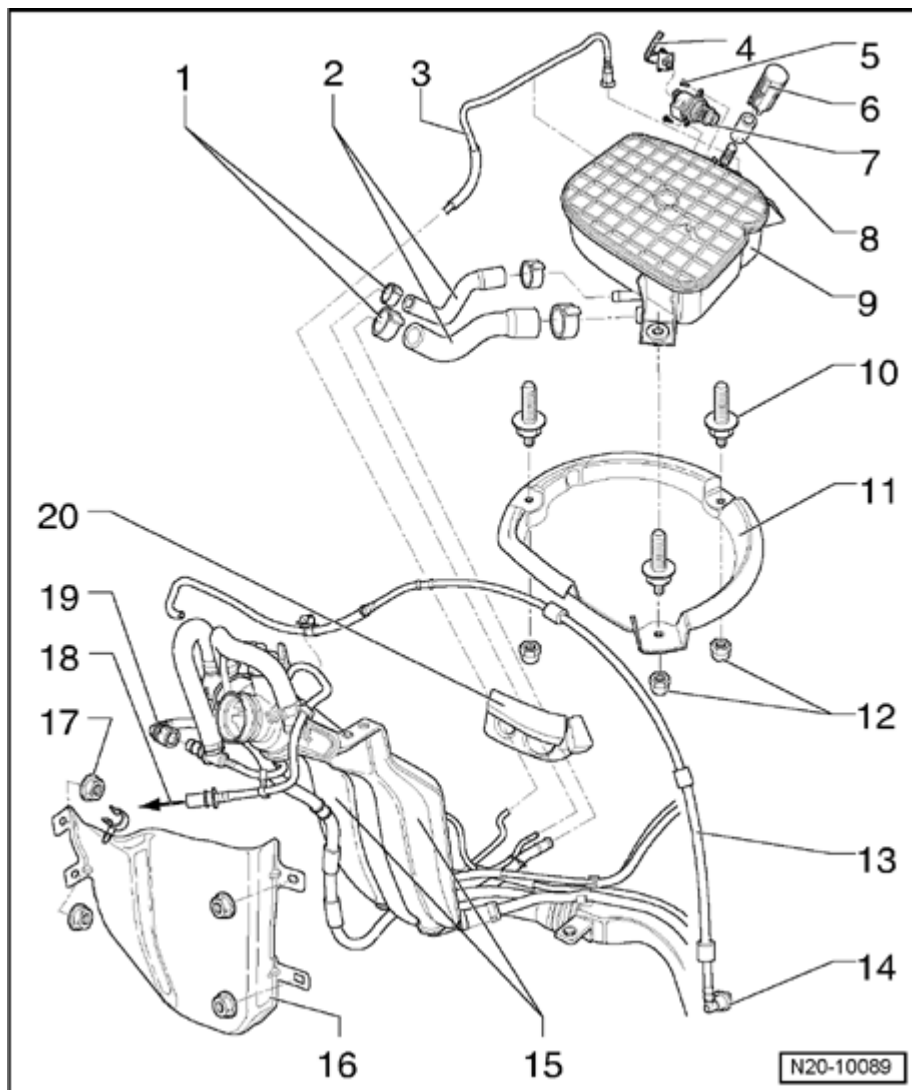


Fig. 206: EVAP Canister System, Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- 1 - Hose clamp
- 2 - Connecting hose
 - For breather lines
- 3 - Vent line
 - Connected to EVAP canister
- 4 - Connector
 - Black, 2-pin
 - For Evaporative Emission (EVAP) Canister Purge Solenoid Valve N115

5 - Bolt

6 - Filter housing

- For Evaporative Emission (EVAP) Canister Purge Solenoid Valve N115

7 - Evaporative emission (EVAP) canister purge solenoid valve N115

8 - Filter element

- For Evaporative Emission (EVAP) Canister Purge Solenoid Valve N115

9 - EVAP canister

- Removing and installing, refer to **Leak detection pump and EVAP canister, removing and installing**

10 - 23 Nm

11 - Cover

12 - 8 Nm

13 - Vent line

- From the Leak Detection Pump (LDP) V144 to Evaporative Emission (EVAP) Canister Purge Regulator Valve N80
- Clipped in wheelhousing

14 - Separating point

- For breather line
- To separate, press together front release button

15 - Reservoir

16 - Trim strip

- Secured in wheelhousing

17 - 15 Nm

18 - To leak detection pump (LDP) V144

- Ensure seated tightly

19 - Vent line

- For fuel tank
- Ensure seated tightly

20 - Gasket

Leak detection pump (LDP) components, assembly overview

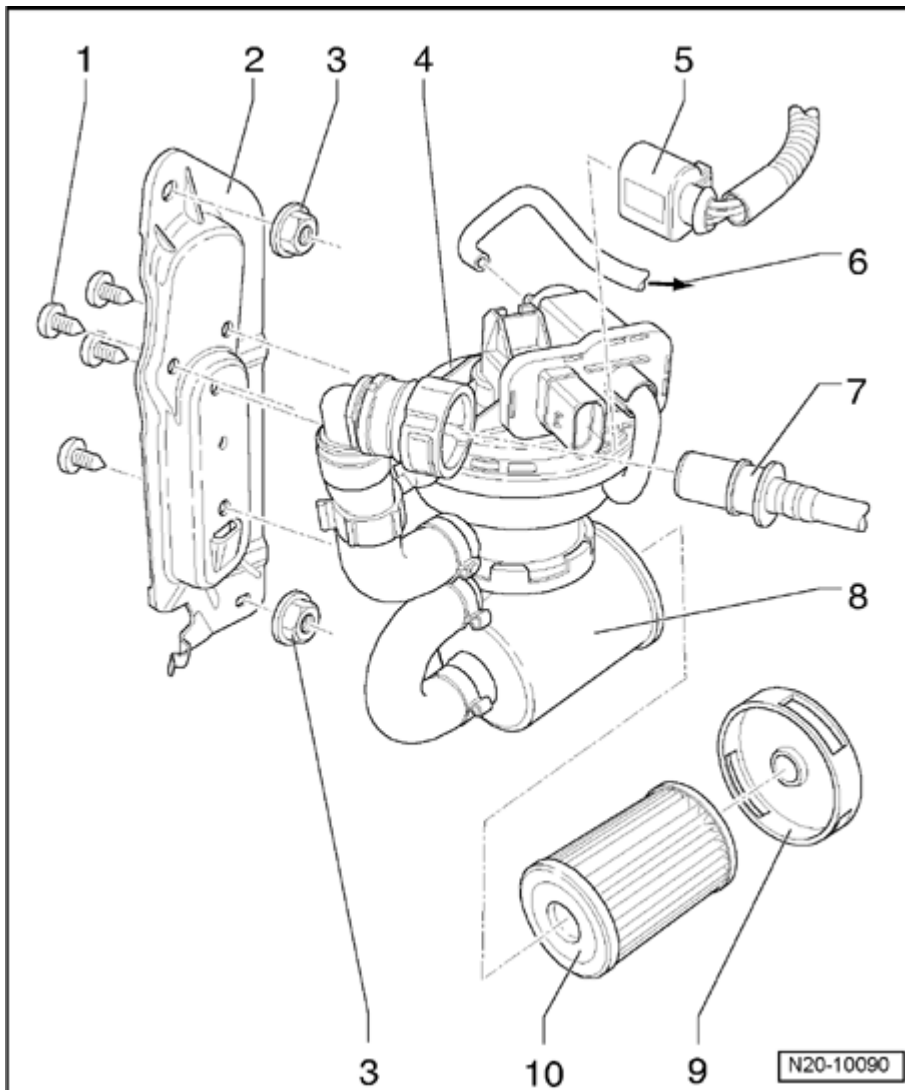


Fig. 207: Leak Detection Pump Components, Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Bolt

2 - Bracket

- For leak detection pump (LDP) V144

3 - 15 Nm

4 - Leak detection pump (LDP) V144

- Removing and installing, refer to **Leak detection pump and EVAP canister, removing and installing**

5 - Connector

- Black, 3pin
- For leak detection pump (LDP) V144

6 - To Evaporative emission (EVAP) canister purge regulator valve N80

Is connected

7 - Vent line

- For fuel tank
- Ensure seated tightly

8 - Filter housing

9 - Cover

- Clipped onto the filter housing

10 - Filter element

- For Leak detection pump (LDP) V144

Leak detection pump and EVAP canister, removing and installing

The leak detection pump (LDP) V144 is installed in right rear wheel housing. It is connected to the Evaporative Emission (EVAP) Canister Purge Regulator Valve N80 in the engine compartment and EVAP canister via connecting lines. The EVAP canister is installed below vehicle floor in area of spare tire well.

Removing leak detection pump

- Raise vehicle.
- Remove right rear wheel.
- Remove rear right wheel housing liner: Refer to **66 EXTERIOR EQUIPMENT**
- Unbolt cover plate in front of tank filler tube.
- Disconnect the connector - **1** - from the leak detection pump (LDP) V144, and separate vent line - **2** - at the connection.

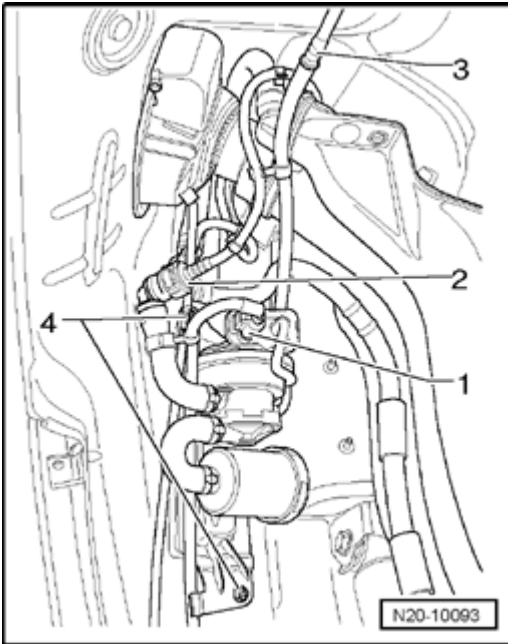


Fig. 208: EVAP Canister Purge Regulator Valve N80 And Securing Nuts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unclip vent line to Evaporative Emission (EVAP) Canister Purge Regulator Valve N80 - **3** - in wheelhousing and separate connection.
- Securing nuts - **4** - can be removed and remove leak diagnosis pump (LDP) V144.

Removing EVAP canister

- Remove muffler, refer to **Muffler with mountings, assembly overview** .
- Remove heat shield above muffler from floor.
- Unscrew right and left stabilizer bar mounts from the underbody. Refer to **42 REAR SUSPENSION**
- Remove cover under the EVAP canister.

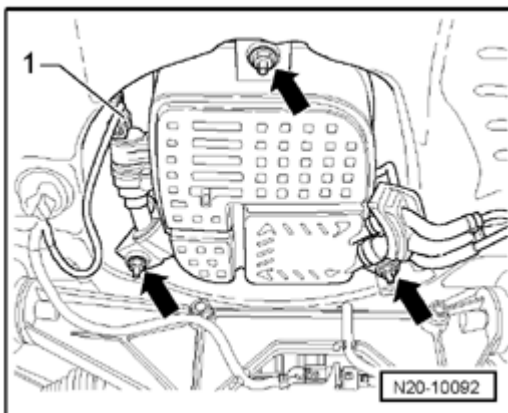


Fig. 209: EVAP Canister Studs & Connector
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect connector - **1** - from Evaporative Emission (EVAP) Canister Purge Solenoid Valve 2 N115.
- Turn out three studs - **arrows** -, and remove the EVAP canister from well.

Installing

- Installation of EVAP canister system is performed in reverse order.

When installing, make sure that the vent lines are connected securely and not kinked.

ELECTRONIC POWER CONTROL (EPC) SYSTEM**Electronic Power Control (EPC) system**

Functions of EPC system, refer to **Functions of EPC system**

Assembly overview, refer to **Assembly overview**

Functions of EPC system

With EPC, the throttle valve is not actuated through a cable from the accelerator. There is no mechanical connection between the accelerator and the throttle valve.

The position of the accelerator pedal is transmitted to the Engine Control Module (ECM) via two accelerator pedal position senders (adjustable resistances, accommodated in one housing), that are connected to the accelerator pedal.

The position of the accelerator pedal (driver controlled) is a main input for the Engine Control Module (ECM).

Operation of the throttle valve occurs via an electric motor (throttle valve actuator) in the throttle valve control module. This applies across the entire engine speed and engine load spectrum.

The throttle valve is operated by the throttle drive according to the instructions of the Engine Control Module (ECM).

With the engine at standstill and the ignition switched on, the Engine Control Module (ECM) activates the throttle valve actuator precisely according to the specifications of the Throttle Position (TP) Sensor. This means, if the accelerator pedal is depressed half way, the throttle drive opens the throttle valve to the same degree; i.e. throttle valve is then opened approx. half way.

With engine running (under load) the Engine Control Module (ECM) can open and close the throttle valve independently of the accelerator pedal position sender.

That way the throttle valve can already be completely opened, although the accelerator pedal is only depressed half-way. An advantage of this is that throttle losses at the throttle valve are avoided.

Aside from that, it results in clearly better pollutant output and consumption values under certain load conditions.

The Engine Control Module (ECM) calculates after evaluation of torque requirements of the different components (e.g. A/C system, automatic transmission, ABS/ESP, etc.) a throttle valve opening angle optimal for the respective situation.

Observe safety precautions, refer to **Safety precautions when working on fuel supply system** .

Observe rules for cleanliness, refer to **Rules for cleanliness** .

Assembly overview

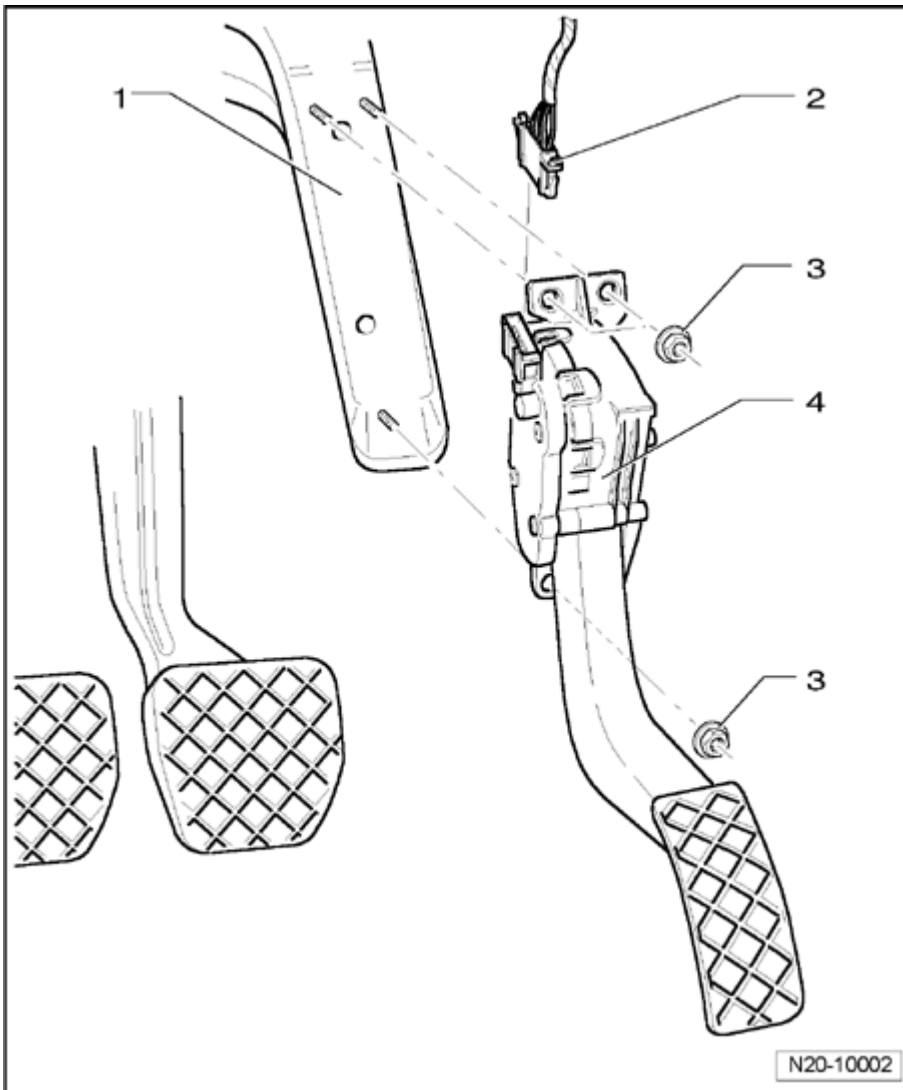


Fig. 210: Electronic Power Control System Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Bracket

- Removing and installing: Refer to **46 BRAKES - MECHANICAL COMPONENTS**

2 - Connector

- Black, 6-pin

3 - 10 Nm

4 - Throttle position (TP) sensor G79

- Not adjustable
- Remove footwell cover to remove sensor

24 - MULTIPOINT FUEL INJECTION (MPI)

FUEL INJECTION SYSTEM, SERVICING

Fuel injection system, servicing

Overview of component locations, refer to **Component locations, overview**

General notes on fuel injection, refer to **General notes on fuel injection**

Fuel injection system components, assembly overview, refer to **Fuel injection system components, assembly overview**

Intake manifold, assembly overview, refer to **Intake manifold, assembly overview**

Intake manifold, removing and installing, refer to **Intake manifold, removing and installing**

Fuel rail, assembly overview, refer to **Fuel rail, assembly overview**

Air filter, assembly overview, refer to **Air filter, assembly overview**

Safety precautions, refer to **Safety precautions**

Rules of cleanliness, refer to **Rules for cleanliness**

Technical data, refer to **Technical data**

Component locations, overview

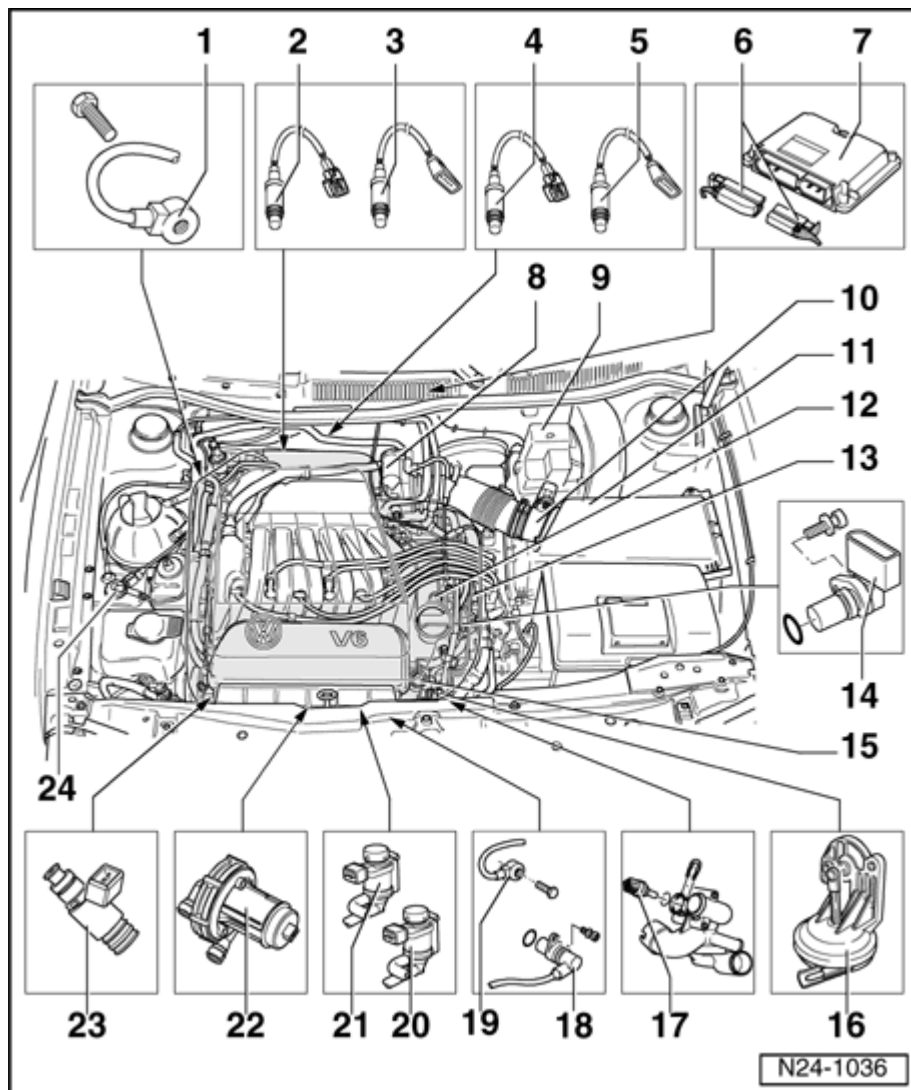


Fig. 211: Electronic Power Control System Component Locations, Overview
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Knock sensor 1 G61

- Component location: Cylinder block, exhaust side

2 - Heated Oxygen Sensor (HO2S) G39, 50 Nm

- Component location: in front exhaust pipe for cylinder 1, 2 and 3

3 - Oxygen sensor (O2S) behind three way catalytic converter (TWC) G130, 50 Nm

- Component location: in rear catalytic converter

4 - Heated oxygen sensor (HO2S) 2 G108, 50 Nm

- Component location: in front exhaust pipe for cylinder 4, 5 and 6

5 - Oxygen sensor (O2S) 2 behind three way catalytic converter (TWC) G131, 50 Nm

- Component location: in rear catalytic converter

6 - Connector

- For Engine Control Module (ECM)
- Only disconnect and connect the connector with the ignition switched off.
- Release to disconnect

7 - Motronic Engine Control Module (ECM) J220

- Component location: in plenum chamber

8 - Throttle valve control module J338

- Coolant heated

9 - Protective housing

- For secondary air injection (AIR) pump relay J299

10 - Mass air flow (MAF) sensor G70 with Intake air temperature (IAT) sensor G42

11 - Air filter housing

12 - Valves for camshaft adjustment

13 - Ignition coil N152

- Not on engine code BJS
- With spark plug wire identification, do not interchange

14 - Camshaft Position (CMP) sensor G40

15 - Fuel pressure regulator

16 - Vacuum actuator

- For variable intake manifold

17 - Engine coolant temperature (ECT) sensor G62

- Blue

- For Engine Control Module (ECM)
- With engine coolant temperature (ECT) sensor G2
- If necessary release pressure in cooling system before removing

18 - Engine speed (RPM) sensor G28

19 - Knock sensor 2 G66

- Component location: Cylinder block, intake side

20 - Secondary air injection (AIR) solenoid valve N112

21 - Intake manifold change-over valve N156

- For variable intake manifold

22 - Secondary air injection (AIR) pump motor V101

23 - Cylinder 1 fuel injector N30

- Cylinder 2 fuel injector N31
- Cylinder 3 fuel injector N32
- Cylinder 4 fuel injector N33
- Cylinder 5 fuel injector N83
- Cylinder 6 fuel injector N84

24 - Evaporative emission (EVAP) canister purge regulator valve N80

General notes on fuel injection

Ignition system, servicing: Refer to **Ignition system, servicing**

- The Engine Control Module (ECM) is equipped with On Board Diagnostics (OBD). Before repairs such as fault finding, check the Fault memory first. Also the vacuum hoses and connections must be checked (unmetered air).
- Fuel hoses in engine compartment must only be secured with spring-type clips. The use of clamp or screw type clips is not permissible.
- For trouble-free operation of the electrical components a voltage of at least 11.5 V is necessary.
- Do not use sealants containing silicone. Particles of silicone drawn into the engine, will not be burnt in the engine and damage the oxygen sensor.

Safety precautions, refer to **Safety precautions** .

Rules for cleanliness, refer to **Rules for cleanliness** .

Technical data, refer to **Technical data** .

Fuel injection system components, assembly overview

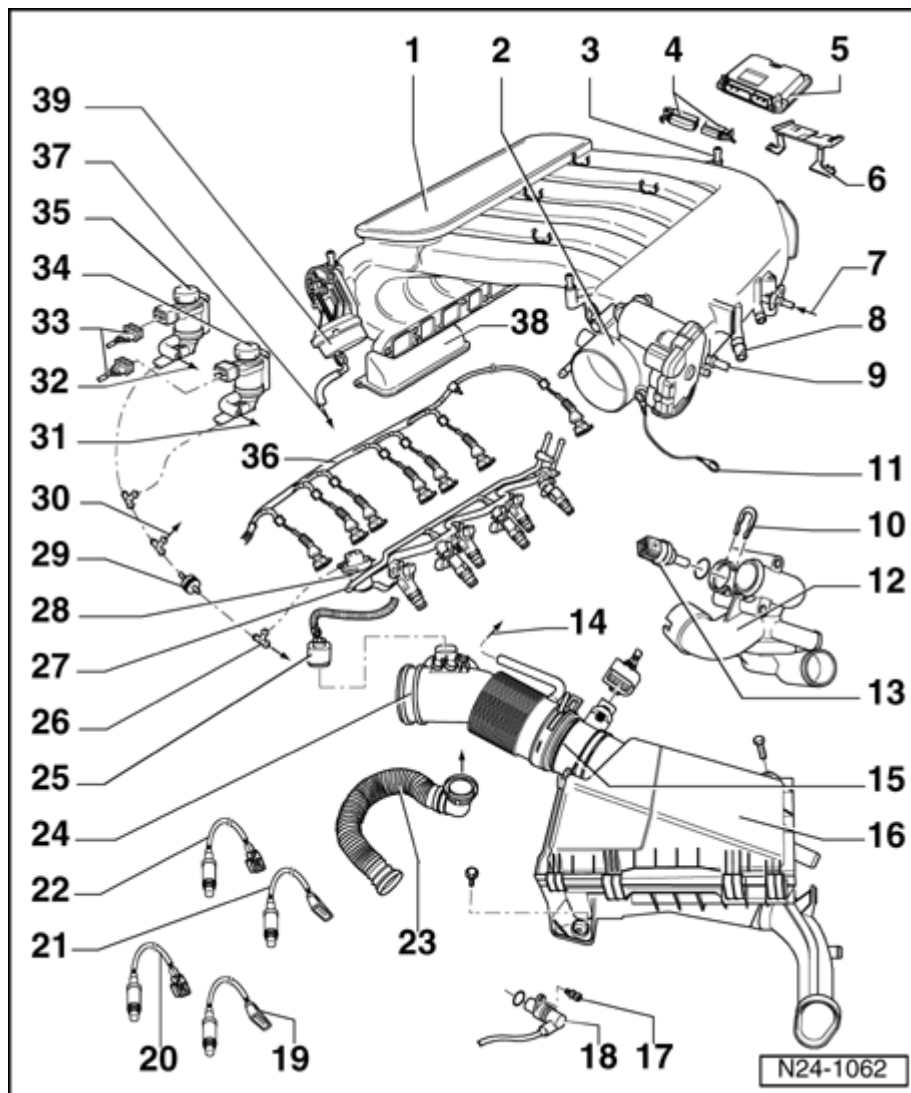


Fig. 212: Fuel Injection System Components, Assembly Overview
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Intake manifold

- Disassembling and assembling, refer to **Intake manifold, assembly overview**

2 - Throttle valve control module J338

- When replacing, adapt Engine Control Module (ECM) to throttle valve control module "Guided functions"

3 - Mounting pin

- For engine cover

4 - Connector

- For Motronic Engine Control Module (ECM) J220
- Release to disconnect
- Only disconnect and connect the connector with the ignition switched off.

5 - Motronic Engine Control Module (ECM) J220

- Component location: in plenum chamber
- Removing and installing, refer to **Engine Control Module (ECM), removing and installing**
- When replacing, the Engine Control Module (ECM) must be adapted to the electronic immobilizer, refer to **Adapting functions and components** .

6 - Mounting frame

7 - Vacuum connection from fuel pressure regulator

8 - Vacuum connection for brake booster

9 - Connection for EVAP canister

10 - Retaining clip

- Check for secure seat

11 - Ground wire

- Check for secure seat

12 - Coolant thermostat housing

- Component location, refer to **Component locations, overview**

13 - Engine coolant temperature (ECT) sensor G62

- Blue identification
- For Engine Control Module (ECM)
- With engine coolant temperature (ECT) sensor G2
- If necessary release pressure in cooling system before removing
- Wiring terminal 3 and wiring terminal 4 for Engine Coolant Temperature (ECT) Sensor G62
- Contacts gold plated

14 - To connections on cylinder head

- For air shrouded fuel injectors

15 - Mass air flow (MAF) sensor G70 with intake air temperature (IAT) sensor G42

- Sensor contacts and connector contacts gold plated

16 - Air filter housing

- Disassembling and assembling, refer to **Air filter, assembly overview**

17 - 10 Nm

18 - Engine speed (RPM) sensor G28

- Component location, refer to **Component locations, overview**

19 - Oxygen sensor (O2S) 2 behind three way catalytic converter (TWC) G131, 50 Nm

- Component location: in left rear side of catalytic converter
- Grease only the threads with "G 052 112 A3" ; "G 052 112 A3" must not get into the slots on the probe body
- Use ring spanner set for oxygen sensor 3337 for removal and installation
- With 4-pin connector
- Voltage supply for sensor heater via fuel pump relay J17

20 - Heated oxygen sensor (HO2S) 2 G108, 50 Nm

- Component location: in front left side of exhaust pipe
- Grease only the threads with "G 052 112 A3" ; "G 052 112 A3" must not get into the slots on the probe body
- Use ring spanner set for oxygen sensor 3337 for removal and installation
- With 6-pin connector
- Voltage supply for sensor heater via fuel pump relay J17

21 - Oxygen sensor (O2S) behind three way catalytic converter (TWC) G130, 50 Nm

- Component location: in right rear side of catalytic converter
- Grease only the threads with "G 052 112 A3" ; "G 052 112 A3" must not get into the slots on the probe body
- Use ring spanner set for oxygen sensor 3337 for removal and installation
- With 4-pin connector

- Voltage supply for sensor heater via fuel pump relay J17

22 - Heated Oxygen Sensor (HO2S) G39, 50 Nm

- Component location: in front right side of exhaust pipe
- Grease only the threads with "G 052 112 A3" ; "G 052 112 A3" must not get into the slots on the probe body
- Use ring spanner set for oxygen sensor 3337 for removal and installation
- With 6-pin connector
- Voltage supply for sensor heater via fuel pump relay J17

23 - Connecting hose

- For crankcase ventilation
- From ventilation housing on cylinder head cover

24 - Positive Crankcase Ventilation (PCV) Heating Element N79

- For crankcase ventilation
- Not for engine code BJS

25 - Connector

- Black, 2-pin
- For Positive Crankcase Ventilation (PCV) Heating Element N79
- Check specified value of voltage supply for positive crankcase ventilation (PCV) heating element between contacts 1 and 2 with engine running: min. 11.5 V

26 - To vacuum connection**27 - Fuel rail****28 - Fuel pressure regulator****29 - Non-return valve**

- Black side of valve faces the junction piece of fuel pressure regulator

30 - To vacuum reservoir**31 - To vacuum actuator****32 - To combi-valve**

33 - Connector

34 - Intake manifold change-over valve N156

- Component location, refer to **Component locations, overview**

35 - Secondary air injection (AIR) solenoid valve N112

- Component location, refer to **Component locations, overview**

36 - Wiring harness

- With harness connectors for fuel injectors

37 - To intake manifold change-over valve N156

38 - To vacuum reservoir

39 - Vacuum actuator

- For variable intake manifold

Intake manifold, assembly overview

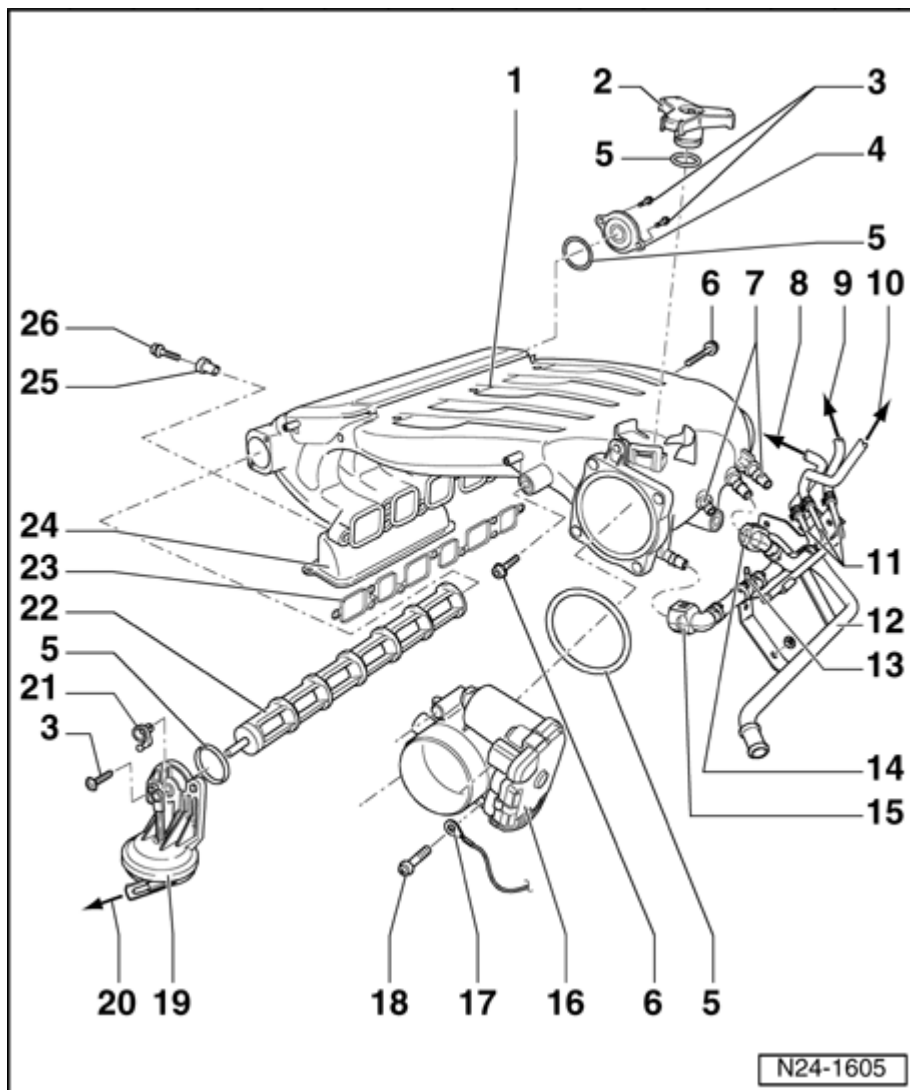


Fig. 213: Intake Manifold, Assembly Overview
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- 1 - Intake manifold
- 2 - Plug
- 3 - 10 Nm
- 4 - Bearing cap
 - For change-over roller of intake manifold change-over
- 5 - Oil seal
 - Replace

6 - 25 Nm

7 - Vacuum connection

8 - To evaporative emission (EVAP) canister purge regulator valve N80

- Evaporative emissions (EVAP) system: Refer to **Evaporative emissions (EVAP) system**

9 - To reservoir

- For coolant

10 - To vacuum actuator

- For exhaust flap valve 1 N321

11 - Connecting lines

12 - Coolant line

13 - Vacuum connection

- For crankcase ventilation

14 - Vacuum connection

- For exhaust flap valve 1 N321

15 - Vacuum connection

- For EVAP canister system

16 - Throttle valve control module J338

- Connector contacts gold plated
- Coolant heated
- When replacing, adapt Engine Control Module (ECM) to throttle valve control module "Guided functions"

17 - Ground wire

18 - 10 Nm

19 - Vacuum actuator

- For variable intake manifold

20 - To intake manifold change-over valve N156

21 - Control lever

- For change-over roller
- Ensure seated tightly

22 - Change-over roller

23 - Seal

- Note installation position
- Replace if damaged

24 - To vacuum reservoir

- For variable intake manifold
- For secondary air injection system

25 - Dowel sleeve

- For intake manifold mount
- For attaching seal

26 - 15 Nm

Intake manifold, removing and installing

Removing

Installing

Special tools, testers and auxiliary items required

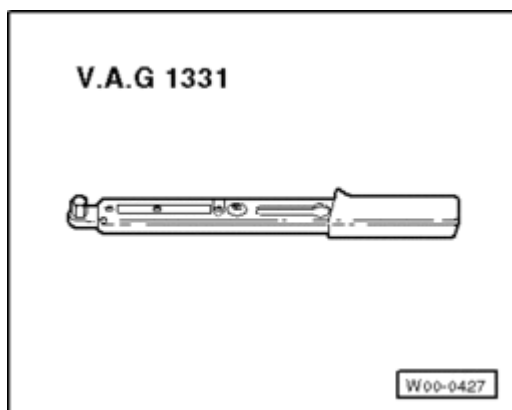


Fig. 214: Torque Wrench V.A.G. 1331 (5 To 50 Nm)

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Torque wrench V.A.G 1331

Removing

NOTE:

- To perform work sequence, the Ground cable must be disconnected from battery. Check whether a coded radio is installed. If so, obtain anti-theft coding beforehand.

- With ignition switched off disconnect battery Ground (GND) strap.
- All cable ties which are opened or cut open when removing, must be replaced in the same position when installing.
- Remove engine cover.

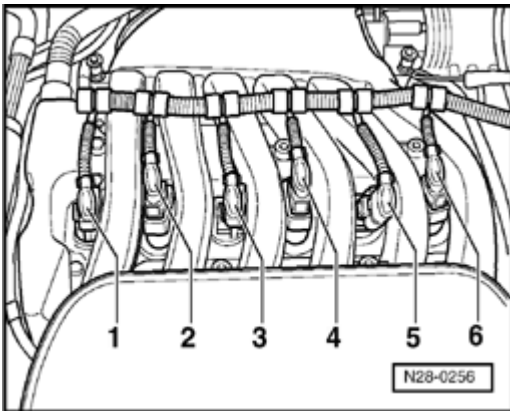


Fig. 215: Identifying Ignition Coils

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- On engine codes BJS remove the ignition coils with power output stages for cylinders - **1 through 6** - using the puller for ignition coil T10095 A, refer to **Ignition coils with power output stage, removing and installing** .
- Remove intake hose between Mass Air Flow (MAF) Sensor G70 and Throttle Valve Control Module J338. Refer to **Air filter, assembly overview**

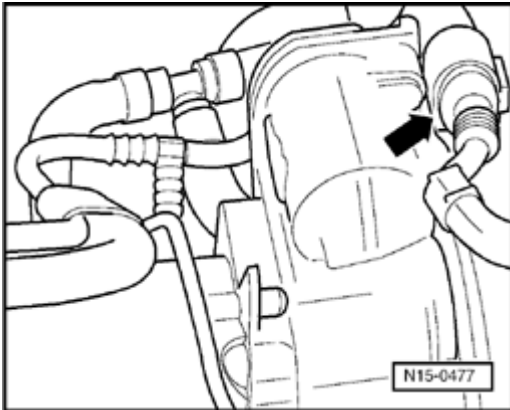


Fig. 216: Throttle Valve Control Module J338

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect 6-pin connector from Throttle Valve Control Module J338 - **arrow** -.
- Remove ground connection from Throttle Valve Control Module J338.

CAUTION: Hot steam may escape when opening expansion tank. Wear protective goggles and protective clothing to prevent damage to eyes and scalding. Cover cap with a rag and open carefully.

- Open and close cap on expansion tank, to relieve cooling system pressure.
- Disconnect coolant hoses from Throttle Valve Control Module J338 and plug hose ends.
- Remove coolant and connecting lines and as well as vacuum connection, and behind intake manifold.

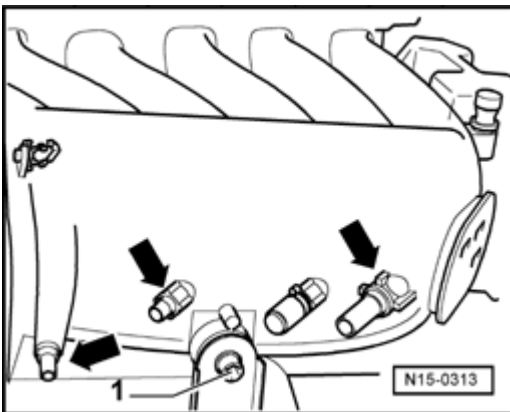


Fig. 217: Intake Manifold Vacuum Lines

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull off vacuum lines - **arrows** - from intake manifold.
- Unbolt intake manifold supports from right and left of intake manifold.
- Remove bolt - **1** - for intake manifold support.

CAUTION: Fuel system is under pressure! Wear eye protection and protective

clothing in order to avoid injuries by contact with fuel. Before removing from hose connection wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

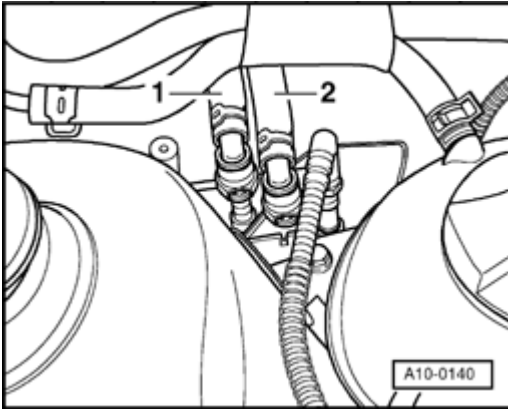


Fig. 218: Identifying Supply Line And Return Line
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull off supply line - 1 - (with white marking) and return line - 2 - (with blue marking) and catch any released fuel with a shop rag.

NOTE:

- Press buttons on hose couplings to do this.

- Seal lines so that the fuel system is not contaminated by dirt etc.
- Unclip fuel and vacuum lines at cylinder head cover.
- Remove two sideways bolts for intake manifold support.
- Remove sound insulation pan, along with left and right sides: Refer to **50 BODY, FRONT**
- Remove front bumper cover: Refer to **63 BUMPER**
- Remove retaining clamp(s) from refrigerant lines.

CAUTION: The air conditioning refrigerant circuit must not be opened.

- Bring lock carrier into service position: Refer to **50 BODY, FRONT**
- Pull off connecting hose from cylinder head cover.
- Pull off vacuum hose from combi-valve.
- Unclip pressure hose and all additional lines from retainers on intake manifold and cylinder head cover.

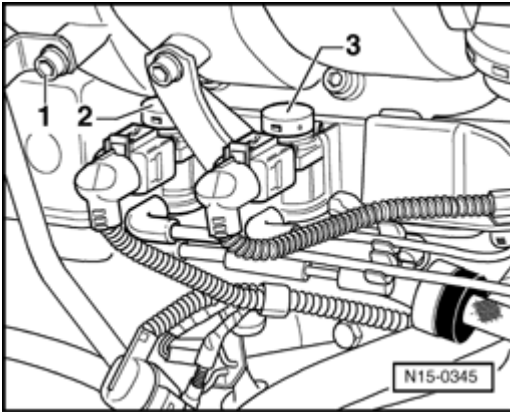


Fig. 219: Oil Dipstick Guide Tube, Secondary Air Injection Solenoid Valve & Variable Intake Manifold Valve

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove oil dipstick guide tube - **1** - from intake manifold.
- Unclip secondary air injection solenoid valve - **2** - and variable intake manifold valve - **3** - at vacuum reservoir.

NOTE:

- **The connectors for the valves can remain connected.**

- Pull off vacuum hose from intake manifold change-over vacuum actuator.
- Remove securing bolts from intake manifold on cylinder head.
- Remove intake manifold and place it on a suitable surface so that vacuum actuator is not damaged.

NOTE:

- **Seal the intake ports in the intake manifold and in cylinder head with clean cloths.**

Installing

Installation is performed in reverse order of removal. Note the following:

- Ensure fuel hoses are seated securely.
- If necessary, fill with coolant, refer to *Cooling system, draining and filling* under **Cooling system, draining and filling** .

Fuel rail, assembly overview

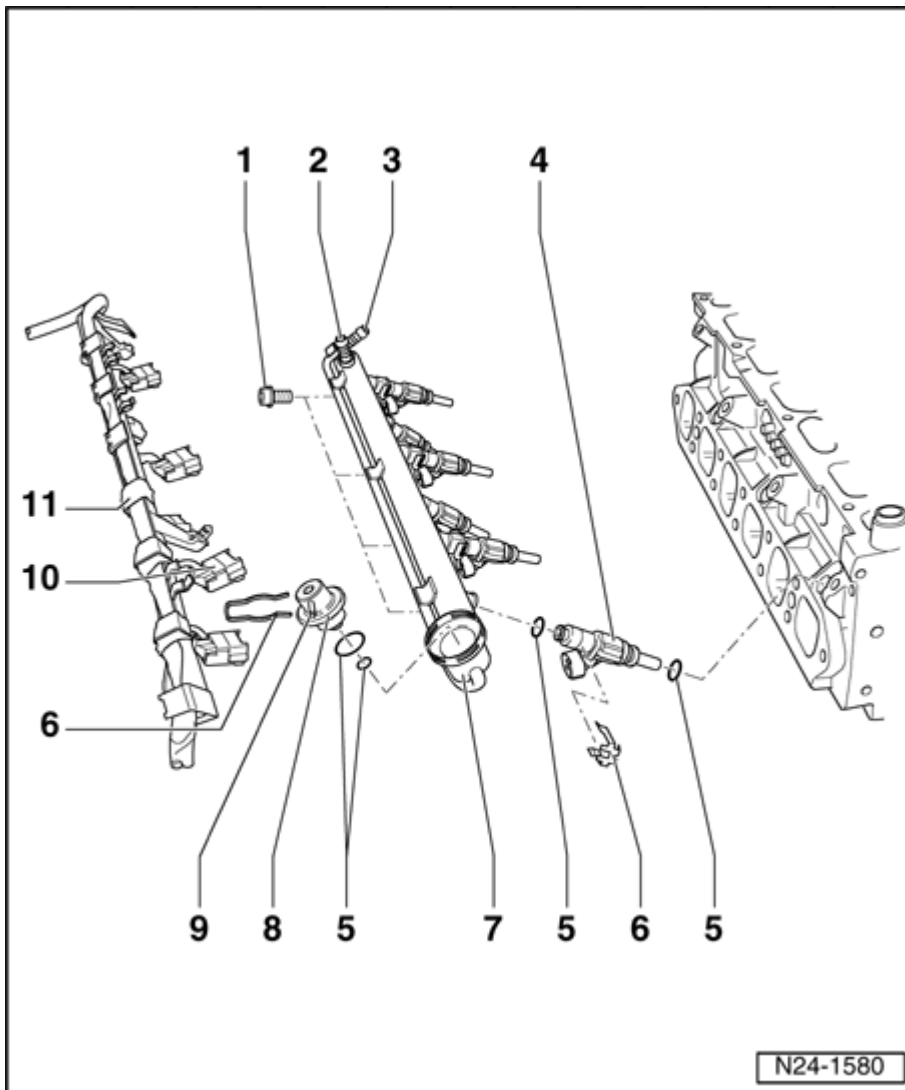


Fig. 220: Fuel Rail, Assembly Overview

Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 10 Nm

2 - Supply line connection

3 - Return line connection

4 - Cylinder 1 fuel injector N30

- Cylinder 2 fuel injector N31
- Cylinder 3 fuel injector N32
- Cylinder 4 fuel injector N33
- Cylinder 5 fuel injector N83
- Cylinder 6 fuel injector N84

- Checking, refer to **Fuel injectors, checking**

5 - Oil seal

- Replace

6 - Retaining clip

- Check for secure seat

7 - Fuel rail

8 - Fuel pressure regulator

- Checking, refer to **Fuel pressure regulator and residual pressure, checking**

9 - Vacuum connection

- To check valve/intake manifold junction piece

10 - Connector

- Black, 2-pin
- Check for secure seat

11 - Wiring harness

- With harness connectors for fuel injectors
- Clipped into cable runner

Air filter, assembly overview

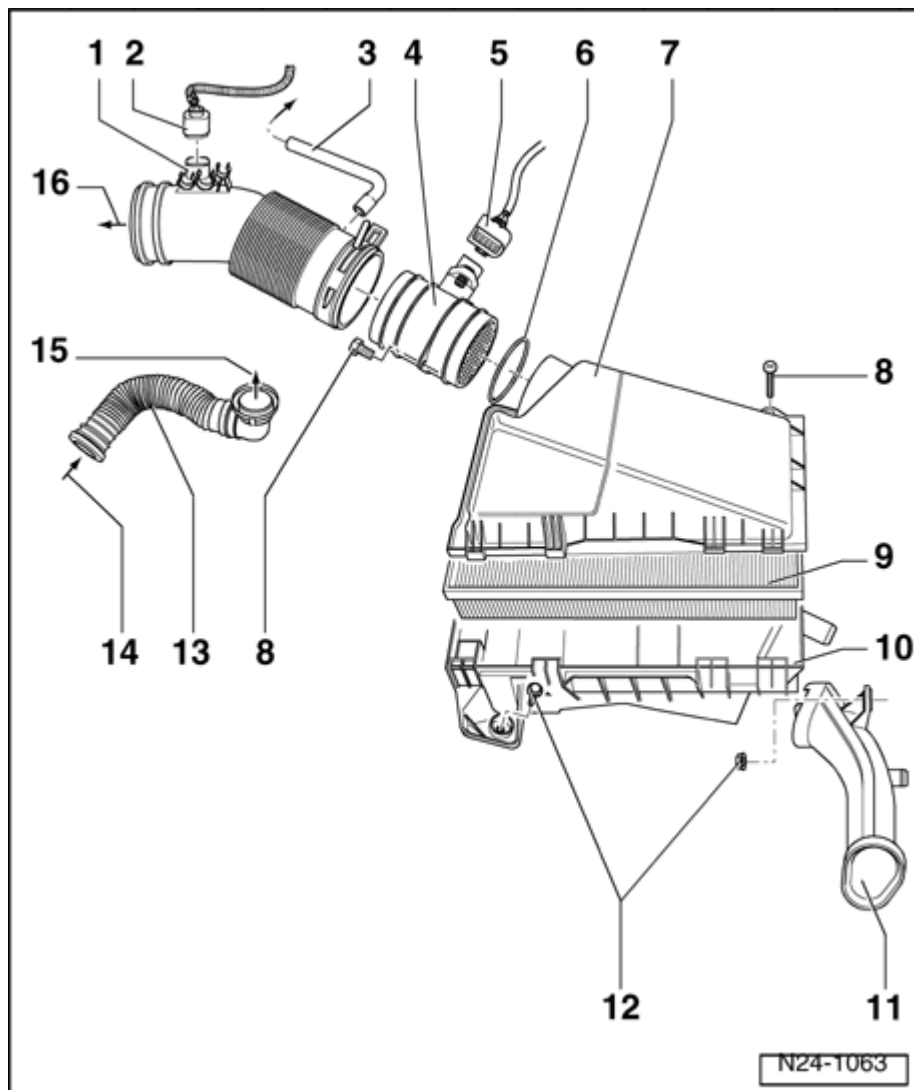


Fig. 221: Air Filter, Assembly Overview

Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Positive Crankcase Ventilation (PCV) Heating Element N79

- For crankcase ventilation

2 - Connector

- Black, 2-pin
- For Positive Crankcase Ventilation (PCV) Heating Element N79
- Check specified value of voltage supply for positive crankcase ventilation (PCV) heating element between contacts 1 and 2 with engine running: min. 11.5 V

3 - Connecting hose

- For air shrouded fuel injectors
- Not on engine codes BJS.

4 - Mass air flow (MAF) sensor G70 with intake air temperature (IAT) sensor G42

- Sensor contacts and connector contacts gold plated

5 - Connector

- Black, 5-pin
- Sensor contacts and connector contacts gold plated

6 - Oil seal

- Replace if damaged

7 - Air filter upper part

8 - 6 Nm

9 - Filter element

10 - Air filter lower part

11 - Air duct

12 - 10 Nm

13 - Intake tube

- For crankcase ventilation
- From ventilation housing on cylinder head cover
- Ensure seated tightly
- Press together at front to release

14 - From cylinder head cover

15 - To crankcase ventilation valve

- Under the PCV heating element

16 - To Throttle Valve Control Module J338

Safety precautions

- For safety reasons, fuse No. 28 must be removed from fuse holder before opening fuel system as fuel

pump can be activated by door contact switch in drivers door.

CAUTION: Fuel system is under pressure! Wear eye protection and protective clothing in order to avoid injuries by contact with fuel. Before removing from hose connection wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

To reduce risk of personal injury and/or damage to the fuel injection and ignition system, always observe the following:

- Do not touch or remove ignition wires when engine is running or turning at starter speed.
- Only disconnect and reconnect wires for injection and ignition system, including test leads, when ignition is switched off.

If test and measuring equipment is required during road test, note the following:

- Test and measuring instruments must be secured to rear seat and operated by a 2nd person from this location.

If test and measuring instruments are operated from the front passenger seat and the vehicle is involved in an accident, there is a possibility that the person sitting in this seat may receive serious injuries when the airbag is triggered.

- If engine is to be turned at starter speed, without starting:
 - Disconnect connector from ignition coils 1 to 6.

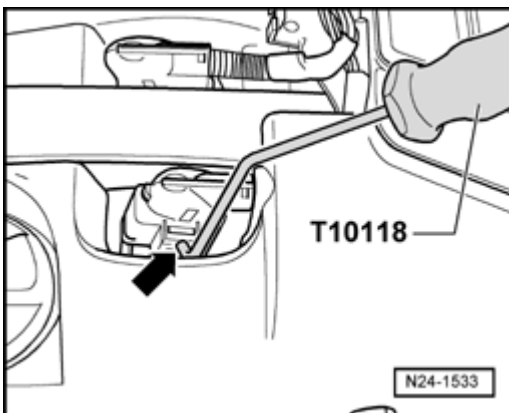


Fig. 222: Identifying Assembly Tool T10118 On Release Button
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- To do this, place assembly tool T10118 against release button - **arrow** -, and carefully remove connector.

Rules for cleanliness

When working on fuel supply/injection system, pay careful attention to the following "5 rules" :

2004 Volkswagen R32

ENGINE 3.2 Liter VR6 4V Engine Mechanical, Fuel Injection Ignition, Engine Code(s): BJS

- Thoroughly clean all connections and surrounding area before disconnecting.
- Place parts that have been removed on a clean surface and cover them. Do not use fluffy cloths!
- Carefully cover over opened components or seal, if repairs are not performed immediately.
- Only install clean components: Only unpack replacement parts immediately prior to installation. Do not use parts that have been stored loose (e.g. in tool boxes etc.).
- When system is open: Avoid working with compressed air if possible. Do not move vehicle unless absolutely necessary.

Technical data

Engine code			BJS
Idle check			
Engine idle speed * See note	RPM		650 to 750
Engine Control Module (ECM)			
System designation			Motronic ME71.1
Replacement part number			refer to Parts catalog
Engine speed (RPM) limitation	RPM		from approx. 6500

* Not adjustable

COMPONENTS, CHECKING

Components, checking

Check fuel injectors, refer to **Fuel injectors, checking**

Fuel pressure regulator and residual pressure, checking, refer to **Fuel pressure regulator and residual pressure, checking**

Fuel injectors, checking

Checking fuel injectors for injection quantity and proper seal

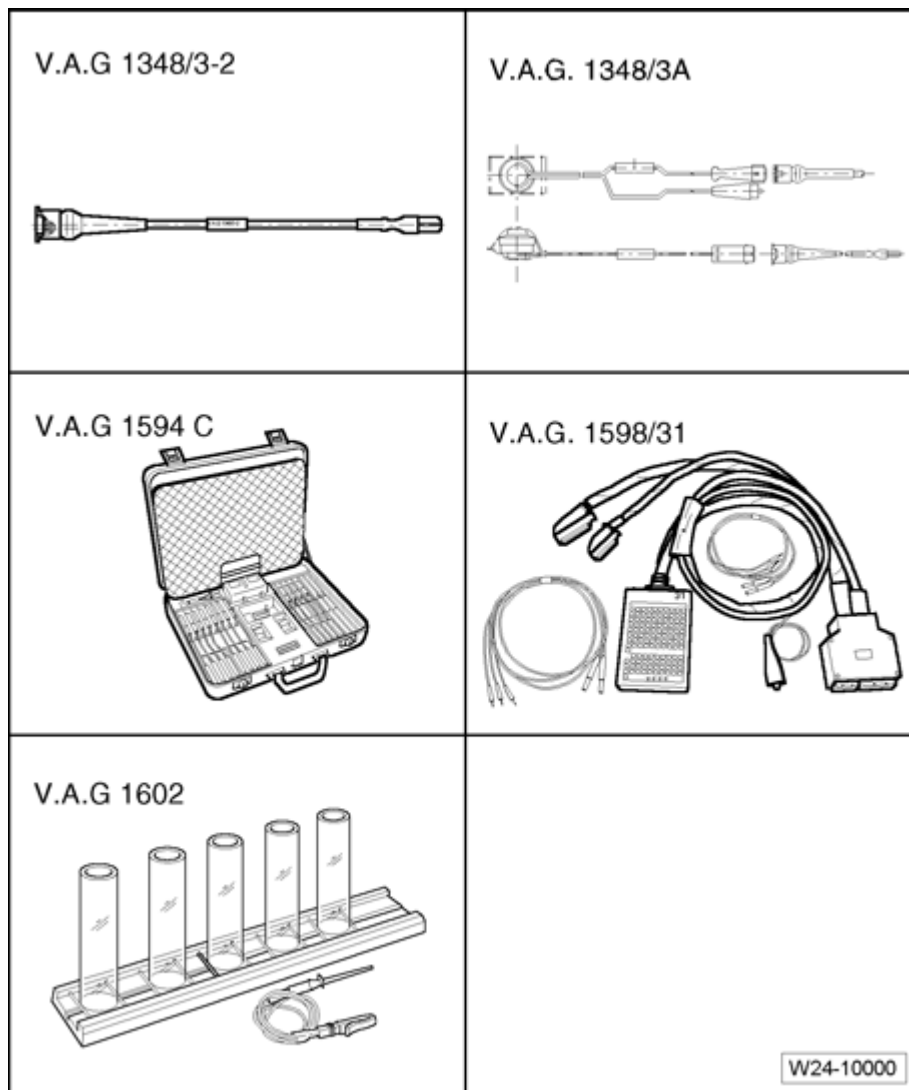


Fig. 223: Identifying Special Tools - Fuel Injectors, Checking
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Adapter cable V.A.G 1348/3-2
- Remote control connection V.A.G 1348/3A
- Connector test set V.A.G 1594C
- Adapter cable, 121-pin V.A.G 1598/31
- Injector quantity testing device V.A.G 1602

Fuel injectors, checking for leaks and quantity injected

Test conditions

- Fuel pressure must be OK, checking, refer to **Fuel pressure regulator and residual pressure, checking**.

Test sequence

- Remove intake manifold, refer to **Cylinder head cover, removing and installing**.
- Remove fuel rail completely (fuel lines remain connected)

Checking for leaks

- Remove cover in front of fuse holder.

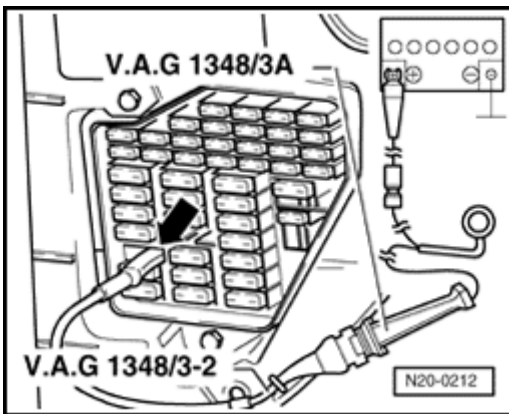


Fig. 224: Connecting VAG 1348/3A With Adapter Cable VAG 1348/3-2 To Contact And Battery Positive
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull fuse No. 28 from the fuse holder.
- Connect remote control V.A.G 1348/3A with adapter cable V.A.G 1348/3-2 to contact 28a to fuel pump and battery positive (+).
- Operate remote control.

If fuel pump is activated:

- Check injectors for leaks (visual inspection). Only 1 to 2 drops per minute may emit from each valve when fuel pump is running.

If fuel loss is greater:

- Switch off ignition.
- Replace faulty fuel injector.

When installing fuel injector, observe the following:

- Replace O-rings on all injectors and lightly moisten with clean engine oil.
- Insert fuel injectors into fuel rail perpendicular and in correct position, and secure them with retaining

clips.

- Position fuel rail with secured fuel injectors on intake manifold and apply uniform pressure to press it in.

Fuel injection quantity, checking

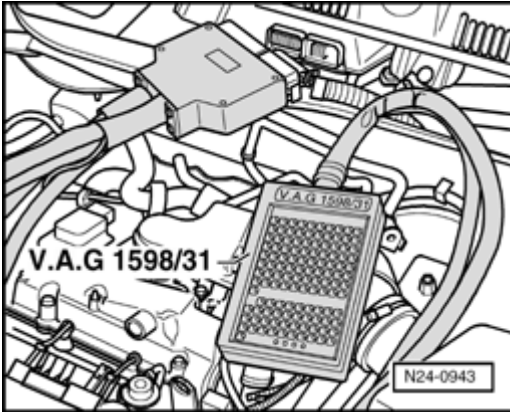


Fig. 225: Identifying Test Box V.A.G 1598/31 Connect To Control Module Wiring Harness
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect adapter cable, 121-pin V.A.G 1598/31 to Engine Control Module (ECM) wiring harness. The Engine Control Module (ECM) remains disconnected.
- Disconnect connectors from fuel injectors.
- Switch ignition on.
- Bridge sockets 2 and 65 of adapter cable, 121-pin V.A.G 1598/31 with adapter wires from connector test kit V.A.G 1594C. Fuel pump must run.

NOTE:

- This work step allows the fuel pump to run when the engine is not running.

- Insert injector to be tested in a measuring glass of calibration tester V.A.G 1602.

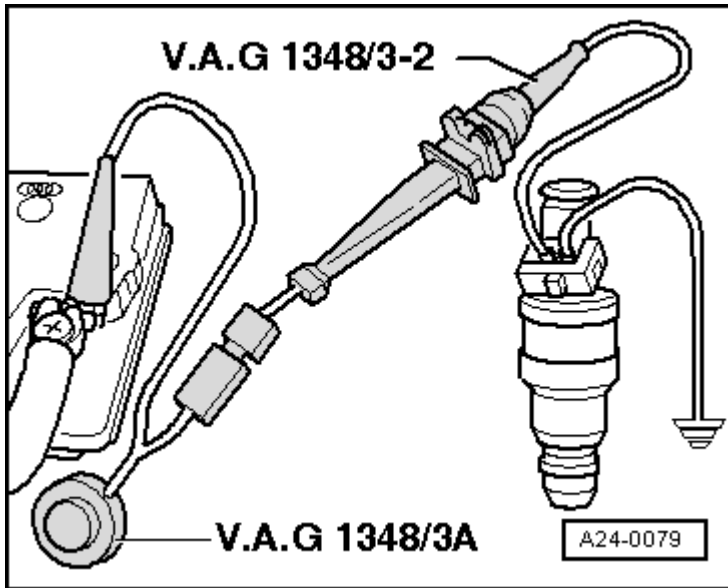


Fig. 226: Connecting Second Injector Contact To Remote Control V.A.G 1348/3 With V.A.G 1348/3-2
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Using adapter cables from connector test kit V.A.G 1594C, connect one terminal of fuel injector to be checked to engine Ground (GND).
- Connect second fuel injector terminal with adapter cable to remote control for VAG 1348 V.A.G 1348/3A using adapter cable V.A.G 1348/3-2.
- Connect alligator clip to battery (+).
- Operate remote control for VAG 1348 V.A.G 1348/3A for 30 seconds.
- Repeat check on other injectors. To do this use new measuring beakers.
- After all injectors have been activated, place measuring glasses on a horizontal surface and compare injected quantity. Specified value for:

Engine code BJS: 128 to 140 ml per injector

If measured value of one or more fuel injectors is below or above the indicated specified value:

- Switch off ignition.
- Replace faulty fuel injector.

When installing fuel injector, observe the following:

- Replace O-rings on all injectors and lightly moisten with clean engine oil.
- Insert fuel injectors into fuel rail perpendicular and in correct position, and secure them with retaining clips.
- Position fuel rail with secured fuel injectors on intake manifold and apply uniform pressure to press it in.

Fuel pressure regulator and residual pressure, checking

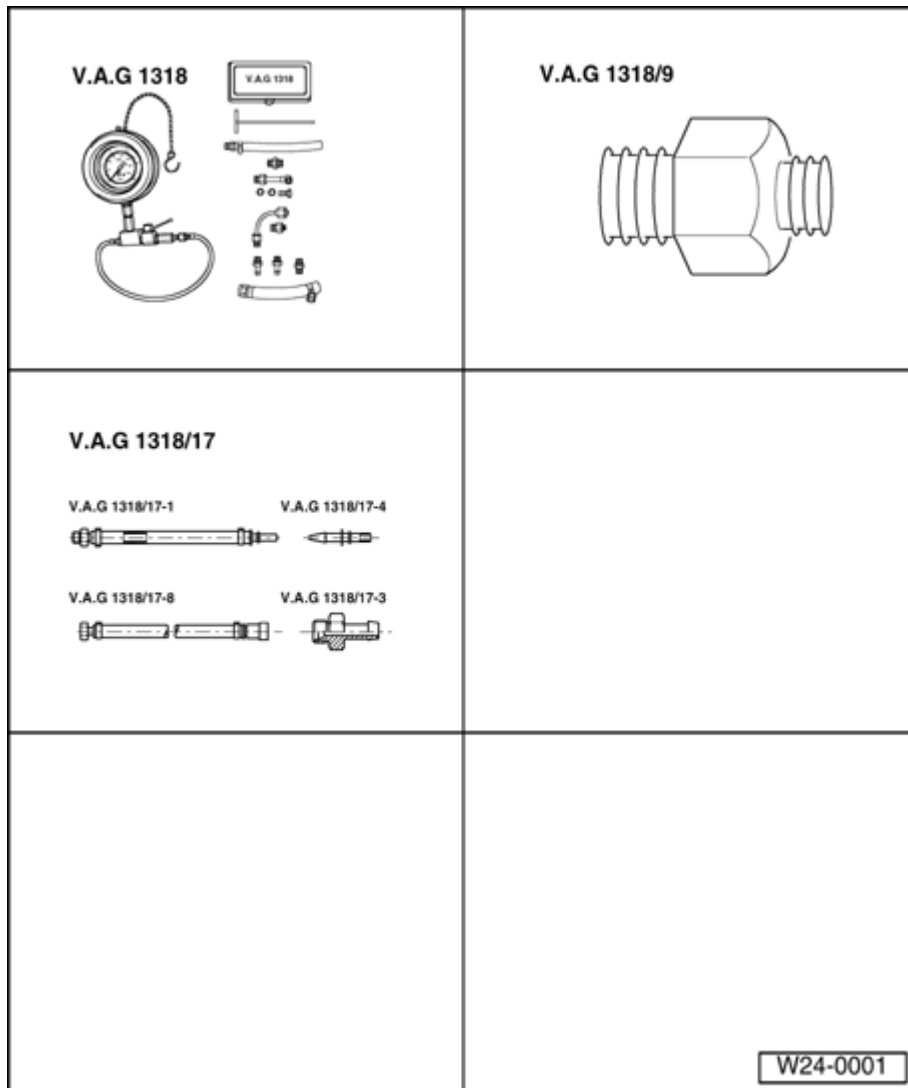


Fig. 227: Identifying Special Tools - Fuel Pressure Regulator And Residual Pressure, Checking
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Pressure gauge V.A.G 1318
- Adapter V.A.G 1318/9
- Pressure gauge adapter V.A.G 1318/17

The fuel pressure regulator controls the fuel pressure and is dependent on intake manifold pressure.

The specification for the check is dependent upon the working pressure of the fuel pump. For engine codes:

BJS approx. 3.5 bar

Test sequence

Test conditions

- Fuel pump delivery rate OK, checking: Refer to **Fuel pump, checking** .
- Remove fuse 28 for the Fuel Pump (FP) from fuse holder.

CAUTION: Fuel system is under pressure! Wear eye protection and protective gloves to avoid injuries and skin contact with fuel. Before opening the system place a cloth around the connection. Then release pressure by carefully loosening the connection.

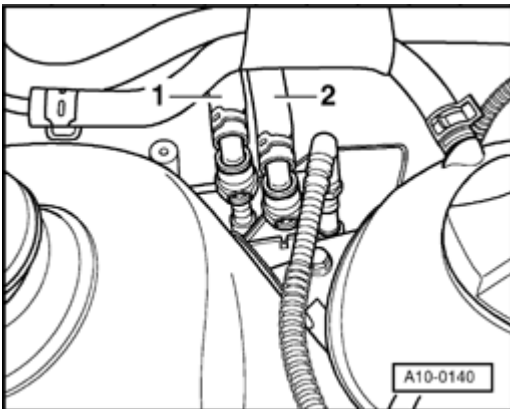


Fig. 228: Identifying Supply Line And Return Line
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull fuel supply hose - 1 - (black or black marking) off fuel rail and collect fuel that leaks out with a cloth.

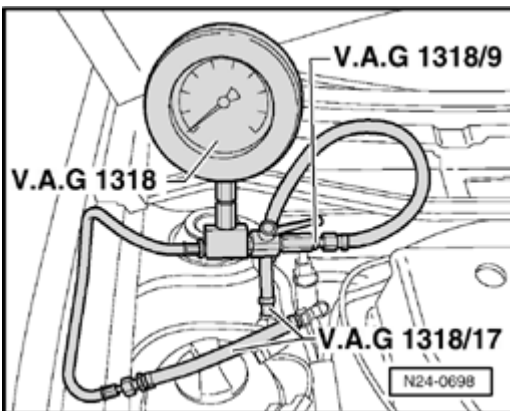


Fig. 229: V.A.G 1318 Components Connected To Supply Line And Fuel Rail
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect pressure gauge V.A.G 1318 to supply line and hose to fuel rail using adapter V.A.G 1318/9 and adapter V.A.G 1318/17.
- Open shut-off tap on pressure gauge V.A.G 1318. The lever points in direction of flow.

- Insert fuse No. 28 for the fuel pump into fuse holder.
- Start the engine and run at idle speed.
- Measure fuel pressure.

Specified value for engine code:

Engine code BJS: approx. 3.5 bar

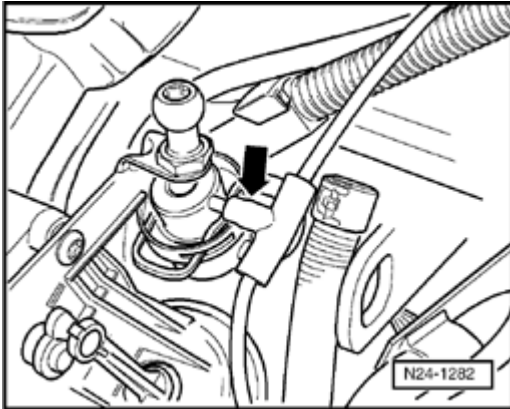


Fig. 230: Locating Vacuum Hose At Fuel Pressure Regulator
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull vacuum hose off from fuel pressure regulator - **arrow** -.

The fuel pressure must increase to:

Engine code BJS: approx. 4.0 bar

If specification is not obtained:

- Check delivery rate of fuel pump, refer to **Fuel pump, checking** .

If specification is obtained:

- Switch off ignition.
- Check for leaks and residual pressure. Observe pressure drop on pressure gauge. After 10 minutes there must be a holding pressure of at least:

3.0 bar for engine codes BJS.

If the holding pressure drops below these specifications:

- Start engine and run at idle speed.

When fuel pump has built up pressure again:

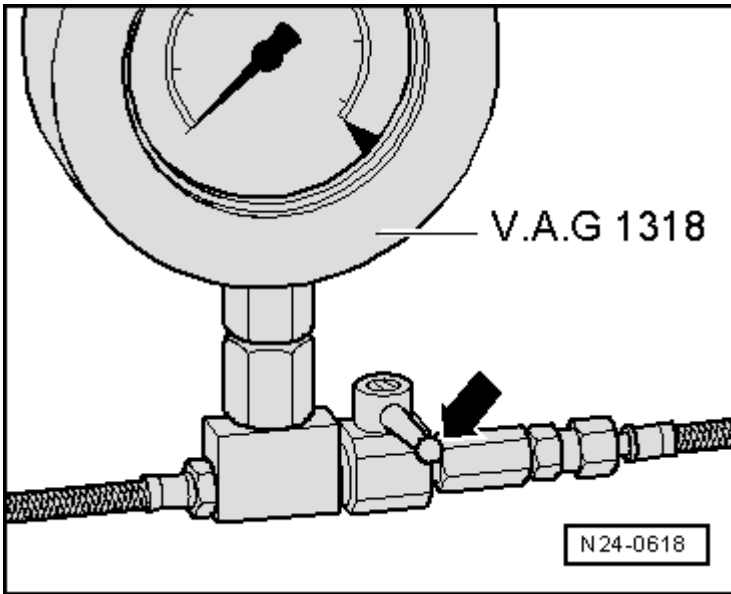


Fig. 231: Locating V.A.G 1318 Shut-Off Tap
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Wait until pressure has risen, and then switch off ignition. Simultaneously close shut-off valve of pressure gauge V.A.G 1318 (lever perpendicular to direction of flow - **arrow** -).
- Observe pressure drop again on pressure gauge.

If pressure does not drop:

- Test check valve of fuel pump, refer to **Fuel pump, checking** .

If pressure drops again:

- Check pressure gauge V.A.G 1318 for proper seal.
- Check line connections, O-rings on fuel rail and injectors for leaks.

If no leaks are found:

- Switch off ignition.
- Replace fuel pressure regulator.

When removing pressure gauge V.A.G 1318 after completing test:

- Hold a rag around connections when loosening adapters and removing pressure gauge.

ENGINE CONTROL MODULE (ECM)

Engine Control Module (ECM)

Engine Control Module (ECM), removing and installing, refer to **Engine Control Module (ECM), removing**

and installing

Adapting functions and components, refer to **Adapting functions and components**

Fault memory of Engine Control Module (ECM), erasing and checking, refer to **Engine Control Module (ECM) Fault memory, checking and erasing**

Engine Control Module (ECM), removing and installing

- Before removing Motronic Engine Control Module (ECM) J220 control module identification and coding must first be retrieved. Refer to **Engine Control Module (ECM) Fault memory, checking and erasing**

Removing

- Switch off ignition.
- Remove wiper arms and wind cowl, refer to **92 WINDSHIELD WIPER & WASHER SYSTEM** .
- Release connector from Engine Control Module (ECM) and pull off.

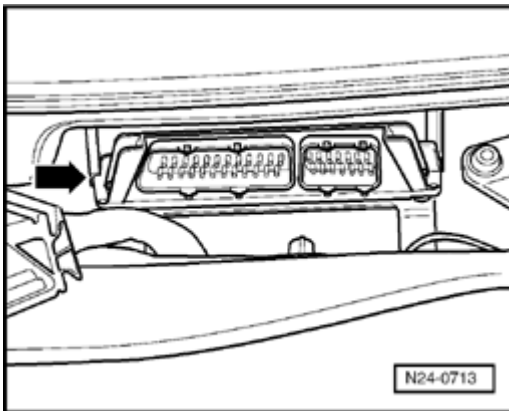


Fig. 232: Engine Control Module
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press Motronic Engine Control Module (ECM) J220 in direction of - **arrow** - and pull it out from the securing frame.

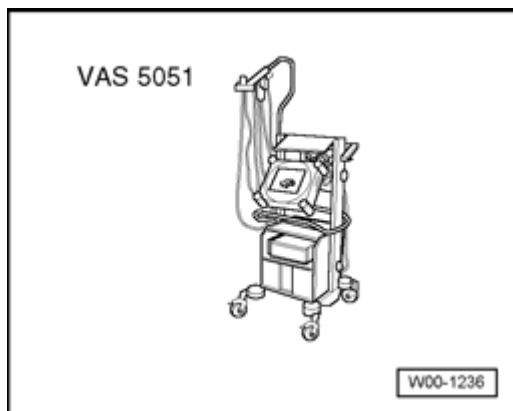
Installing

- Insert new control module and press it in so far rearward until it engages.
- Connect electrical connector and latch into place.

The further installation is performed in reverse order of removal.

- Check previous coding and code new control module, refer to **Adapting functions and components** .
- Adapt new Engine Control Module (ECM) to throttle valve control module "Guided functions"

Adapting functions and components

Special tools, testers and auxiliary items required**Fig. 233: Identifying Special Tool - VAS 5051**

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Vehicle diagnostic, testing, and information system VAS 5051B
- Diagnosis cable VAS 5051/1 or VAS 5051/3

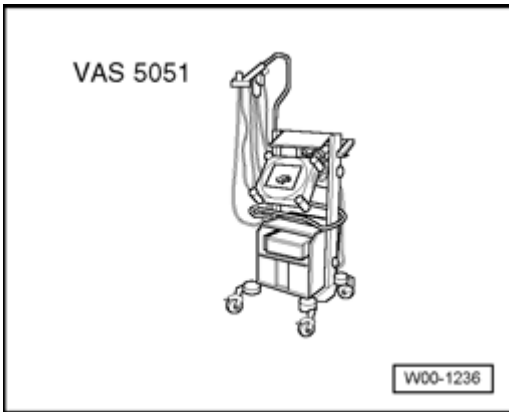
Work procedure

On Vehicle diagnostic, testing, and information system VAS 5051B, select "Guided Fault Finding".

Once all control modules have been checked:

- Press "Go to" button
- Select "Function/component selection"
- "Select powertrain"
- Select "Engine code"
- Select "01-Systems capable of On Board Diagnostic (OBD)"
- Select "Engine management system"
- Select "Functions"
- Select "Function or component"

Engine Control Module (ECM) Fault memory, checking and erasing**Special tools, testers and auxiliary items required**

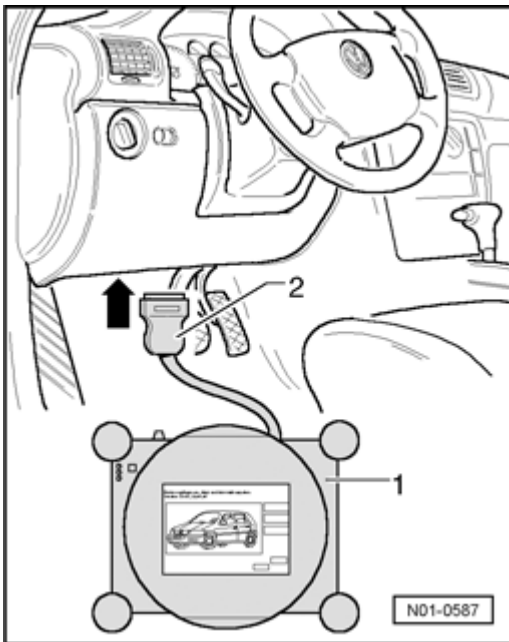
**Fig. 234: Identifying Special Tool - VAS 5051**

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Vehicle diagnostic, testing, and information system VAS 5051B
- Diagnosis cable VAS 5051/1 or VAS 5051/3

Work procedure

- Connect vehicle diagnosis, testing and information system VAS 5051 A as follows:

**Fig. 235: Diagnostic Cable Connector VAS 5051/1 Or VAS 5051/3 Connected To Data Link Connector**

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect diagnostic cable connector - 2 - VAS 5051/1 or VAS 5051/3 to Data Link Connector (DLC) - **arrow** -.
- Start engine and run at idle speed.

Only when engine does not start:

- Switch ignition on.

Selecting operating mode:

- Press button on display for "Vehicle On Board Diagnostic (OBD)".

Selecting vehicle system:

- Press button "01 - Engine electronics" on display.

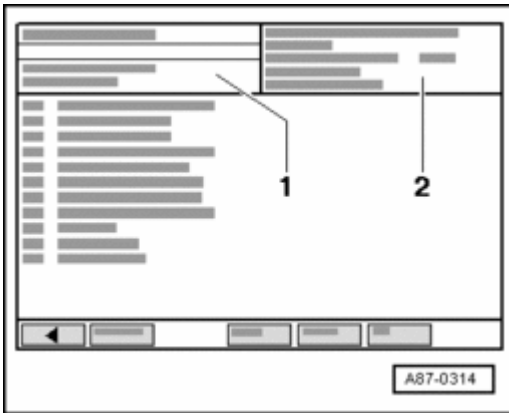


Fig. 236: Locating Control Module Identification With Code Indicated On The Display
Courtesy of VOLKSWAGEN UNITED STATES, INC.

The control module identification with code - **2** - as well as chassis number and immobilizer identification number will be indicated on the display.

NOTE:

- **A print-out is available. Press the "print" button if required.**

Selecting diagnosis function:

- Press button "02 - Interrogate fault memory" on display.
- If no malfunction is stored in Engine Control Module (ECM), "0 Fault(s) detected" is displayed.
- If malfunctions are stored in the Engine Control Module (ECM), these are shown one below another on the display.
- Press the <-- key.
- Press button "05 - Erase Fault memory" on display.
- Press function "06 - End output".

NOTE:

- **If an emissions test is to be performed after the fault memory is erased, generate readiness code. "Guided fault function."**

26 - EXHAUST SYSTEM, EMISSION CONTROLS

EXHAUST SYSTEM COMPONENTS, REMOVING AND INSTALLING

Exhaust system components, removing and installing

NOTE:

- After working on the exhaust system ensure that the system is not under stress, and that it has sufficient clearance from the bodywork. If necessary, loosen double clamps and align exhaust pipe so that sufficient clearance is maintained to the bodywork and mounts carry uniform loads.
- Replace self-locking nuts.

Special tools, testers and auxiliary items required

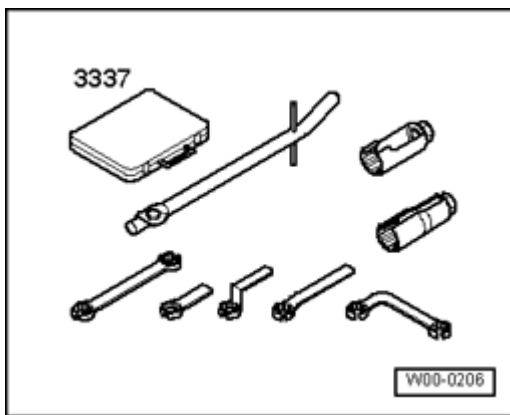


Fig. 237: 3337 Oxygen Sensor Ring Spanner

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Ring spanner 7-piece set for oxygen sensor 3337

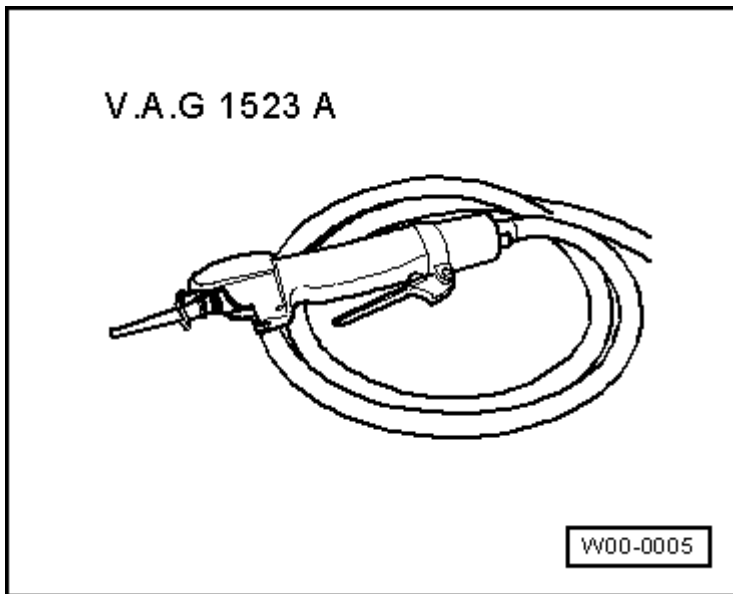


Fig. 238: Body Repair Saw V.A.G 1523A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Body repair saw V.A.G 1523A

Exhaust manifold, front exhaust pipe with double catalytic converter and attachments, assembly overview, refer to **Exhaust manifold, front exhaust pipe with double catalytic converter and attachments, assembly overview**

Muffler with mountings, assembly overview, refer to **Muffler with mountings, assembly overview**

Exhaust manifold, front exhaust pipe with double catalytic converter and attachments, assembly overview

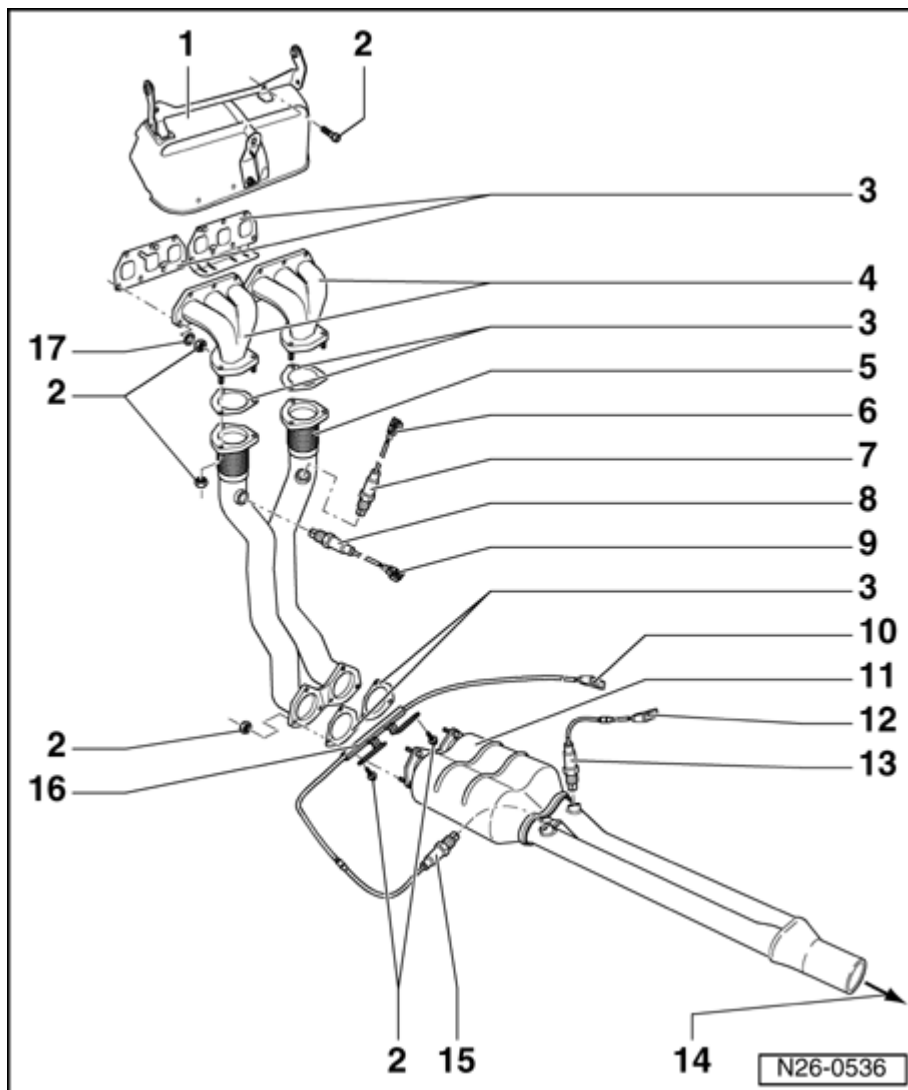


Fig. 239: Exhaust Manifold, Front Exhaust Pipe With Double Catalytic Converter And Attachments, Assembly Overview

Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Heat shield

2 - M6 - 10 Nm, M8 - 25 Nm, M10 - 40 Nm

3 - Seal

- Replace

4 - Exhaust manifold

5 - Front exhaust pipe

- For removal, remove front driveshaft tube: Refer to **39F - FINAL DRIVE, FRONT DIFFERENTIAL**

or **39R - FINAL DRIVE, REAR DIFFERENTIAL**

6 - Connector

- Black, 6-pin

7 - Heated Oxygen Sensor (HO2S) G39, 50 Nm

- Grease only the threads with "G 052 112 A3" ; "G 052 112 A3" must not get into the slots on the probe body
- Use ring spanner set for oxygen sensor 3337 for removal and installation

8 - Heated oxygen sensor (HO2S) 2 G108, 50 Nm

- Grease only threads with "G 052 112 A3" ; "G 052 112 A3" must not get into slots on probe body
- Use ring spanner set for oxygen sensor 3337 for removal and installation

9 - Connector

- Brown, 6-pin

10 - Connector

- Brown, 4-pin

11 - Double catalytic converter

- Behind the pipe junction with limit stop for double clamps

12 - Connector

- Black, 4-pin

13 - Oxygen sensor (O2S) behind three way catalytic converter (TWC) G130, 50 Nm

- Grease only threads with "G 052 112 A3" ; "G 052 112 A3" must not get into slots on probe body
- Use ring spanner set for oxygen sensor 3337 for removal and installation

14 - To front muffler

15 - Oxygen sensor (O2S) 2 behind three way catalytic converter (TWC) G131, 50 Nm

- Grease only the threads with "G 052 112 A3" ; "G 052 112 A3" must not get into slots on probe body
- Use ring spanner set for oxygen sensor 3337 for removal and installation

16 - Wiring router

- Fastened to subframe

17 - Washer

Muffler with mountings, assembly overview

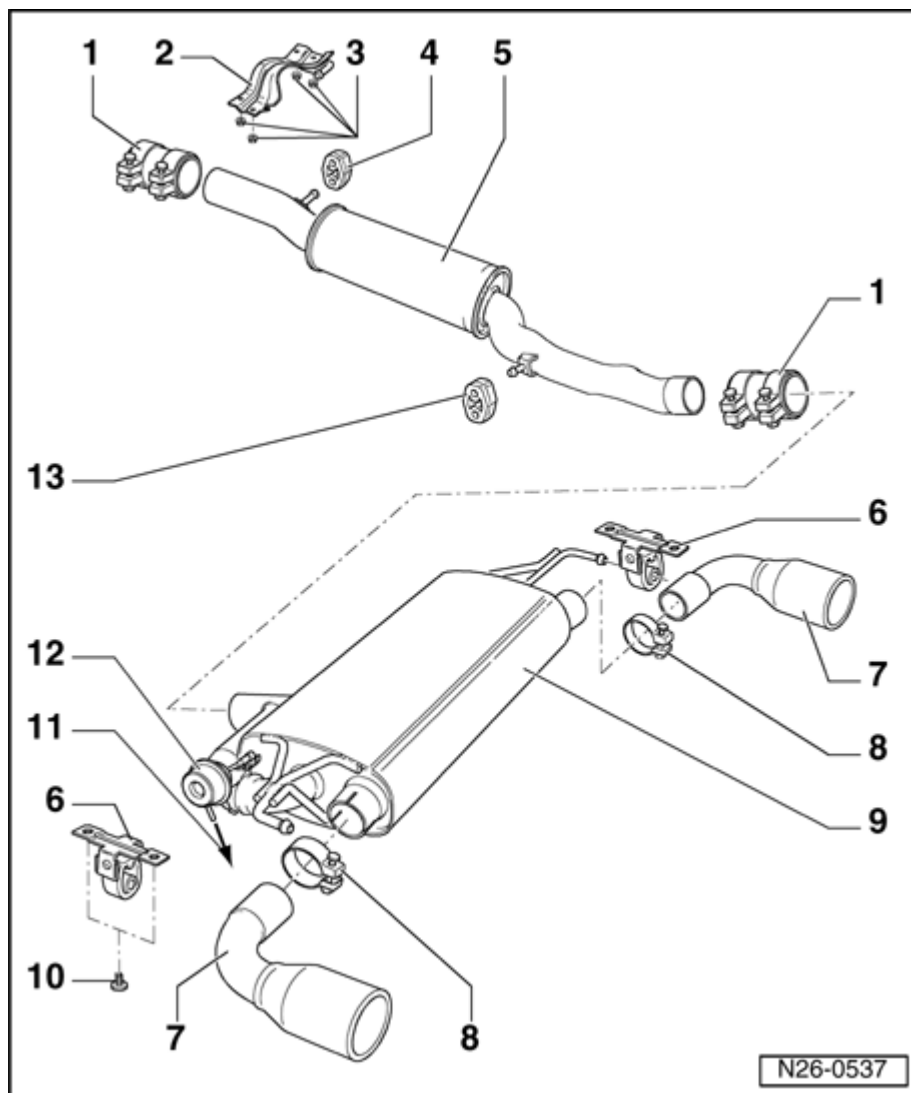


Fig. 240: Muffler With Mountings, Assembly Overview
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Double clamp, 40 Nm

- Note installed position: *Installed location of double clamp, in driving direction under Muffler with mountings, assembly overview*

2 - Connection support

3 - M6 - 10 Nm, M8 - 25 Nm, M10 - 40 Nm

4 - Retaining ring

- Grey color identification
- Replace if damaged

5 - Front muffler

- Note installation position **Aligning the exhaust system**

6 - Suspended mount

- With retaining ring
- Replace if damaged

7 - Exhaust tailpipe

8 - Clamp, 40 Nm

9 - Rear muffler

- Installing muffler free of tension

10 - M6 - 10 Nm, M8 - 25 Nm, M10 - 40 Nm

11 - To vacuum control module

- Installed location behind left rear wheel housing
- Individual components *Installed location of vacuum control module* under **Muffler with mountings, assembly overview**

12 - Vacuum actuator

- Use hand vacuum pump VAS 6213 to check operation

13 - Retaining ring

- Red color identification
- Replace if damaged

Aligning the exhaust system

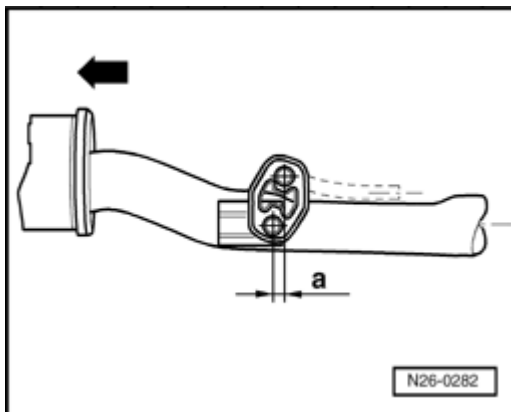


Fig. 241: Exhaust System Alignment Dimensions

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Engine must be cold.
- Align exhaust system to the mounting so that it reflects dimension - **a** -. - **Arrow** - indicates direction of travel. Dimension - **a** - = 10 ± 2 mm

Installed location of double clamp, in driving direction

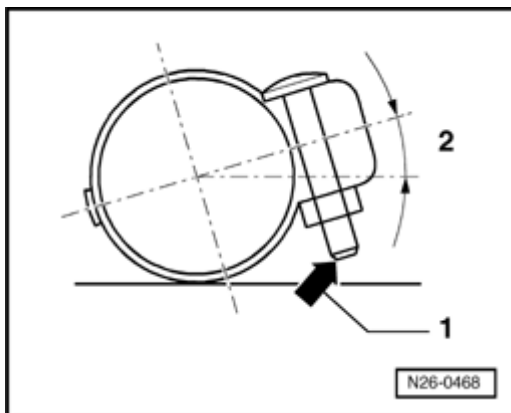


Fig. 242: Installed Location Of Double Clamp, In Driving Direction

Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - The end of the bolt must not project beyond lower edge of clamp.

2 - Angle $10^\circ + 5^\circ$

Installed location of vacuum control module

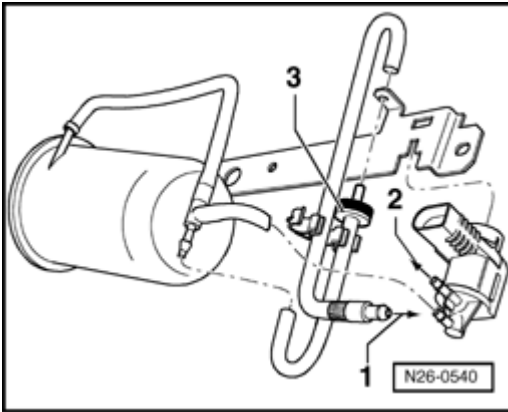


Fig. 243: Installed Location Of Vacuum Control Module
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- 1 - From check valve to intake manifold
- 2 - from exhaust flap valve 1 N321 to vacuum actuator
- 3 - Check valve (white side faces the vacuum reservoir)

SECONDARY AIR INJECTION (AIR) SYSTEM

Secondary air injection (AIR) system

Function, refer to **Function**

Secondary air injection (AIR) system components, assembly overview, refer to **Secondary air injection (AIR) system components, assembly overview**

Combination valve, checking, refer to **Combi-valve, checking**

Function

During cold start (+15 ° C to +35 ° C coolant temperature), air is blown behind exhaust valve by Secondary Air Injection (AIR) system for 65 seconds. This produces an oxygen rich exhaust gas, causes afterburning and reduces the heating-up phase of the catalytic converter. Activation is triggered by the Motronic Engine Control Module (ECM) J220 via Secondary Air Injection (AIR) Pump Relay J299 to Secondary Air Injection (AIR) Solenoid Valve N112 and combination valve. In addition, the Secondary Air Injection (AIR) system is switched on with a delay of approx. 20 seconds during idle for 5 seconds after every subsequent engine start (up to max. 85 ° C engine temperature) and is checked via On Board Diagnostic (OBD).

Secondary air injection (AIR) system components, assembly overview

NOTE:

- The installed location of secondary air injection (AIR) pump relay J299 is **Secondary Air Injection (AIR) pump relay J299 - arrow -**

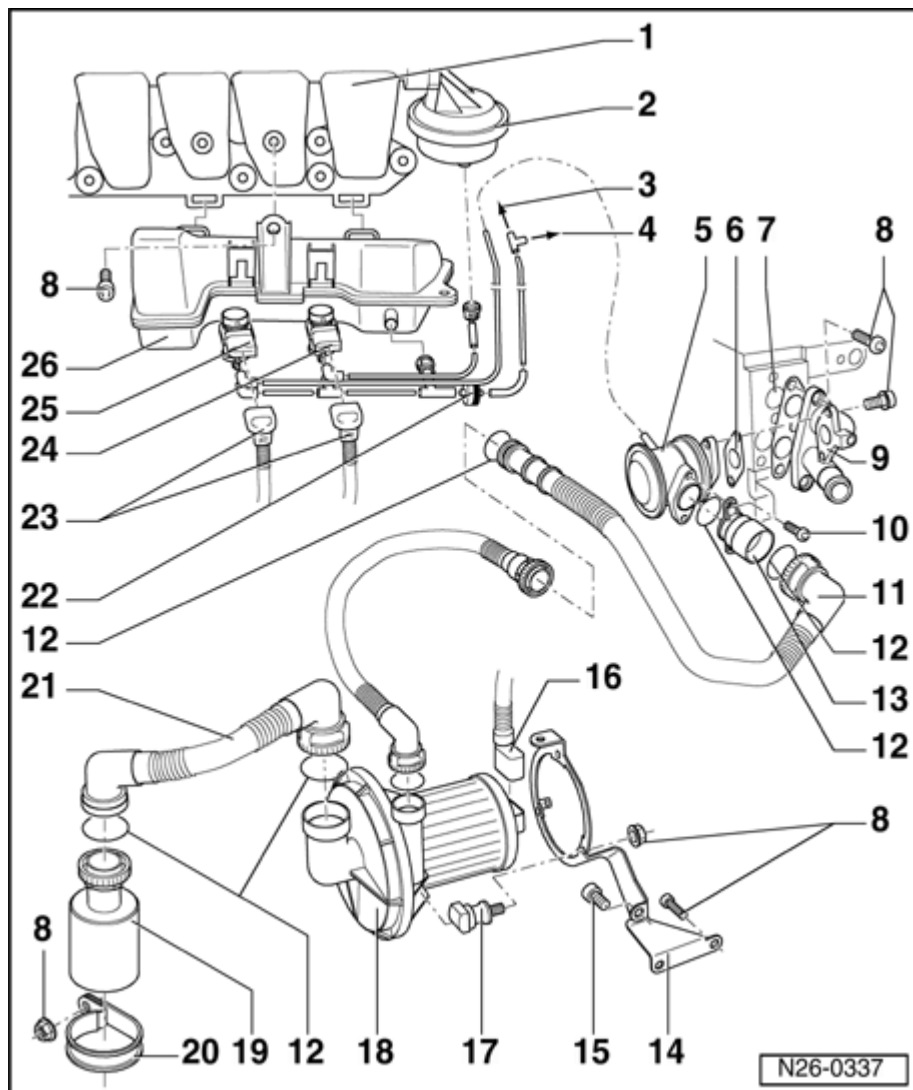


Fig. 244: Secondary Air Injection System Components, Assembly Overview
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- 1 - Intake manifold
- 2 - Vacuum actuator for variable intake manifold
- 3 - To Intake manifold
- 4 - To fuel pressure regulator
- 5 - Combi-valve
 - Checking, refer to **Combi-valve, checking**
- 6 - Gasket

- Replace

7 - Air channel

- In cylinder head

8 - 10 Nm

9 - Connection

- For combi-valve

10 - 5 Nm

11 - Pressure hose

- Ensure seated tightly

12 - O-ring

- Replace if damaged

13 - Connection

14 - Bracket

- For secondary air injection (AIR) pump motor
- With brace to oil pan

15 - 20 Nm

16 - Connector

- For secondary air injection (AIR) pump motor

17 - Rubber bushing

18 - Secondary air injection (AIR) pump motor V101

19 - Air filter housing

- Clean if soiled

20 - Retaining clip

21 - Intake tube

- Ensure seated tightly

22 - Non-return valve

- White connector faces towards Secondary Air Injection (AIR) Solenoid Valve N112 / Intake Manifold Tuning (IMT) Valve N156

23 - Connector

- Black, 2-pin

24 - Intake manifold change-over valve N156

25 - Secondary air injection (AIR) solenoid valve N112

26 - To vacuum reservoir

Secondary Air Injection (AIR) pump relay J299 - arrow -

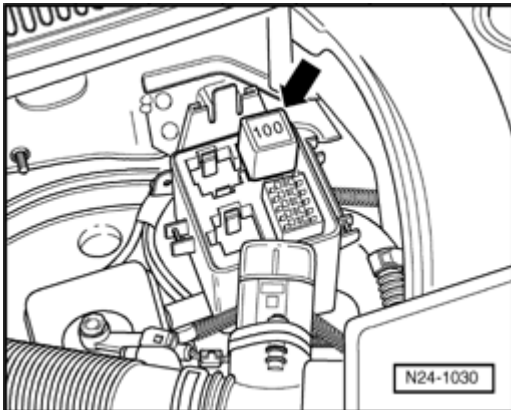


Fig. 245: Secondary Air Injection Pump Relay J299
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE:

- If tools are necessary to pull relays or control modules out of the relay plate, first disconnect battery Ground (GND) strap.
- Obtain radio code for radios with anti-theft coding before disconnecting battery.

Combi-valve, checking

Special tools, testers and auxiliary items required

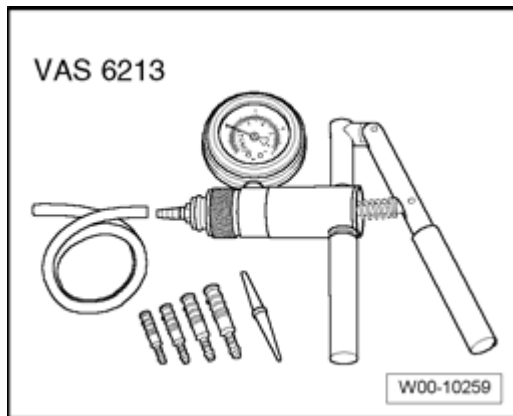


Fig. 246: Hand Vacuum Pump VAS 6213
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Hand vacuum pump VAS 6213

Test conditions

- Vacuum lines and hose connections free of leaks
- Vacuum lines not blocked or kinked

Test sequence

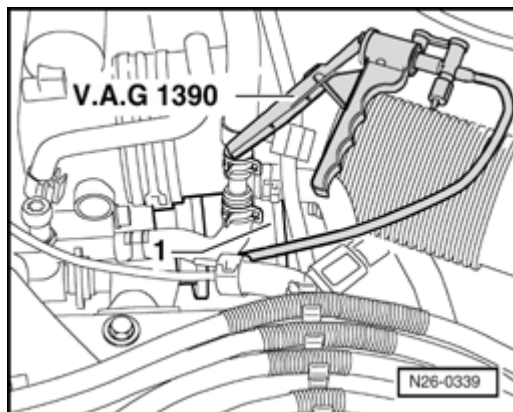


Fig. 247: Hand Vacuum Pump Connected To Vacuum Hose From Combi-Valve
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull off vacuum hose at combi-valve - **1** -.
- Connect hand vacuum pump VAS 6213 to vacuum hose from combi-valve - **1** -.

NOTE:

- **Do not use compressed air during following check!**

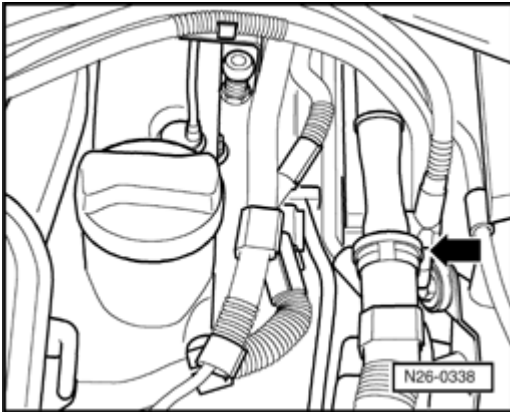


Fig. 248: Locating Pressure Hose To Combi-Valve At Connection
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Detach pressure hose to combi-valve at connection - **arrow** - and pressurize slightly by blowing into hose. Combi-valve must be closed.
- Operate Hand vacuum pump VAS 6213. Combi-valve must open.

If combi-valve does not open:

Replace combi-valve.

28 - IGNITION/GLOW PLUG SYSTEM

IGNITION SYSTEM, SERVICING

Ignition system, servicing

General notes on ignition system

- Only the components which specifically relate to the ignition system are dealt with here. The other components of the injection and ignition system, refer to **Fuel injection system, servicing** .
- For trouble-free operation of the electrical components a voltage of at least 11.5 V is necessary.
- During some checks it is possible that the control module will detect and store a malfunction. Therefore after completing all checks and repairs the Fault memory must be checked and if necessary erased.

Ignition system components - assembly overview for engine code BJS, refer to **Ignition system components, assembly overview**

Ignition coils with power output stages, removing and installing, refer to **Ignition coils with power output stage, removing and installing**

Safety precautions, refer to **Safety precautions**

Test Data, Spark Plugs, refer to **Technical data, spark plugs**

Ignition system components, assembly overview

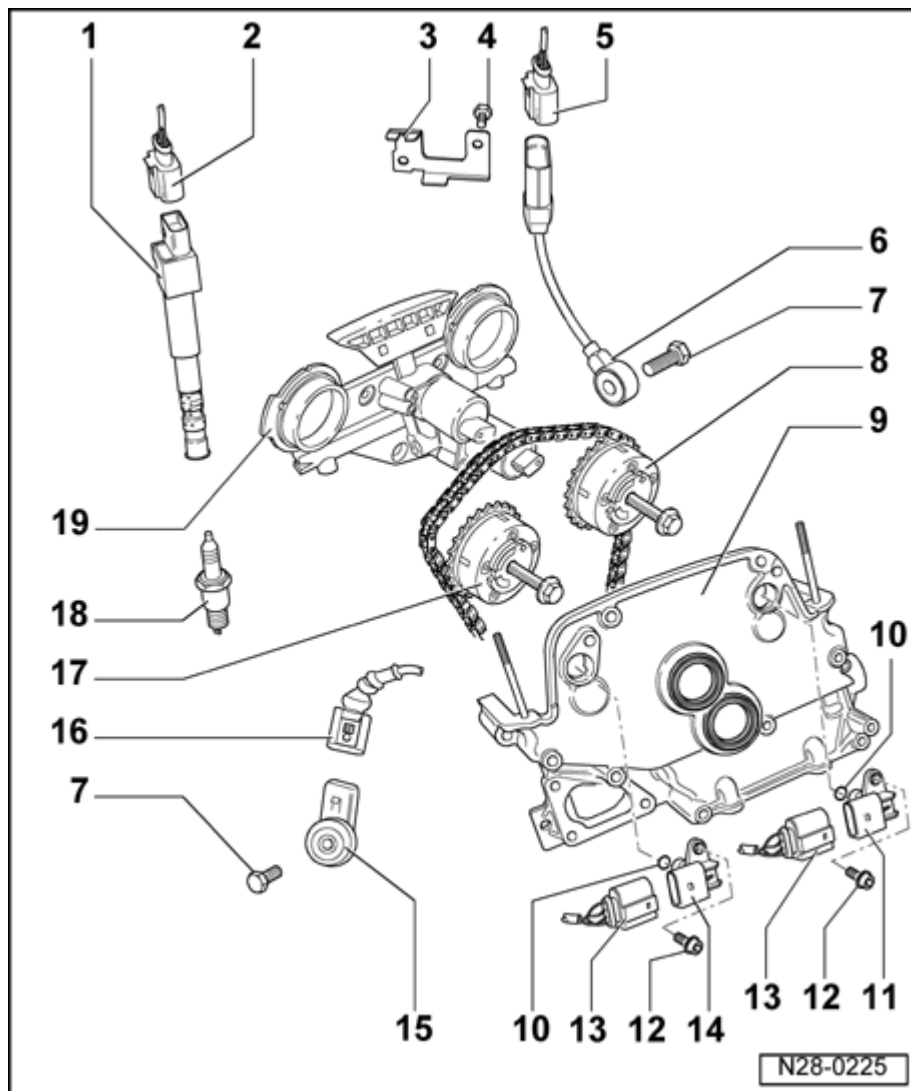


Fig. 249: Ignition System Components, Assembly Overview

Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Ignition Coil 1 with Power Output Stage N70

- Ignition Coil 2 with Power Output Stage N127
- Ignition Coil 3 with Power Output Stage N291
- Ignition Coil 4 with Power Output Stage N292
- Ignition Coil 5 with Power Output Stage N323
- Ignition Coil 6 with Power Output Stage N324
- Use puller for ignition coil T10095 A for removal refer to **Ignition coils with power output stage, removing and installing**

2 - Connector

- 4-pin

3 - Bracket

- For knock sensor (KS) 1 G61 connector

4 - 10 Nm

5 - Connector

- Black, 3pin
- Sensor contacts and connector contacts gold plated

6 - Knock sensor 1 G61

- Sensor contacts and connector contacts gold plated
- Component location: Cylinder block, exhaust side

7 - 20 Nm

- Torque setting influences the function of knock sensor

8 - Exhaust camshaft adjuster

- With sensor wheel for Hall sender 2 G163
- If camshaft adjuster has been removed, adjust valve timing after installation, refer to **Valve timing, adjusting** .

9 - Cover

- Removing and installing, refer to **Cover, assembly overview** .

10 - Oil seal

- Replace

11 - Camshaft position (CMP) sensor 2 G163

- For exhaust camshaft
- Sensor contacts and connector contacts gold plated

12 - 10 Nm

13 - Connector

- Black, 3pin
- Sensor contacts and connector contacts gold plated
- Mark connector before removing

14 - Camshaft Position (CMP) sensor G40

- For intake camshaft
- Sensor contacts and connector contacts gold plated

15 - Knock sensor 2 G66

- Sensor contacts and connector contacts gold plated
- Component location: Cylinder block, intake side

16 - Connector

- Black, 2-pin
- Sensor contacts and connector contacts gold plated

17 - Intake-camshaft adjuster

- With sensor wheel for camshaft position (CMP) sensor G40
- If camshaft adjuster has been removed, adjust valve timing after installation, refer to **Valve timing, adjusting** .

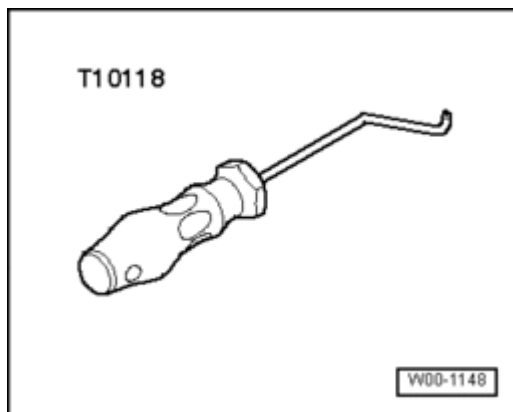
18 - Spark plug

- Removing and installing with spark plug removal tool 3122 B
- Type, torque specification and electrode gap, refer to **Technical data, spark plugs**

19 - Control housing

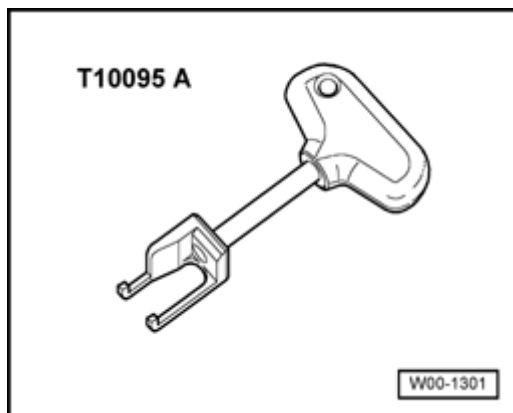
- For camshaft adjustment
- Removing and installing, refer to **Camshafts, removing and installing**

Ignition coils with power output stage, removing and installing**Special tools, testers and auxiliary items required**

**Fig. 250: Seal Puller T10118**

Courtesy of VOLKSWAGEN UNITED STATES, INC.

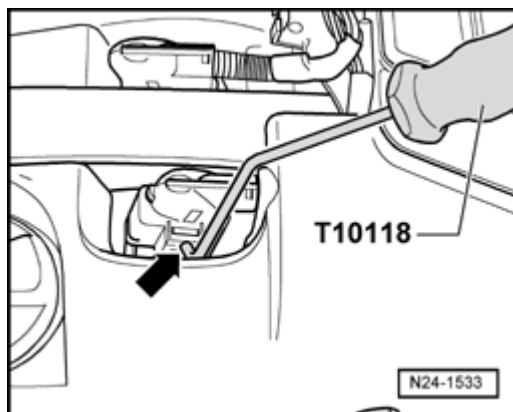
- Assembly tool T10118

**Fig. 251: Puller T10095 A**

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Puller T10095 A

Removing

**Fig. 252: Identifying Assembly Tool T10118 On Release Button**

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place assembly tool T10118 against release button - **arrow** -, and carefully remove connector from respective ignition coil with power output stage.

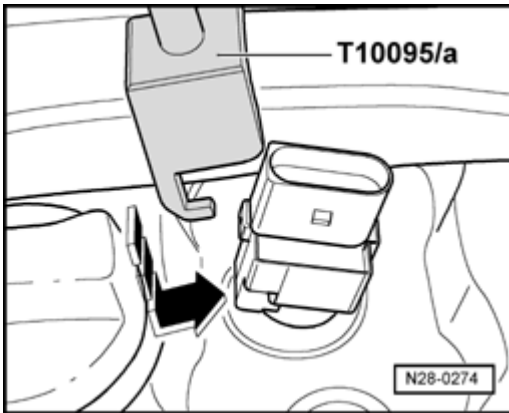


Fig. 253: Pushing The Remover T10095/A From The Straight Connector Side
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- From straight side of connector, push puller T10095 A on in direction of - **arrow** -, and pull out ignition coil with power output stage.

Installing

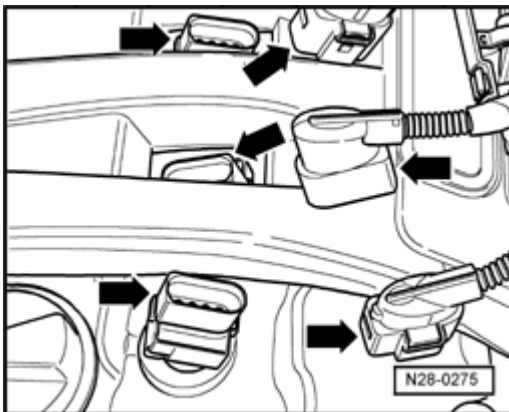


Fig. 254: Identifying Removed Ignition Coils, Power Output Stages & Connectors
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- To install, insert ignition coil with power output stage in respective spark plug shaft, so that the straight sides of the connectors match one another - **arrow** -.

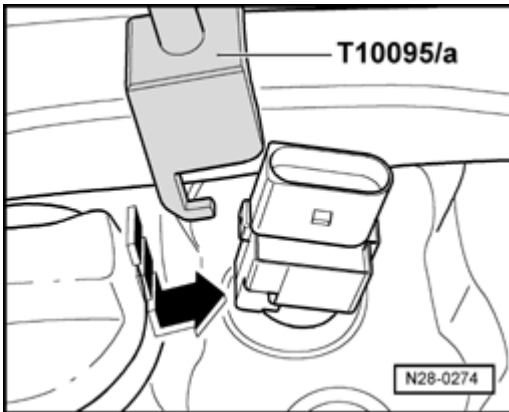


Fig. 255: Pushing The Remover T10095/A From The Straight Connector Side
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- From the straight side of connector, push puller T10095 A on indirection of - **arrow** -, and push ignition coil with power output stage onto spark plug.

Safety precautions

To reduce the risk of personal injury and/or damage to the fuel injection and ignition system, always observe the following:

- Do not touch or remove ignition wires when engine is running or turning at starter speed.
- Only disconnect and reconnect wires for injection and ignition system, including test leads, when ignition is switched off.
- If engine is to be turned at starter speed, without starting:

For engine codes BJS

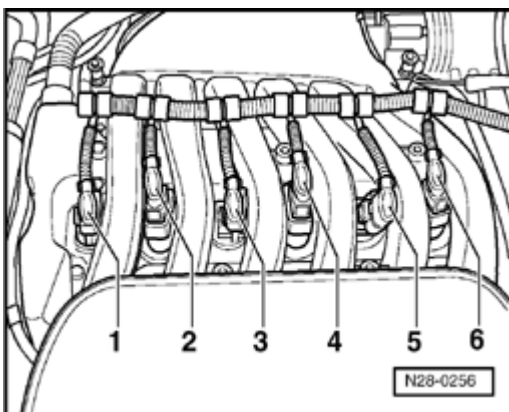


Fig. 256: Identifying Ignition Coils
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Using assembly tool T10118, disconnect connectors from ignition coils 1 through 6.

If test and measuring equipment is required during road test, note the following:

2004 Volkswagen R32

ENGINE 3.2 Liter VR6 4V Engine Mechanical, Fuel Injection Ignition, Engine Code(s): BJS

- Test and measuring instruments must be secured to rear seat and operated by a 2nd person from this location.

CAUTION: If test and measuring instruments are operated from the front passenger seat and the vehicle is involved in an accident, there is a possibility that the person sitting in this seat may receive serious injuries when the airbag is triggered.

Technical data, spark plugs

Engine code	BJS * See note
Ignition sequence	1-5-3-6-2-4
Spark plugs * See note	
VW/Audi	101 905 606 A
Manufacturer designation	IZK R7B
Electrode gap	max. 1.1 mm
Torque specifications	20 Nm

* Remove and install spark plugs with spark plug removal tool 3122 B and suitable extension.

* Use only puller for ignition coil T10095 A to remove ignition coils with power output stages.