ENGINE

1.8 Liter 4-Cyl. 5V Turbo Engine Mechanical, Engine Code(s): AWD, AWW, AWP

00 - GENERAL, TECHNICAL DATA

TECHNICAL DATA

Engine number

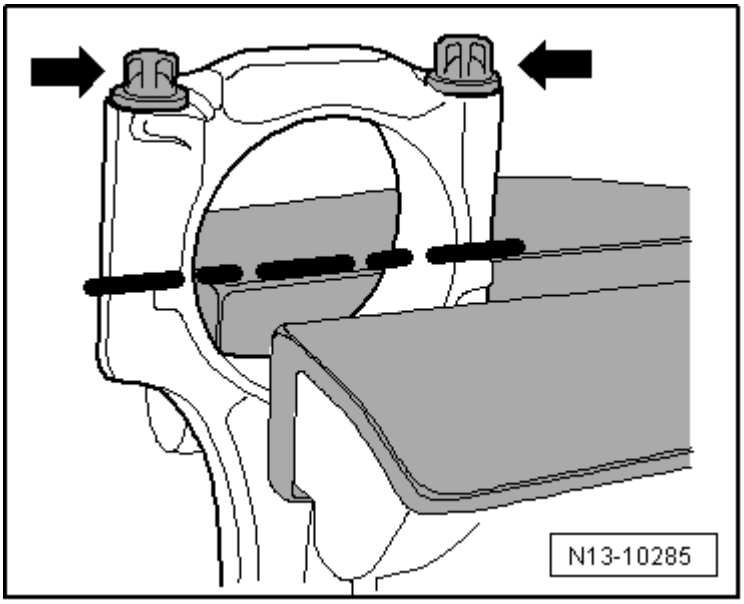

Fig. 1: Locating Engine Number
Courtesy of VOLKSWAGEN UNITED STATES, INC.

The engine number ("engine code" and "serial number") are located at the front of the engine/transmission joint.

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

The engine code is also included on the vehicle data plate.

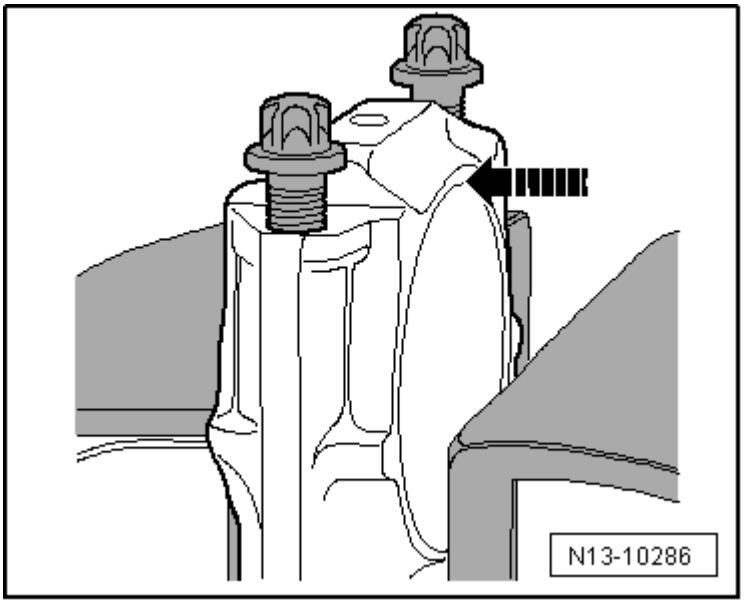

Fig. 2: Locating Engine Code Sticker
Courtesy of VOLKSWAGEN UNITED STATES, INC.

In addition, a sticker with "engine code" and "serial number" is affixed to timing belt cover - **arrow** -.

NOTE:

- **The engine code - arrow - is also stamped on the engine lifting eye.**

Engine data

Engine code		AWD	AWW	AWP
Manufactured		11.99 -->	07.00 -->	06.01 -->
Displacement	ltr.	1.8	1.8	1.8
Output	kW at 1/rpm	110/5700	110/5700	132/5500
Torque	Nm at rpm	210/1750 to 4600	220/1950 to 4500	235/1950 to 5000
Bore	diameter mm	81.0	81.0	81.0
Stroke	mm	86.4	86.4	86.4
Compression ratio		9.5	9.3	9.5
RON		95 unleaded	95 unleaded	98 unleaded
System designation		Motronic ME7.1	Motronic ME7.1	Motronic ME7.1
Emission values in accordance with		TLEV * See note	LEV * See note	LEV * See note
Knock sensor control		2 knock sensors	2 knock sensors	2 knock sensors
On Board Diagnostic (OBD)		OBD II	OBD II	OBD II
Oxygen sensor regulation		2 sensors	2 sensors	2 sensors
Catalytic converter		yes	yes	yes
Exhaust gas recirculation (EGR)		no	no	no
Variable intake manifold		no	no	no
Variable valve timing		no	yes	yes

Turbocharger	yes	yes	yes
Electronic Power Control (EPC)	yes	yes	yes
Boost pressure regulation	Yes	Yes	Yes
Secondary air injection (AIR) system	Yes	Yes	Yes

* TLEV = Transitional Low Emission Vehicles (emission values max. 0.125 g/mi HC)

* LEV = Low Emission Vehicles (emission values max. 0.075 g/mi HC)

10 - ENGINE - ASSEMBLY

ENGINE, REMOVING AND INSTALLING

Engine, removing and installing

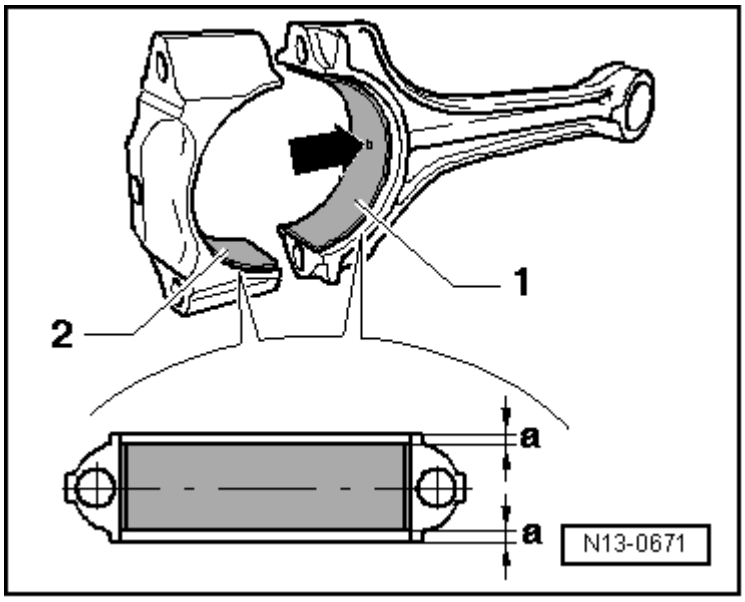

Fig. 3: Identifying Special Tools - Engine, Removing And Installing (1 Of 2)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Holding fixture VW 313
- Engine and transmission holder VW 540
- Lifting tackle 2024 A
- Retainer 3180
- Shop Crane V.A.G 1202 or Shop Crane VAS 6100
- Drip Tray V.A.G 1306 or Drip Tray for VAS 6100 VAS 6208

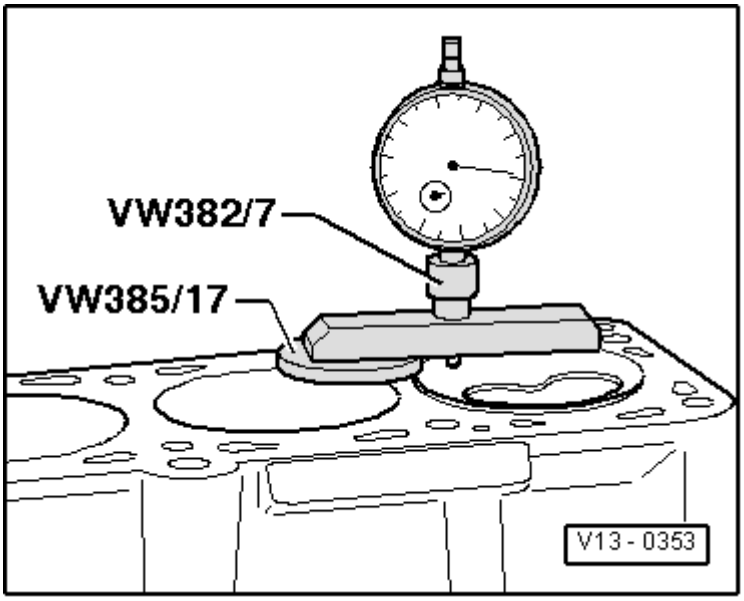

Fig. 4: Identifying Special Tools - Engine, Removing And Installing (1 Of 2)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Torque wrench V.A.G 1331
- Torque wrench V.A.G 1332
- Engine/transmission jack V.A.G 1383 A
- Engine mount T10012
- Spring-type clip pliers VAS 5024A
- Step ladder VAS 5085
- *Grease G 000 100* (Vehicles with manual transmission) (Part numbers are for reference only. Always check with your Parts Department for the latest part number information).
- Bolt M10x25 / 8.8
- Cable tie

Notes on removing

- First, check whether a coded radio is installed. If necessary, obtain anti-theft coding.
- The engine is removed downward together with transmission.
- Disconnect battery Ground (GND) strap with ignition switched off.
- All cable ties which are opened or cut open when removing engine, must be replaced in the same position when installing engine.

- Remove engine cover.

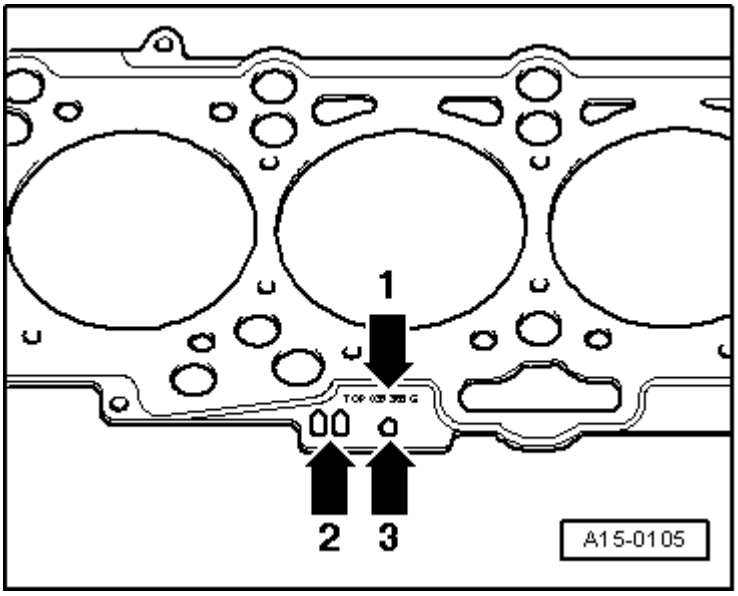

Fig. 5: Identifying Connecting Hoses Between Secondary Air Injection Pump/Combination Valve And Secondary Air Injection Pump/Air Filter
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove connecting hoses - **arrows** - between Secondary Air Injection (AIR) pump/combination valve and Secondary Air Injection (AIR) pump/air filter.

NOTE:

- **Press buttons together on hose connections to remove connecting hoses..**

- Remove connector - **1** - on secondary air injection (AIR) pump.
- Remove air filter, refer to **AIR CLEANER, DISASSEMBLING AND ASSEMBLING** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWD or **AIR CLEANER, DISASSEMBLING AND ASSEMBLING** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION IGNITION, ENGINE CODE(S): AWW, AWP .
- Remove vacuum and vent hoses off from engine.

CAUTION: Fuel supply line is under pressure! Wear protective goggles and protective clothing to prevent injuries and contact with skin. Before removing from hose connection wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

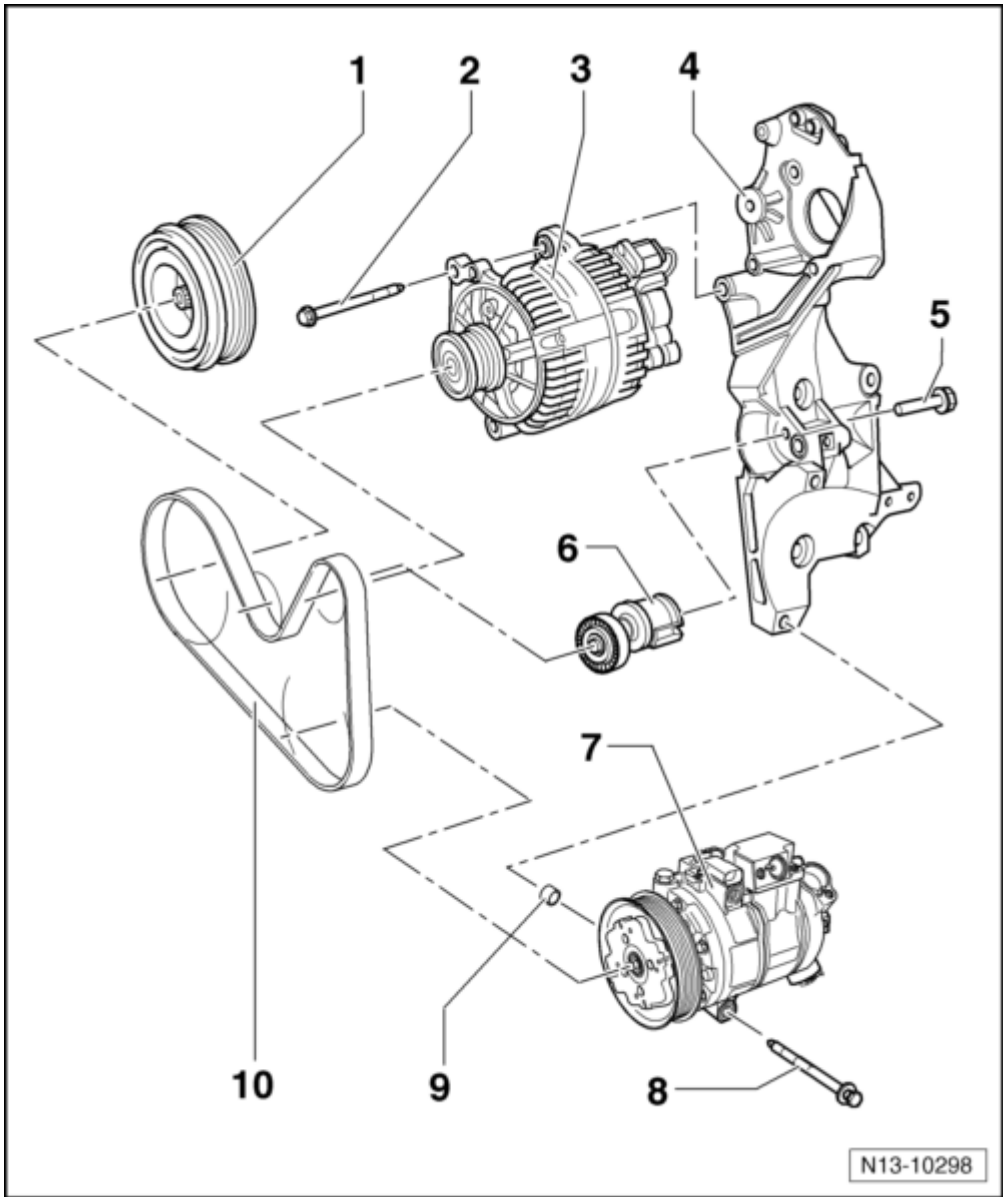

Fig. 6: Identifying Supply Line And Return Line
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull off supply line - **1** - (with white marking) and return line - **2** - (with blue marking) and catch any released fuel with a shop rag.
- Remove hose from solenoid valve.

NOTE:

- **Press buttons together on hose connections.**

- Seal lines so that the fuel system is not contaminated by dirt etc.
- Remove intake hose between Mass Air Flow (MAF) Sensor G70 and exhaust turbocharger, refer to **MASS AIR FLOW (MAF) SENSOR -G71-, CHECKING** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWD or **MASS AIR FLOW (MAF) SENSOR G70 ,**

CHECKING for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION IGNITION, ENGINE CODE(S): AWW, AWP .

- Loosen intake hose (between charge air cooler and Throttle Valve Control Module J338) at Throttle Valve Control Module J338 and remove.

Vehicles with manual transmission

- Disconnect selector mechanism from transmission, refer to **GEAR SELECTOR MECHANISM, SERVICING** for 5 & 6 SPD. MANUAL TRANSMISSION 02M or **GEAR SELECTOR MECHANISM UP TO 05.99, SERVICING** or **GEAR SELECTOR MECHANISM FROM 05.99, SERVICING** for 5 SPD. MANUAL TRANSMISSION 02J .
- Remove slave cylinder for hydraulic clutch:, refer to 30 CLUTCH in appropriate MANUAL TRANSMISSION article .

NOTE:

- **Clutch pedal must not be depressed.**

Vehicles with automatic transmission

- Disconnect selector lever cable from transmission, refer to **SELECTOR LEVER CABLE, REMOVING AND INSTALLING** for 4 SPD. AUTOMATIC TRANSMISSION 01M or **SELECTOR LEVER CABLE, REMOVING AND INSTALLING** for 5 SPD. AUTOMATIC TRANSMISSION 09A .

Continuation for all vehicles

- Remove sound insulation tray, refer to **NOISE INSULATION (GASOLINE ENGINES), ASSEMBLY OVERVIEW** or **NOISE INSULATION (DIESEL ENGINES), ASSEMBLY OVERVIEW** .
- Drain coolant, refer to *Cooling system, draining and filling* under **Cooling system, draining and filling** .
- Remove coolant hoses from radiator on engine.

NOTE:

- **Pliers for spring clamps VAS 5024A or Hose clamp pliers V.A.G 1921 are recommended for installing spring clamps.**

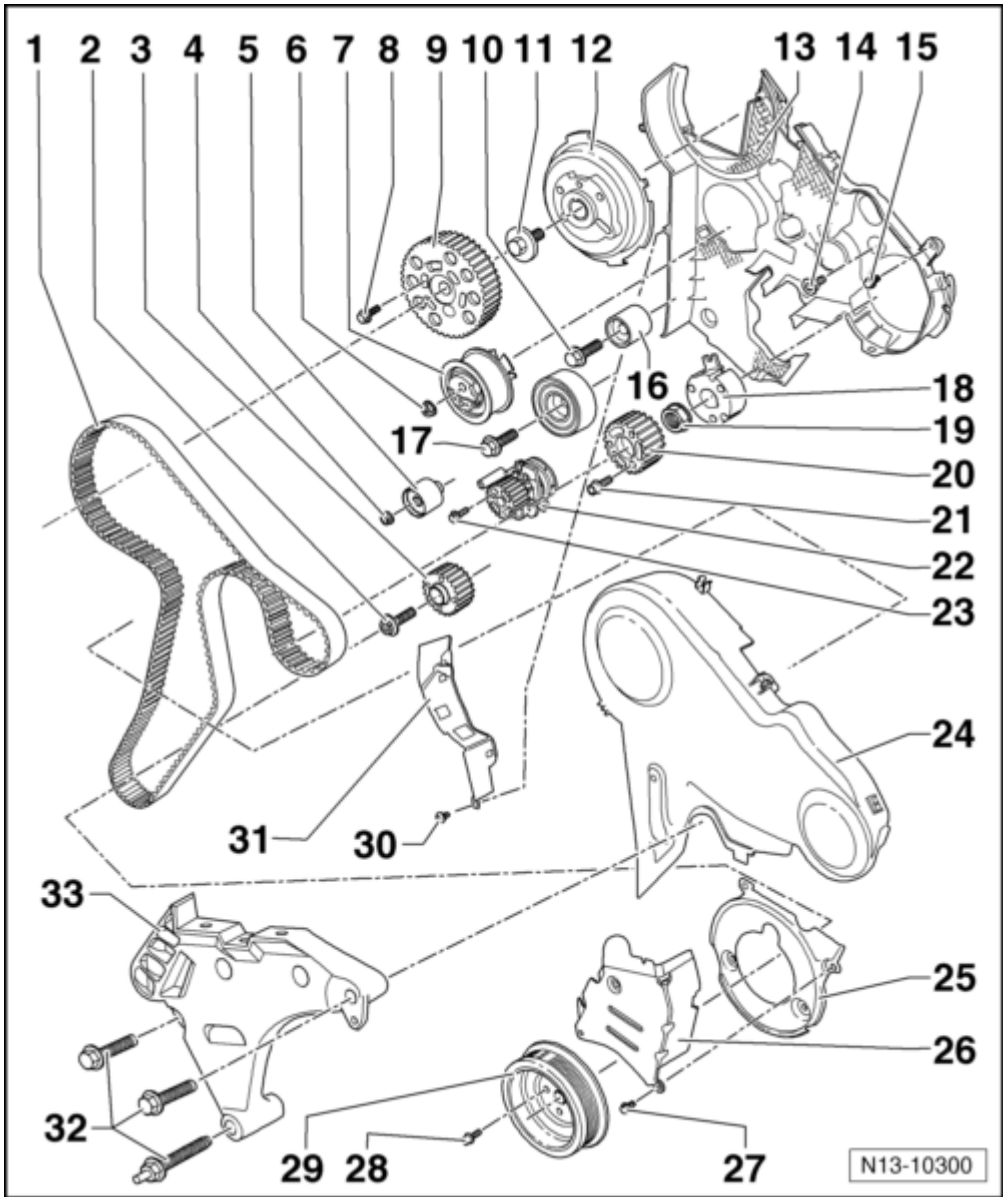

Fig. 7: Identifying Pendulum Support & Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove pendulum supports - **arrows** -.
- Disconnect and lay aside all electrical harnesses from transmission, generator, and starter.
- Remove front exhaust pipe, refer to **Exhaust system components** .
- Remove ribbed belt, refer to *Ribbed belt, removing and installing* under **Ribbed belt, removing and installing** .

- Remove securing clamps for power steering pressure line.
- Remove power steering pump from bracket and place to side; hoses remain connected:, refer to **P.A.S. POWER STEERING PUMP, VEHICLES WITH LOW MOUNTED POWER STEERING PUMP, REMOVING AND INSTALLING** or **P.A.S. POWER STEERING PUMP, VEHICLES WITH**

HIGH MOUNTED POWER STEERING PUMP, REMOVING AND INSTALLING .

- Disconnect all electrical connections as necessary from engine and lay aside.
- Remove right and left drive axles at transmission, refer to **FRONT SUSPENSION, SERVICING** or **FRONT SUSPENSION (R32), SERVICING** .

Vehicles with air conditioning:

- Remove air conditioner compressor:
- 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** .

Continuation for all vehicles

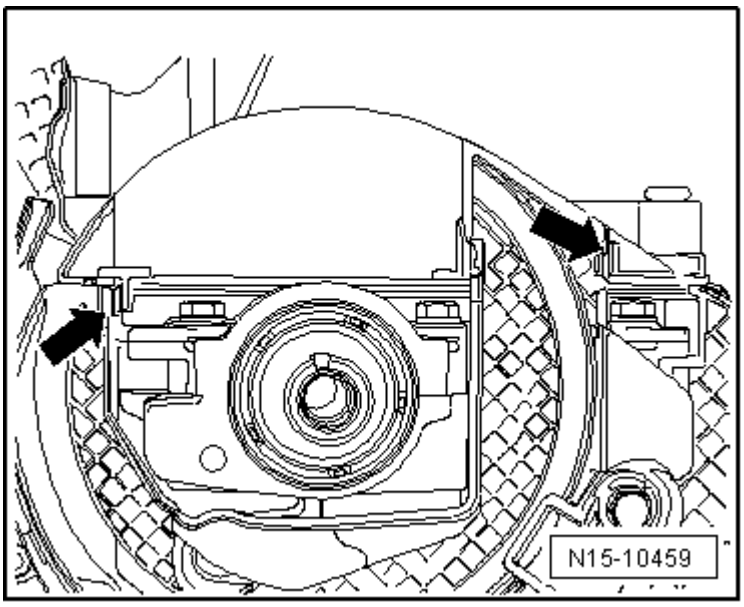

Fig. 8: Identifying Engine Bracket T10012 & Engine/Transmission Jack V.A.G. 1383A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install Engine and Transmission Holder T10012 to cylinder block with nut and bolt M10x25/ 8.8 to approx. 40 Nm.
- Gently lift engine and transmission using engine/transmission jack V.A.G 1383 A.

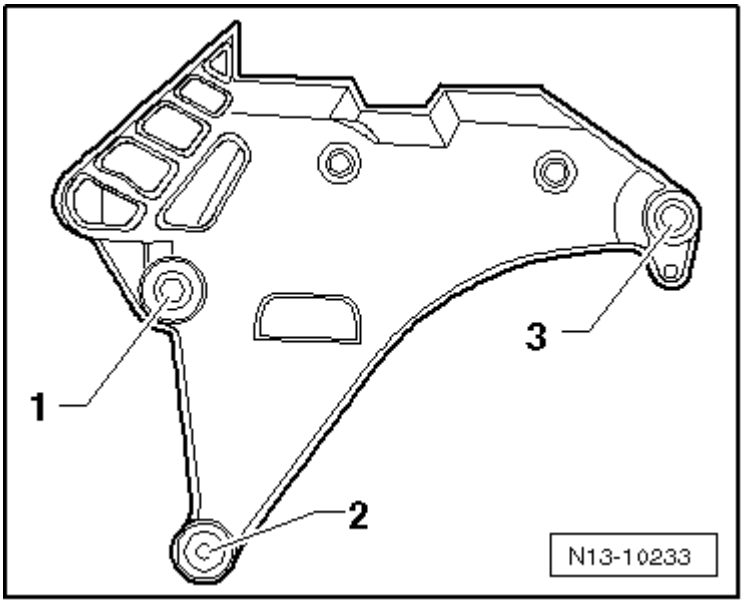

Fig. 9: Locating Engine Carrier Bolts (Engine Side)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove engine side of assembly mounting from engine support at top - **arrows** -.

NOTE:

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

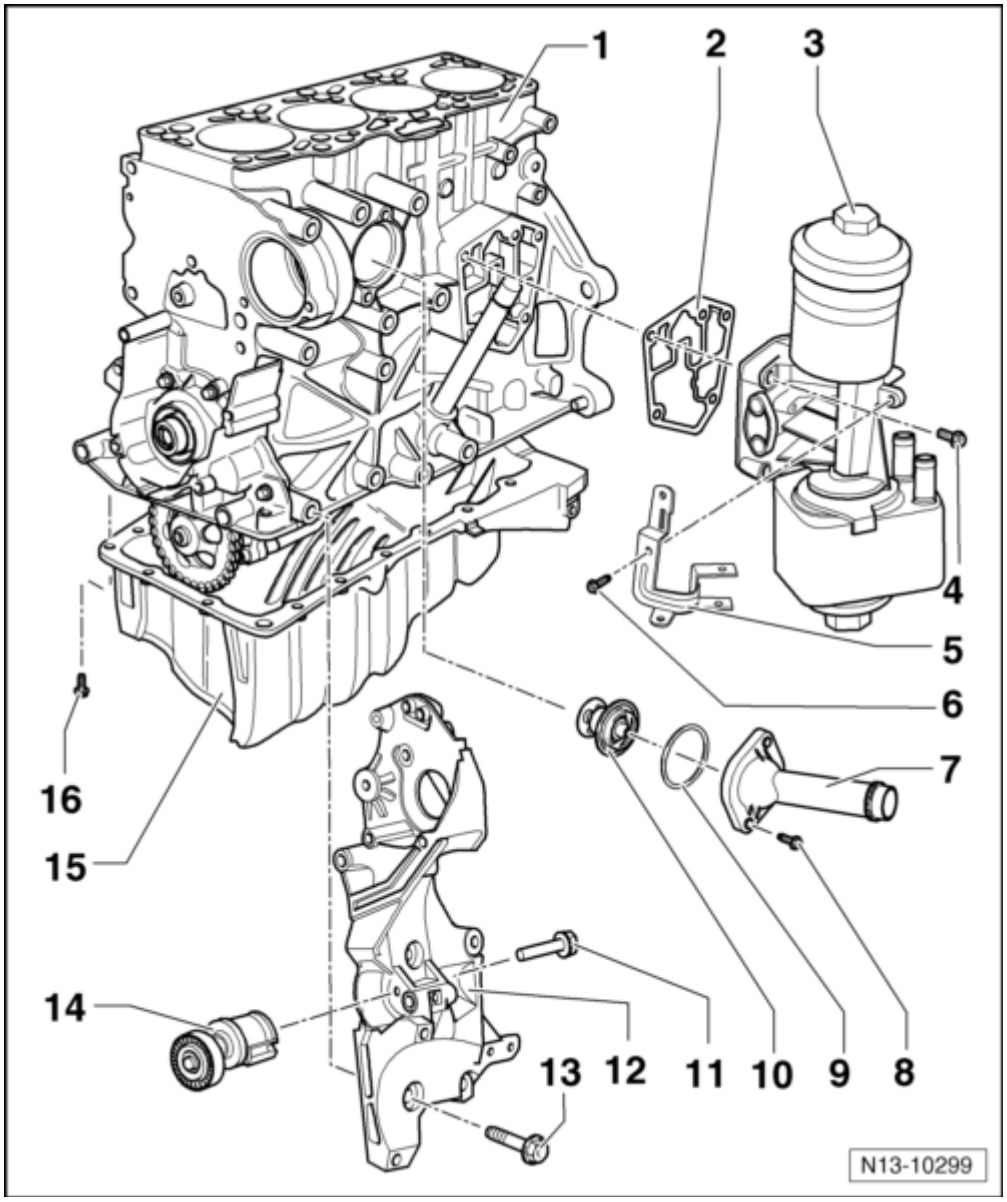

Fig. 10: Locating Engine Carrier Bolts (Transmission Side)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove subframe mount from transmission bracket - **arrows** - on transmission side from above.
- Carefully lower engine with transmission.

NOTE:

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

Engine, securing to assembly stand

Secure engine to holding fixture VW 313 of assembly stand using engine and transmission holder VW 540 when performing repair work.

Work procedure

- Remove transmission.

Vehicles with automatic transmission

- After separating engine from transmission, secure torque converter to prevent it from "falling out".

Continuation for all vehicles

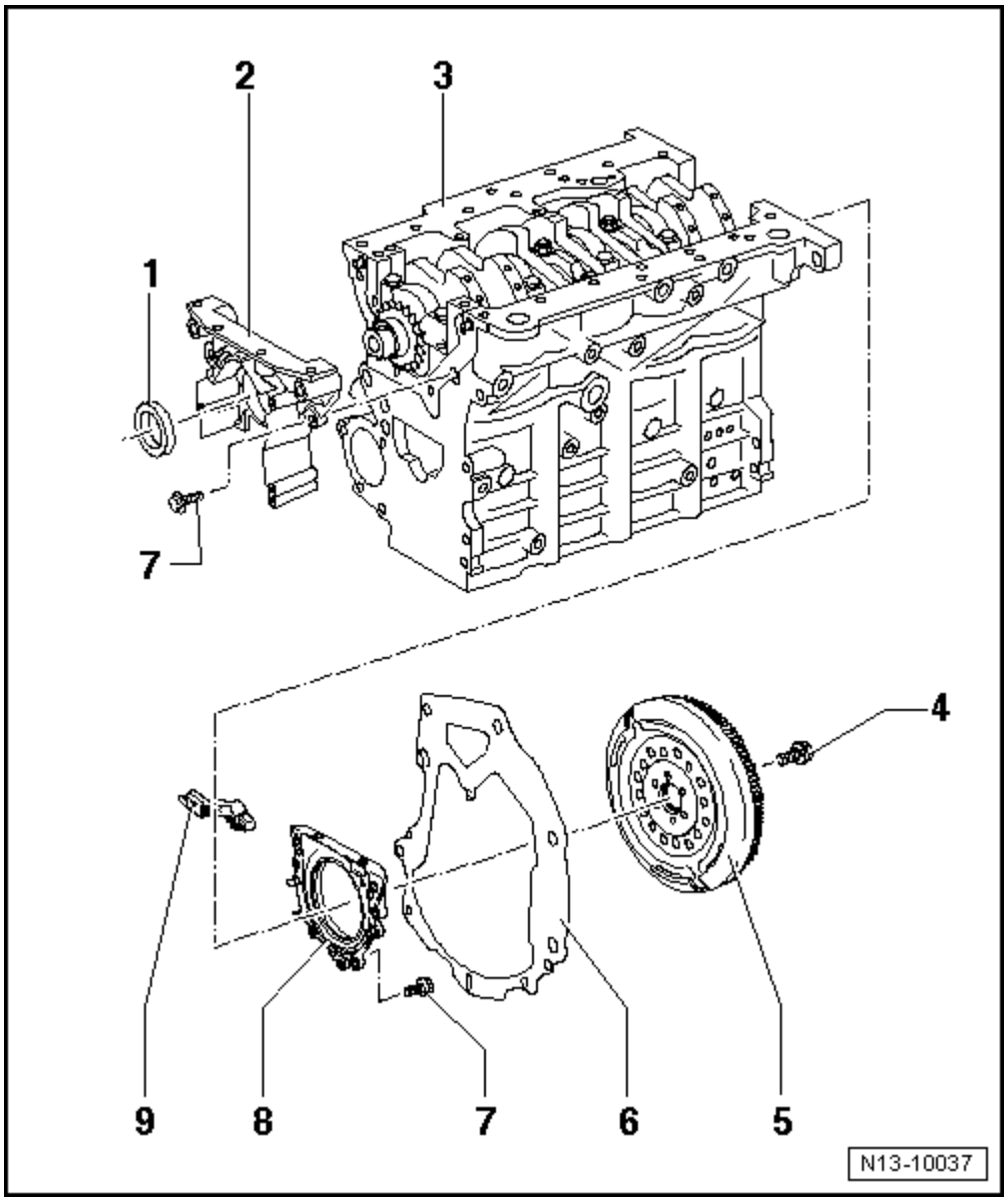

Fig. 11: Identifying Engine Sling 2024 A With Retainer 3180 Connected To Engine/Transmission
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Engage Engine Sling 2024 A with Retainer 3180 as follows and raise with Shop Crane V.A.G 1202 from

engine/transmission jack V.A.G 1383 A.

Belt pulley side: 3rd hole of rail in position 1.

Flywheel side: 2nd hole of rail in position 5.

CAUTION: Use securing pins at hooks and pins.

NOTE:

- **The peg positions on the carrying strap marked with 1 to 4 face the belt pulley.**
- **The bores in the hole rail are counted from the hook.**

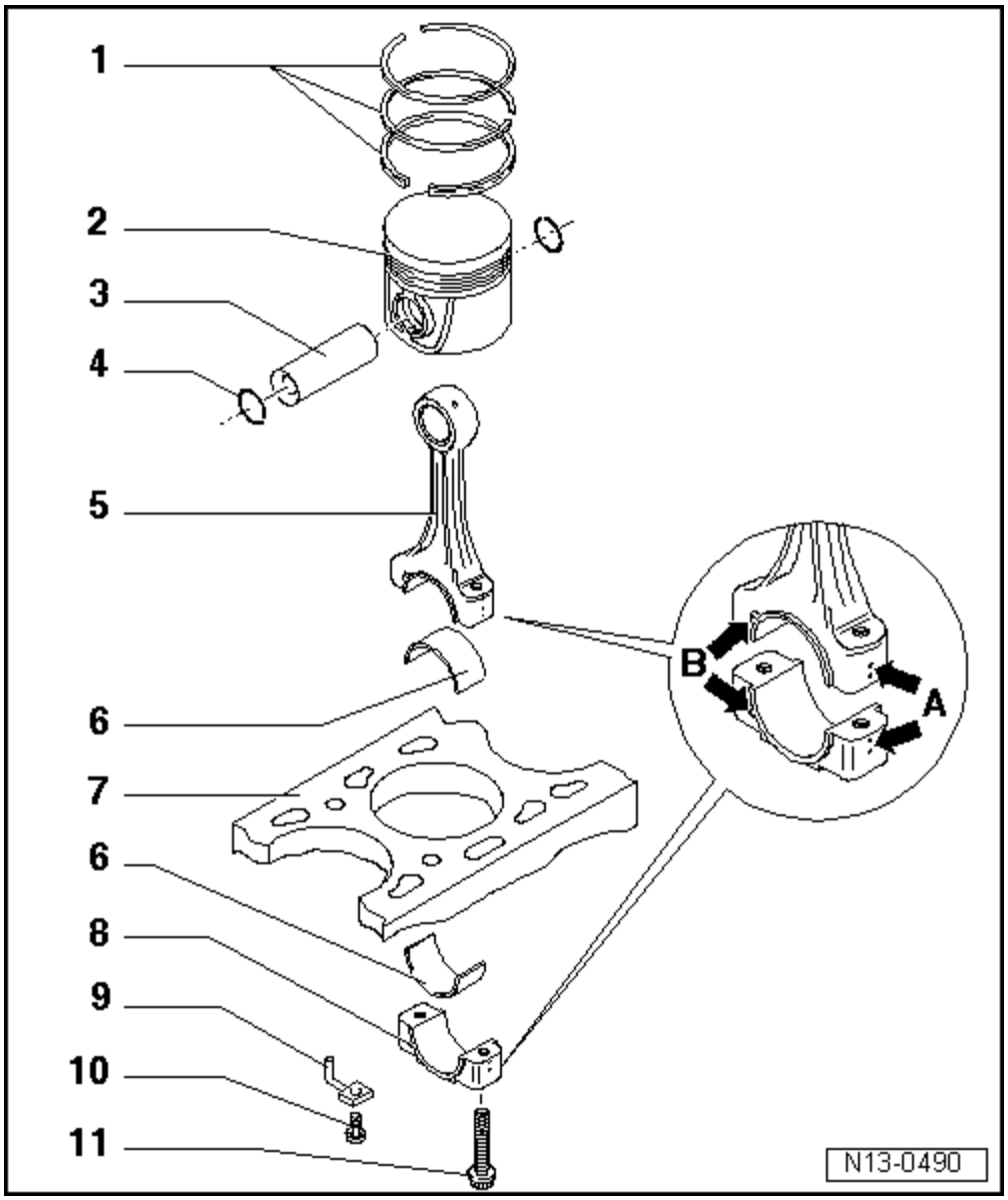

Fig. 12: Identifying Engine Fastened Using Holding Fixture VW 540 & Holding Fixture VW 313
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Fasten engine using holding fixture VW 540 to holding fixture VW 313.

Notes on installing

Installation is in reverse of removal, note the following:

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 canister 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.**

- Make sure alignment sleeves for engine to transmission are installed in cylinder block. Install if necessary.

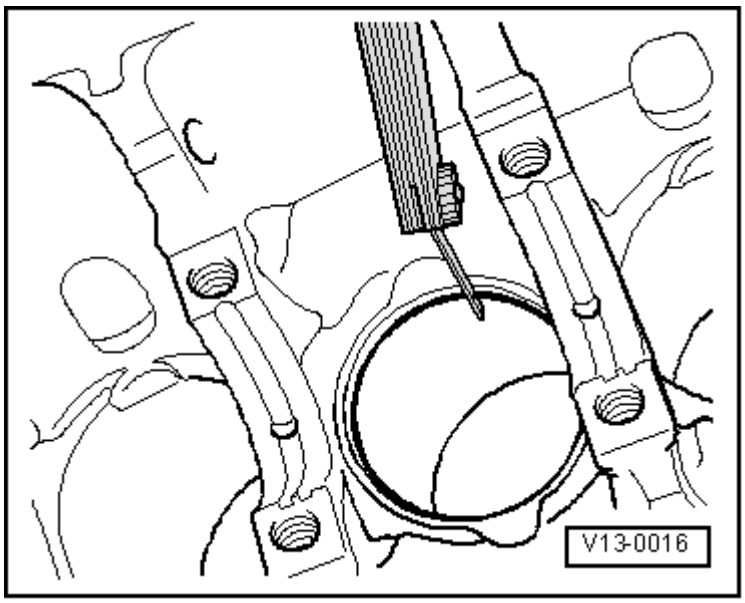

Fig. 13: Identifying Intermediate Plate, Sealing Flange And Dowel Sleeves
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Engage intermediate plate at sealing flange and slide onto alignment sleeves - **arrows** -.

Vehicles with manual transmission:

- If necessary, check centering of clutch drive plate.
- Check clutch release bearing for wear and replace if necessary.

- Lightly grease clutch release bearing, guide sleeve for release bearing and input shaft splines with *Grease G 000 100* . (Part numbers are for reference only. Always check with your Parts Department for the latest part number information).
- Install hydraulic clutch slave cylinder, refer to 30 CLUTCH in appropriate MANUAL TRANSMISSION article .
- Install shift mechanism, refer to **GEAR SELECTOR MECHANISM, SERVICING** for 5 & 6 SPD. MANUAL TRANSMISSION 02M or **GEAR SELECTOR MECHANISM UP TO 05.99, SERVICING** or **GEAR SELECTOR MECHANISM FROM 05.99, SERVICING** for 5 SPD. MANUAL TRANSMISSION 02J .
- If necessary, adjust selector lever cable, refer to **INSTALLATION POSITION OF GEAR SELECTOR MECHANISM** for 5 & 6 SPD. MANUAL TRANSMISSION 02M or **GEAR SELECTOR MECHANISM UP TO 05.99, SERVICING** or **GEAR SELECTOR MECHANISM FROM 05.99, SERVICING** for 5 SPD. MANUAL TRANSMISSION 02J .

Vehicles with automatic transmission 01M

- To secure torque converter to drive plate, only use nuts approved by replacement parts program.
- Install selector lever cable on transmission, adjust if necessary, refer to **SELECTOR LEVER CABLE, REMOVING AND INSTALLING** for 4 SPD. AUTOMATIC TRANSMISSION 01M or **SELECTOR LEVER CABLE, REMOVING AND INSTALLING** for 5 SPD. AUTOMATIC TRANSMISSION 09A ON BOARD DIAGNOSTIC (OBD) .
- Adapt automatic transmission control module1.

Vehicles with automatic transmission 09A

- To secure torque converter to drive plate, only use nuts approved by replacement parts program.
- Install selector lever cable on transmission, adjust if necessary, refer to **SELECTOR LEVER CABLE, REMOVING AND INSTALLING** for 4 SPD. AUTOMATIC TRANSMISSION 01M or **SELECTOR LEVER CABLE, REMOVING AND INSTALLING** for 5 SPD. AUTOMATIC TRANSMISSION 09A ON BOARD DIAGNOSTIC (OBD) .
- Adapt automatic transmission control module.

Continuation for all vehicles

- When installing assembly, ensure clearance to drive axles.
- Align engine and transmission mountings, refer to **Engine and transmission mountings, aligning** .
- Install drive axles, refer to **FRONT SUSPENSION, SERVICING** or **FRONT SUSPENSION (R32), SERVICING** .
- Install front exhaust pipe refer to **Exhaust system components** .
- Position intake hose (between charge air cooler and Throttle Valve Control Module J338) at Throttle Valve Control Module J338 and secure.
- Install power steering pump, refer to **P.A.S. POWER STEERING PUMP, VEHICLES WITH LOW MOUNTED POWER STEERING PUMP, REMOVING AND INSTALLING** or **P.A.S. POWER**

STEERING PUMP, VEHICLES WITH HIGH MOUNTED POWER STEERING PUMP, REMOVING AND INSTALLING .

- Electrical connections and routing, refer to **97 WIRING** in ELECTRICAL EQUIPMENT and **97 - WIRING** in ELECTRICAL EQUIPMENT - GENERAL INFORMATION .
- Install ribbed belt, refer to *Ribbed belt, removing and installing* under **Ribbed belt, removing and installing** .
- Install connecting hoses between Secondary Air Injection (AIR) pump/combination valve and Secondary Air Injection (AIR) pump/air filter.
- Install sound insulation tray, refer to **NOISE INSULATION (GASOLINE ENGINES), ASSEMBLY OVERVIEW** or **NOISE INSULATION (DIESEL ENGINES), ASSEMBLY OVERVIEW** .
- Fill with coolant, refer to *Cooling system, draining and filling* under **Cooling system, draining and filling** .
- Perform "Procedure after interrupting voltage supply", refer to **PROCEDURE AFTER VOLTAGE SUPPLY OPEN CIRCUIT** .

Torque specifications:

Bolted connections		Torque specifications
Bolts, nuts	M6	10 Nm
	M7	15 Nm
	M8	25 Nm
	M10	40 Nm
	M 12	60 Nm
Deviation from		
Connecting bolts, engine to transmission	M10	45 Nm
Connecting bolts, engine to transmission	M12	80 Nm
Converter to drive plate		60 Nm
Drive axle to drive flange/transmission		40 Nm

NOTE:

- **Tightening torques of subframe mount, refer to Assembly mounting .**

Engine and transmission mountings, aligning

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

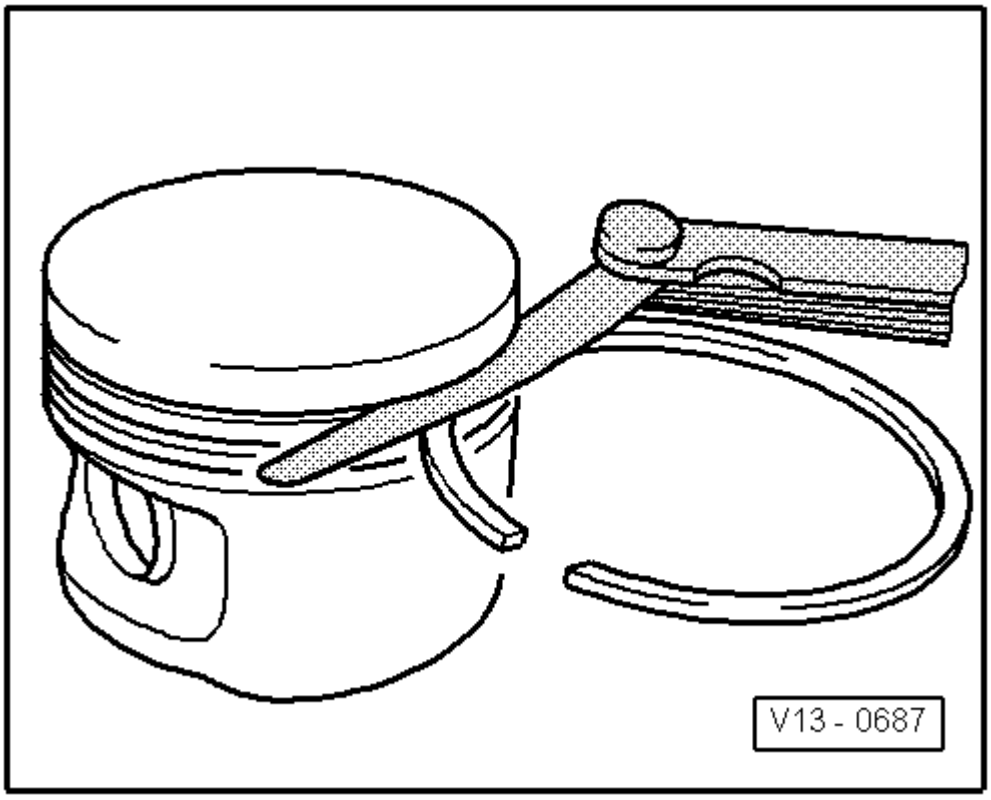

Fig. 14: Measuring Engine Mounting
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Engine mounting

a = 14.0 mm

b = minimum 10.0 mm

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

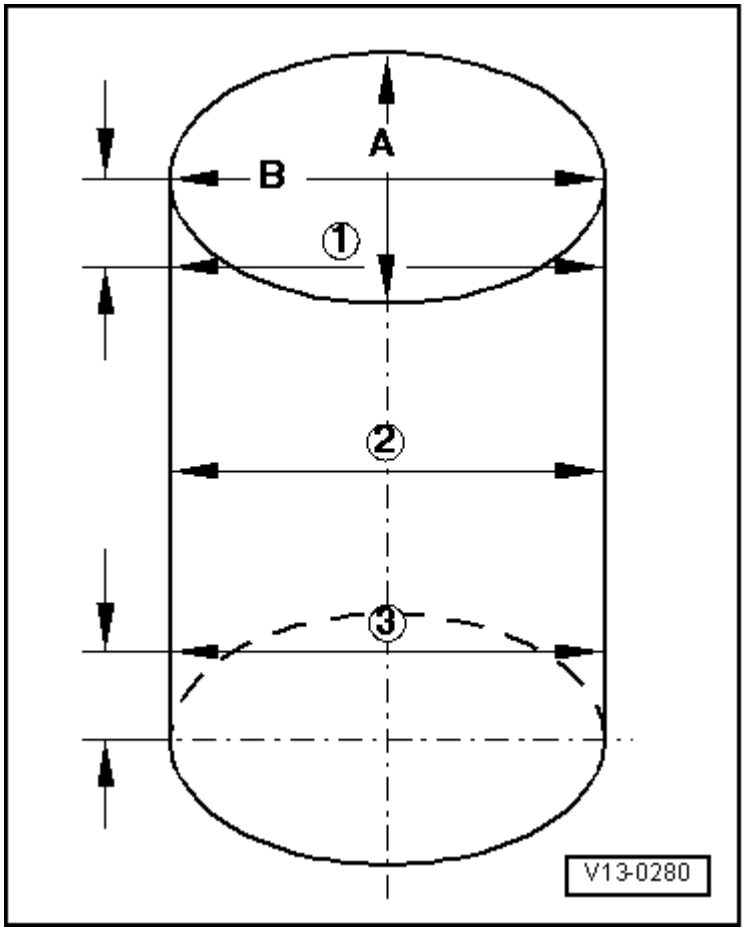

Fig. 15: Transmission Mount Dimensions
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Transmission assembly mounting

Edges a and b must be parallel to each other.

Assembly mounting

Torque specifications

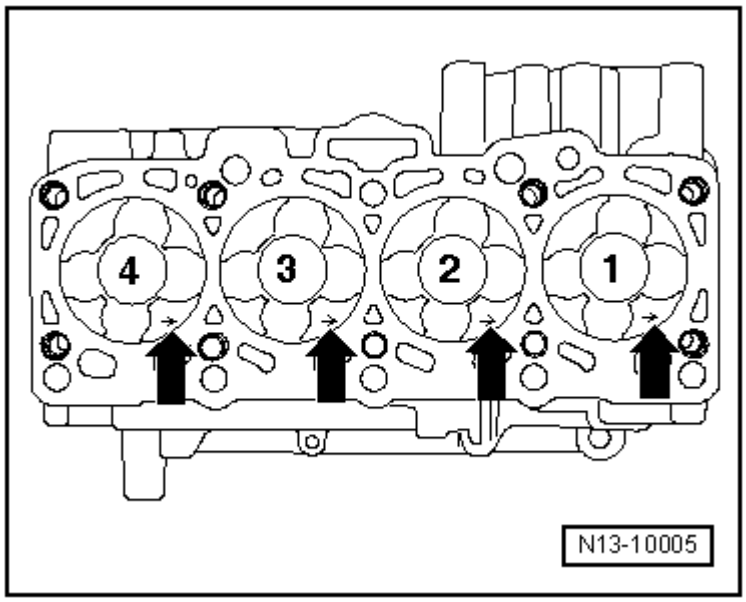

Fig. 16: Identifying Engine Mounting Bracket & Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Engine mounting

1 -	Mounting to body * See note	40 Nm plus an additional 90 ° ($^{1}/_{4}$ turn)
2 -	Mount/bracket to body	25 Nm
3 -	Mount to engine bracket	100 Nm

* Replace bolts

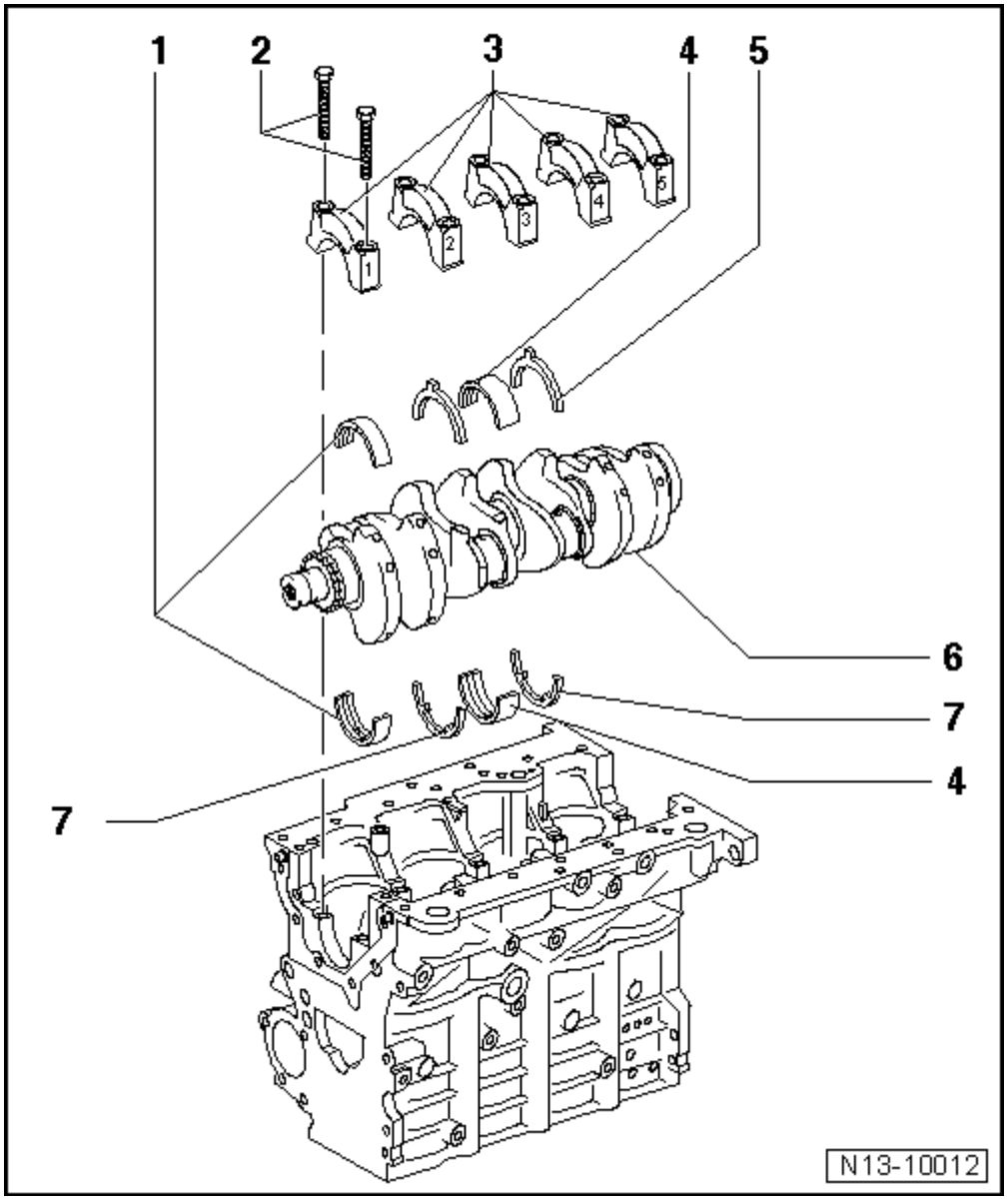

Fig. 17: Identifying Transmission Mounting Bracket & Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Transmission assembly mounting

1 -	Mounting to body * See note	40 Nm plus an additional 90 ° ($^{1}/_{4}$ turn)
2 -	Mounting to body	25 Nm
3 -	Mounting to transmission console	100 Nm

*Replace bolts

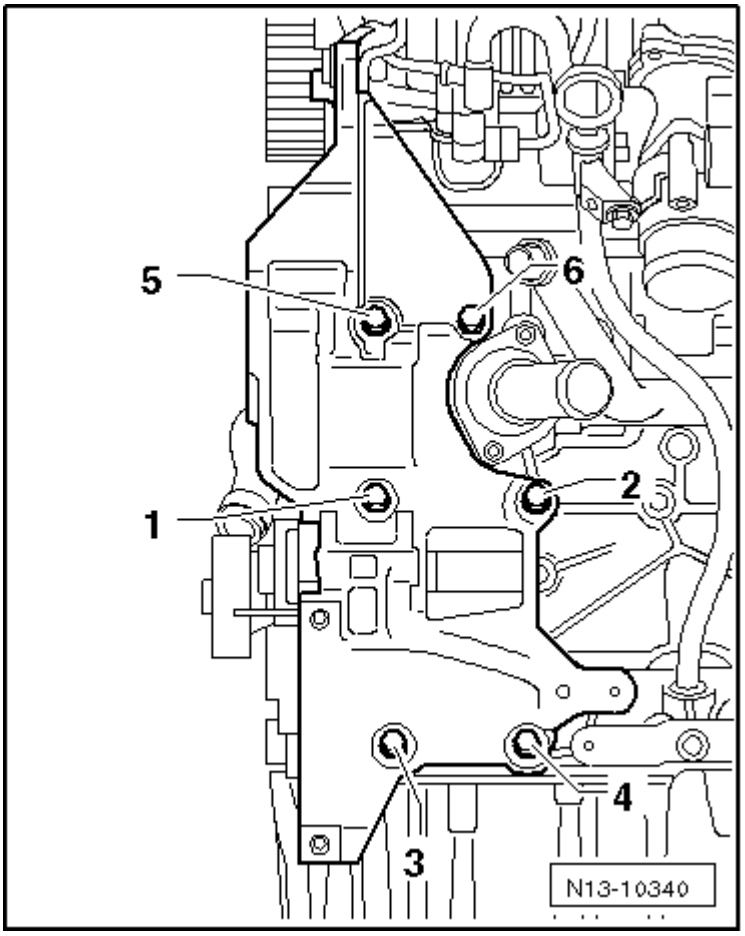

Fig. 18: Identifying Pendulum Support & Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Pendulum supports

1 -	Pendulum supports to transmission * See note	40 Nm plus an additional 90 ° ($^{1}/_{4}$ turn)
2 -	Pendulum supports to transmission * See note	40 Nm plus an additional 90 ° ($^{1}/_{4}$ turn)
3 -	Pendulum supports to subframe * See note	20 Nm plus an additional 90 ° ($^{1}/_{4}$ turn)

* Replace bolts

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 lines and hoses are not stretched, kinked or bent.**

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

- Remove retaining clamp(s) from refrigerant lines.
- Remove ribbed belt, refer to *Ribbed belt, removing and installing* under **Ribbed belt, removing and installing** .
- Remove air conditioner compressor, refer to **A/C COMPRESSOR AND BRACKET** .

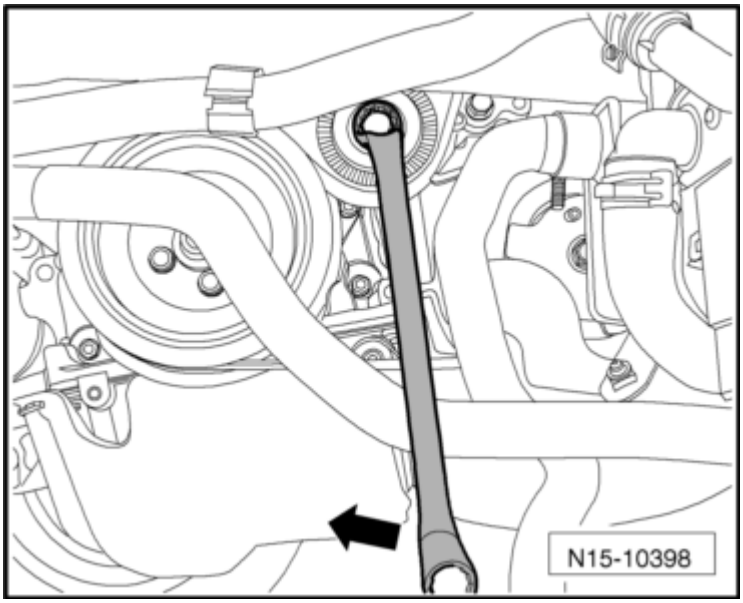

Fig. 19: Identifying Air Conditioning Compressor Secured To Towing Eye
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Secure A/C compressor to tow hook so that the refrigerant lines/hoses are not under tension.

NOTE:

- **Shield bumper from damage using adhesive tape.**

13 - ENGINE - CRANKSHAFT, CYLINDER BLOCK

ENGINE, DISASSEMBLING AND ASSEMBLING

Engine, disassembling and assembling

NOTE:

- **Secure engine to assembly stand using holding fixture VW 540 and adapter set for engine and transmission support VW 540/1 B when performing repair work.**
- **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**

Assembly overview

I

II

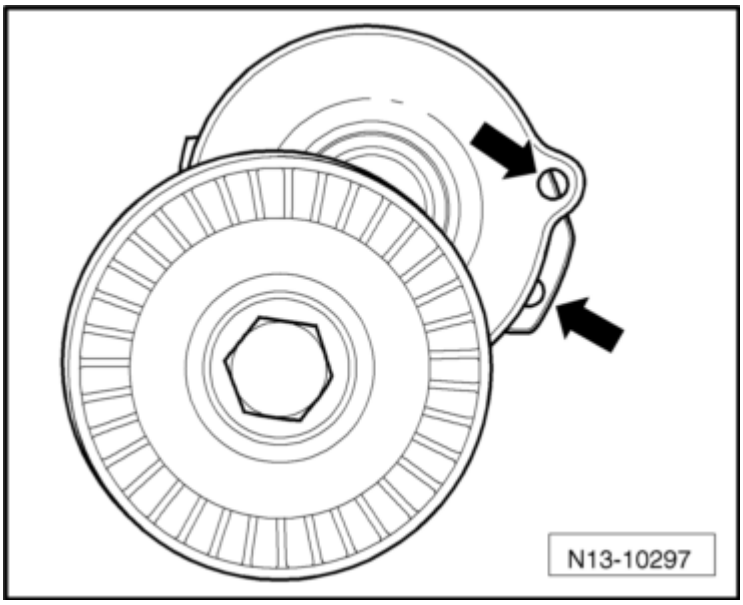

Fig. 20: Engine Assemby Overview I & II
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Part I

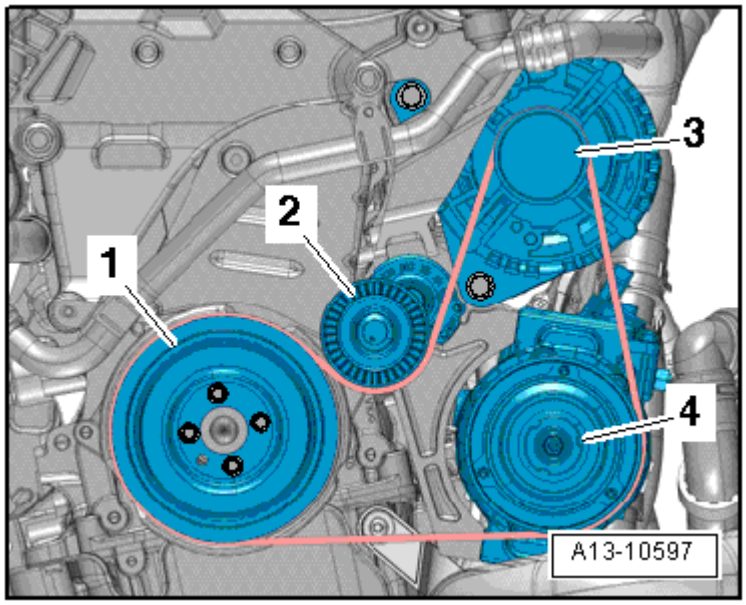

Fig. 21: Engine Assemby Overview I
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 25 Nm

2 - Tensioning device for ribbed belt

- To release tension on ribbed belt, pivot using open-end wrench, refer to *Ribbed belt, removing and installing* under **Ribbed belt, removing and installing**

3 - Toothed belt cover - upper part

4 - Toothed belt cover - center part

5 - 27 Nm

6 - Idler roller

7 - Tensioning roller

- Toothed belt, removing, installing and tensioning, refer to **Toothed belt, removing, installing and tensioning**

8 - Toothed belt

- Mark direction of rotation before removing
- Check for wear
- Do not kink
- Removing and installing, tensioning, refer to **Toothed belt, removing, installing and tensioning**

9 - Coolant pump

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

10 - O-ring

- Replace

11 - 15 Nm

12 - Tensioning device for toothed belt

- Toothed belt, removing, installing and tensioning, refer to **Toothed belt, removing, installing and tensioning**

13 - Crankshaft toothed belt gear

14 - 15 Nm

15 - 20 Nm

16 - 90 Nm plus an additional $^{1}/_{4}$ turn (90 °)

- Replace
- Use counter-holder 3415 to loosen and tighten
- Threads and shoulder must be free of oil and grease

17 - Toothed belt cover - lower part

18 - 10 Nm

- Insert using *locking fluid D 000 600 A2*

19 - Pulley

- For power steering pump

20 - 25 Nm

21 - Ribbed belt

- Mark direction of rotation before removing
- Check for wear

- Do not kink
- Removing and installing, refer to **Ribbed belt, removing and installing**

22 - 25 Nm

23 - Belt pulley/vibration damper

- Only possible to install in one position - Bores are offset
- Note position when installing toothed belt, refer to **Toothed belt, removing, installing and tensioning**

Part II

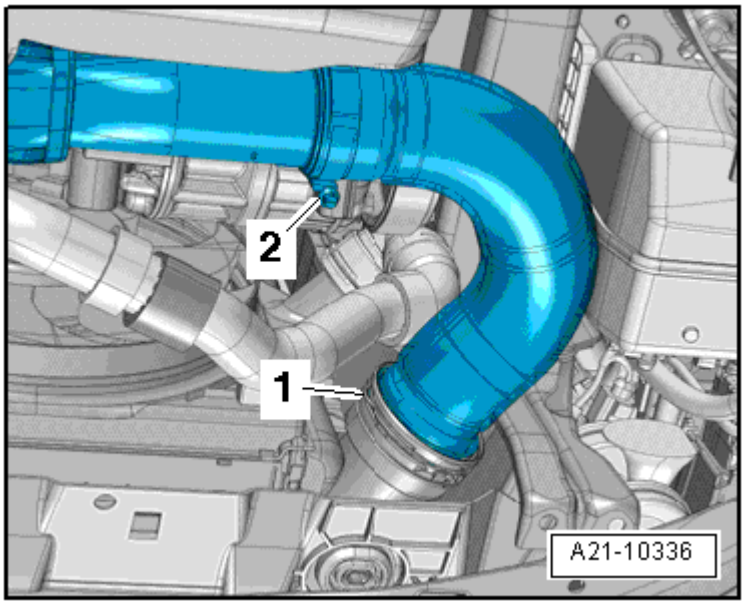

Fig. 22: Engine Assemby Overview II
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Knock sensor 1 G61

- Checking

2 - 20 Nm

- Tightening torque affects function of Knock Sensor (KS)

3 - Knock sensor 2 G66

- Checking

4 - Oil dipstick

- Oil level must not be above max. mark!
- Marks *Markings on oil dipstick* under **Lubrication system components, assembly overview**

5 - Inlet spout

- For oil dipstick

6 - O-ring

- Replace

7 - Coolant line

8 - 20 Nm

9 - Oil filter bracket

- Disassembling and assembling

10 - 15 Nm plus an additional $^{1}/_{4}$ turn (90 °)

- Replace

11 - Oil cooler

- Coat contact area to oil filter bracket, outside the seal, with AMV 188 100 02. (Part numbers are for reference only. Always check with your Parts Department for the latest part number information).
- Ensure sufficient clearance to surrounding components
- See note, refer to **Engine, disassembling and assembling**

12 - 25 Nm

13 - Oil filter element

- Remove with tension strap
- Fasten by hand
- Observe installation instructions for oil filter

14 - Gasket

- Replace

15 - 10 Nm

16 - Engine speed (RPM) sensor G28

- Checking

17 - Connecting piece

18 - 15 Nm

19 - O-ring

- Replace

20 - Coolant thermostat

- Removing and installing, refer to **Coolant thermostat, removing and installing**
- Note installation position, refer to **Coolant thermostat, removing and installing**
- Checking: Heat up thermostat in water
- Opening begins approx. 86 ° C
- Opening lift min. 7 mm

21 - 45 Nm

22 - Compact bracket

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

23 - Right engine bracket

Ribbed belt, removing and installing

Special tools, testers and auxiliary items required

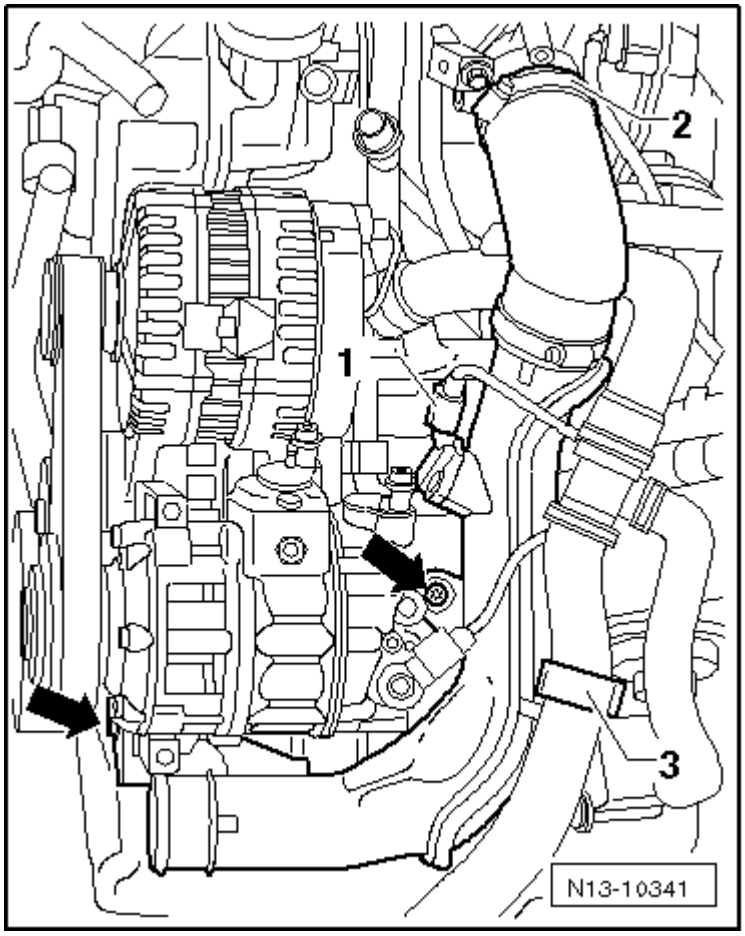

Fig. 23: Locking Pin T10060A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Locking Pin T10060A

Removing

- Mark direction of rotation of ribbed belt.

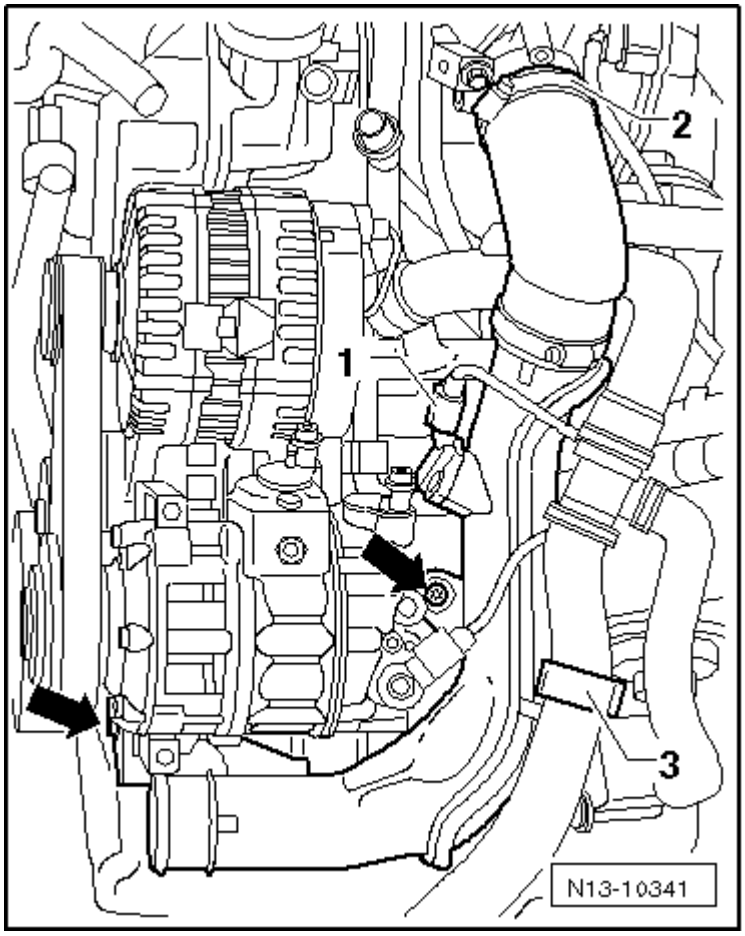

Fig. 24: Relieving Tension On Poly V-Belt
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Swing tensioner in direction of - **arrow** - with an open-end wrench until it can be locked.

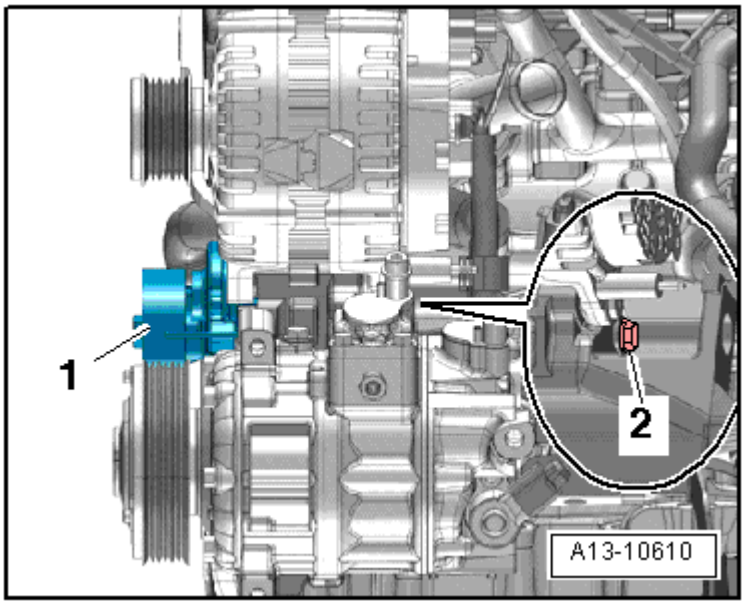

Fig. 25: Securing Tensioner Using Locking Pin T10060 A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Secure tensioner using Locking Pin T10060 A - **arrow** -.
- Remove sound insulation tray, refer to **NOISE INSULATION (GASOLINE ENGINES), ASSEMBLY OVERVIEW** or **NOISE INSULATION (DIESEL ENGINES), ASSEMBLY OVERVIEW** .
- Remove ribbed belt.

Installing

- Installation is in reverse order of removal.

NOTE:

- **Ensure, before installing ribbed belt, that all ancillaries (generator, air conditioner compressor, power steering pump) are secured tightly.**
- **Note previously marked direction of belt rotation and be sure that it is seated correctly on pulley.**
- **In vehicles without A/C system, lay ribbed belt last on the generator.**
- **In vehicles with A/C system, lay ribbed belt last on the A/C compressor.**

After completing repairs always:

- Start engine and check belt running.

Ribbed belt routing

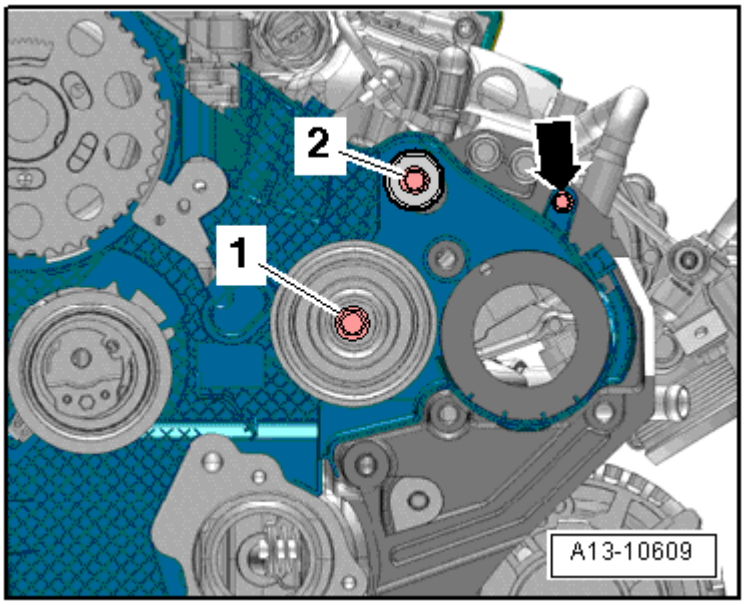

Fig. 26: Identifying Belt Drive For Vehicles Without Air Conditioning
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Belt drive without air conditioning compressor

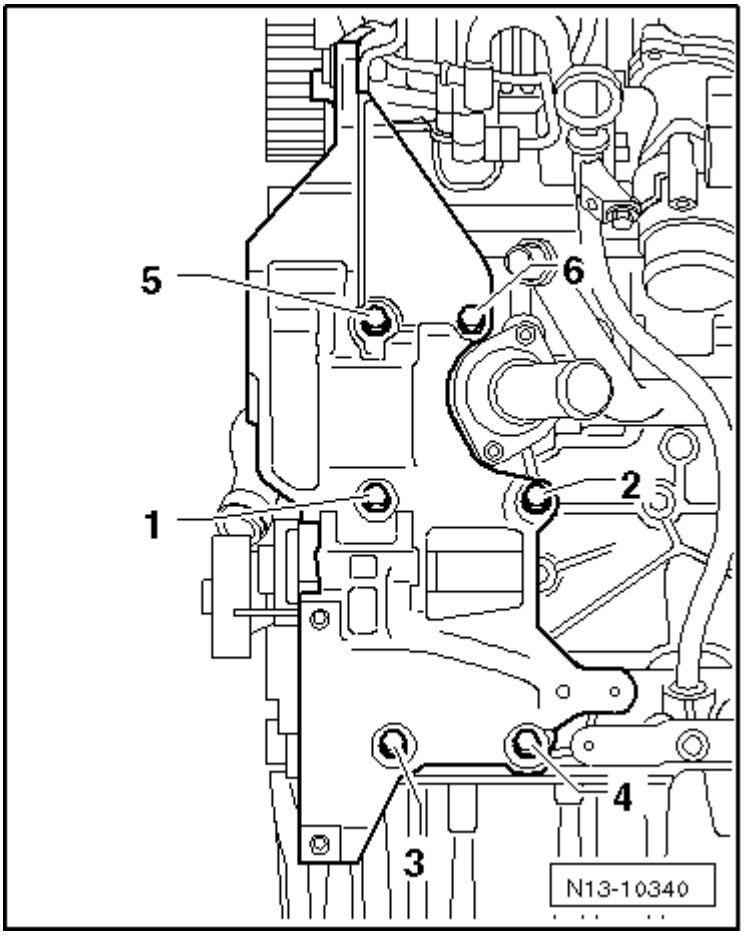

Fig. 27: Identifying Belt Drive For Vehicles With Air Conditioning
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Belt drive with air conditioning compressor

NOTE:

- **Engines with A/C compressor are equipped with a double ribbed belt.**

SEALING FLANGES AND FLYWHEEL/DRIVE PLATE

Sealing flanges and flywheel/drive plate

NOTE:

- **Servicing clutch, refer to 30 CLUTCH in appropriate MANUAL TRANSMISSION article**

Sealing flanges and flywheel/drive plate, assembly overview

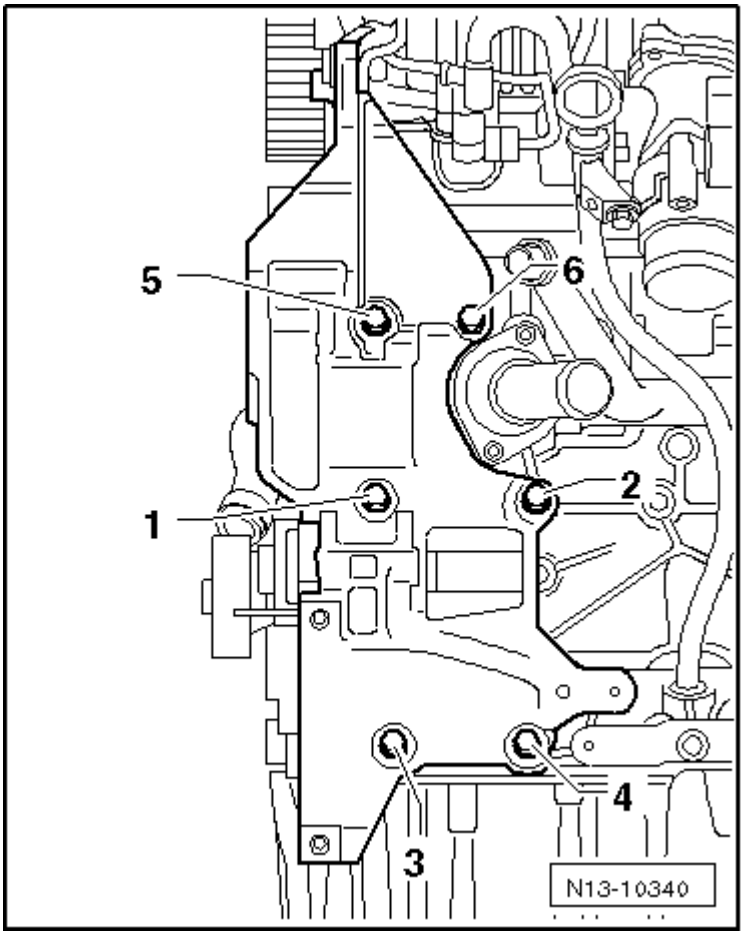

Fig. 28: Identifying Sealing Flanges And Flywheel/Drive Plate
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 90 Nm plus an additional $^{1}/_{4}$ turn (90 °)

- Replace
- Use counter-holder 3415 to loosen and tighten
- Threads and shoulder must be free of oil and grease

2 - Crankshaft toothed belt sprocket

3 - 15 Nm

4 - Seal

- Replacing, refer to **Crankshaft seal - ribbed belt side, replacing** .

5 - Sealing flange

- Must be located on alignment sleeves

- Clean sealing surface before installing
- Insert with *silicone sealant D 176 404 A2*
- Removing and installing refer to **Sealing flange (belt pulley side), removing and installing**

- To remove and install, remove oil pan

6 - Cylinder block

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

7 - 60 Nm plus an additional $^{1}/_{4}$ turn (90 °)

- Replace

8 - Flywheel/drive plate

- To remove and install flywheel, secure using flywheel retainer 3067
- Drive plate, removing and installing refer to **Drive plate, removing and installing**

9 - Intermediate plate

- Must be located on alignment sleeves
- Do not damage or bend when doing assembly work

10 - Sealing flange with seal

- Only replaced as complete unit
- To remove and install, remove oil pan, refer to **Oil pan, removing and installing**
- Before installing, remove oil remains from crankshaft journal with a clean cloth
- Do not additionally oil or grease sealing lip of sealing ring

- To install, use provided support sleeve
- Support sleeve may only be removed after sealing flange has been slid onto crankshaft pin.

Crankshaft seal - ribbed belt side, replacing

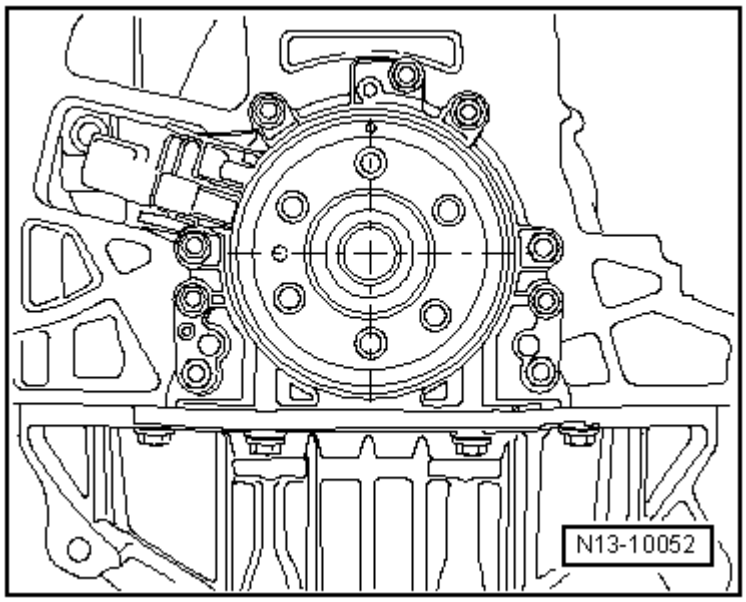

Fig. 29: Identifying Special Tools - Replacing Crankshaft Seal, Ribbed Belt Side
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Seal remover 3203
- Counter-holder tool 3415
- Assembly tool T10053
- Torque wrench V.A.G 1331
- Torque wrench V.A.G 1332

Removing

- Remove ribbed belt and tensioner, refer to **Ribbed belt, removing and installing** .
- Toothed belt, removing, refer to **Toothed belt, removing, installing and tensioning** .

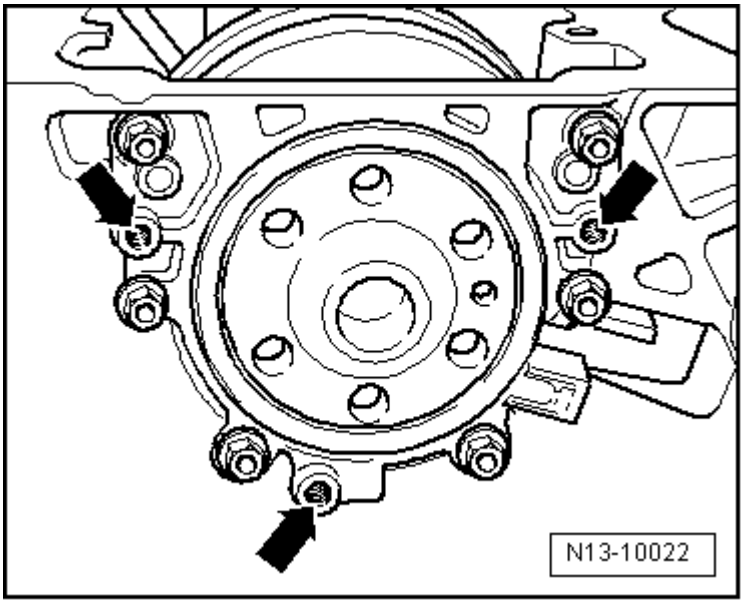

Fig. 30: Counter-Holding Crankshaft Toothed Belt Sprocket With 3415
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove toothed belt crankshaft sprocket. To do this, lock toothed belt gear using counter support 3415.

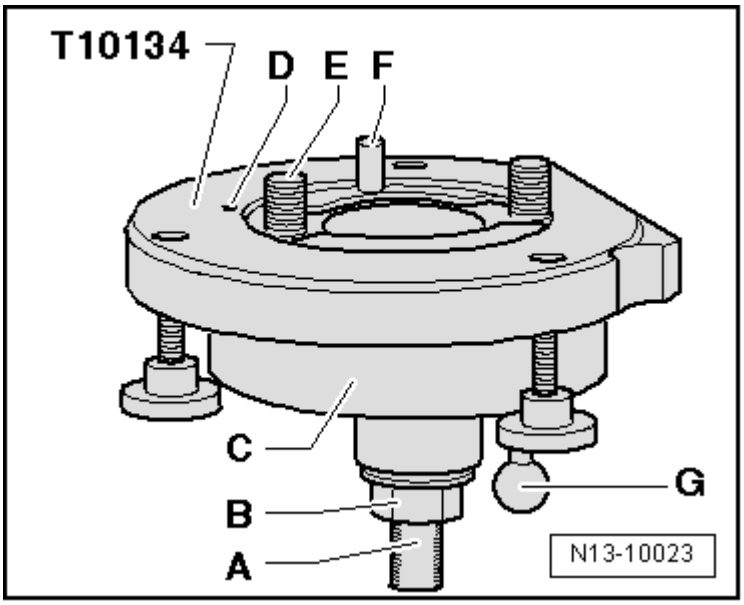

Fig. 31: Identifying Center Bolt & Crankshaft
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- To guide Seal Remover 3203 , thread center bolt into crankshaft by hand until stop.
- Remove inner portion of seal remover 3203 nine rotations (approx. 20 mm) from outer portion and secure with knurled-head screw.

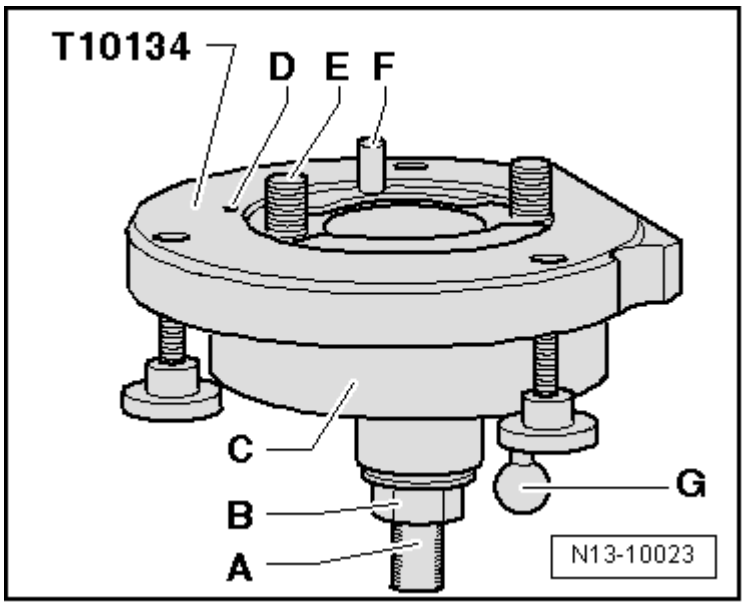

Fig. 32: Identifying Special Tool - 3203
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Lubricate threaded head of seal remover 3203 , position and screw into oil seal as far as possible with forced pressure.
- Loosen knurled screw and turn inner portion against crankshaft until oil seal is pulled out.

Installing

NOTE:

- **Phased in introduction of PTFE sealing rings (Distinguishing features: without ring spring, sealing lip designed wider). The sealing lip of this sealing ring may not be oiled or greased. An oil seal of the old version (with ring spring) can be replaced by a PTFE seal - but not the other way around.**

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

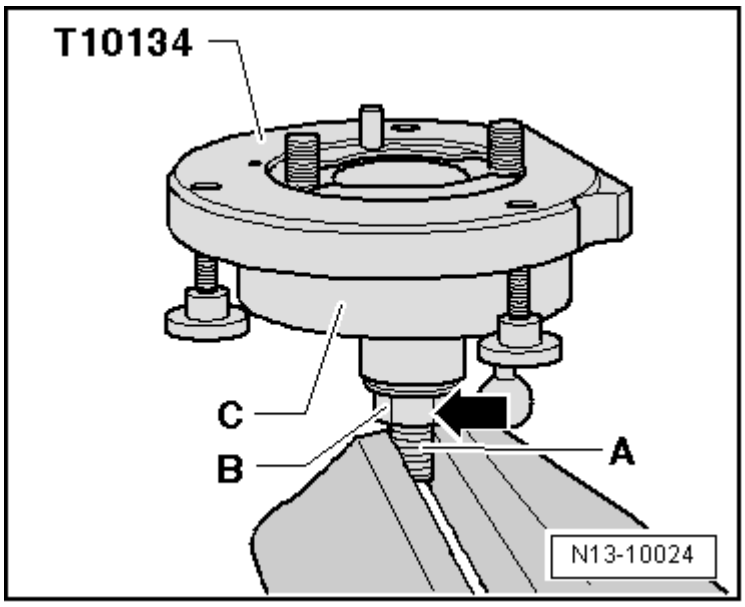

Fig. 33: Identifying Guide Sleeve T10053/1 Mounted Onto Crankshaft Journal
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position guide sleeve T10053/1 on crankshaft pin.
- Slide sealing ring over guide sleeve onto crankshaft pin.

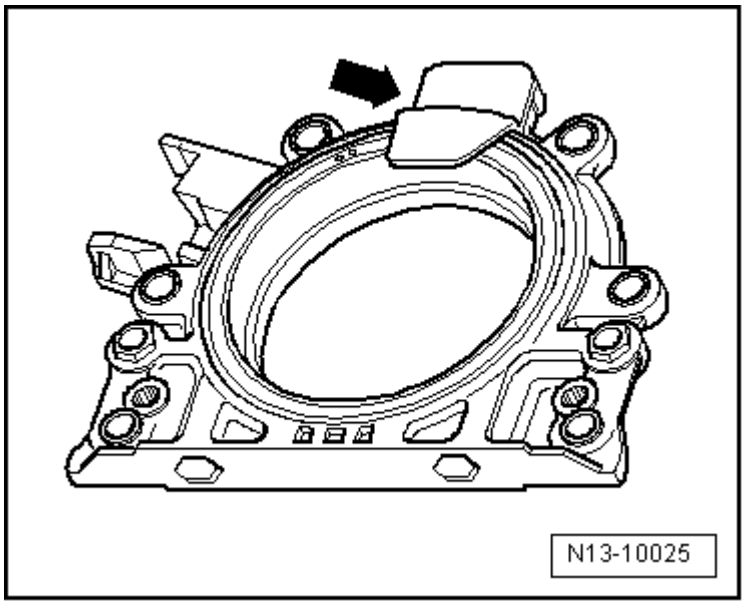

Fig. 34: Identifying Press Sleeve T10053 & Bolt Mounted
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press in oil seal using pressure sleeve T10053 and bolt T10053/2 (M16 x 1.5 x 60) up to stop.

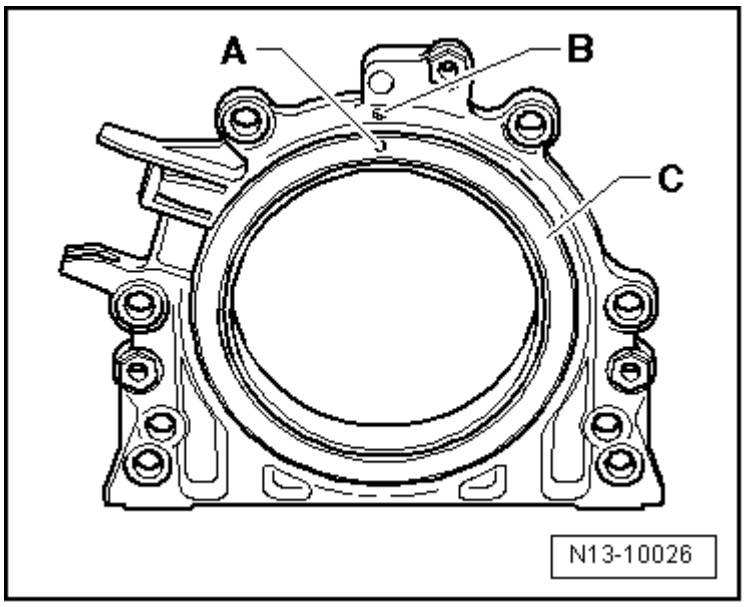

Fig. 35: Counter-Holding Crankshaft Toothed Belt Sprocket With 3415
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install toothed belt crankshaft sprocket and lock with counter support 3415.
- Tighten new center bolt to 90 Nm and turn an additional 90 ° (1/4 turn, additional turn may occur in several stages).

NOTE:

- **The threads and shoulder must be free of oil and grease.**

Install toothed belt and adjust valve timing, refer to **Toothed belt, removing, installing and tensioning** .

- Installing ribbed belt and tensioner, refer to **Ribbed belt, removing and installing** .

Sealing flange (belt pulley side), removing and installing

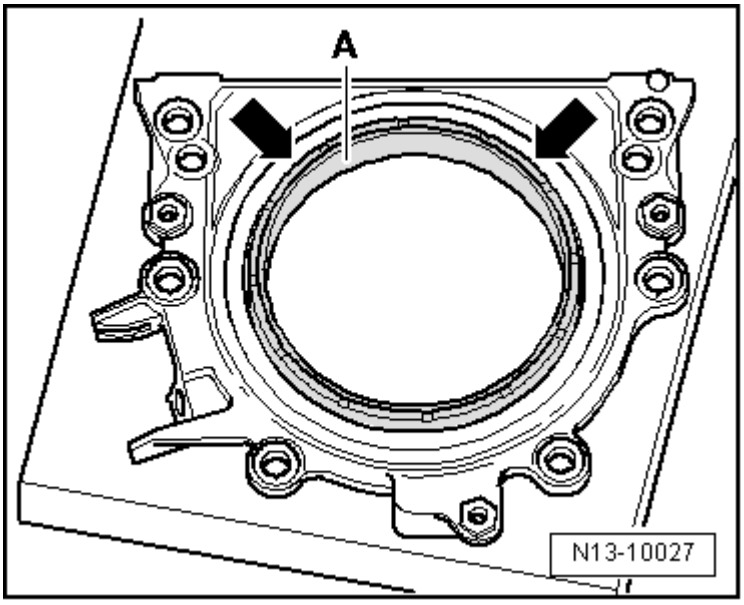

Fig. 36: Identifying Special Tools - Removing And Installing Sealing Flange (Belt Pulley Side)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Counter-holder tool 3415
- Assembly tool T10053
- Torque wrench V.A.G 1331
- Torque wrench V.A.G 1332
- Hand drill with plastic brush attachment
- *Silicone sealant D 176 404 A2* (Part numbers are for reference only. Always check with your Parts Department for the latest part number information).
- Protective glasses
- Flat scraper

Removing

- Remove ribbed belt and tensioner, refer to **Ribbed belt, removing and installing** .
- Toothed belt, removing, refer to **Toothed belt, removing, installing and tensioning** .

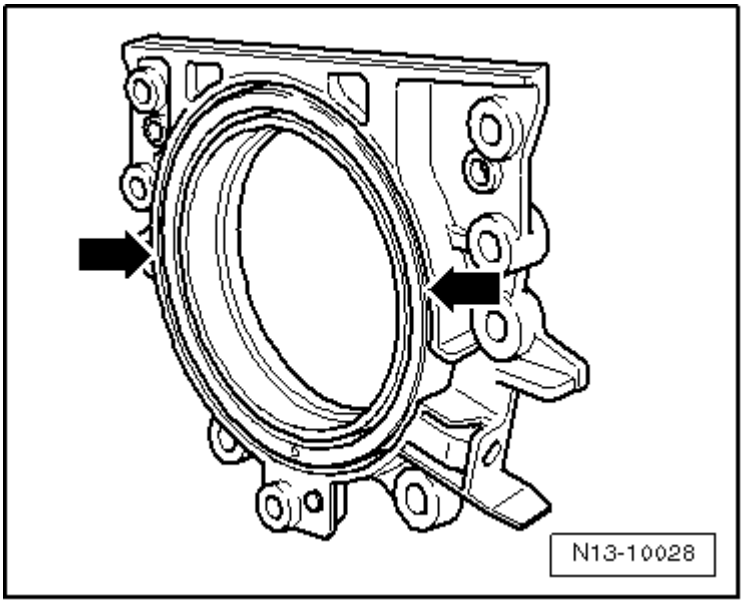

Fig. 37: Counter-Holding Crankshaft Toothed Belt Sprocket With 3415
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove toothed belt crankshaft gear. To do this, lock toothed belt gear using counter support 3415.
- Drain engine oil.
- Remove oil pan, refer to **Oil pan, removing and installing** .
- Remove front sealing flange.

- Remove sealing flange, and if necessary loosen by applying light strikes with a rubber hammer.
- Remove sealant residue from cylinder block with a flat scraper.
- Cover seal with a clean rag.

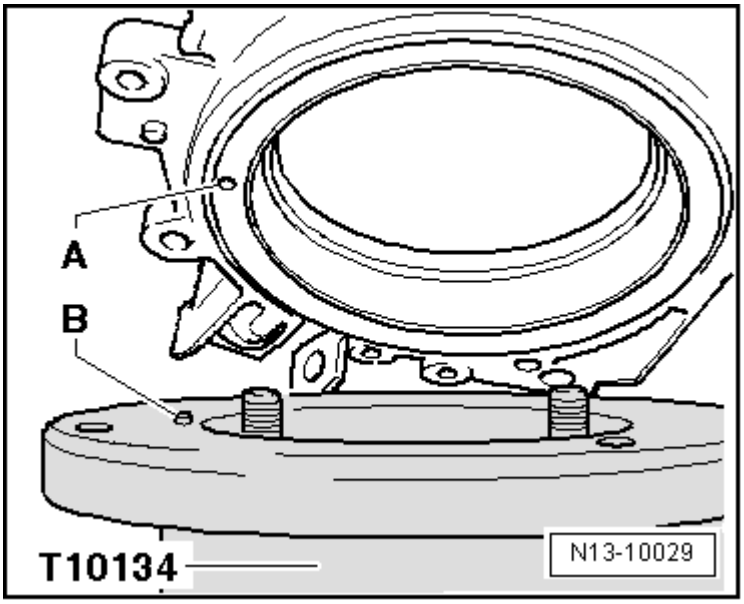

Fig. 38: Removing Sealant Remains On Sealing Flange With A Rotating Plastic Brush

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove sealant residue from sealing flange using a rotating plastic brush (wear safety glasses).
- Clean sealing surfaces. They must be free of oil and grease.

Installing

NOTE:

- **Note the expiration date of the sealing compound.**
- **The sealing flange must be installed within 5 minutes after application of silicon sealant.**

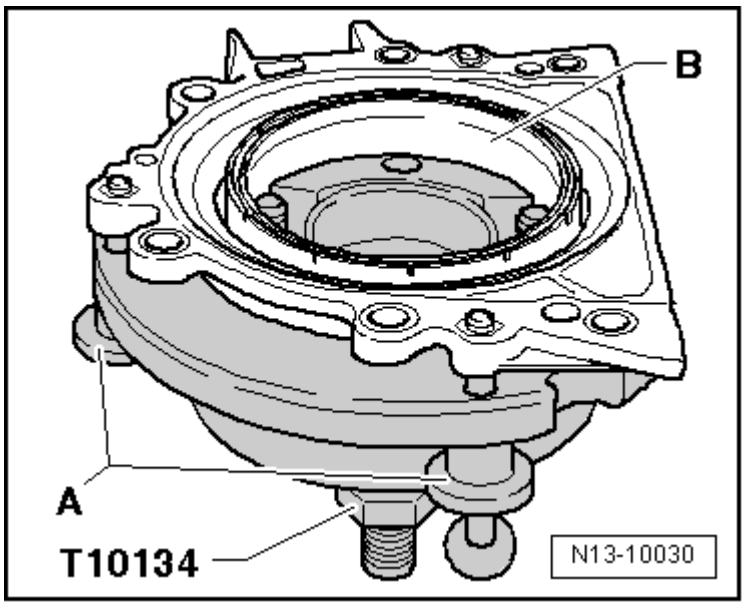

Fig. 39: Cutting Off Tube Nozzle At Front Marking & Applying Silicone Sealing Compound To Clean Sealing Surface Of Sealing Flange
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Cut off nozzle on tube of sealant at front mark (diameter of nozzle approx. 3 mm).
- Apply silicone sealing compound, as shown, to clean sealing surface of the sealing flange. Sealing compound bead must be:

- 2 to 3 mm thick
- and run on inside of bolt holes - **arrows** -

NOTE:

- **The sealing compound bead must not be thicker, otherwise excess sealing compound could enter the oil pan and may block the oil suction pipe strainer. Likewise, it could drip onto the sealing surface of the crankshaft seal.**
- **Before applying the bead of sealant, cover the sealing surface of the seal with a clean rag.**

- Set sealing flange in place immediately and lightly tighten bolts.

NOTE:

- **To position sealing flange with sealing ring installed, use guide sleeve T10053/1.**

- Fasten sealing flange bolts in a diagonal sequence. Torque specification: 15 Nm
- Remove excess sealant.
- Install oil pan, refer to **Oil pan, removing and installing** .

NOTE:

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

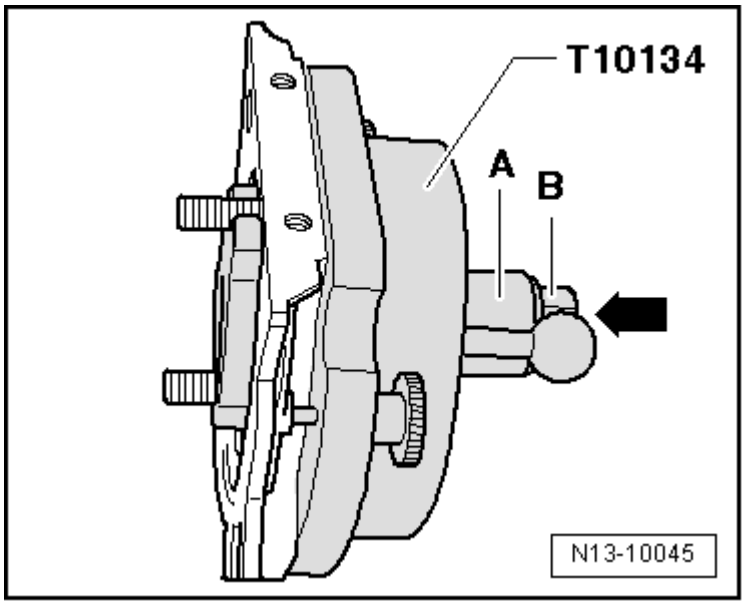

Fig. 40: Counter-Holding Crankshaft Toothed Belt Sprocket With 3415
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install toothed belt crankshaft sprocket and lock with counter support 3415.
- Tighten new center bolt to 90 Nm plus an additional 90 ° (1/4 turn, additional turn may occur in several stages).

NOTE:

- **The threads and shoulder must be free of oil and grease.**

- Install toothed belt and adjust valve timing, refer to **Toothed belt, removing, installing and tensioning** .
- Installing ribbed belt and tensioner, refer to **Ribbed belt, removing and installing** .

Drive plate, removing and installing

Special tools, testers and auxiliary items required

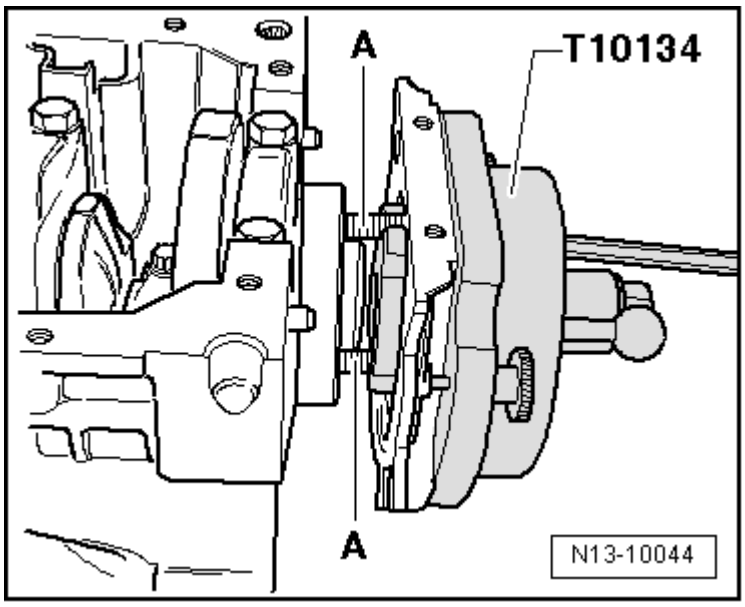

Fig. 41: Identifying Counterhold VW 558
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Flywheel lock adapter VW 558
- Hex bolt M8x45 and two M10 hex nuts
- Depth gauge

Drive plate, loosening and tightening

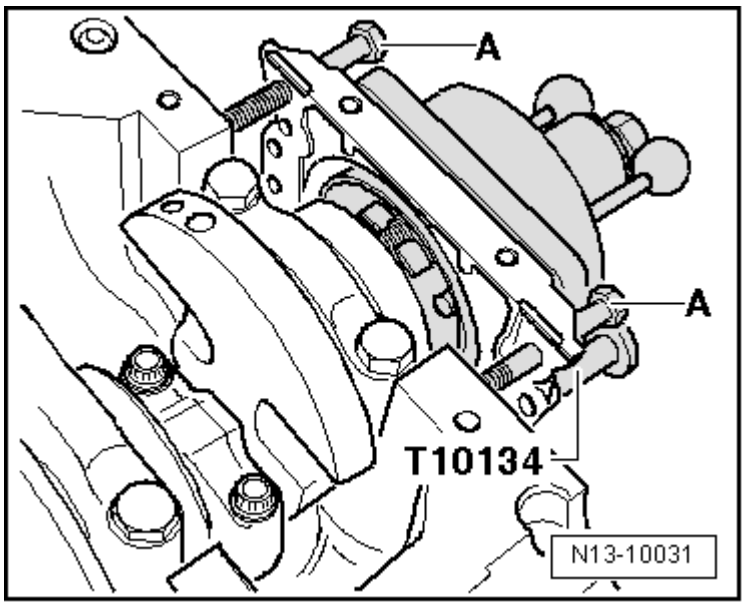

Fig. 42: Identifying Position Of Counterhold VW 558
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Secure flywheel lock adapter VW 558 with hex bolt M8x45 to drive plate. Insert two M10 hex nuts - **1** - between flywheel lock adapter and drive plate.

Installed location of flywheel retainer:

- **A** - to loosen

- **B** - to tighten

  - Loosen drive plate bolts.

Installing drive plate.

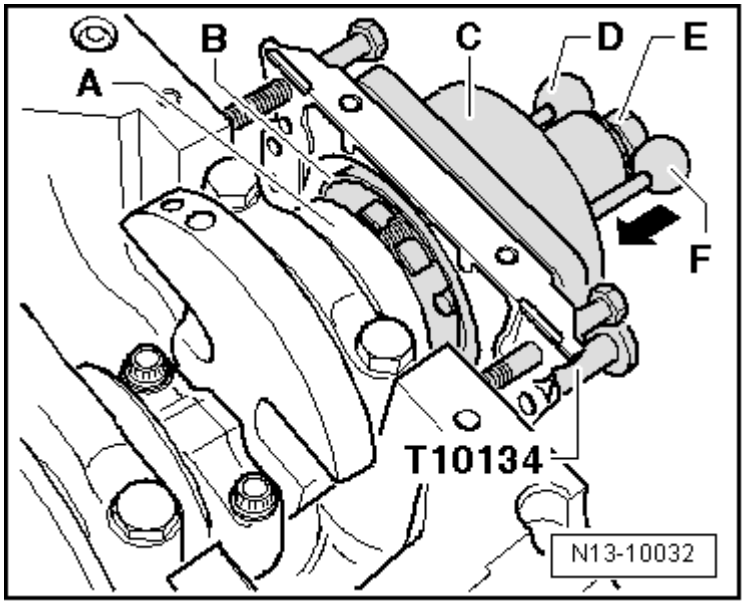

Fig. 43: Identifying Drive Plate And Appropriate Shims
Courtesy of VOLKSWAGEN UNITED STATES, INC.

  - Set drive plate in place, using washer with notches - **1** -.
  - Insert new bolts - **3** - and tighten to 30 Nm.

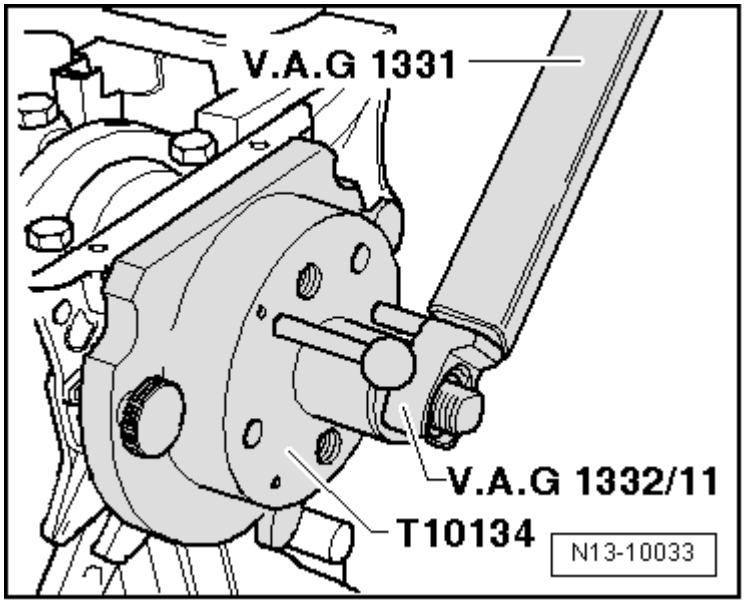

Fig. 44: Measuring Through Hole In Drive Plate To The Milled Surface Of The Cylinder Block
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Check dimension - **a** - an three points and calculate mean value. Specified value: 19.5 to 21.1 mm

NOTE:

- **This is measured through the hole in the drive plate to the machined surface of the cylinder block.**

If specification is not obtained:

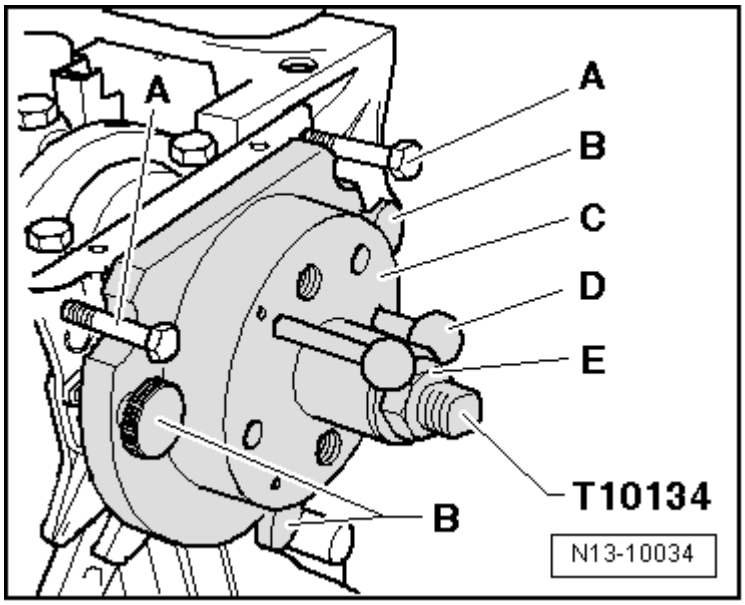

Fig. 45: Identifying Drive Plate And Appropriate Shims
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove drive plate again and use shim - **2** -. Tighten bolts again to 30 Nm.
- Tighten bolt to 60 Nm and turn an additional 90 ° (1/4 turn, additional turn may occur in several stages).

CRANKSHAFT

Crankshaft

- Secure engine to assembly stand using holding fixture VW 540 and adapter set for engine and transmission support VW 540/1 B when performing repair work.

Crankshaft, assembly overview

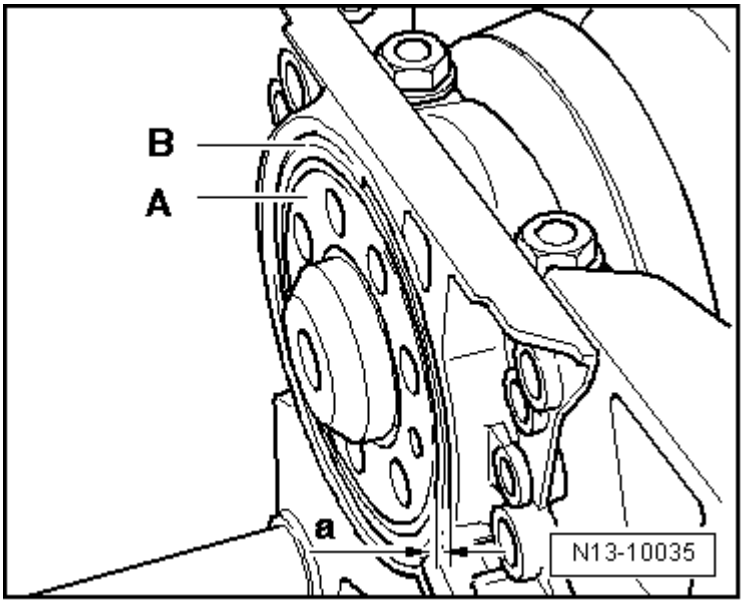

Fig. 46: Crankshaft, Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Oil pump with chain sprocket

- With pressure relief valve 12 bar
- Before installing, check to be sure both alignment sleeves are present (for centering oil pump/cylinder block)
- Removing and installing, refer to **Lubrication system components**

2 - 15 Nm

3 - Chain sprocket

- For oil pump drive
- Check for wear

4 - Bearing shells 1, 2, 3, 4 and 5

- For bearing cap without oil groove
- For cylinder block with oil groove
- Do not interchange used bearings (mark)
- Vehicles from approx. 05/00: Classification for replacement part ordering *Cylinder block crankshaft bearing shells identification* under **Crankshaft, assembly overview**

5 - 65 Nm plus an additional 90 ° ($^{1}/_{4}$ turn)

- Replace
- Fully threaded
- When measuring crankshaft radial play, fasten to 65 Nm

6 - Bearing cap

- Bearing cap 1: Belt pulley side
- Retaining tabs of bearing shells and cylinder block/bearing caps must lie above one another

7 - Bearing shell 3

- Do not interchange used bearings (mark)

8 - Sensor wheel

- Replace
- For Engine Speed (RPM) Sensor G28
- Only possible to install in one position - Bores are offset

9 - 10 Nm plus an additional $^{1}/_{4}$ turn (90 °)

- Replace

10 - Thrust washer

- For bearing 3
- Observe locating point

11 - Crankshaft

- Axial play new: 0.07 to 0.23 mm, wear limit: 0.30 mm
- Check radial clearance with Plastigage 0.01 to 0.04 mm, wear limit: 0.15 mm
- Do not turn crankshaft when measuring radial play

- Crankshaft dimensions refer to **Crankshaft dimensions**

Vehicles from approx. 05/00

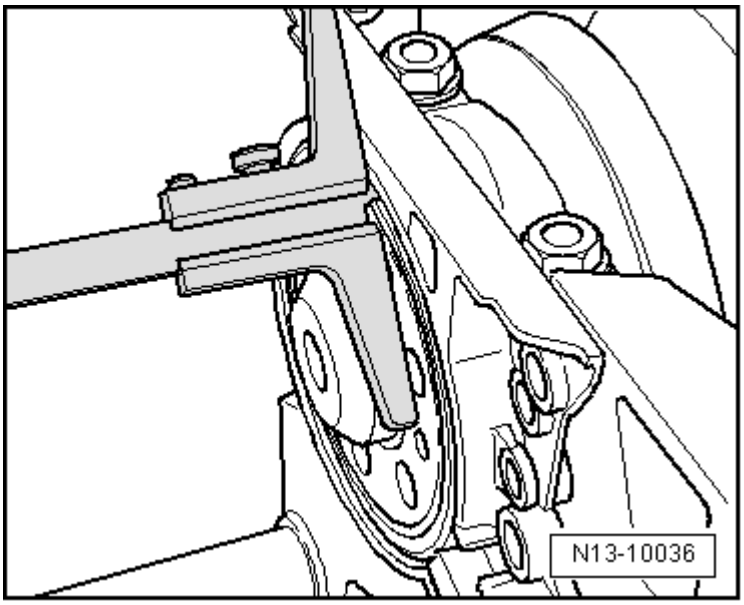

Fig. 47: Cylinder Block Crankshaft Bearing Shells Identification
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Cylinder block crankshaft bearing shells identification

From the factory, the upper bearing shells are allocated to cylinder block with the correct thickness. Colored spots serve to identify bearing thicknesses.

NOTE:

- **Arrow points in direction of travel.**

The letters marked on lower sealing surface of cylinder block identify which bearing thickness must be installed in which location.

Color identification

Letter on cylinder block		Color of bearing
S	=	black
R	=	red
G	=	yellow

- The crankshaft bearing shells in the bearing caps are only available as a replacement part with a "yellow" color marking.

Crankshaft dimensions

(Dimensions in mm)

Honing dimension	Crankshaft bearing pins-diameter		Connecting rod bearing pins-diameter	
Basic dimension	54.00	-0.017 -0.037	47.80	-0.022 -0.042
1st oversize	53.75	-0.017 -0.037	47.55	-0.022 -0.042
2nd oversize	53.50	-0.017 -0.037	47.30	-0.022 -0.042
Stage III	53.25	-0.017 -0.037	47.05	-0.022 -0.042

PISTON AND CONNECTING ROD

Pistons and connecting rods (engine code AWD), assembly overview

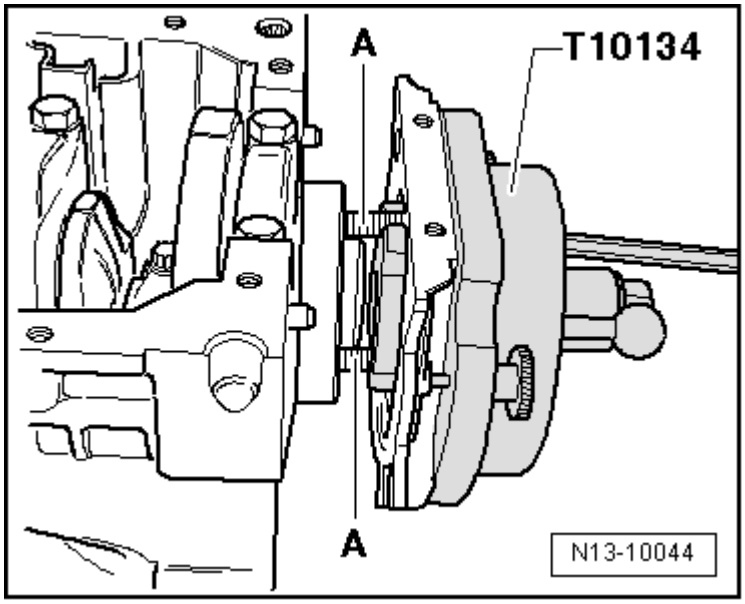

Fig. 48: Pistons And Connecting Rods (Engine Code AWD), Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Piston rings

- Offset gaps by 120 °
- Use piston ring pliers for removal and installation
- "TOP" faces toward piston crown
- Checking ring gap *Checking piston ring gap* under **Checking piston ring gap**
- Check piston ring groove clearance *Checking ring to groove clearance* under **Pistons and connecting rods (engine code AWD), assembly overview**
- Oil scraping ring, 2-part or 3-part, mixed installation is permitted

2 - Piston

- Checking *Checking piston* under **Pistons and connecting rods (engine code AWD), assembly overview**

- Mark installed position and cylinder allocation
- Arrow on piston face points toward belt pulley side
- Install with piston ring compressor

3 - Connecting rod

- Only replace as set
- Affiliation to cylinder mark - **B** -
- Installed location: Markings - **A** - point to belt pulley side

4 - Connecting rod bearing cap

- Installed location: Markings - **A** - point to belt pulley side
- Affiliation to cylinder mark - **B** -

5 - 30 Nm plus an additional $^{1}/_{4}$ turn (90 °)

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

6 - Pressure relief valve, 27 Nm

- Opening pressure 1.3 to 1.6 bar positive pressure

7 - Oil spray jet

For piston cooling

8 - Bearing shell

- Note installation position
- Do not interchange used bearing shells
- Check for secure fit in retaining tabs
- Axial play new: 0.10 to 0.31 mm, wear limit: 0.40 mm
- Measure radial clearance with Plastigage: New: 0.01 to 0.05 mm, wear limit: 0.09 mm
- Do not turn crankshaft when checking radial clearance

9 - Cylinder block

- Cylinder bore, checking *Checking cylinder bores* under **Pistons and connecting rods (engine code AWD), assembly overview**
- Piston and cylinder dimensions, refer to **Piston and cylinder dimensions, engine code AWD**

10 - Connecting rod bolt

- Replace

11 - Circlip

12 - Piston pin

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

Checking piston ring gap

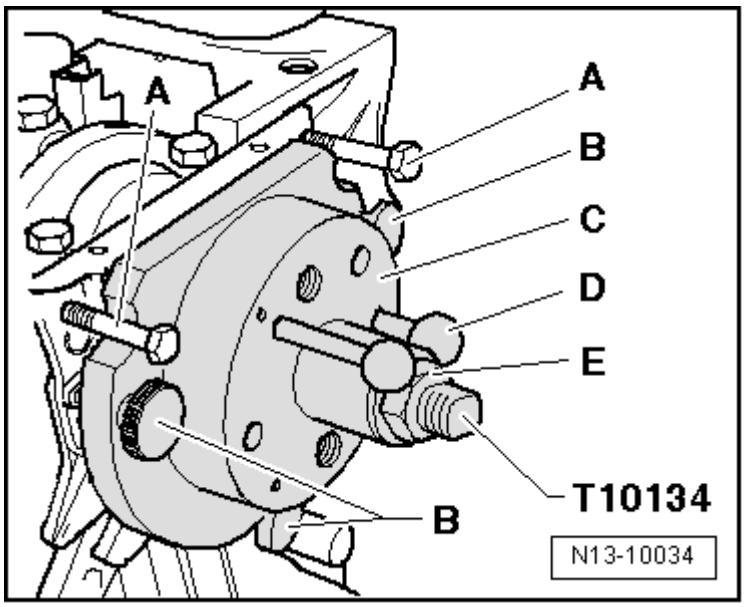

Fig. 49: Checking Piston Ring Gap
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Feeler gauge

  - Insert ring into lower cylinder bore at a right angle from above, approx. 15 mm from cylinder edge.

Piston ring		Gap	
		New	Wear limit
Compression rings	mm	0.15 to 0.40	0.8
Oil scraping ring	mm	0.25 to 0.50	1.00

Checking ring to groove clearance

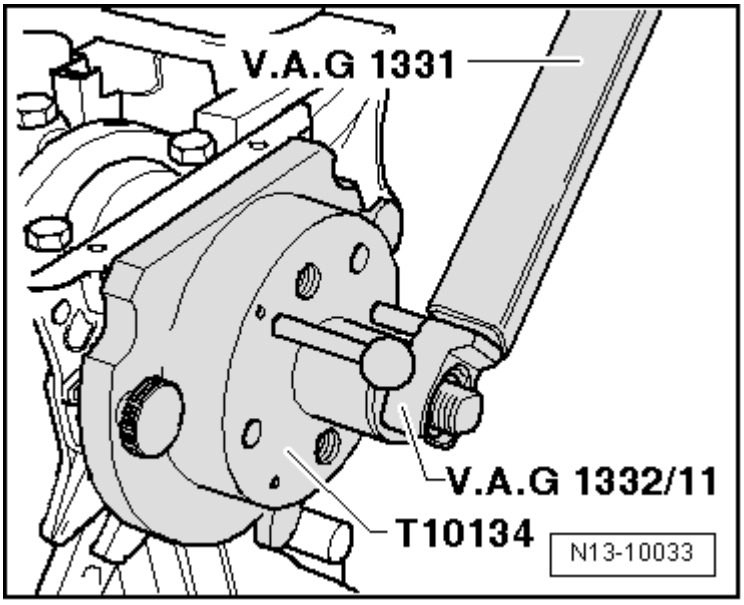

Fig. 50: Checking Ring To Groove Clearance
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Feeler gauge

Clean ring groove before checking.

Piston ring		Ring to groove clearance	
		New	Wear limit
compression rings	mm	0.02 to 0.07	0.12
Oil scraping ring	mm	0.02 to 0.06	0.12

Checking piston

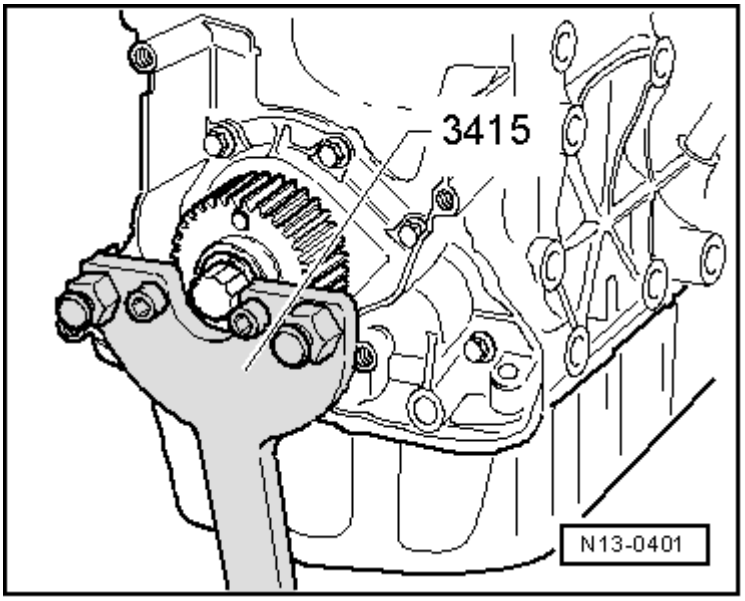

Fig. 51: Checking Piston
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- External micrometer 75 to 100 mm

Take measurement approx. 10 mm from lower edge of piston skirt and offset 90 ° to piston axis.

Deviation from nominal size: max. 0.04 mm.

Checking cylinder bores

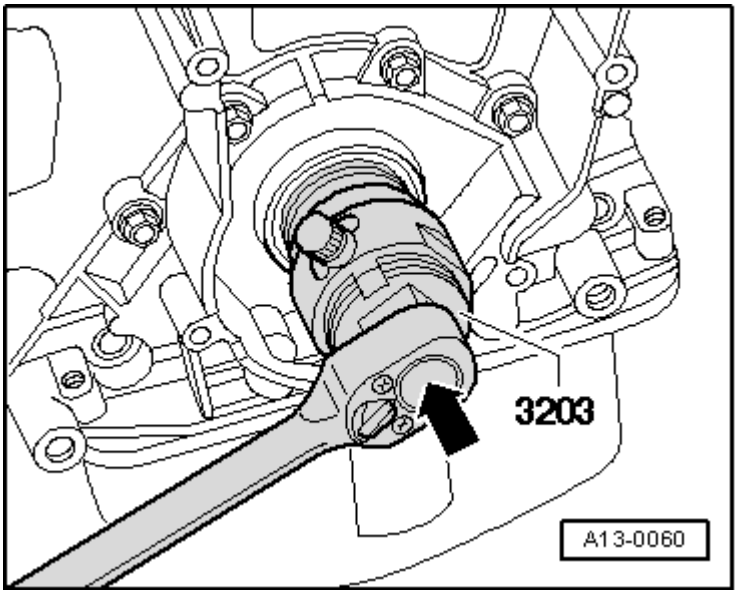

Fig. 52: Checking Cylinder Bores

Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Internal dial gauge 50 to 100 mm
  - Measure diagonally at 3 positions transversely - **A** - and longitudinally - **B** -.

Deviation from nominal size: max. 0.10 mm.

NOTE:

- **Cylinder bore measurement must not be performed if cylinder block is secured to assembly stand with holding fixture VW 540 , since inaccurate measurements are possible.**

Piston and cylinder dimensions, engine code AWD

Honing dimension		Piston diameter	Cylinder bore diameter
Basic dimension	mm	80.965 * See note	81.01
1st oversize	mm	81.465 * See note	81.51

* Measurement without graphite coating (0.02 mm thick). The graphite coating wears off.

Pistons and connecting rods (engine code AWD, AWW), assembly overview

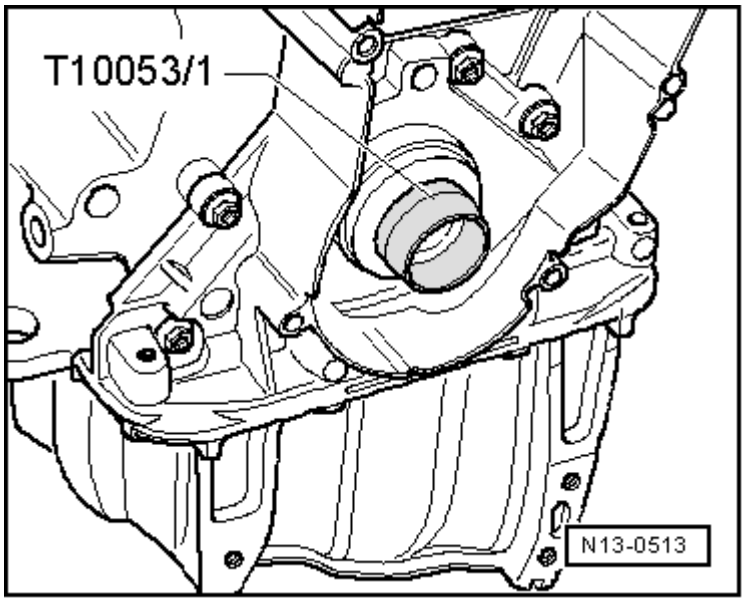

Fig. 53: Pistons And Connecting Rods (Engine Code AWD, AWW), Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Piston rings

- Offset gaps by 120 °

- Use piston ring pliers for removal and installation
- "TOP" faces toward piston crown
- Checking ring gap *Checking piston ring gap* under **Checking piston ring gap**
- Check piston ring groove clearance *Checking ring to groove clearance* under **Pistons and connecting rods (engine code AWD), assembly overview**

2 - Piston

- Checking *Checking piston* under **Pistons and connecting rods (engine code AWD), assembly overview**
- Mark installed position and cylinder allocation
- Arrow on piston face points toward belt pulley side
- Install with piston ring compressor

3 - Piston pin

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

4 - Circlip

5 - Connecting rod

- Only replace as a set
- Affiliation to cylinder mark - **B** -
- Installed location: Markings - **A** - points to belt pulley side

6 - Bearing shell

- Note installation position *Bearing shells - installed positions* under **Pistons and connecting rods (engine code AWD, AWW), assembly overview**
- Do not interchange used bearing shells
- Axial play new: 0.05 to 0.31 mm, wear limit: 0.37 mm
- Measure radial clearance with Plastigage: New: 0.01 to 0.06 mm, wear limit: 0.09 mm
- Do not turn crankshaft when checking radial clearance

7 - Cylinder block

- Cylinder bore, checking *Checking cylinder bores* under **Pistons and connecting rods (engine code AWD, AWW), assembly overview**
- Piston and cylinder dimensions refer to **Piston and cylinder dimensions, engine codes AWP, AWW**

8 - Connecting rod bearing cap

- Note installation position

9 - Oil spray jet

- For piston cooling

10 - Pressure relief valve, 27 Nm

- Opening pressure 1.3 to 1.6 bar positive pressure

11 - Connecting rod bolt, 30 Nm plus an additional $^{1}/_{4}$ turn (90 °)

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

Checking piston ring gap

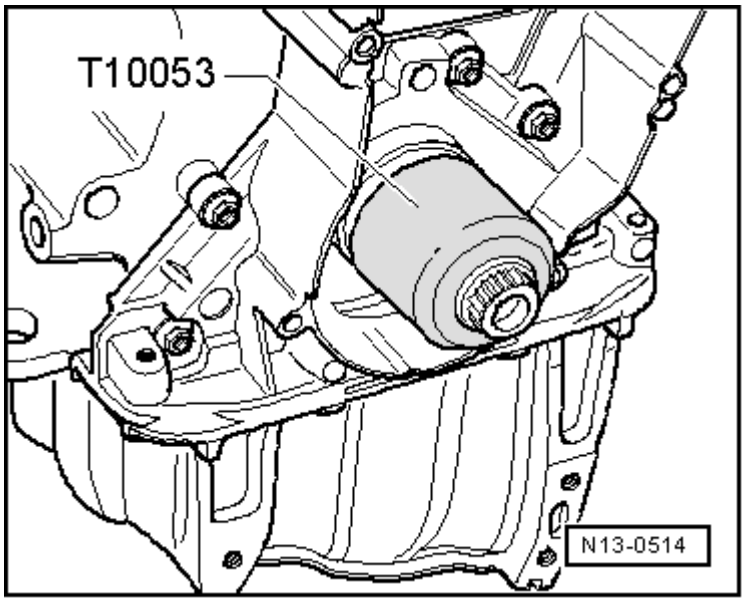

Fig. 54: Checking Piston Ring Gap
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Feeler gauge

  - Insert ring into lower cylinder bore at a right angle from above, approx. 15 mm from cylinder edge.

Piston ring		Gap

		New	Wear limit
Compression rings	mm	0.200.40	0.8
Oil scraping ring	mm	0.250.50	0.8

Checking ring to groove clearance

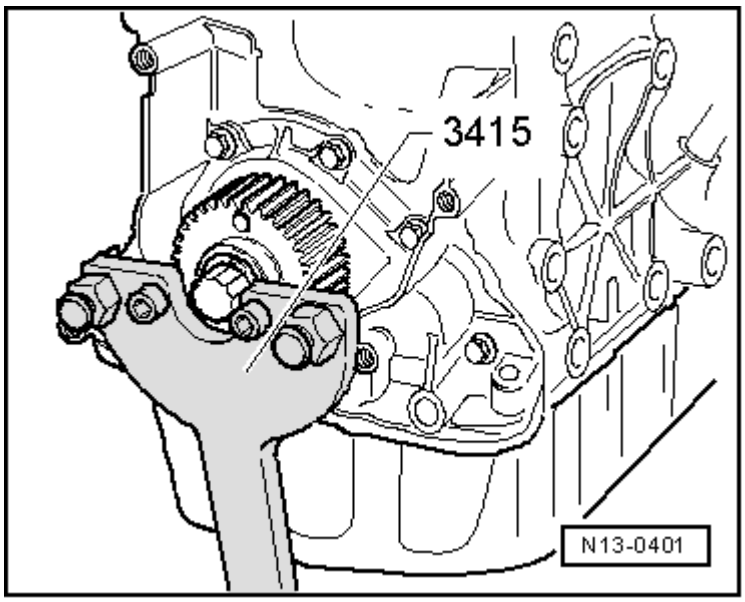

Fig. 55: Checking Ring To Groove Clearance
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Feeler gauge

Clean ring groove before checking.

Piston ring		Ring to groove clearance	
		New	Wear limit
compression rings	mm	0.06 to 0.09	0.20
Oil scraping ring	mm	0.03 to 0.06	0.15

Checking piston

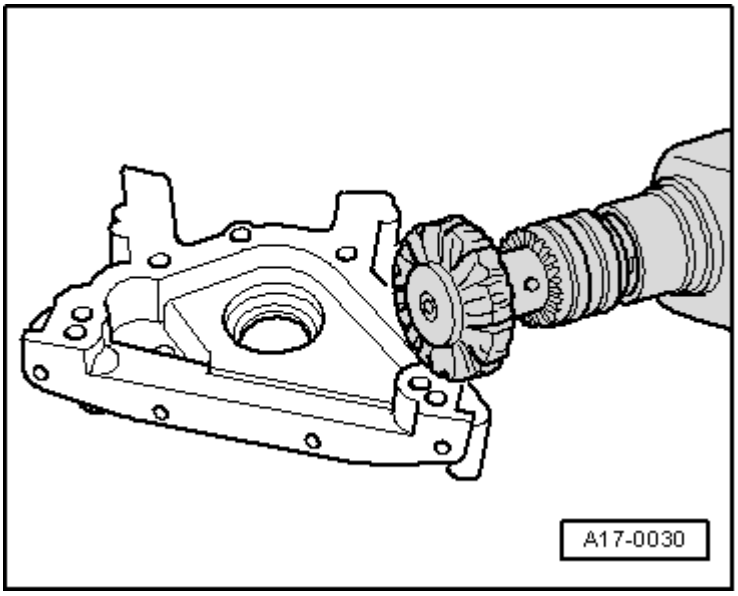

Fig. 56: Checking Piston
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- External micrometer 75 to 100 mm

Take measurement approx. 10 mm from lower edge of piston skirt and offset 90 ° to piston axis.

Deviation from nominal dimension: max. 0.04 mm

Bearing shells - installed positions

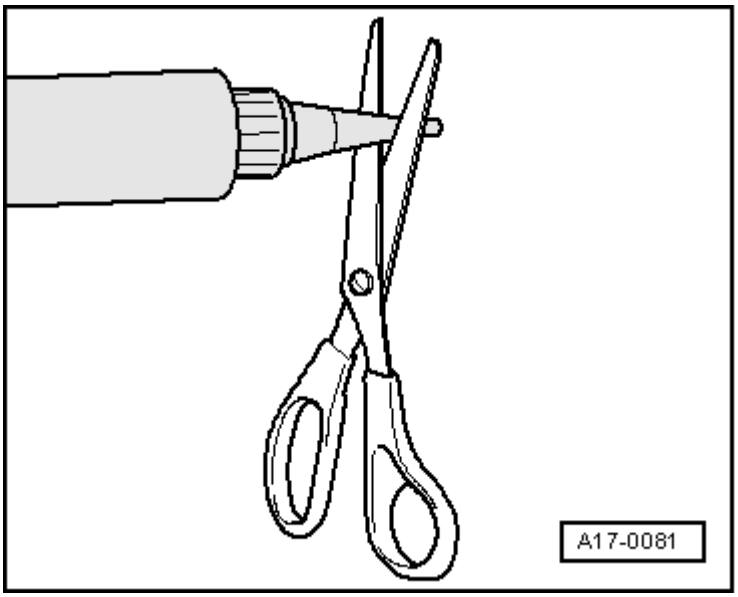

Fig. 57: Installation Position Of Bearing Shells
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Bearing shell - **1** - with oil bore - **arrow** - for connecting rod.

Bearing shell - **2** - without oil bore for connecting rod cover.

- Place bearing shells centered into connecting rod and connecting rod cap.

Dimension - **a** - must be the same at left and right. Max. deviation: 0.2 mm

Checking cylinder bores

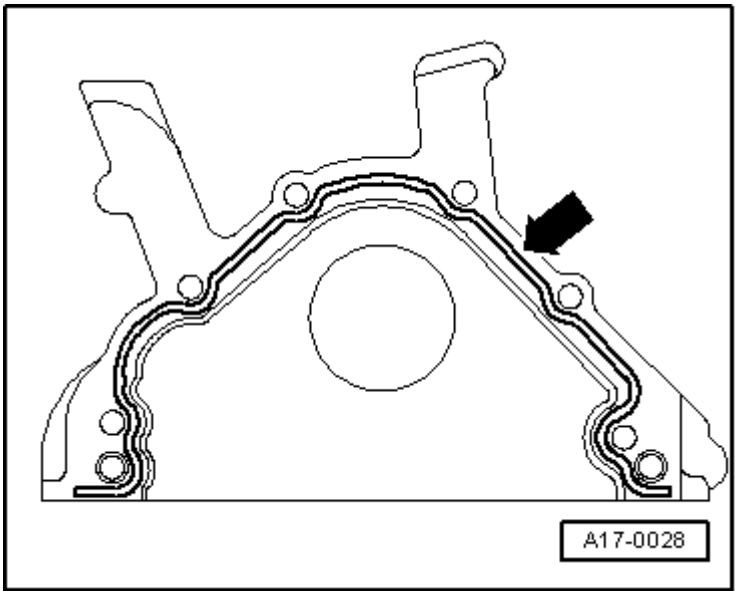

Fig. 58: Checking Cylinder Bores
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Internal dial gauge 50 to 100 mm

- Measure diagonally at 3 positions transversely - **A** - and longitudinally - **B** -.

Deviation from nominal size: max. 0.08 mm.

NOTE:

- **Cylinder bore measurement must not be performed if cylinder block is secured to assembly stand with holding fixture VW 540 , since inaccurate measurements are possible.**

Piston and cylinder dimensions, engine codes AWP, AWW

Honing dimension		Piston diameter	Cylinder bore diameter
Basic dimension	mm	80.965 * See note	81.01
1st oversize	mm	81.465 * See note	81.51

* Measurement without graphite coating (0.02 mm thick). The graphite coating wears off.

15 - ENGINE - CYLINDER HEAD, VALVETRAIN

CYLINDER HEAD

Cylinder head

NOTE:

- **When using an exchanged cylinder head with camshaft installed, the contact surfaces between the lifters and cam lobes must be lubricated before installing the cylinder head cover.**
- **The plastic protectors installed to protect the open valves must only be removed immediately before installing the cylinder head.**
- **When cylinder head is replaced, all coolant must also be replaced.**
- **Intake manifold, removing and installing, refer to INJECTION SYSTEM COMPONENTS, REMOVING AND INSTALLING .**

Compression, checking, refer to **Compression pressures, checking** .

Cylinder head, assembly overview

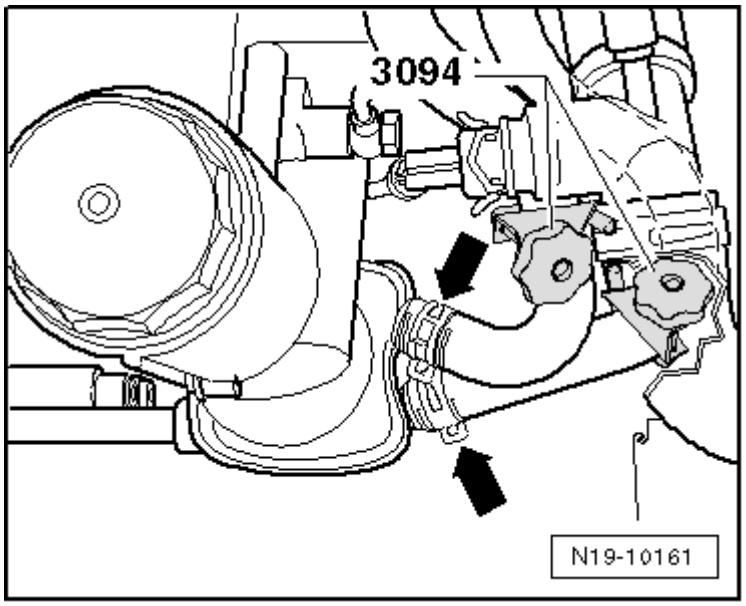

Fig. 59: Cylinder Head, Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Cap

2 - 10 Nm

3 - Cylinder head cover

4 - Gasket for cylinder head cover

- Replace if damaged
- Before installing, coat contact surfaces of bearing cap or camshaft adjuster/chain tensioner to cylinder head with *Sealant AMV 174 004 01* **Double bearing cap contact surfaces, sealing** and **Chain tensioner or camshaft adjuster/cylinder head contact surfaces, sealing** (Part numbers are for reference only. Always check with your Parts Department for the latest part number information).

5 - Oil deflector

- Note installation position: Above intake camshaft

6 - Cylinder head

- Check for distortion *Checking cylinder head for distortion* under **Cylinder head, assembly overview**
- Resurfacing sealing surfaces *Refacing cylinder head sealing surface* under **Valvetrain, assembly overview**
- Removing and installing, refer to **Cylinder head, removing and installing**
- After replacing replace entire amount of coolant

7 - Intake manifold gasket

- Replace
- Note installation position

8 - Cylinder head gasket

- Replace
- Metal gasket
- After replacing replace entire amount of coolant
- Note installation position: Identification: Part number must be visible from intake side

9 - Toothed belt

- Mark direction of rotation before removing
- Check for wear
- Do not kink
- Removing and installing, tensioning, refer to **Toothed belt, removing, installing and tensioning**

10 - Gasket for exhaust manifold

- Replace
- Note installation position

11 - Cylinder head bolt

- Replace
- Removing and installing polydrive cylinder head bolt using polydrive key 3452 or socket T10070
- Sequence for loosening and tightening, refer to **Cylinder head, removing and installing**

12 - Gasket

- Replace if damaged

Checking cylinder head for distortion

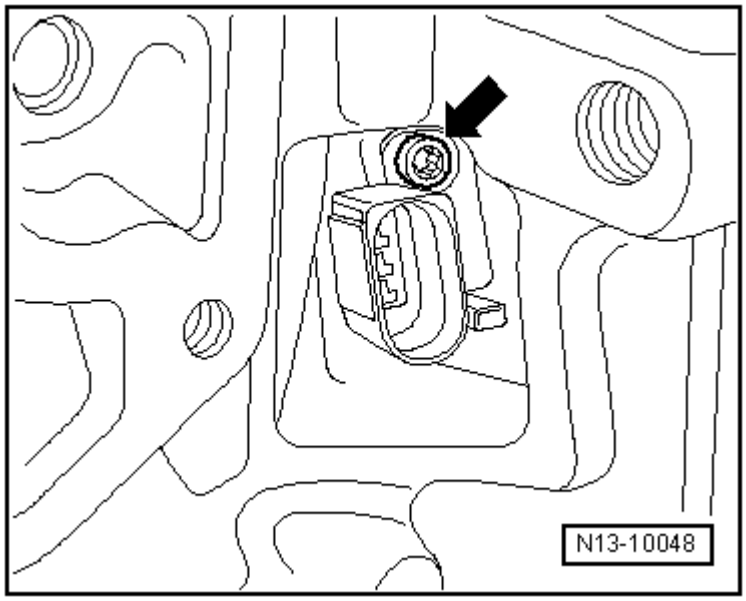

Fig. 60: Checking Cylinder Head For Distortion
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Straight edge
- Feeler gauge

Max. permissible distortion: 0.1 mm

Toothed belt, removing, installing and tensioning

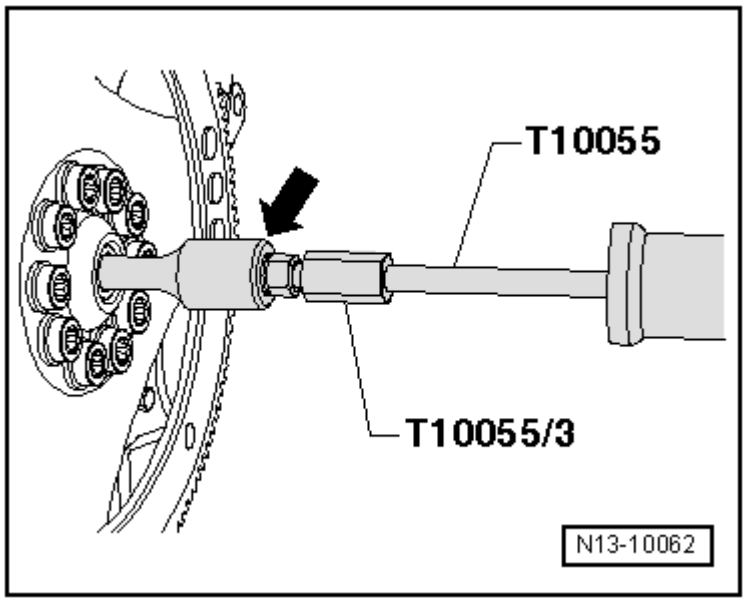

Fig. 61: Identifying Special Tools - Toothed Belt, Removing, Installing And Tensioning
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Engine support bridge 10 - 222 A with bracket for engine 10 - 222 A /1
- Retainer 3180
- Tensioning bolt T10092
- Securing pin T40011

- Torque wrench V.A.G 1331
- Torque wrench V.A.G 1332
- Locking fluid D 000 600 A2

Removing

- Read safety precautions before beginning work refer to **Safety precautions when working on fuel supply system** .
- Observe rules for cleanliness refer to **Rules for cleanliness** .
- Remove engine cover.
- Remove sound insulation tray, refer to **NOISE INSULATION (GASOLINE ENGINES), ASSEMBLY OVERVIEW** or **NOISE INSULATION (DIESEL ENGINES), ASSEMBLY OVERVIEW** .

- Remove right headlamp, refer to **94 LIGHTS, SWITCHES - EXTERIOR** .
- Remove air guide pipe between turbocharger and charge air cooler.
- Remove ribbed belt, refer to *Ribbed belt, removing and installing* under **Ribbed belt, removing and installing** .
- Remove ribbed belt tensioning element.

Engine installed:

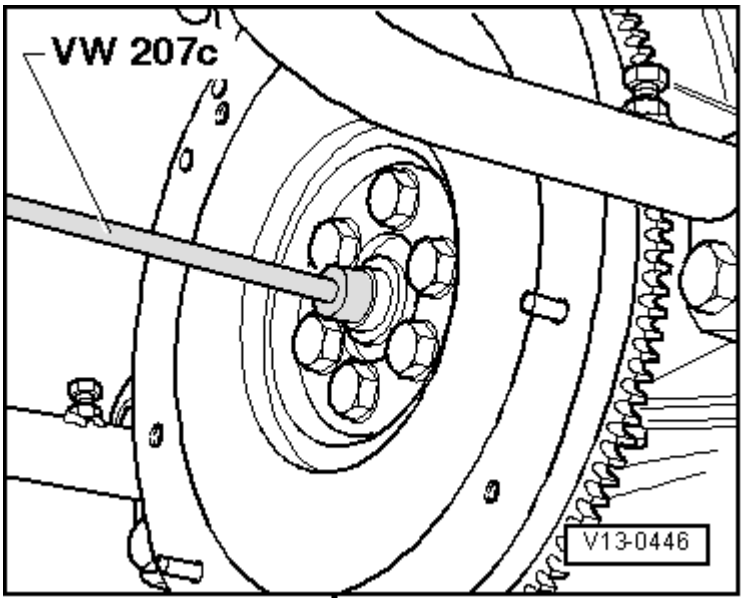

Fig. 62: Identifying Crankshaft At TDC No. 1 Cylinder (Vehicles With A Manual Transmission)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position crankshaft at TDC cylinder 1 (vehicles with manual transmission).

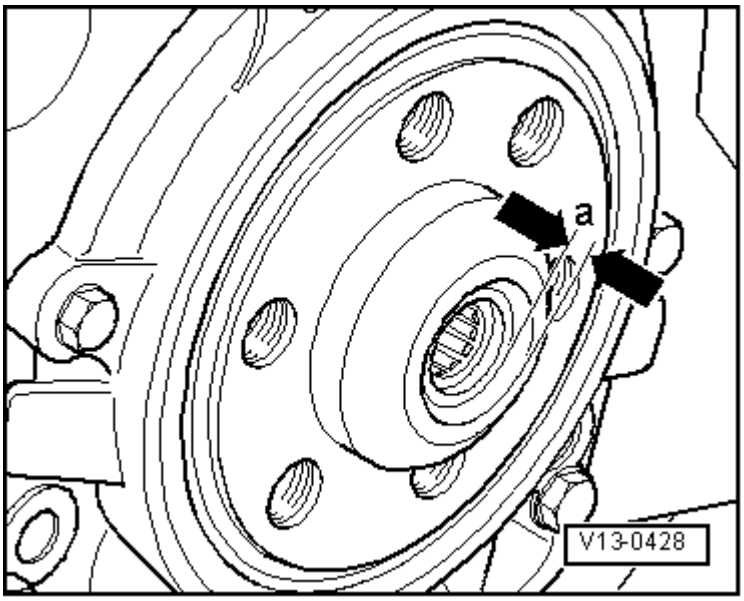

Fig. 63: Identifying Crankshaft At TDC No. 1 Cylinder (Automatic Transmission)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position crankshaft at TDC cylinder 1 (vehicles with automatic transmission).

With engine removed:

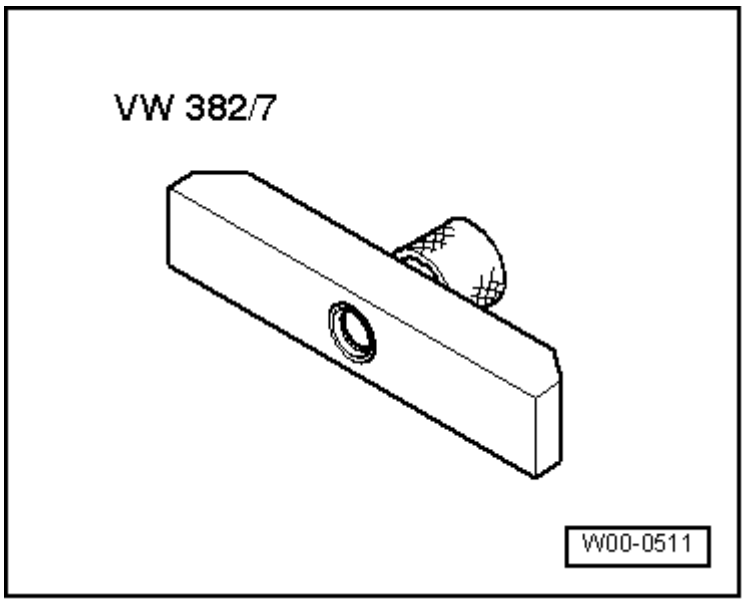

Fig. 64: Identifying Vibration Damper At TDC No. 1 Cylinder
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position vibration damper to TDC cylinder 1 - **arrows** -.
- Remove coolant expansion tank and set aside.
- Remove power steering fluid reservoir and set aside.
- Remove vacuum line to throttle valve connection.
- Remove upper toothed belt guard.

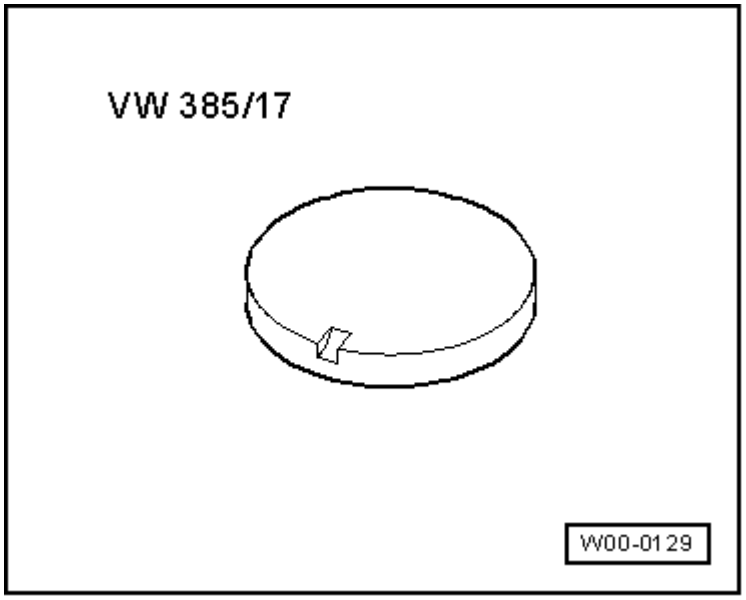

Fig. 65: Engine Support Bridge 10 - 222 A Install With Bracket For Engine 10 - 222 A /1
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install engine support bridge 10 - 222 A with bracket for engine 10 - 222 A /1.
- Engage Retainer 3180 on right lifting eye and tighten on cylinder head and lightly pre-tension engine.

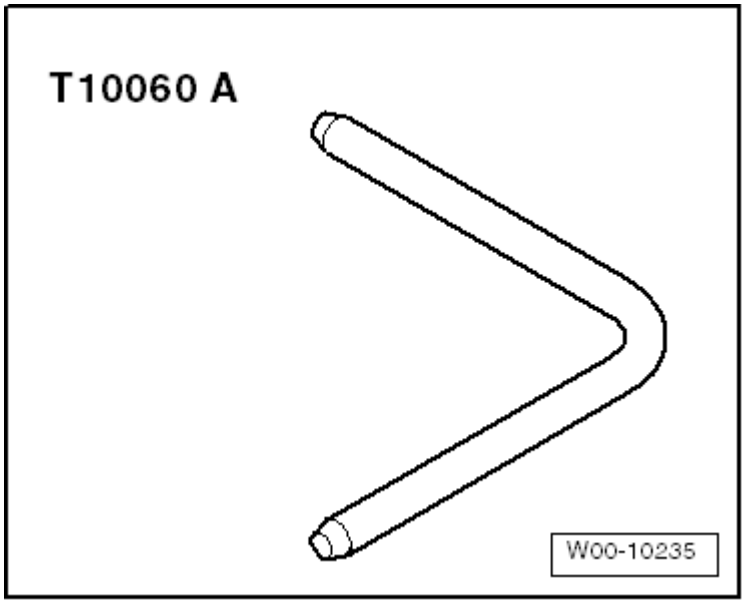

Fig. 66: Locating Securing Bolts From Assembly Mounting/Engine Bracket, Assembly Mounting/Body And Assembly Mounting Bracket/Body
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts from subframe/engine bracket, subframe/body and subframe brackets/body - **arrows** - and completely remove subframe.
- Remove engine bracket on cylinder block.

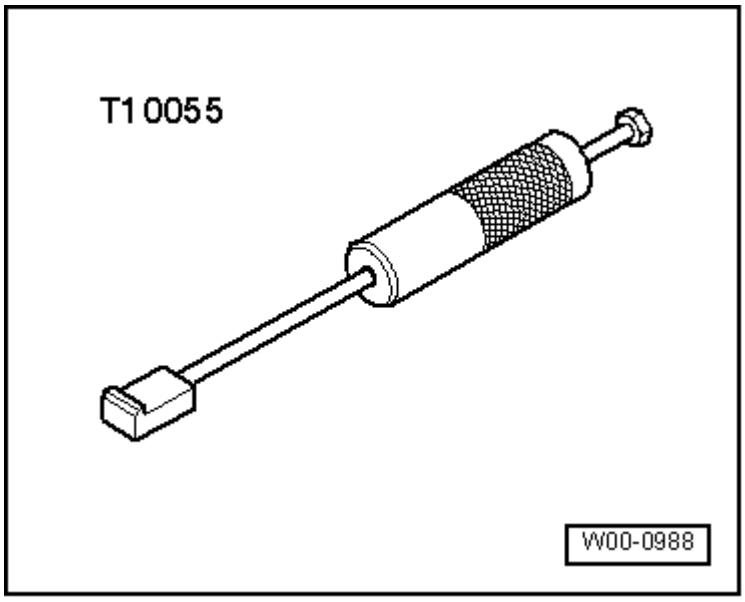

Fig. 67: Removing/Installing Vibration Damper/Belt Pulley
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove vibration damper/belt pulley.
- Remove lower and middle toothed belt cover.
- Mark direction of rotation of toothed belt.

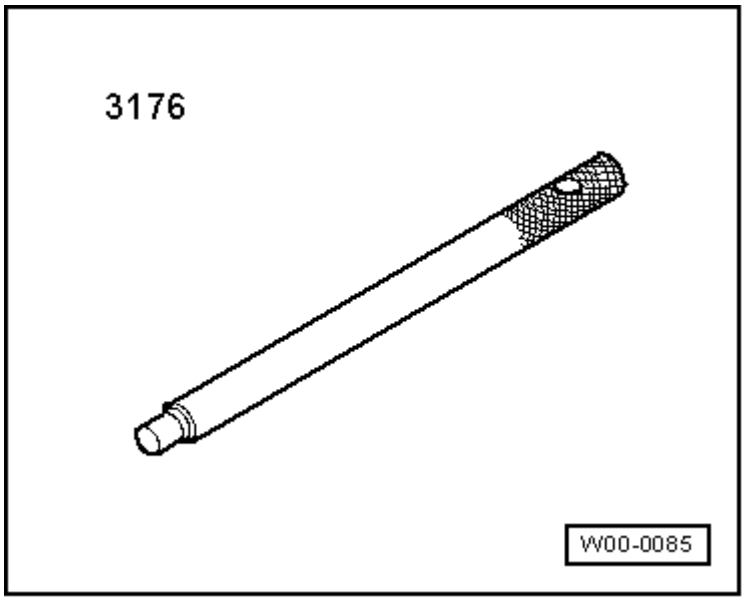

Fig. 68: Tensioning Bolt T10092 And Locking Pin T40011 Installed
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install tensioning bolt T10092 into tensioning device for toothed belt.
- If necessary, align pressure piston before tensioning using needle nose pliers or a thin wire (hole in pressure piston and hole in housing must line up).
- Tension pressure piston of tensioner just enough that the pressure piston can be secured using Locking Pin T40011.
- Remove toothed belt.
- Turn crankshaft back slightly.

Installing

NOTE:

- **When turning camshaft, crankshaft must not be at TDC. Valves and/or pistons may be damaged.**

A - Toothed belt completely removed

If toothed belt was only removed from camshaft gear **B - Toothed belt only removed from camshaft gear**

Conditions

- The pistons must not be positioned at TDC.

Work procedure

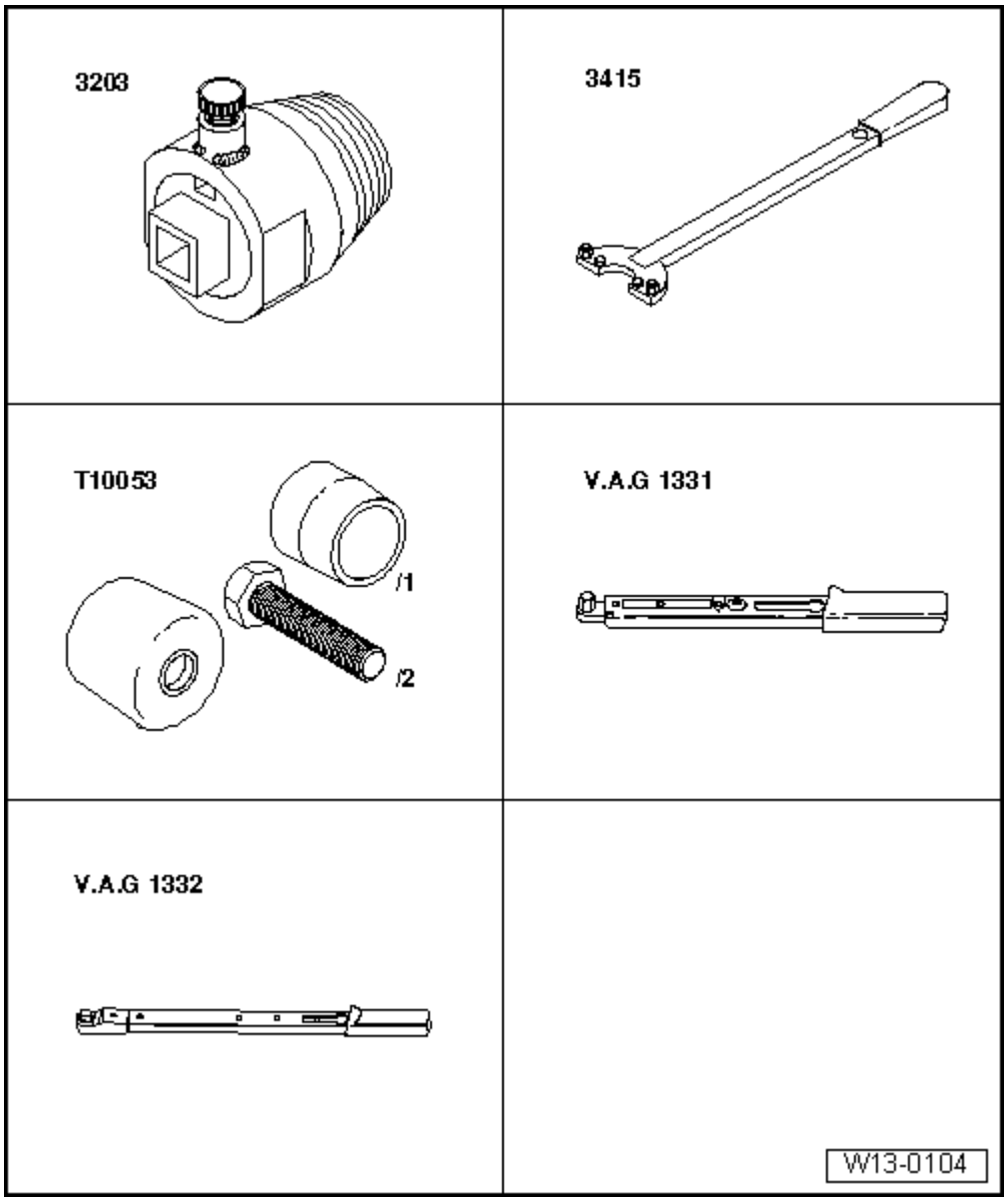

Fig. 69: Marking On Camshaft Gear Aligned With Marking On Cylinder Head Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Align marking on camshaft gear with marking on cylinder head cover.
- Place toothed belt onto crankshaft sprocket (observe direction of rotation).
- Install engine bracket on cylinder block. Torque specification 45 Nm

NOTE:

- **Before installing engine bracket, insert bolts in bracket.**

- Install toothed belt cover - lower part. (Insert bolts with Locking Compound D 000 600 A2.) (Part numbers are for reference only. Always check with your Parts Department for the latest part number

information). Torque specification: 10 Nm

- Using a bolt, secure vibration damper/belt pulley (watch locating point).

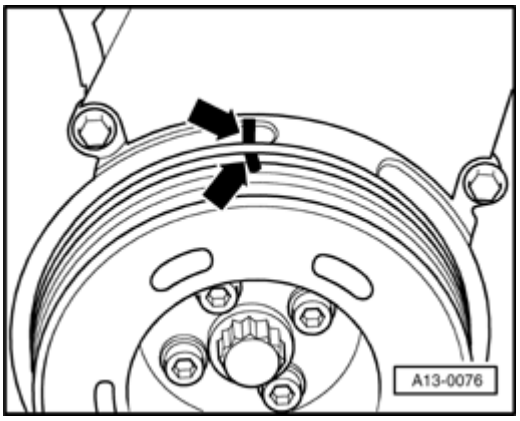

Fig. 70: Identifying Vibration Damper At TDC No. 1 Cylinder
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Turn crankshaft to set cylinder 1 at TDC.
- Position toothed belt on coolant pump, tensioning roller and camshaft gear.
- Tension toothed belt.

B - Toothed belt only removed from camshaft gear

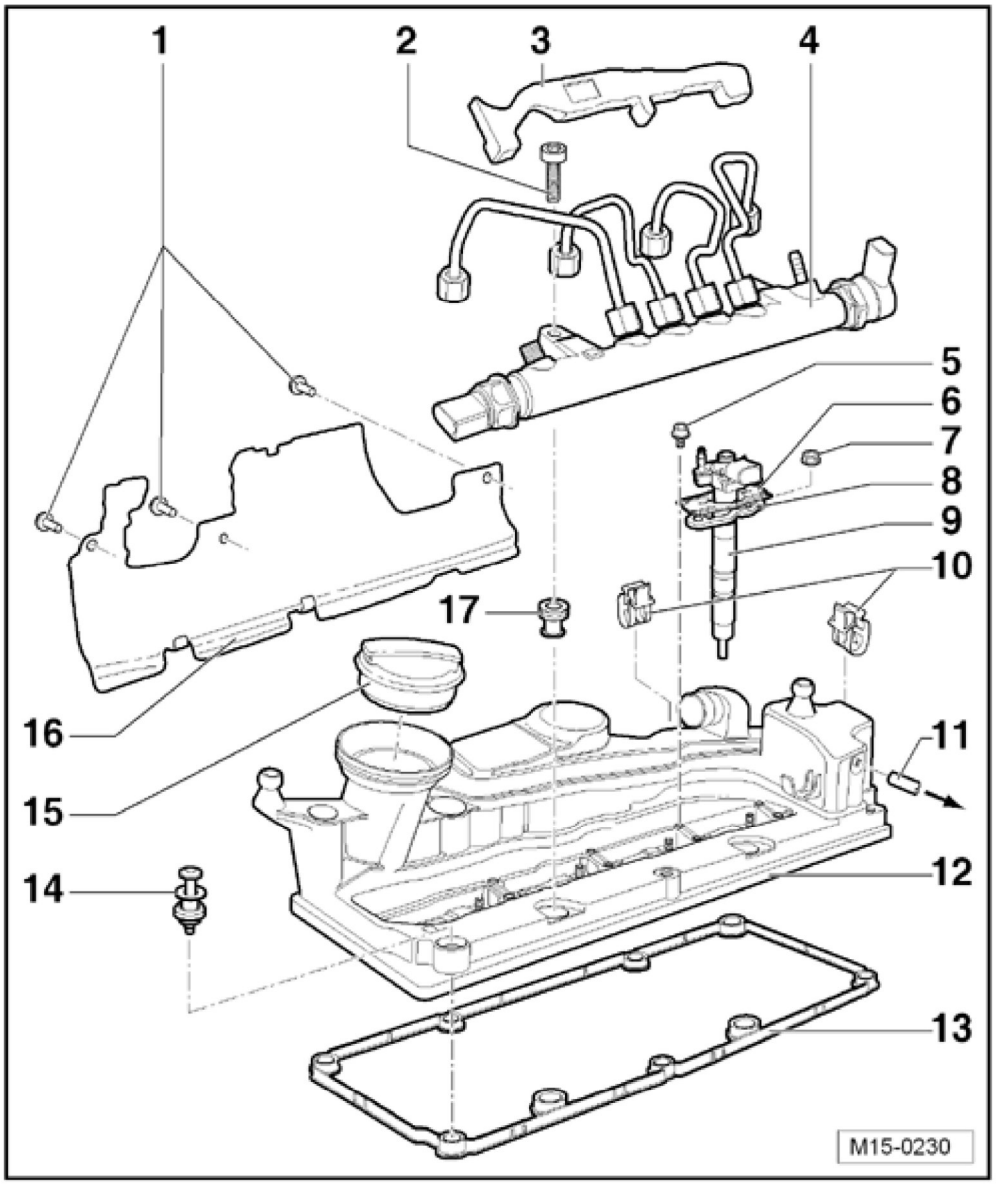

Fig. 71: Marking On Camshaft Gear Aligned With Marking On Cylinder Head Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Align marking on camshaft sprocket with marking on cylinder head cover.
- Turn crankshaft to set cylinder 1 at TDC.
- Place toothed belt on camshaft gear.
- Tension toothed belt

Toothed belt, tensioning

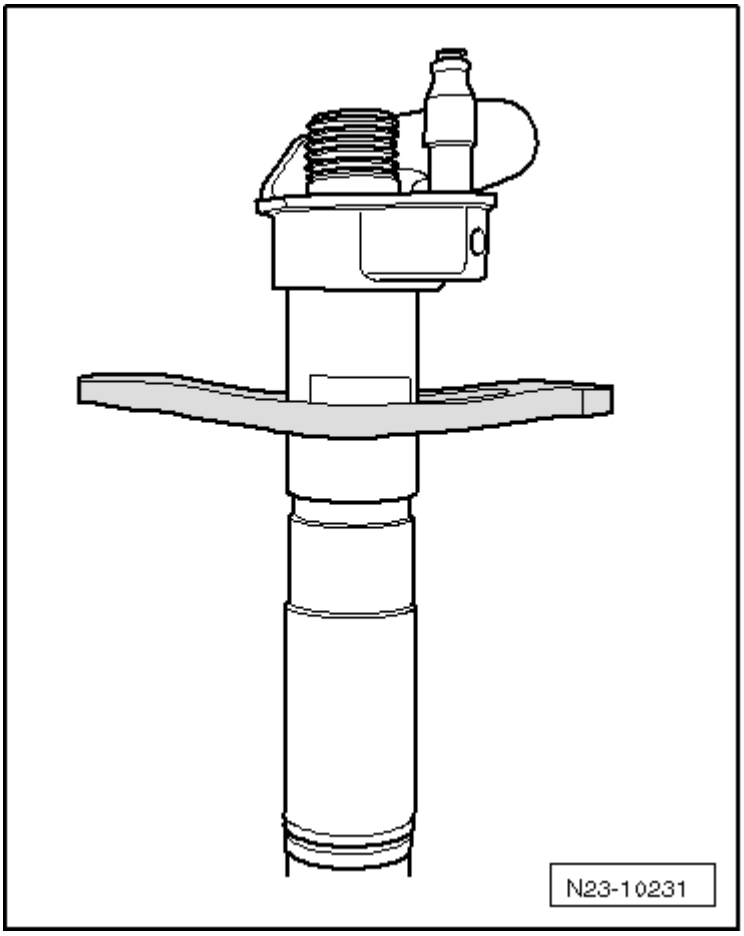

Fig. 72: Tensioning Bolt T10092 And Locking Pin T40011 Installed
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tension toothed belt. To do this, remove pin T40011 and remove tensioning bolt T10092.
- Turn over crankshaft twice and check if markings on camshaft and crankshaft still align with their reference points.
- Install vibration damper and belt pulley tightening torque: 25 Nm
- Install center part of toothed belt (insert bolts with Locking Compound D 000 600 A2.) (Part numbers are for reference only. Always check with your Parts Department for the latest part number information). Torque specification: 10 Nm

- Install toothed belt cover - upper part.
- Install engine mount. Torque specifications:, refer to **Assembly mounting** .
- Install tensioner for ribbed belt. Torque specification: 25 Nm
- Install ribbed belt, refer to **Ribbed belt, removing and installing** .

Cylinder head, removing and installing

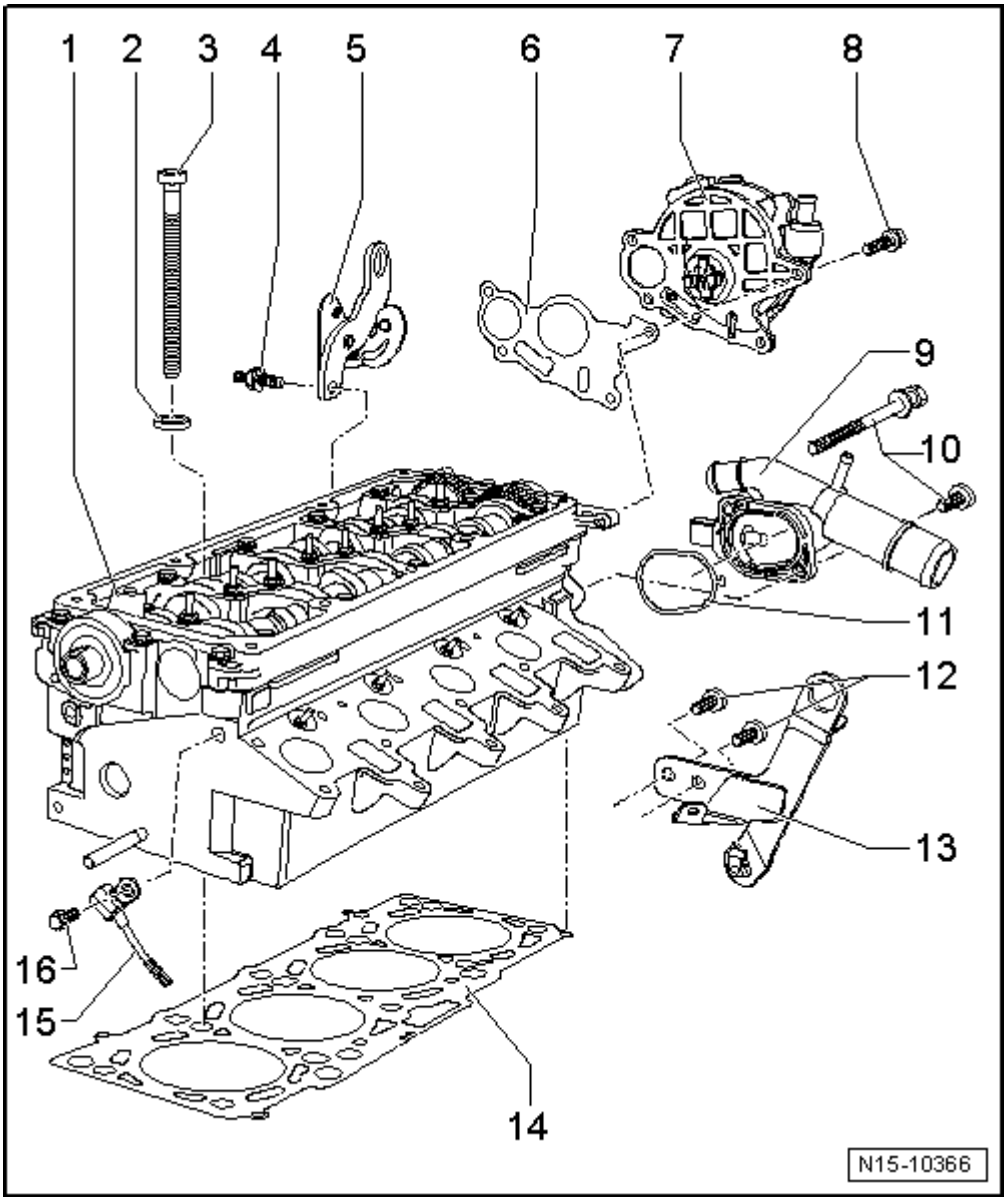

Fig. 73: Identifying Special Tools - Cylinder Head, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Guide pins 3070
- Drip Tray V.A.G 1306 or Drip Tray for VAS 6100 VAS 6208
- Torque wrench V.A.G 1332
- Spring-type clip pliers VAS 5024A
- Polydrive Key 3452 or Polydrive Bit and Drive Socket T10070 (engines with polydrive cylinder head bolts)

Requirements

- The engine must be no more than warm to the touch.

Removing

- Read safety precautions before beginning work refer to **Safety precautions when working on fuel supply system** .
- Observe rules for cleanliness refer to **Rules for cleanliness** .
- First, check whether a coded radio is installed. If necessary, obtain anti-theft coding.
- With ignition switched off disconnect battery ground (GND) strap.
- Remove engine cover.
- Drain coolant, refer to **Cooling system, draining and filling** .

CAUTION: Fuel supply line is under pressure! Wear protective goggles and protective clothing to prevent injuries and contact with skin. Before removing from hose connection wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

- Disconnect fuel supply and return lines at connecting point of fuel rail.
- Seal lines so that the fuel system is not contaminated by dirt etc.
- Remove front exhaust pipe from exhaust manifold or turbocharger.
- Disconnect all required connections:

- Cooling system
- Crankcase ventilation
- Secondary air injection (AIR) system
- Turbocharger/regulation
- Fuel injection and ignition system

- Remove ribbed belt, refer to **Ribbed belt, removing and installing** .
- Remove ribbed belt tensioning element.
- Remove upper toothed belt guard.

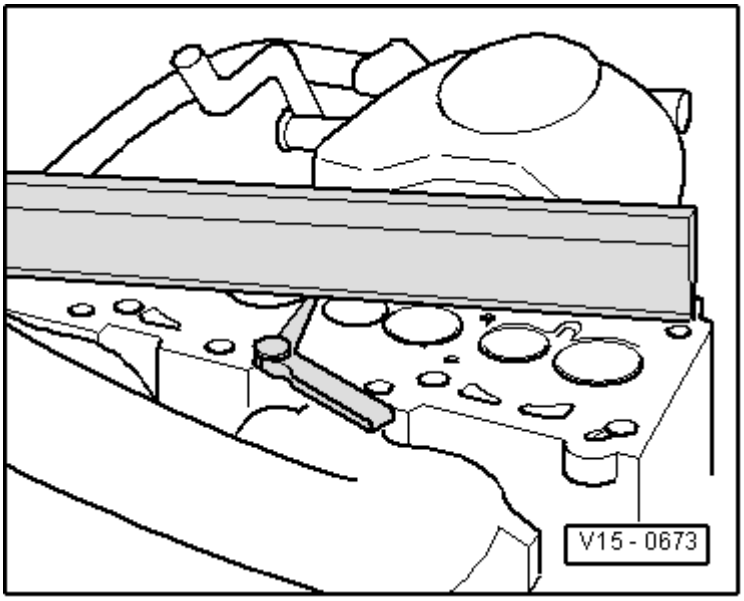

Fig. 74: Marking On Camshaft Gear Aligned With Marking On Cylinder Head Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Bring camshaft gear to marking for TDC cylinder 1 by turning crankshaft. Marking on camshaft gear must align with - **arrow** - on toothed belt guard.
- Remove toothed belt from camshaft gear, refer to **Toothed belt, removing, installing and tensioning** .
- Turn crankshaft back slightly.
- Remove cylinder head cover.

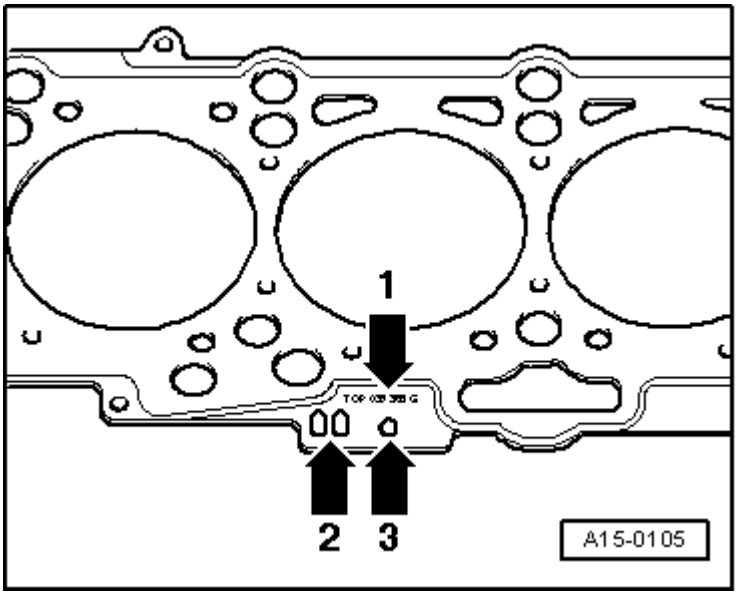

Fig. 75: Cylinder Head Bolts Loosening Order
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen and remove cylinder head bolts in specified sequence.

NOTE:

- **For polydrive cylinder head bolts, use Polydrive Key 3452 or Polydrive Bit and Drive Socket T10070.**

- Carefully lift cylinder head off.

Installing

NOTE:

- **There must be no oil or coolant in the blind holes for the cylinder head bolts in the cylinder block.**
- **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.**

- Stuff clean cloths into cylinder so that no dirt or abrasive powder can get between cylinder wall and piston.
- Do not allow dirt or abrasive powder to get into coolant either.
- Carefully clean cylinder head and cylinder block sealing surfaces. Avoid introducing scratches or scoring (do not use sandpaper with grit below 100).
- Carefully remove metal particles, emery remains and cloths.

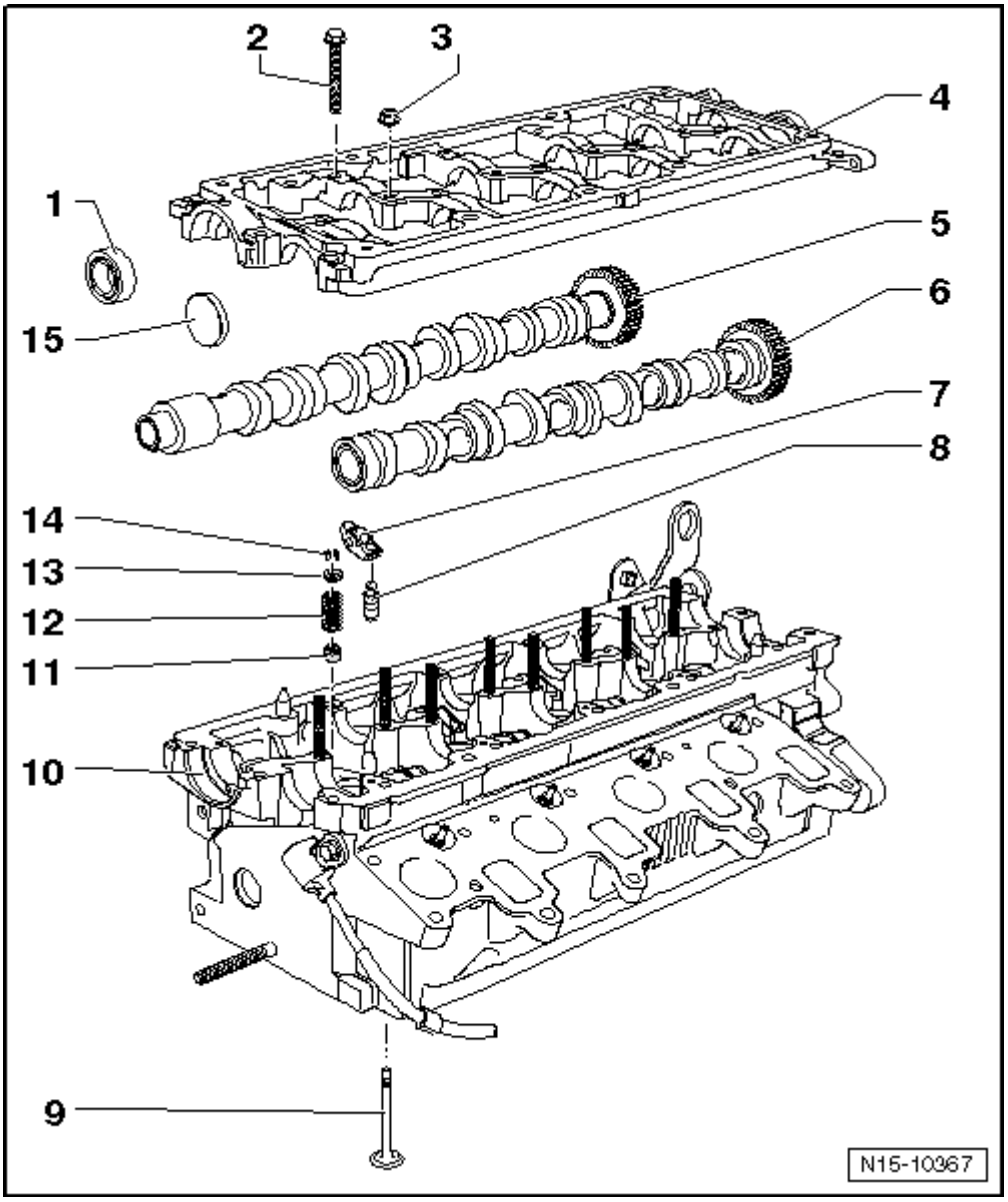

Fig. 76: Identifying Vibration Damper At TDC No. 1 Cylinder
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Turn crankshaft to set cylinder 1 at TDC.
- Turn crankshaft back slightly.

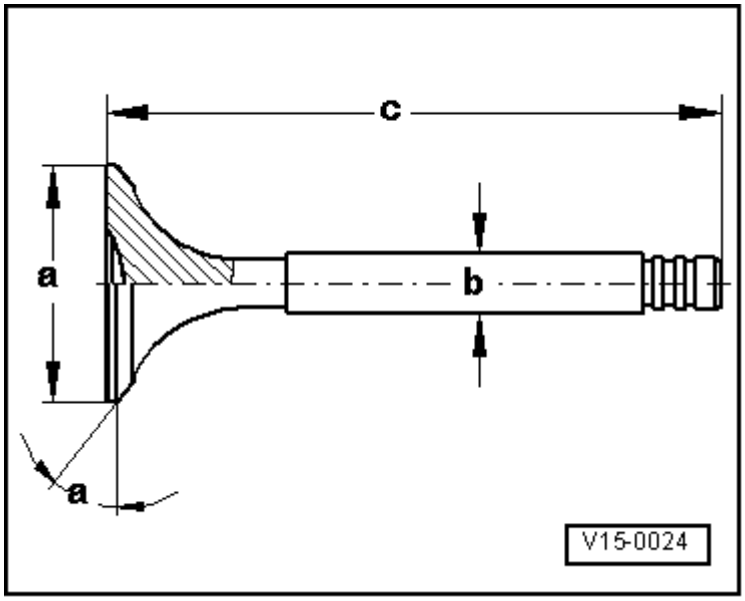

Fig. 77: Cylinder Head Bolt Position Numbers
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- To center, install Guide Pins 3070 in cylinder head bolts 8 and 10.
- Install new cylinder head gasket. Text (replacement part number) must be visible.
- Install cylinder head, insert remaining 8 cylinder head bolts and hand tighten.
- Remove Guide Pins 3070 through bolt holes with guide pin handle. Do this by turning pin handle toward left until pins are free.

- Insert both remaining cylinder head bolts and then fasten them hand-tight.

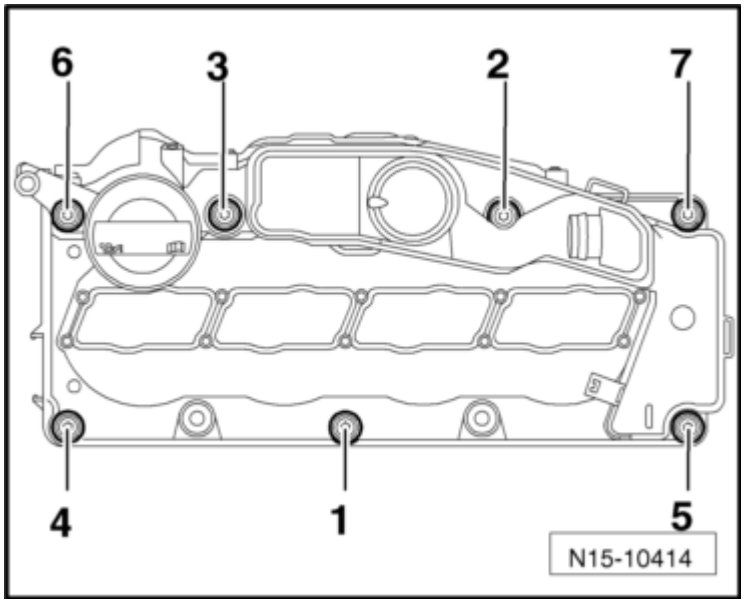

Fig. 78: Cylinder Head Bolt Position Numbers
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tighten cylinder head in tightening sequence as follows:
- Pre-tighten all bolts to 40 Nm.
- Then tighten all bolts a $^{1}/_{4}$ turn (90 °) further using a rigid wrench.
- Then tighten all bolts again a $^{1}/_{4}$ turn (90 °) further.

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

- Install toothed belt and adjust valve timing, refer to **Toothed belt, removing, installing and tensioning**

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

- Perform "Procedure after interrupting voltage supply", refer to **PROCEDURE AFTER VOLTAGE SUPPLY OPEN CIRCUIT** .

Compression pressures, checking

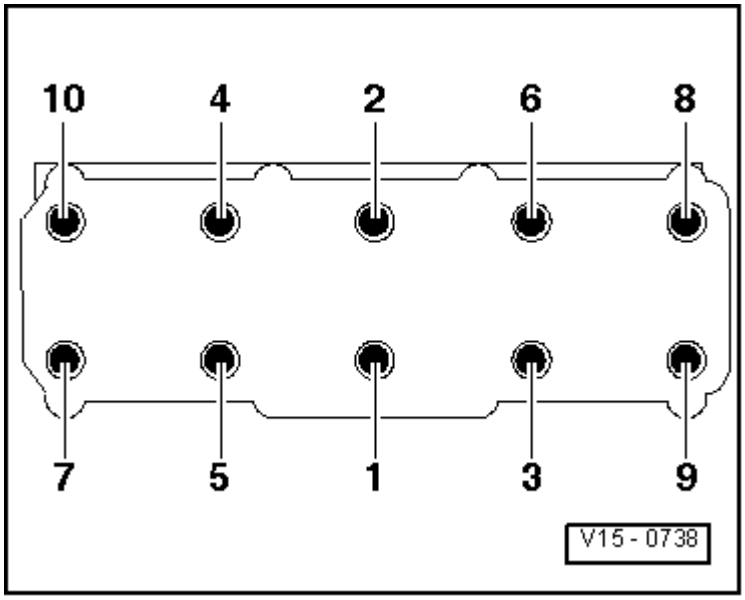

Fig. 79: Identifying Special Tools - Compression Pressures, Checking
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

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

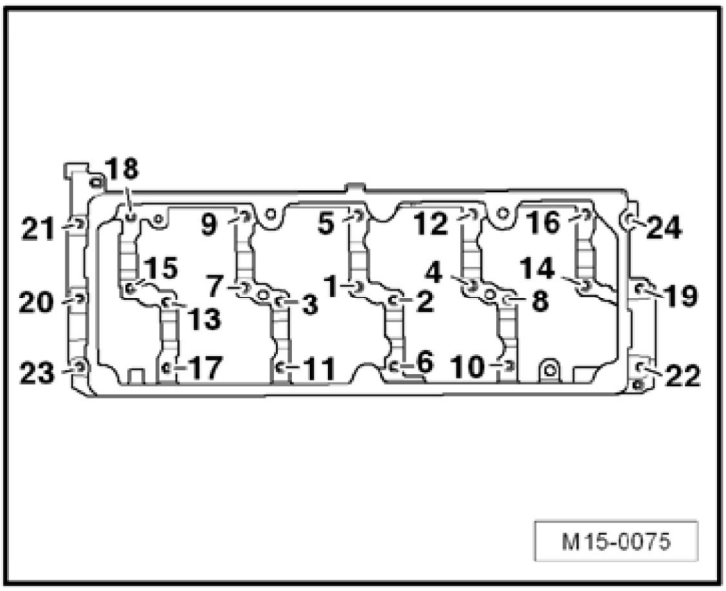

Fig. 80: Identifying Main Fuse Panel
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove fuse 32

NOTE:

- **Removing fuse No. 32 interrupts the voltage supply to the injectors.**

Test conditions:

- Engine oil temperature must be at least 30 ° C.

Work procedure

- Remove engine cover.
- Disconnect ignition coil connectors.
- Remove ignition coils.
- Remove spark plugs using spark plug removal tool 3122 B.
- Using a 2nd technician, have the accelerator pedal completely depressed.
- Check compression pressure using compression tester V.A.G 1763.

NOTE:

- **Using tester Operating instructions.**

- Operate starter until tester shows no further pressure increase.

Compression pressure:

New bar positive pressure	Wear limit bar positive pressure	Difference between cylinders bar positive pressure

10.0 to 14.0	7.0	max. 3.0

- Screw in spark plugs using spark plug removal tool 3122 B and tighten to 30 Nm.

Vehicles with engine code AWD

- Install ignition coils and tighten to 10 Nm.

Vehicles with engine code AWP, AWW

- Install ignition coils. Ensure ignition coils are seated securely.

Continuation for all vehicles

- Check DTC memory
- Read readiness code
- If DTC memory was cleared or engine control module disconnected from voltage supply, readiness code must be regenerated.

VALVETRAIN

Valvetrain

NOTE:

- **Cylinder heads with cracks between the valve seats, or between the valve seat and the spark plug threads, can continue to be used without reducing the service life, as long as the cracks have a width of max. 0.3 mm, or only the first 4 threads of the spark plug threads are cracked.**
- **After installing new valve lifters, the engine may not be started for approx. 30 minutes. (otherwise valves will strike pistons), then turn crankshaft two revolutions.**

Valvetrain, assembly overview

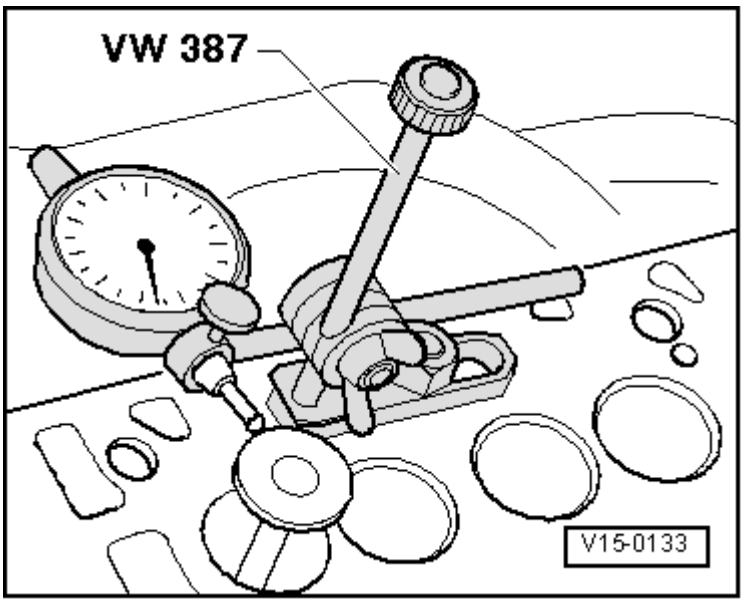

Fig. 81: Valvetrain, Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 10 Nm

2 - Intake camshaft

- Checking axial play *Camshaft, checking axial play* under **Camshaft, checking axial play**
- Removing and installing refer to **Camshafts, removing and installing**
- Checking radial clearance using Plastigage, Wear limit: 0.1 mm
- Run-out: max. 0.01 mm

3 - Drive chain

- Mark direction of rotation before removing (installation position) refer to **Camshafts, removing and installing**

4 - 10 Nm

5 - O-ring

- Replace
- Only vehicles with engine code: AWP, AWW

6 - Camshaft Adjustment Valve 1 N205

- Only vehicles with engine code: AWP, AWW
- Camshaft adjustment, checking refer to **Camshaft adjustment, checking**

7 - 3 Nm

- Only vehicles with engine code: AWP, AWW

8 - Camshaft adjuster

- Only vehicles with engine code: AWP, AWW
- For vehicles with engine code AWD: Chain tensioner
- Before removing, secure using bracket for chain adjustment 3366 refer to **Camshafts, removing and installing**
- Camshaft adjustment, checking refer to **Camshaft adjustment, checking**

9 - Gasket

- Rubber/metal seal
- Replace

10 - Cylinder head

- Removing and installing, refer to **Cylinder head, removing and installing**
- Reworking valve seat, refer to **Valve seats, refacing**
- Resurfacing sealing surfaces **Refacing cylinder head sealing surface**
- Sealing contact surfaces **Double bearing cap contact surfaces, sealing** and **Chain tensioner or camshaft adjuster/cylinder head contact surfaces, sealing**

11 - Valves

- Do not reface, Only lapping is permitted
- Valve dimensions *Valve dimensions* under **Valve dimensions**
- Exhaust valves with sodium filling: Observe note for disposal *Double bearing cap contact surfaces, sealing* under **Double bearing cap contact surfaces, sealing**

12 - Seal

- Replacing refer to **Camshaft seals, replacing** .

13 - Hood

- For Camshaft Position (CMP) sensor G40
- Observe installed location

14 - Washer

- Conical

15 - 25 Nm

16 - Camshaft Position (CMP) sensor G40

- --> - Repair Group 28

17 - 10 Nm

18 - 65 Nm

- Use counter-holder 3036 to loosen and tighten

19 - Camshaft sprocket

- Note installation position: Thin rib of camshaft gear points outward and cylinder 1 TDC marking is visible
- Note position when installing toothed belt, refer to **Toothed belt, removing, installing and tensioning**

20 - Seal

- Replacing refer to **Camshaft seals, replacing** .

21 - Valve guide

- Checking refer to **Valve guides, checking**

22 - Valve stem seal

- Replacing, refer to **Valve stem seals, replacing** .

23 - Valve spring

- Cylinder head removed: remove and install with Valve Spring Compressor 3362.
- Cylinder head installed:, refer to **Valve stem seals, replacing**

24 - Valve spring plate

25 - Valve keepers

26 - Valve lifter

- Do not interchange
- With hydraulic valve clearance compensation
- Checking refer to **Hydraulic valve lifters, checking**
- Place on running surface when setting down

- Before installing, check axial play of camshafts, refer to **Camshaft, checking axial play**
- Lubricate contact surface

27 - Bearing cap for intake camshaft

- Installation position and installation sequence refer to **Camshafts, removing and installing**

28 - Double bearing cap

- Must be located on alignment sleeves
- Lightly coat contact surface with *Sealant AMV 174 004 01* and follow installation position and sequence refer to **Camshafts, removing and installing**
- Seal contact surfaces of double bearing cap/cylinder head, refer to **Double bearing cap contact surfaces, sealing**

29 - Exhaust camshaft bearing cap

- Installation position and installation sequence refer to **Camshafts, removing and installing**

30 - Exhaust camshaft

- Checking axial play, refer to **Camshaft, checking axial play**
- Removing and installing refer to **Camshafts, removing and installing**
- Checking radial clearance using Plastigage, Wear limit: 0.1 mm
- Run-out: max. 0.01 mm

Refacing cylinder head sealing surface

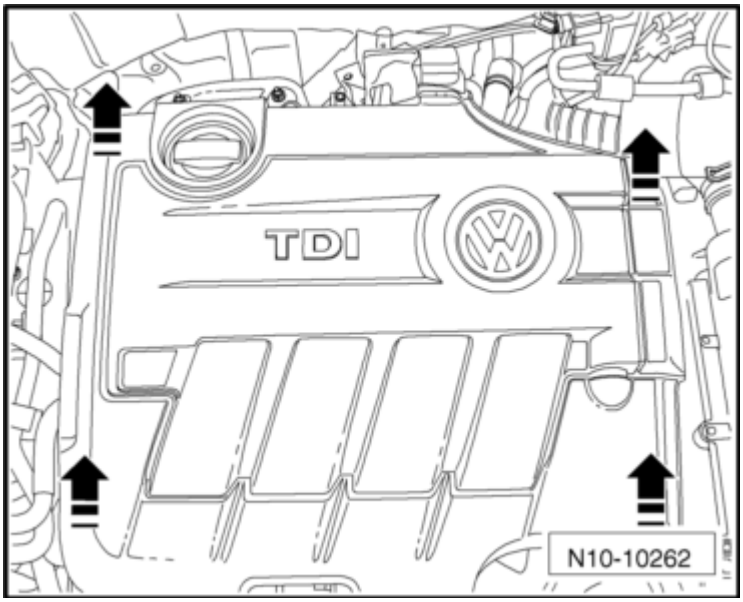

Fig. 82: Refacing Cylinder Head Sealing Surface Measurement

Courtesy of VOLKSWAGEN UNITED STATES, INC.

Refacing measurement is made via holes for cylinder head bolts.

a = at least 139.2 mm

Camshaft, checking axial play

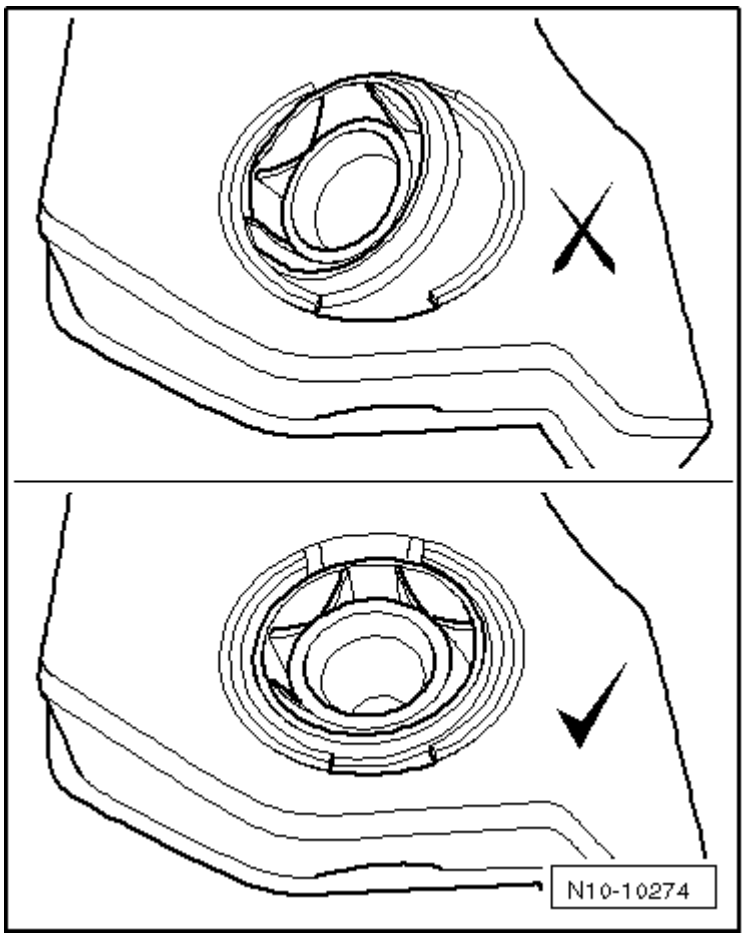

Fig. 83: Camshaft, Checking Axial Play
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Dial gauge holder VW 387
- Dial gauge

Measure with valve lifters removed, chain removed and bearing caps 2 and 4 installed.

Wear limit: max. 0.2 mm

Valve dimensions

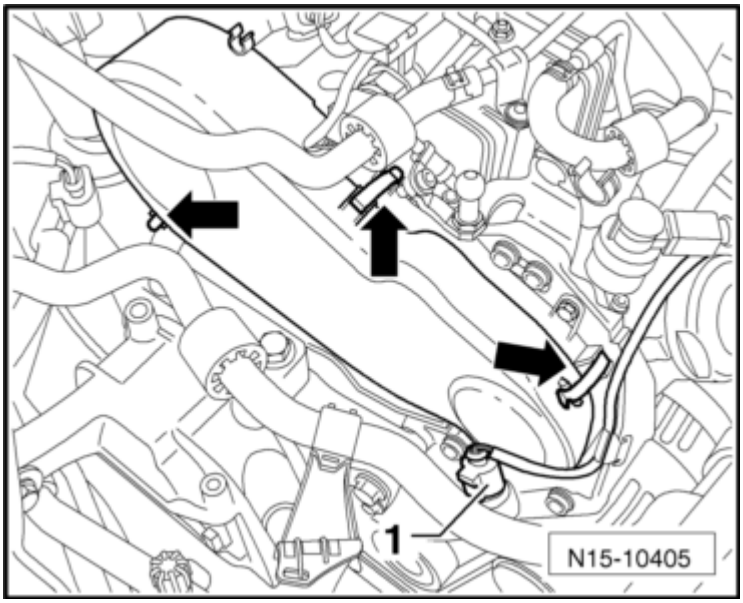

Fig. 84: Identifying Valve Dimensions
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE:

- **Valves must not be refaced. Only lapping is permitted.**

Dimension		Intake valve	Exhaust valve
Dia. a	mm	26.9	29.9
Dia. b	mm	5.963	5.943
c	mm	104.84 to 105.34	103.64 to 104.14
a	Angle °	45	45

NOTE:

- **Worn sodium-filled exhaust valves must not be scrapped without first being properly treated. The valves must be cut at the middle of the shaft using a metal saw. While doing this, do not come into contact with water. At the very most, throw 10 of the prepared valves into a bucket filled with water. Then, move quickly away, because a sudden chemical reaction will occur during which the sodium is burnt away. The treated parts may then be discarded through conventional disposal channels.**

Double bearing cap contact surfaces, sealing

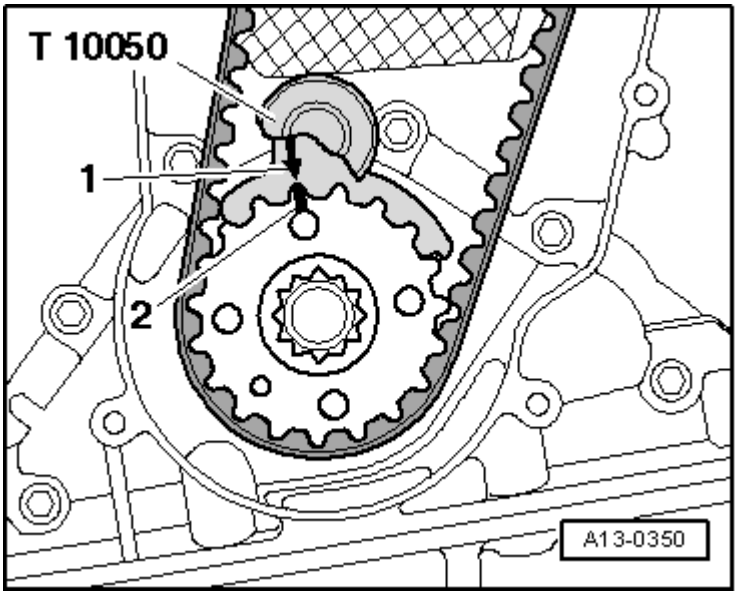

Fig. 85: Double Bearing Cap Contact Surface Sealant Application Areas
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Apply a small amount of *Sealant AMV 174 004 01* to contact surfaces - **arrows** - on double bearing cap. (Part numbers are for reference only. Always check with your Parts Department for the latest part number information).

Chain tensioner or camshaft adjuster/cylinder head contact surfaces, sealing

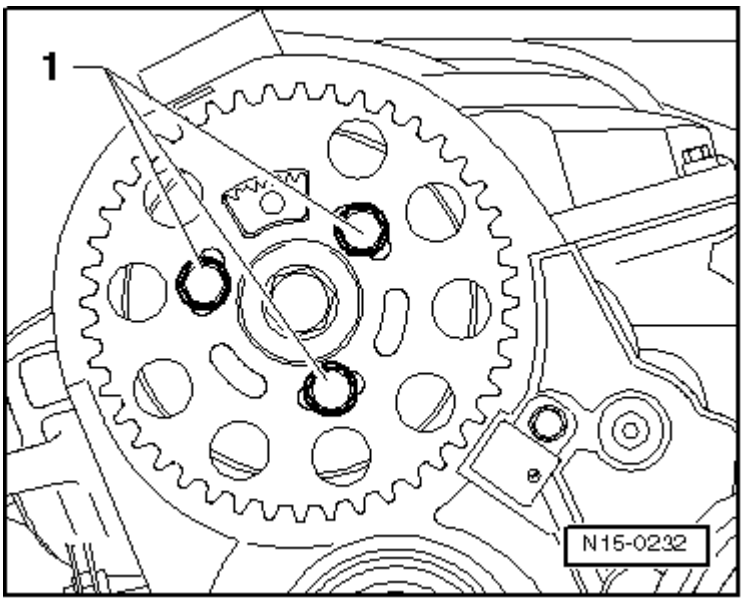

Fig. 86: Chain Tensioner Or Camshaft Adjuster/Cylinder Head Contact Surfaces Sealant Application Areas
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Apply a small amount of *Sealant AMV 174 004 01* to chain tensioner/cylinder head or camshaft adjuster/cylinder head sealing surfaces - **arrows** -. (Part numbers are for reference only. Always check

with your Parts Department for the latest part number information).

Valve seats, refacing

Special tools, testers and auxiliary items required

- Depth gauge
- Valve seat refacing tool

NOTE:

- **When repairing engines with leaking valves, it is not sufficient to reface 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 .**
- **Only reface valve seats enough until a perfect contact pattern is obtained. The maximum permissible refacing 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.**

The maximum permissible 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.**

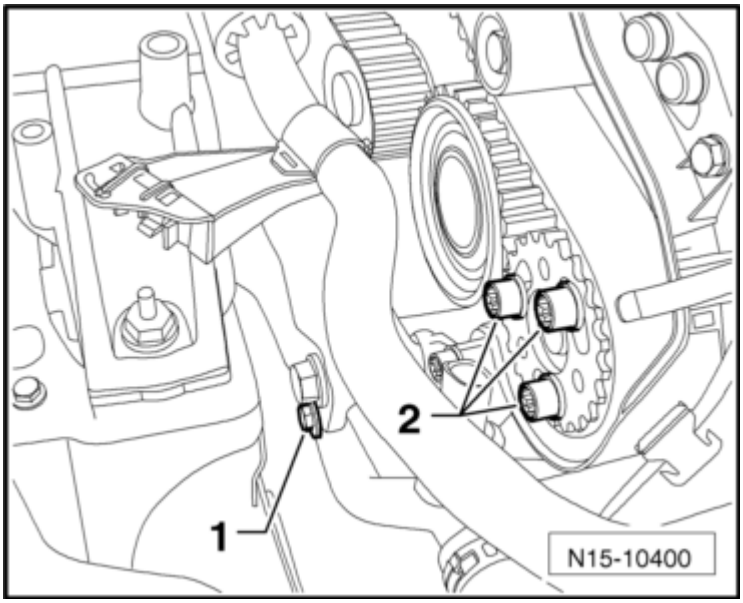

Fig. 87: Measuring Gap Vertically Between Tip Of Valve Stem End And Upper Edge Of Cylinder Head
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Measure gap - **a** - vertically between tip of valve stem end and upper edge of cylinder head - **1** -.
- Calculate max. permissible refacing dimension from measured distance and minimum dimension.

Minimum dimensions: Outer intake valve 34.0 mm, center intake valve 33.7 mm, exhaust valve 34.4 mm

Measured distance minus minimum dimension = max. permissible reworking dimension.

Example:

	Measured distance	34.4 mm
-	Minimum dimension	34.0 mm
=	max. perm. rework dimension * See note	0.4 mm

* Maximum allowable refacing dimension is represented in illustrations for refacing valve seats as dimension "b".

Refacing intake valve seat

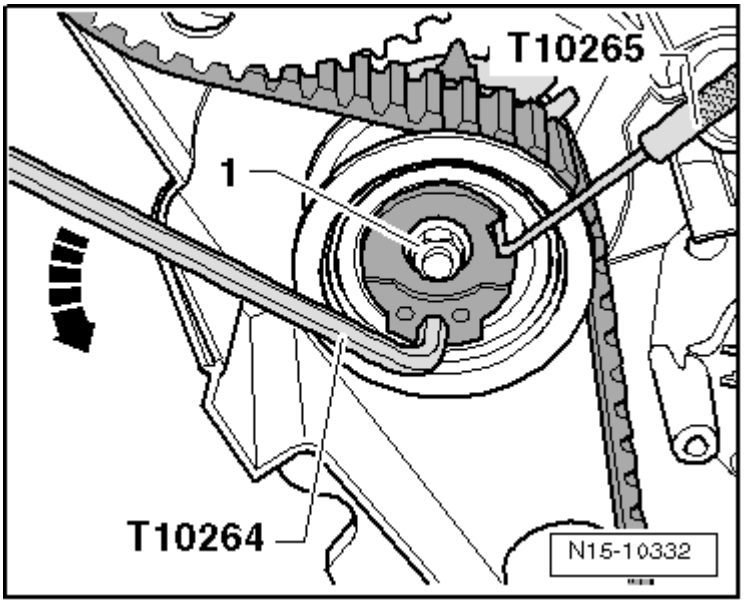

Fig. 88: Intake Valve Seat Measurements
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Dimension		Intake valve seat
Dia. a	mm	26,2
Dia. b	mm	max. permissible rework dimension * See note
c	mm	1.5 to 1.8
Z		Cylinder head lower edge
a		45 ° valve seat angle
ß		30 ° upper correction angle

gamma		60 ° lower correction angle

Refacing exhaust valve seat

Dimension		Intake valve seat
Dia. a	mm	29,0
b	mm	max. perm. refacing dimension * See note
c	mm	approx. 1.8
Z		Cylinder head lower edge
a		45 ° valve seat angle
ß		30 ° upper correction angle
gamma		60 ° lower correction angle

* Calculating maximum permissible refacing dimension *The maximum permissible refacing dimension is calculated as follows:* under **Valve seats, refacing** .

Camshaft seals, replacing

Oil seal at camshaft gear, removing and installing

Camshaft Position (CMP) Sensor G40 gasket, removing and installing.

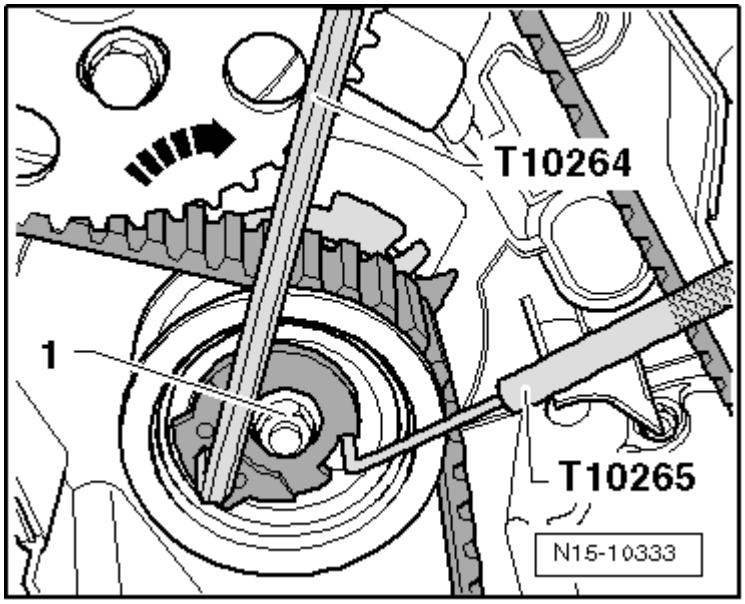

Fig. 89: Identifying Special Tools - Oil Seal At Camshaft Gear, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Seal puller 2085
- Counter-holder tool 3036

- Assembly tool T10071
- Torque wrench V.A.G 1331
- Torque wrench V.A.G 1332

Removing

- Remove upper toothed belt guard.

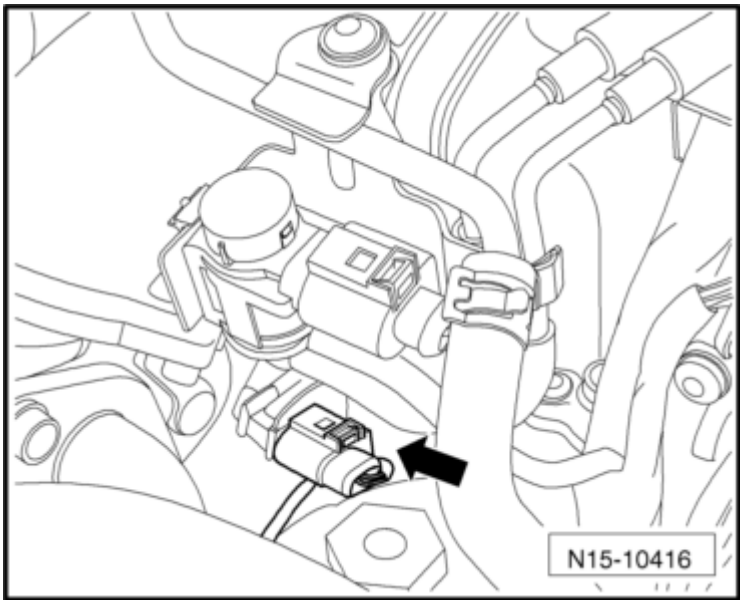

Fig. 90: Marking On Camshaft Gear Aligned With Marking On Cylinder Head Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Bring camshaft gear to marking for TDC cylinder 1 by turning crankshaft. Marking on camshaft gear must be flush with marking on cylinder head cover.
- Remove cylinder head cover.
- Remove toothed belt from camshaft gear, refer to **Toothed belt, removing, installing and tensioning** .
- Turn crankshaft back slightly.

- Remove camshaft sprocket. To loosen bolt, counterhold camshaft gear using retainer 3036.

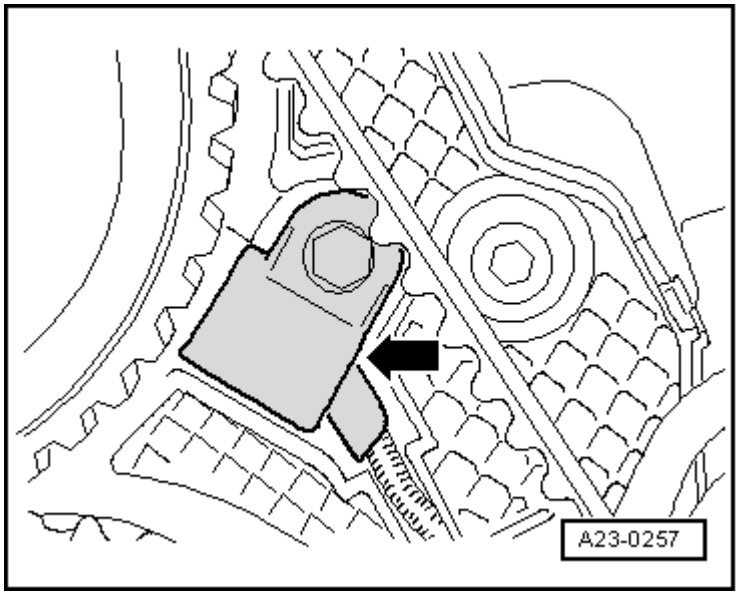

Fig. 91: Camshaft Gear Retaining Bolt Installed Into Camshaft To Stop
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert camshaft gear retaining bolt - **arrow** - into camshaft by hand to stop to guide seal puller.
- Remove inner portion of seal puller 2085 two rotations (approx. 3 mm) from outer portion and secure with knurled-head screw.

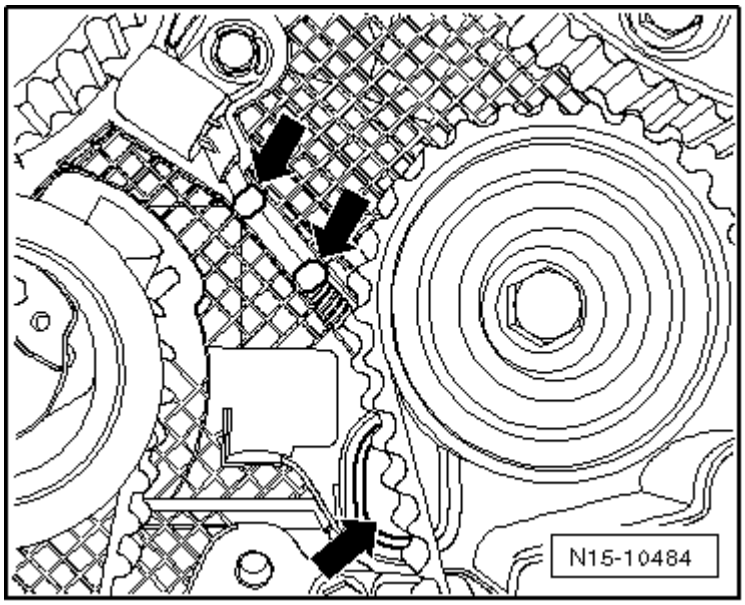

Fig. 92: Positioning And Screwing Bolt Into Oil Seal As Far As Possible With Forced Pressure
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Lubricate threaded head of seal puller 2085 , position and screw into oil seal as far as possible with forced pressure.
- Loosen knurled bolt and turn inner part against camshaft until seal is removed.

Installing

NOTE:

- **Phased in introduction of PTFE sealing rings (Distinguishing features: without ring spring, sealing lip designed wider). The sealing lip of this sealing ring may not be oiled or greased. An oil seal of the old version (with ring spring) can be replaced by a PTFE seal - but not the other way around.**

- Before installing, remove oil remains from camshaft journal with a clean cloth.

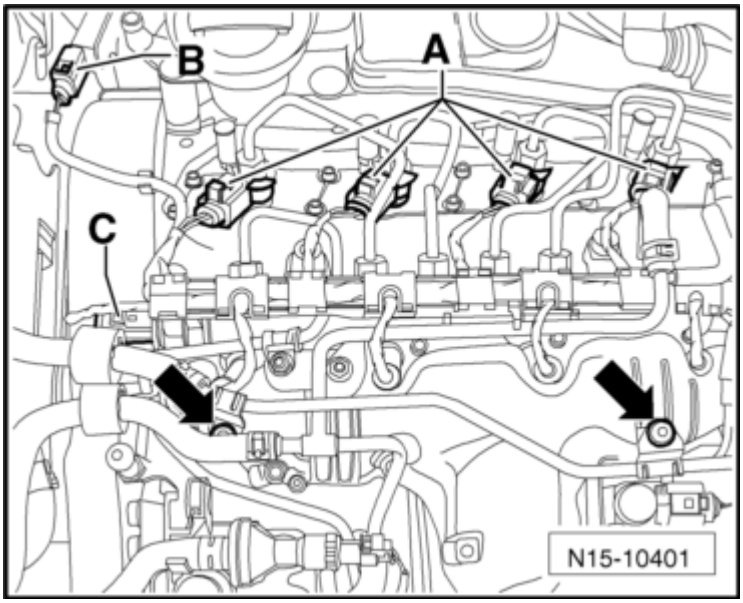

Fig. 93: Guide Sleeve T10071/1 Installed On Camshaft Pin
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install guide sleeve T10071/1 on camshaft pin.
- Slide oil seal over guide sleeve onto camshaft pin.

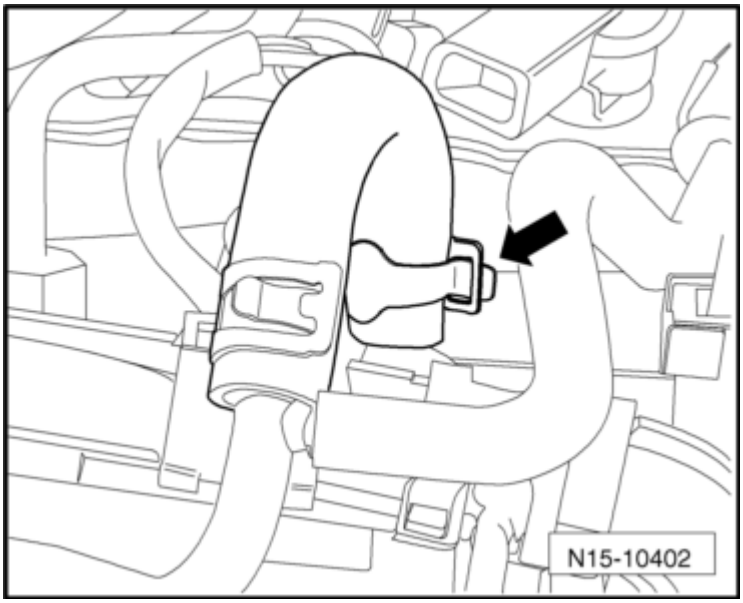

Fig. 94: Pressing In Gasket Up To Stop Using Thrust Sleeve T10071/3 And Bolt T10071/4
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press in gasket up to stop using thrust sleeve T10071/3. To do so, use bolt T10071/4.

The rest of assembly is in reverse order of disassembling.

Install toothed belt and adjust valve timing, refer to **Toothed belt, removing, installing and tensioning**

Camshaft Position (CMP) Sensor G40 gasket, removing

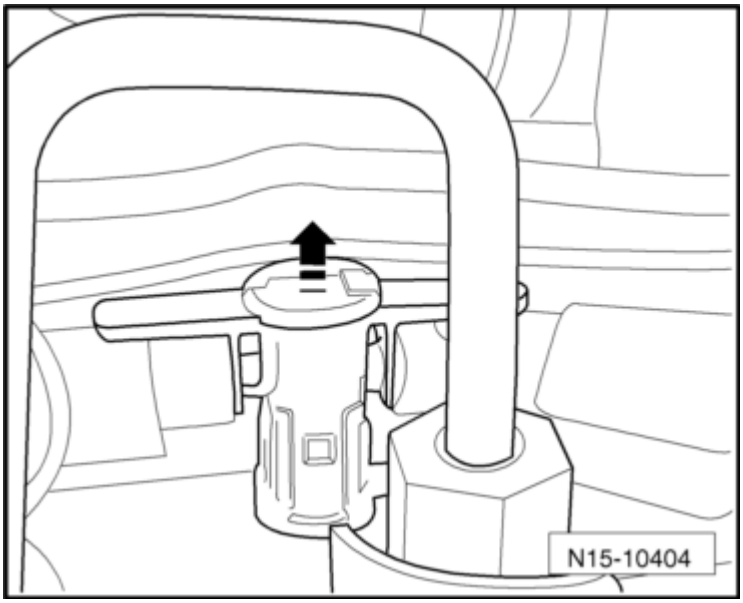

Fig. 95: Identifying Special Tools - Camshaft Position Sensor G40 Gasket, Removing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Seal remover 2085
- Seal Installer 3241 (for standard version gasket with ring spring)
- Assembly Tool T10071 (for PTFE-version of sealing ring)
- Torque wrench V.A.G 1331
- Torque wrench V.A.G 1332
- Bolt M8x60

Removing

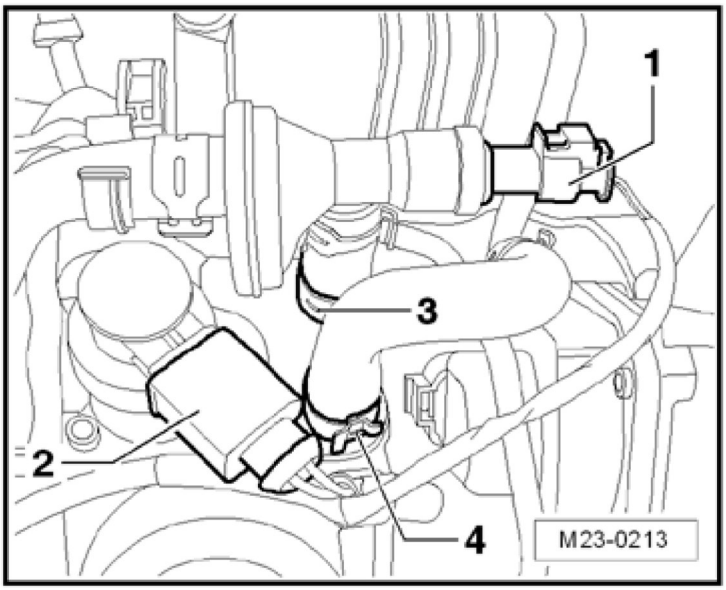

Fig. 96: Locating Connector At Camshaft Position Sensor G40
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect connector from Camshaft Position (CMP) Sensor G40 - **arrow** -.
- Remove upper toothed belt guard.
- Remove housing for Hall sensor.
- Remove washer and cover for Hall sensor.

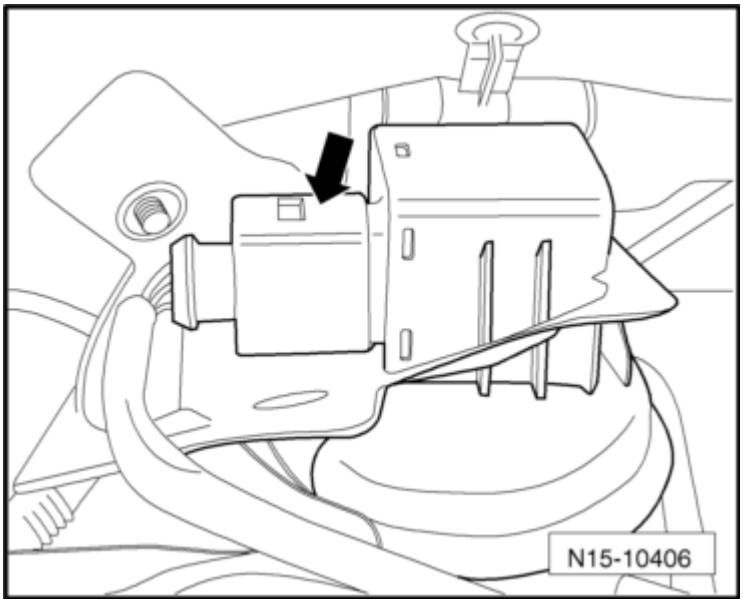

Fig. 97: Adapter 2085/1 Threaded In Camshaft
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- To guide Seal Puller 2085 , thread Adapter 2085/1 in camshaft by hand as far as stop.
- Remove inner portion of seal puller 2085 two rotations (approx. 3 mm) from outer portion and secure with knurled-head screw.

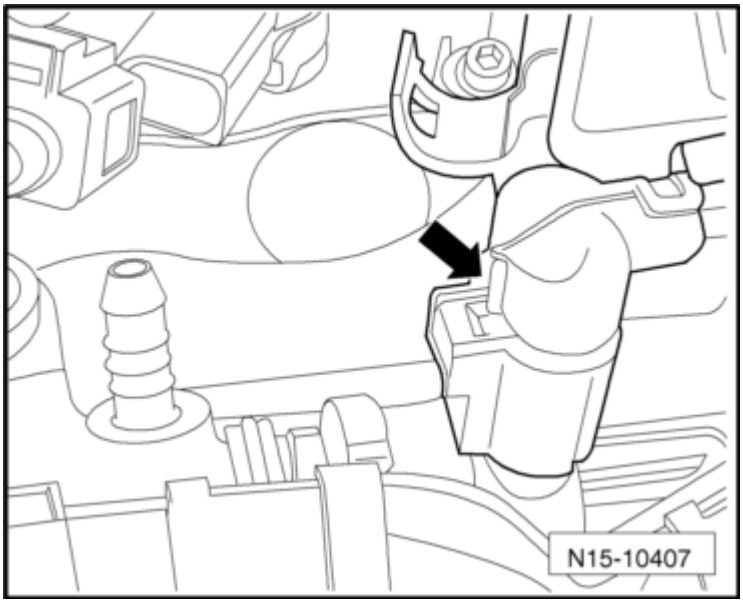

Fig. 98: Screwing Threaded Head Of Seal Extractor With Forced Pressure Into Oil Seal
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Lubricate threaded head of seal extractor, position and with forced pressure screw into oil seal as far as possible.
- Loosen knurled bolt and turn inner part against camshaft until seal is removed.

Installing

NOTE:

- **Phased in introduction of PTFE sealing rings (Distinguishing features: without ring spring, sealing lip designed wider). The sealing lip of this sealing ring may not be oiled or greased. An oil seal of the old version (with ring spring) can be replaced by a PTFE seal - but not the other way around.**

PTFE sealing ring, installing

- Before installing, remove oil remains from camshaft journal with a clean cloth.

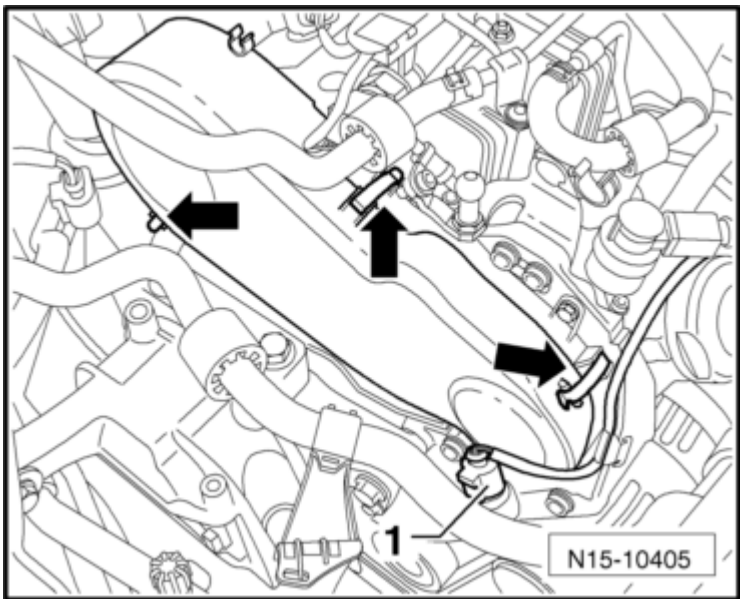

Fig. 99: Guide Sleeve T10071/5 On Camshaft Pin
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place guide sleeve T10071/5 on camshaft pin.
- Slide sealing ring over Sleeve T10071/5.

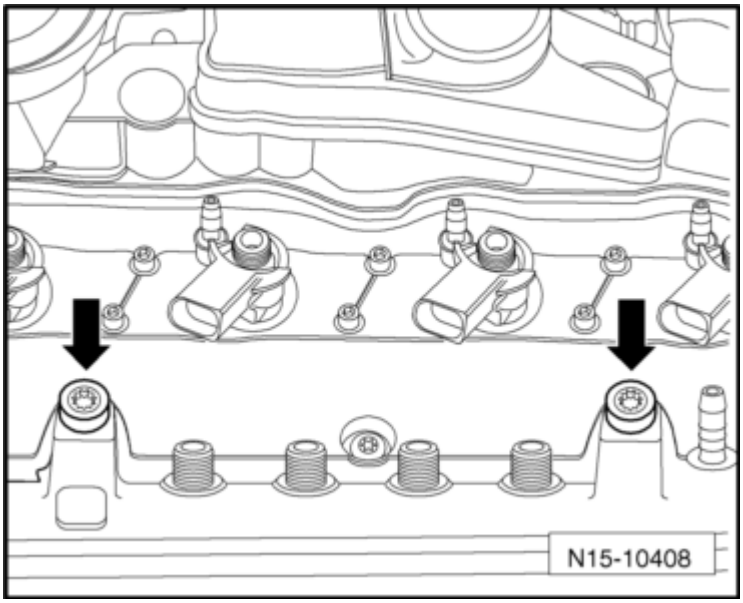

Fig. 100: Pressing In Gasket Up To Stop Using Thrust Sleeve T10071/3 And Bolt M8X60
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press in gasket up to stop using thrust sleeve T10071/3. Use bolt M8x60 - **1** - for this.

Sealing ring, installing with ring spring

- Lightly oil sealing lip of seal.

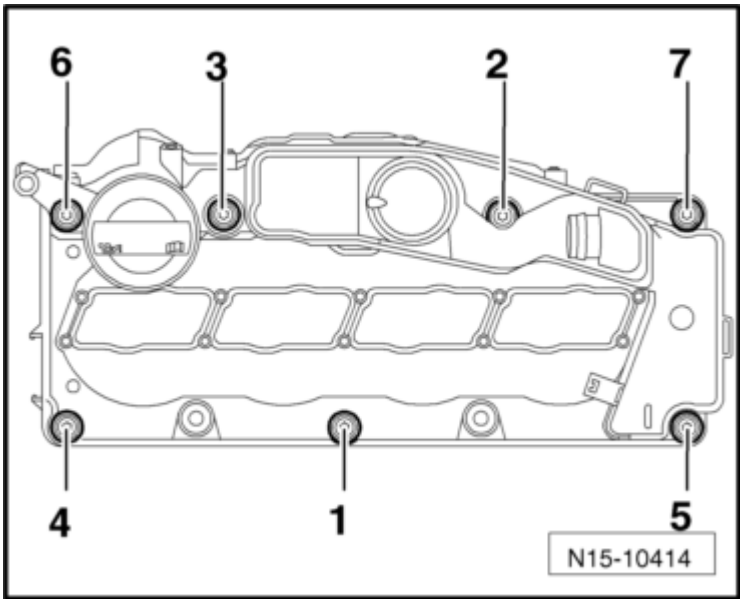

Fig. 101: Guide Sleeve 3241/2 On Camshaft Pin
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place guide sleeve 3241/2 on camshaft pin.
- Slide sealing ring over Sleeve 3241/2.

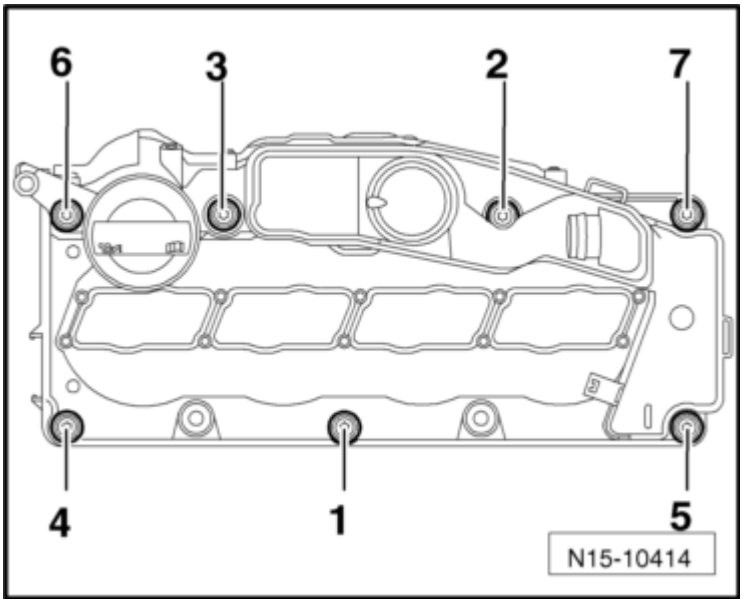

Fig. 102: Pressing In Gasket Up To Stop Using Thrust Sleeve 3241/1 And Bolt 3241/3
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press in gasket up to stop using thrust sleeve 3241/1. To do so, use bolt 3241/3.

Procedure for all sealing rings

- Insert Camshaft Position (CMP) Sensor G40 trim with notch in intake camshaft.
- Install washer (with cone outward) and fasten bolt to 25 Nm.
- Install Camshaft Position (CMP) Sensor G40 housing and tighten to 10 Nm.
- Install toothed belt cover - upper part.

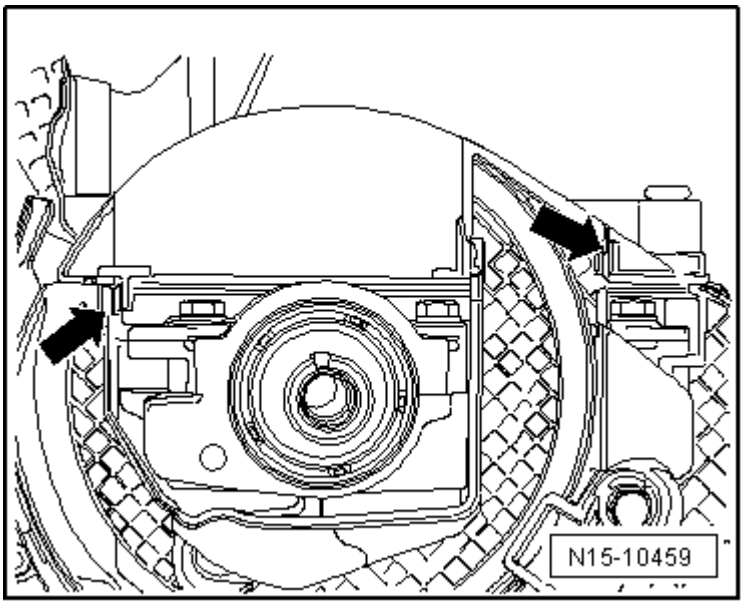

Fig. 103: Locating Connector At Camshaft Position Sensor G40

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect connector from Camshaft Position (CMP) Sensor G40 - **arrow** -.

Hydraulic valve lifters, checking

Special tools, testers and auxiliary items required

- Feeler gauge
- Wooden or plastic wedge

NOTE:

- **Replace complete valve lifters only (cannot be adjusted or serviced).**
- **Irregular valve noises are normal while starting the engine.**

Test sequence

- Start engine and let it run until radiator fan has switched on once.
- Increase engine speed to approx. 2500 RPM for 2 minutes.

If the hydraulic valve lifters are still noisy, determine which lifter or lifters are faulty as follows:

- Remove cylinder head cover.
- Turn crankshaft clockwise until camshaft lobe for valve lifter to be tested is pointing upward.
- Measure play between camshaft lobe and valve lifter.
- If play is greater than 0.2 mm, replace valve lifter. If minimal play of 0.1 mm or no play is measured, continue procedure as follows:

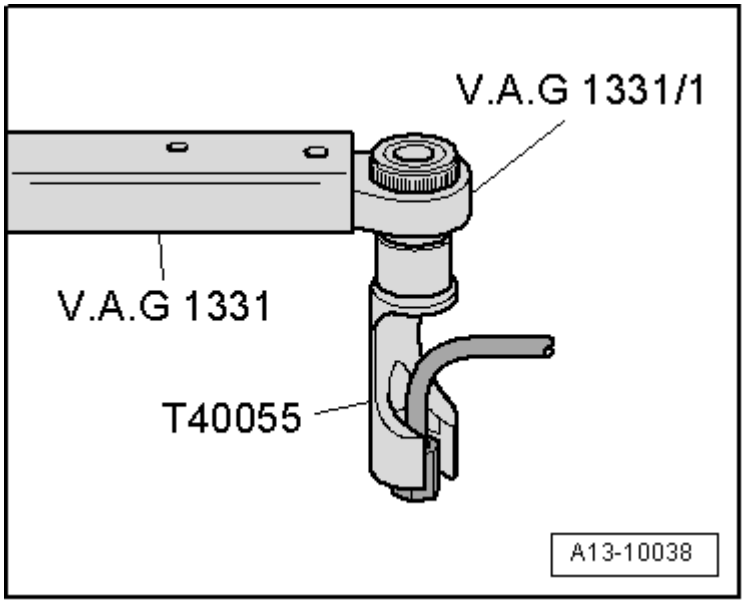

Fig. 104: Pressing Valve Lifter Downwared Using Wedge

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Lightly press valve lifter downward with a wood or plastic wedge. If 0.20 mm thick feeler gauge can be inserted between camshaft and valve lifter, replace valve lifter.

NOTE:

- **After installing new valve lifters, the engine may not be started for approx. 30 minutes. The hydraulic equalization elements must seat themselves (otherwise the valves will crash into the pistons).**

Camshafts, removing and installing

(with cylinder head installed)

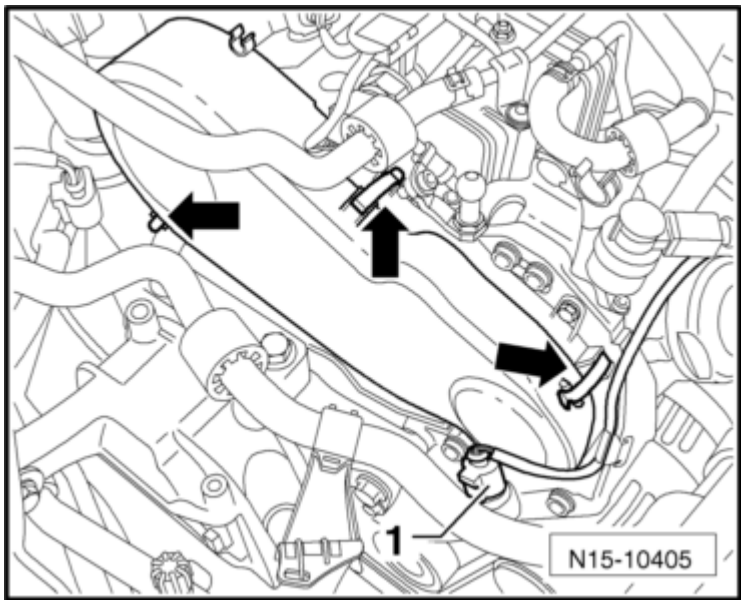

Fig. 105: Identifying Special Tools - Camshafts, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Retainer 3036
- Chain tensioner retainer 3366
- Torque wrench V.A.G 1331
- Torque wrench V.A.G 1332

- *Sealant AMV 174 004 01* (Part numbers are for reference only. Always check with your Parts Department for the latest part number information).
- *Sealant D 454 300 A2* (Part numbers are for reference only. Always check with your Parts Department for the latest part number information).

Removing

- Remove engine cover.
- Remove upper toothed belt guard.

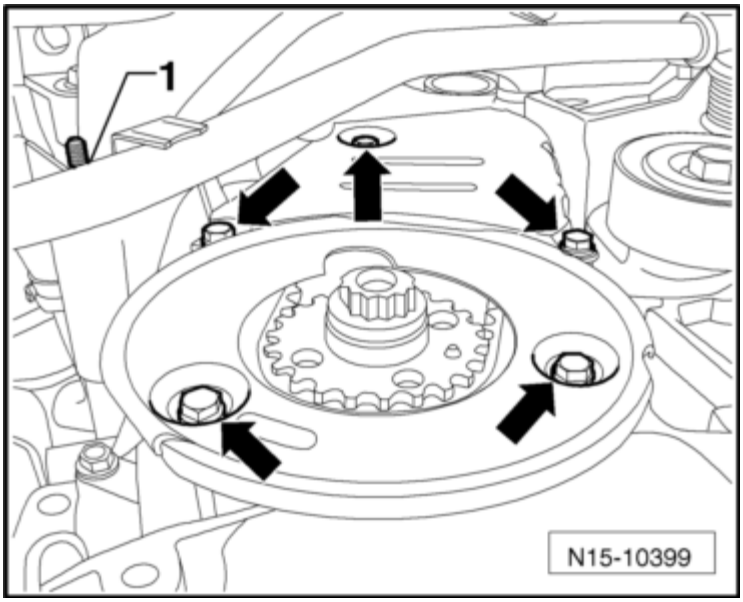

Fig. 106: Marking On Camshaft Gear Aligned With Marking On Cylinder Head Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Bring camshaft gear to marking for TDC cylinder 1 by turning crankshaft. Marking on camshaft gear must be flush with marking on cylinder head cover.
- Remove cylinder head cover.
- Remove toothed belt from camshaft gear, refer to **Toothed belt, removing, installing and tensioning** .
- Turn crankshaft back slightly.

- Remove camshaft sprocket. To loosen bolt, counterhold camshaft gear using retainer 3036.
- Remove Hall sensor housing.
- Remove washer and cover for Hall sensor.

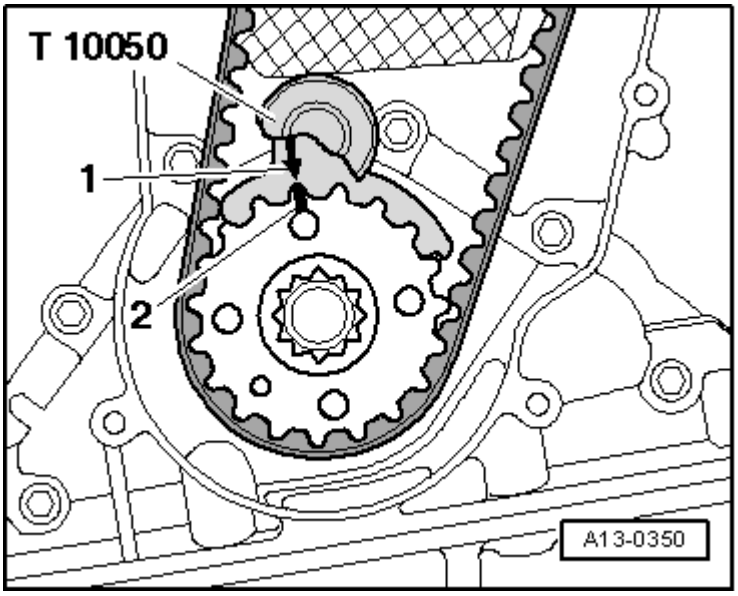

Fig. 107: Drive Chain And Camshaft Chain Sprockets Marked Installed Positions
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Clean drive chain and camshaft chain sprockets - **arrows** - across from both on bearing caps and mark installed position with a color marking.

NOTE:

- **Do not mark chain using a center punch or similar means!**
- **The distance between both - arrows - or colored markings consists of 16 rollers of the drive chain.**

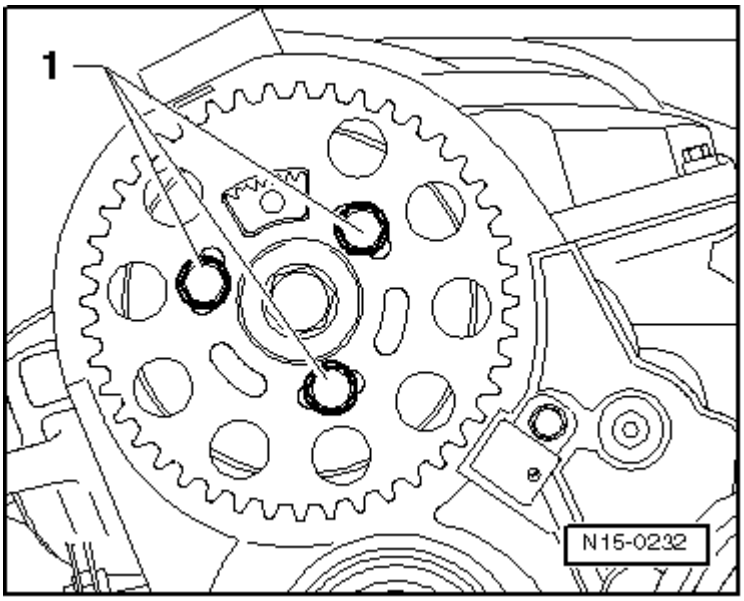

Fig. 108: Securing Camshaft Adjuster Or Chain Tensioner Using Bracket For Chain Adjustment 3366
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Secure camshaft adjuster or chain tensioner using Bracket for Chain Adjustment 3366.

NOTE:

- **Hydraulic chain tensioner can be damaged if Bracket for Chain Adjustment 3366 is tightened too hard.**

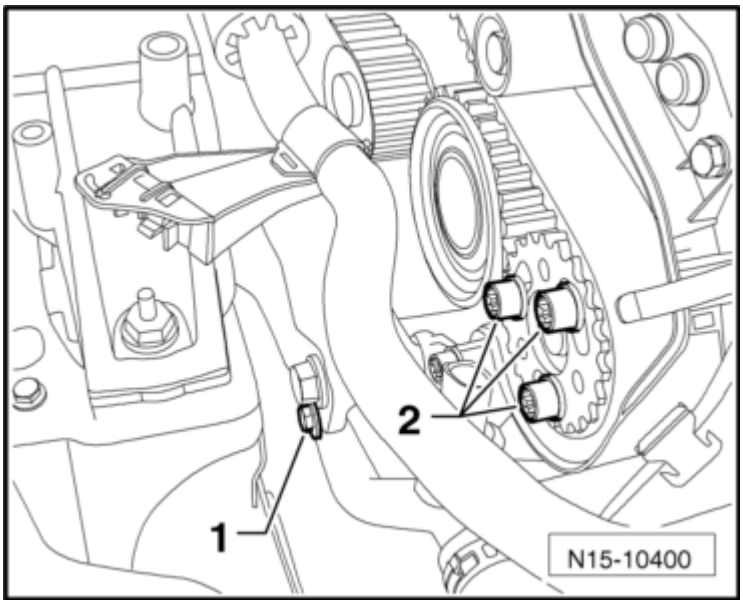

Fig. 109: Identifying Bearing Cap Positions
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- First remove bearing caps 3 and 5 from intake and exhaust camshafts.
- Remove double bearing cap.
- Remove both bearing caps from chain sprocket on intake and exhaust camshafts.
- Remove securing bolts of camshaft adjuster/chain tensioner.
- Alternating in diagonal sequence, loosen bearing caps 2 and 4 of intake and exhaust camshafts and remove.
- Remove intake and exhaust camshafts with camshaft adjuster or chain tensioner and Bracket for Chain Adjustment 3366.

Installing

NOTE:

- **When installing the camshafts, the cam lobes for cylinder 1 must point upward.**
- **When installing bearing caps, verify marking on cap is readable from intake side of cylinder head.**

- Place drive chain onto both camshaft sprockets according to color markings.

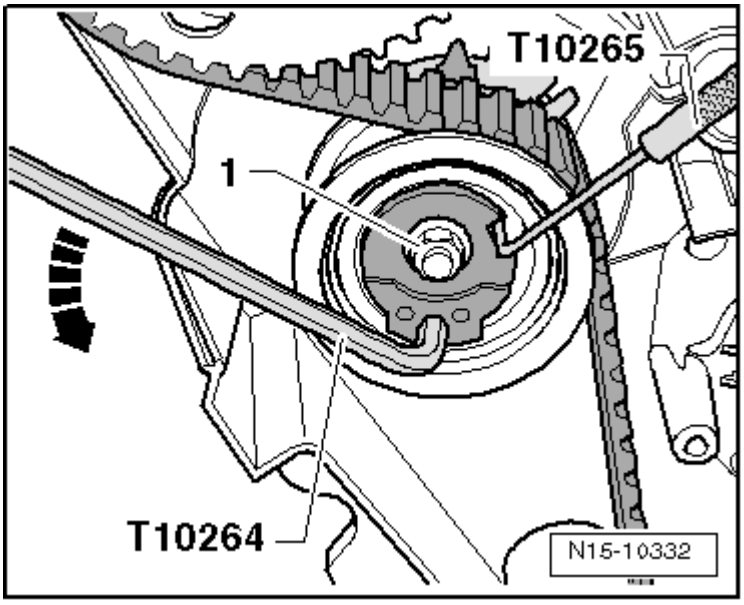

Fig. 110: First And Sixteenth Drive Chain Rollers Installed On Chain Gears
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE:

- **When using a new drive chain, distance between notches - A - and - B - must be 16 rollers on the chain.**
- **Illustration shows where first and sixteenth drive chain rollers must be installed on chain gears.**
- **Notch - A - is slightly offset inward toward chain roller - 1 -**

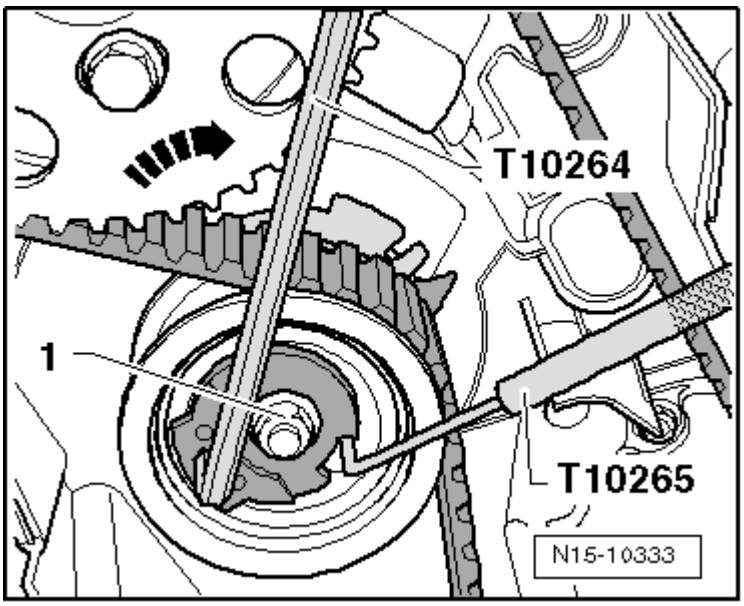

Fig. 111: Sealant Application Area Identified By Hatched Surface
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Replace rubber/metal seal for camshaft adjuster or chain tensioner and coat hatched surface with thin coat

of *sealant D 454 300 A2* . (Part numbers are for reference only. Always check with your Parts Department for the latest part number information).

- Insert camshaft adjuster/chain tensioner between drive chain.
- Oil running surfaces of both camshafts.
- Insert camshafts with drive chain and camshaft adjuster/chain tensioner into cylinder head.
- Tighten camshaft adjuster/chain tensioner to 10 Nm (pay attention to bushing).

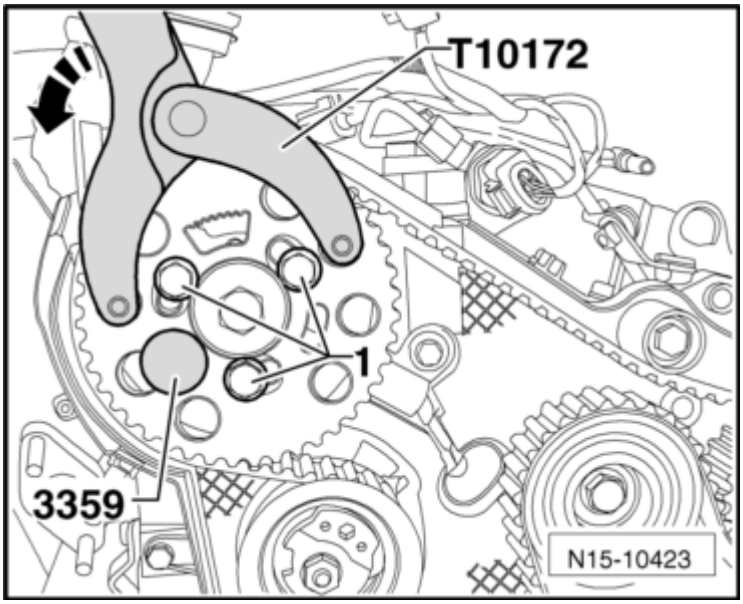

Fig. 112: Identifying Bearing Cap Positions
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Alternating in diagonal sequence, tighten bearing caps 2 and 4 of intake and exhaust camshafts and tighten to 10 Nm (pay attention to bushing).

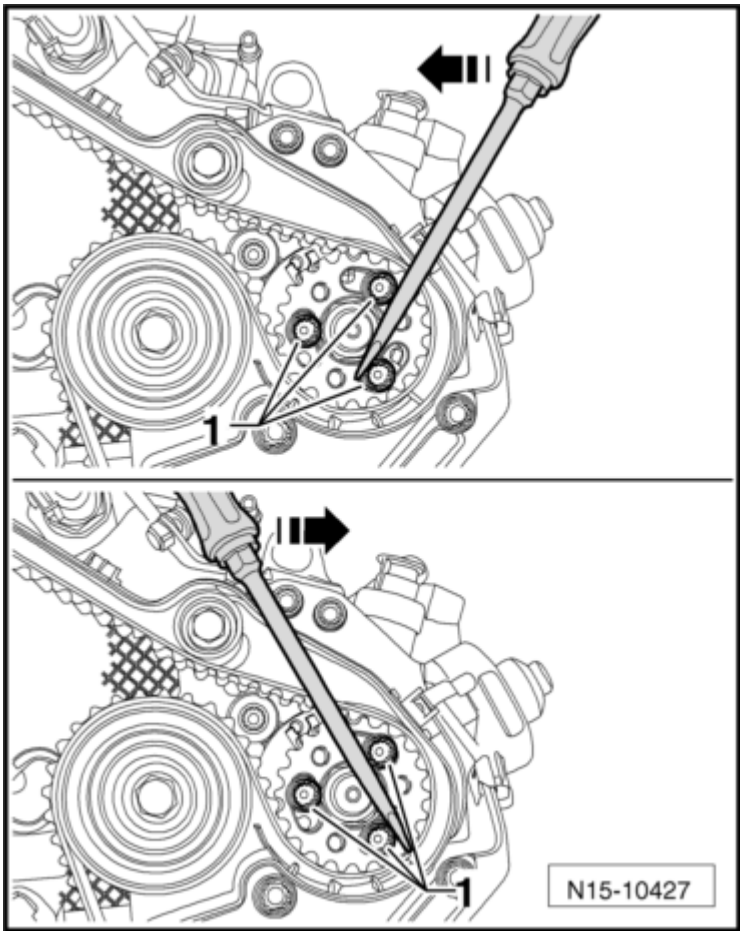

Fig. 113: Identifying Bearing Caps
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install both bearing caps on chain gears of intake and exhaust camshafts. Check camshaft for proper adjustment and tighten bearing cap to 10 Nm (pay attention to alignment bushing).
- Remove chain tensioner retainer 3366.

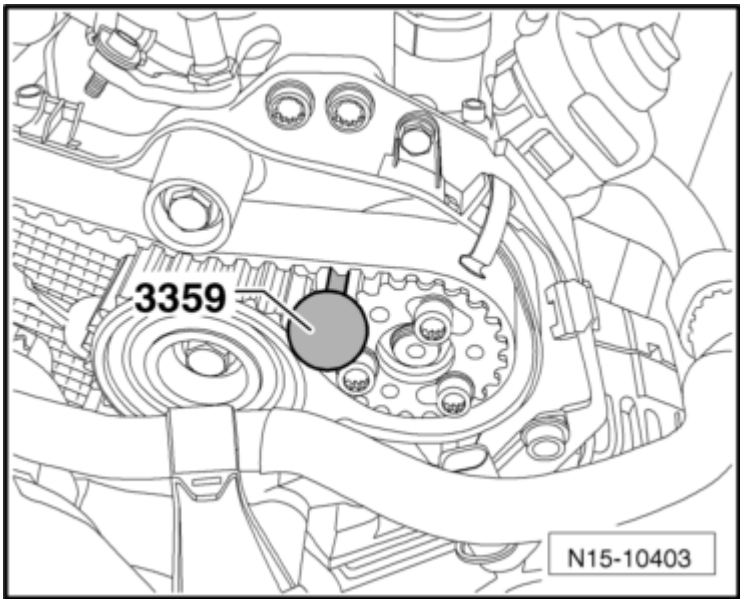

Fig. 114: Identifying Double Bearing Cap Sealant Application Area
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Coat hatched surface of double bearing cap lightly using *sealant AMV 174 004 01* , install and tighten to 10 Nm (pay attention to bushing). (Part numbers are for reference only. Always check with your Parts Department for the latest part number information).
- Install remaining bearing cap and tighten to 10 Nm (pay attention to alignment bushing).

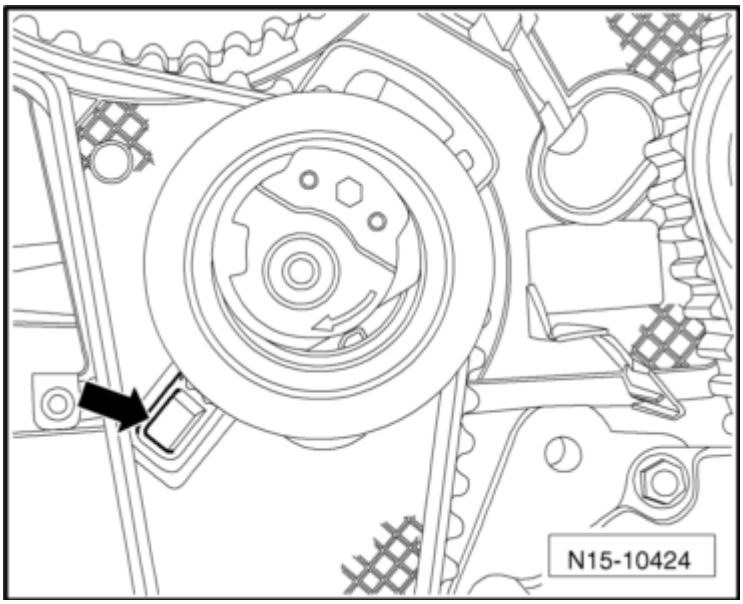

Fig. 115: Identifying Camshaft Gear Thin Rib Toward Outside And TDC Marking Visible
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install camshaft gear (thin rib toward outside and TDC marking visible) and tighten bolt to 65 Nm (use Retainer 3036).

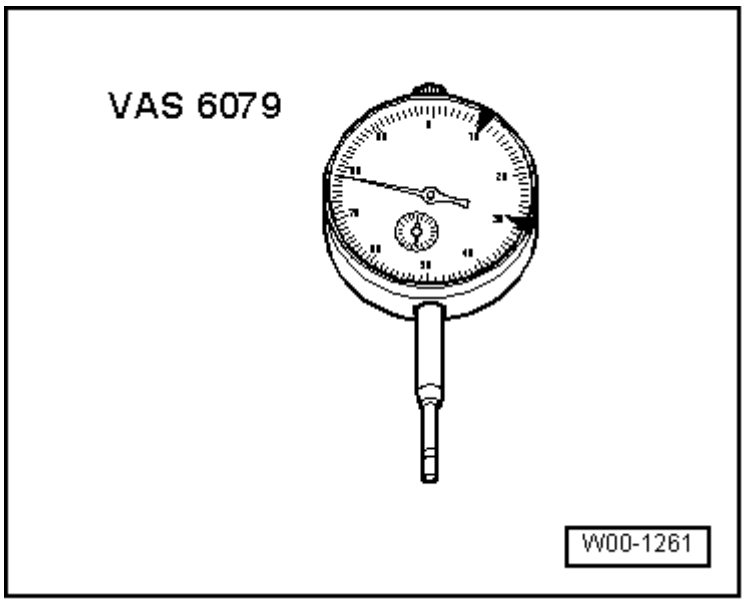

Fig. 116: Checking Position Of Camshafts To Each Other
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Check position of camshafts - **arrows** - to each other again.

The rest of assembly is basically a reverse of disassembling.

How to install toothed belt and adjust valve timing, refer to **Toothed belt, removing, installing and tensioning** .

NOTE:

- **After installing new valve lifters, the engine may not be started for approx. 30 minutes. The hydraulic equalization elements must seat themselves (otherwise the valves will crash into the pistons).**

Camshaft adjustment, checking

Only vehicles with engine code AWP, AWW

The camshaft adjustment is load and RPM dependent. The electrical valve for camshaft adjustment switches oil pressure onto camshaft adjuster (mechanical adjustment mechanisms), which adjusts the camshaft.

Special tools, testers and auxiliary items required

- Fault Read Out Device V.A.G 1551 or Vehicle Diagnosis, Testing and Information System VAS 5051
- Portable multimeter V.A.G 1526C
- Connector test set V.A.G 1594C
- Speed Adjuster Tool V.A.G 1788/10

Activation, checking

- First check camshaft adjuster solenoid valve activation via diagnostic test mode (DTM).

If control is OK:

Solenoid valve, checking

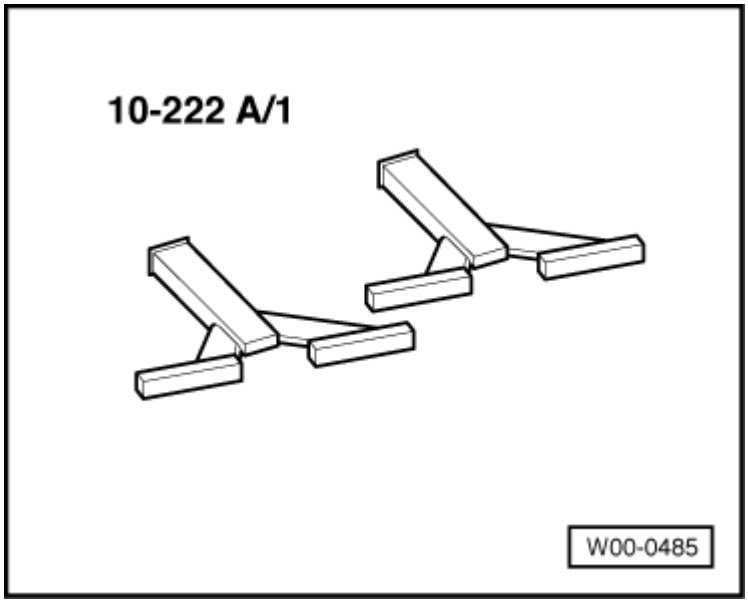

Fig. 117: Measuring Resistance Between Terminals Of Solenoid Valve
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Measure resistance between terminals of solenoid valve. Specification: 10 to 18 ohms (at room temperature)

If no malfunctions are found on valve:

- Check camshaft adjuster function.

Camshaft adjuster, checking function

Test conditions

- Coolant temperature must be at least 85 ° C,, refer to Display group 04, display field 3

Test sequence

- Connect Fault Read Out Device V.A.G 1551 and select engine electronics control module with "Address word 01". Engine must run at idle for this. Connect Fault Read Out Device V.A.G 1551 and select engine control module.

Scan tool display:

Quick data transfer HELP Select function XX

- Press buttons 0 and 4 for function "Initiate basic setting" and press Q button to confirm input.

Scan tool display:

Initiate basic setting HELP Enter display group number XXX

- Press buttons 0 9 and 4 for "Display group number 94" and confirm entry with Q button.

Scan tool display: (1 to 4 = display fields)

System in basic setting 94 ->> 1 2 3 4

Engine code AWW

- Adjust engine speed with Speed Adjuster Tool V.A.G 1788/10 to 1800 to 2200 RPM.
- Hold speed at 1800 to 2200 RPM until display in display field 3 goes from "Test OFF" to "Test ON".
- Continue to hold speed at 1800 to 2200 RPM until specified value "Syst. OK" is shown in display field 3.

Reading results as described:

- Remove Speed Adjuster Tool V.A.G 1788/10 from gas pedal.

Engine code AWP

- Press brake pedal and hold firmly.
- Press gas pedal into wide open throttle (WOT) position. The engine speed is raised to approx. 2300 RPM by engine control module.
- Hold brake and gas pedal down until display in display field 3 goes from "Test OFF" to "Test ON".
- Continue to hold brake and gas pedal until specified value "Syst. OK" is shown in display field 3.

Reading results as described:

- Release brake and gas pedals.

Continued for all engine codes

- Press --> key.

Scan tool display:

Quick data transfer HELP
Select function XX

- Press buttons 0 and 6 for function "End output" and press Q button to confirm input.
- Switch ignition off.

If "Syst. not OK" is shown in display field 3, read out DTC memory.

The following malfunctions can take place with malfunction code 17927:

The camshaft adjuster solenoid valve switches oil pressure correctly on mechanical camshaft adjuster but it cannot reach its end position (e.g. due to difficulty in moving).

- Replace camshaft adjuster.
- Check DTC memory.
- Read readiness code.
- If DTC memory was cleared or engine control module disconnected from voltage supply, readiness code must be regenerated.

- Repeat function test.

If specified value is not obtained again:

- Replace engine control module:, refer to **ENGINE CONTROL MODULE (ECM), REPLACING** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWD or **ENGINE CONTROL MODULE, REPLACING** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION IGNITION, ENGINE CODE(S): AWW, AWP .

Valve guides, checking

Special tools, testers and auxiliary items required

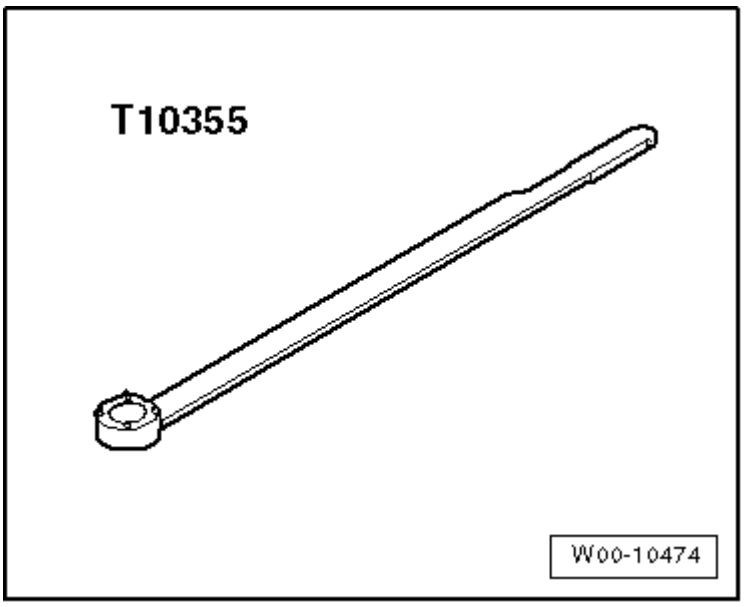

Fig. 118: Dial Gauge Holder VW 387
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Dial gauge holder VW 387
- Dial gauge

Test sequence

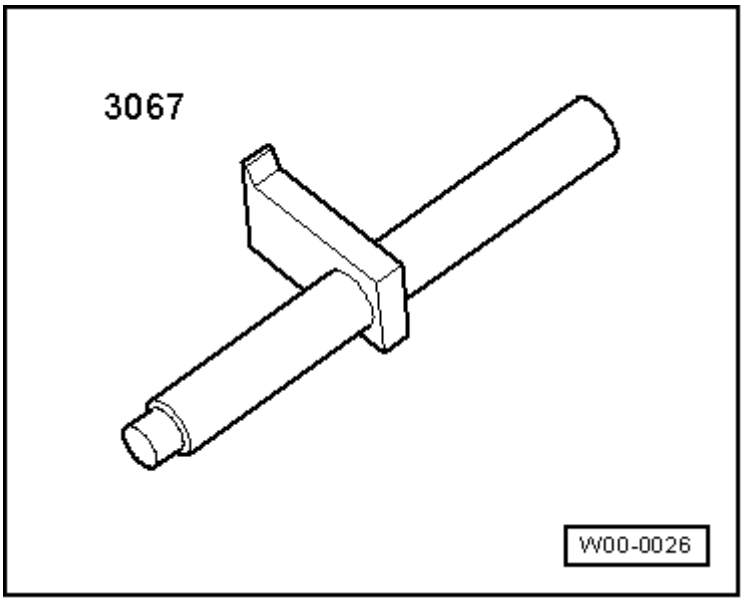

Fig. 119: Identifying Special Tool - VW 387 Installed
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert new valve into guide. The end of the valve stem must be flush with the guide. Due to the slight difference in stem dimensions, 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 stem seals, replacing

(with cylinder head installed)

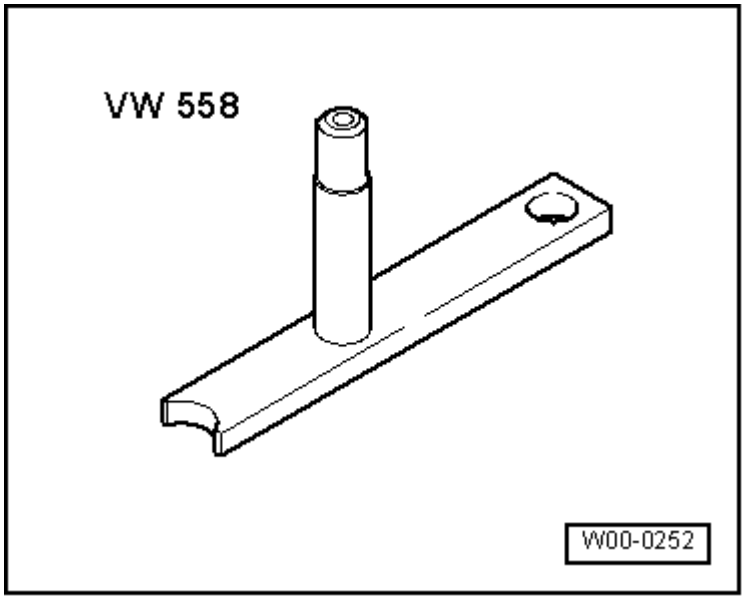

Fig. 120: Identifying Special Tools - Valve Stem Seals, Replacing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Spark plug removal tool 3122 B
- Valve Spring Compressor 3362 and Thrust Piece 3362/1
- Valve seal removal tool 3364
- Pressure hose VW 653/3
- Torque wrench V.A.G 1331
- Torque wrench V.A.G 1332

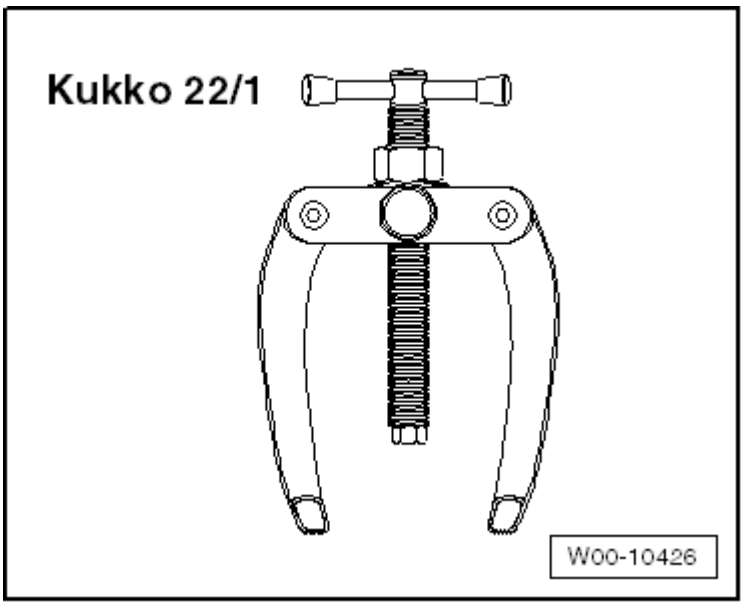

Fig. 121: Valve Stem Seal Driver 3365
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Valve stem seal driver 3365

Removing

- Remove camshafts refer to **Camshafts, removing and installing** .
- Remove valve lifters and place on contact surface when setting down. Be careful not to switch valve lifters.
- Remove spark plugs using spark plug removal tool 3122 B.
- Move piston for respective cylinder to "Bottom Dead Center (BDC) position".

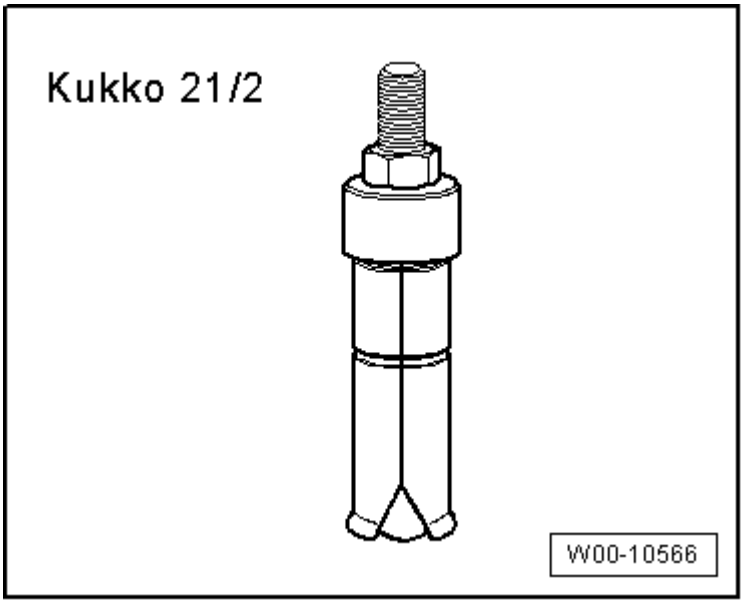

Fig. 122: Identifying Pressure Hose VW 653/3 And Thrust Piece 3362/1 In Valve Spring Compressor 3362
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install pressure hose VW 653/3 into spark plug thread.
- Place thrust piece 3362/1 into valve spring compressor 3362.
- Using retaining bolts bolted in tool, secure valve spring compressor 3362 to cylinder head.
- Bring Valve Spring Compressor 3362 into following position to press valve springs together

Outer intake valves: Lower position

Center intake valve: Upper position

Exhaust valve: Lower position

- Connect compressed air hose to a pressure of at least 6 bar and then remove valve springs.

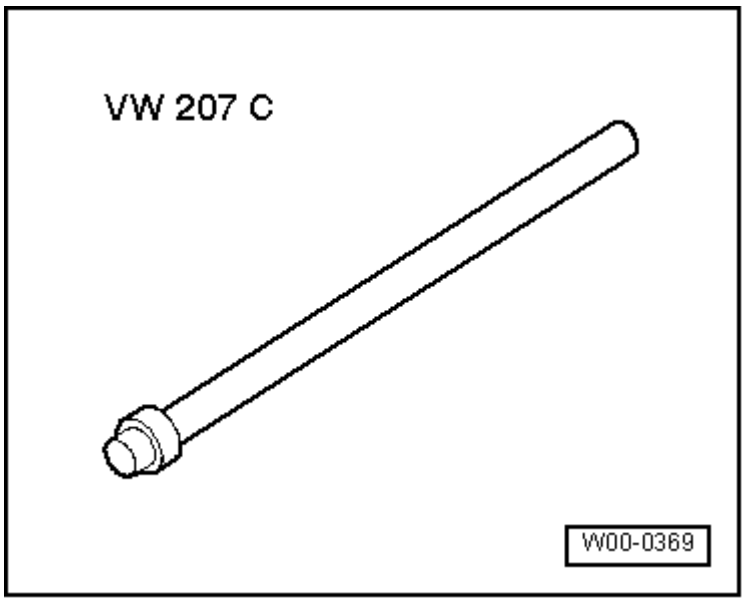

Fig. 123: Removing Valve Stem Seals Using Valve Stem Removal Tool 3364
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove valve stem seals using valve stem removal tool 3364.

Installing

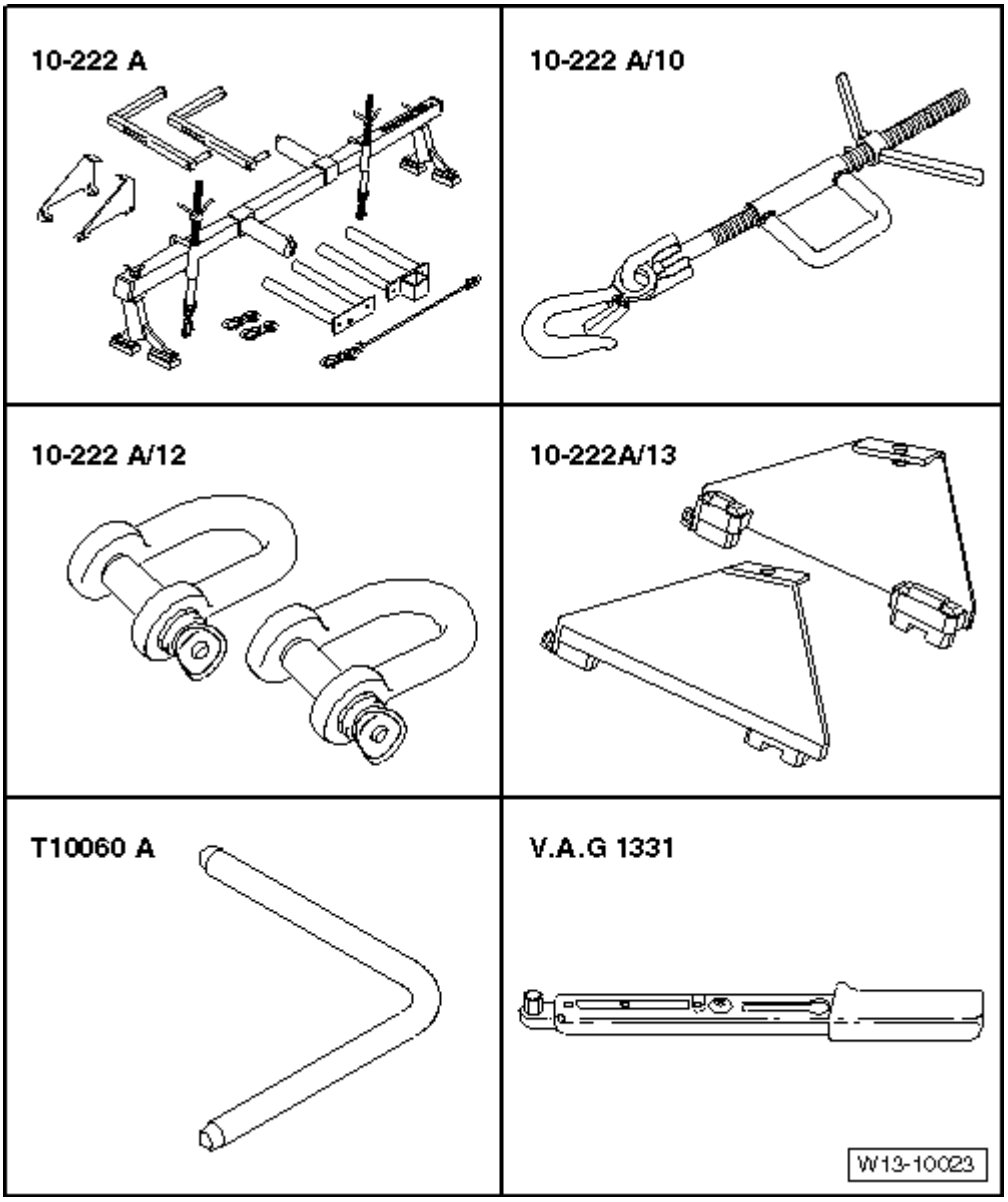

Fig. 124: Identifying Plastic Sleeve, Alve Stem Oil Seal And Valve Stem Seal Diver 3365
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place plastic sleeve - **A** - on valve stem to prevent damage to new valve stem oil seals.
- Oil sealing lip of valve stem oil seal - **B** - , insert into valve stem seal driver 3365 and carefully slide onto valve guide.

The rest of assembly is in reverse order of disassembling.

17 - LUBRICATION

LUBRICATION SYSTEM COMPONENTS

Lubrication system components

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
- The oil level must not be above the max. mark - danger of damage to catalytic converter! Marks *Markings on oil dipstick* under **Lubrication system components, assembly overview**

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

Engine oil

Oil system capacity:

Without oil filter 4.0 L

With oil filter 4.5 ltr.

Engine oil specifications:

Use engine oil conforming to VW standard 502 00. Only in exceptional circumstances: Multi-grade oils corresponding to API-SF or SG.

Lubrication system components, assembly overview

Part I

Part II

Part I

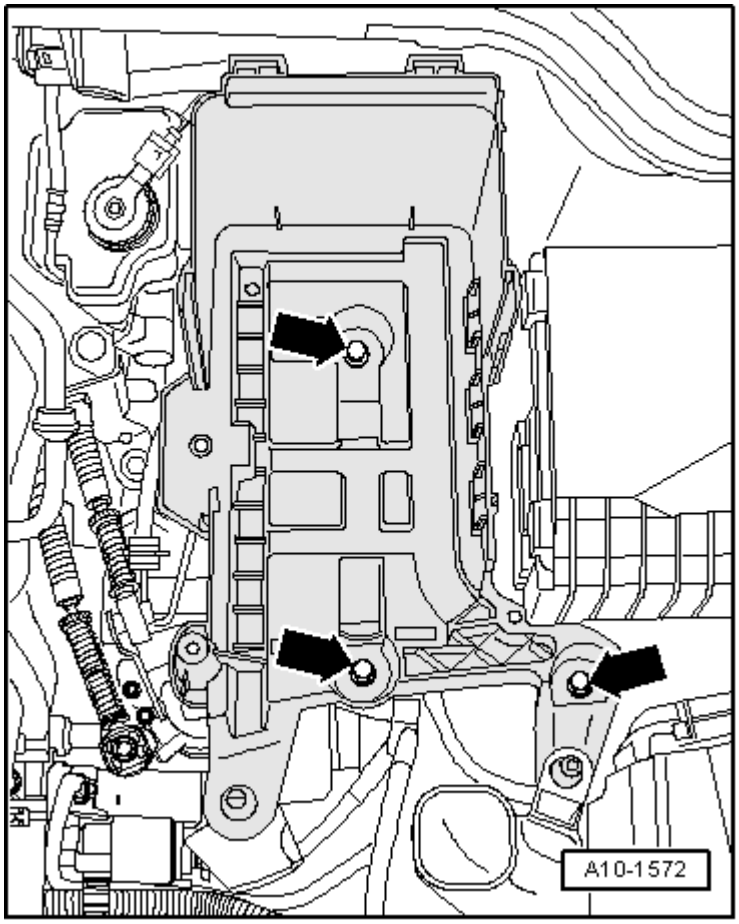

Fig. 125: Lubrication System Components, Assembly Overview - Part I
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 15 Nm

2 - Sealing flange

- Must be located on alignment sleeves
- Clean sealing surface before installing
- Insert with *silicone sealant D 176 404 A2* (Part numbers are for reference only. Always check with your Parts Department for the latest part number information).
- Removing and installing refer to **Sealing flange (belt pulley side), removing and installing**

3 - Chain tensioner with tensioning rail, 15 Nm

- Check for wear
- When installing, pretension spring and install

4 - Chain sprocket

- For oil pump drive

- Check for wear

5 - Cylinder block

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

6 - Oil dipstick

- Oil level must not be above max. mark!
- Marks *Markings on oil dipstick* under **Lubrication system components, assembly overview**

7 - Inlet spout

- For oil dipstick
- For extracting oil

8 - Guide tube

9 - Oil spray jet

- For piston cooling

10 - Pressure relief valve, 27 Nm

- Opening pressure 1.3 to 1.6 bar positive pressure

11 - 15 Nm

12 - Suction pipe

- Clean strainer if dirty

13 - O-ring

- Replace

14 - Splash wall

15 - 15 Nm

- Loosen and tighten with T Bar and Socket 10 mm 3185
- Remove with Socket 3249

16 - Oil pan

- Clean sealing surface before installing
- Insert with *silicone sealant D 176 404 A2* (Part numbers are for reference only. Always check with your Parts Department for the latest part number information).
- Removing and installing, refer to **Oil pan, removing and installing**

17 - Oil drain plug, 30 Nm

- If sealing ring is leaking cut open and replace.

18 - Gasket

- Replace

19 - Oil return pipe

20 - 10 Nm

21 - Oil pump

- With pressure relief valve 12 bar
- Before installing, check to be sure both alignment bushings are present (for centering oil pump/cylinder block)
- Replace if contact surfaces and gears are scored

22 - Chain sprocket

- For oil pump
- Check for wear

23 - 25 Nm

24 - Roller chain

- Mark direction of rotation before removing
- Check for wear

25 - Alignment sleeves

- Check for secure seat

Markings on oil dipstick

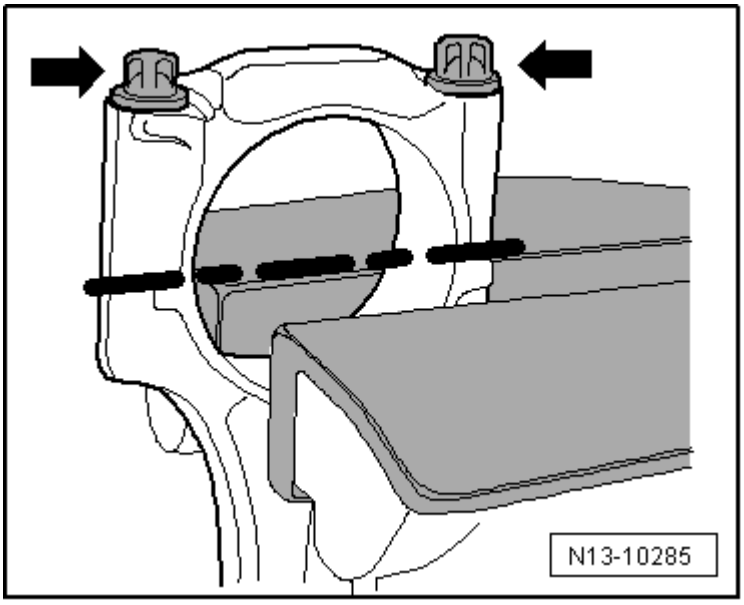

Fig. 126: Identifying Dipstick Markings
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Max. mark

2 - Min. mark

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

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

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

Part II

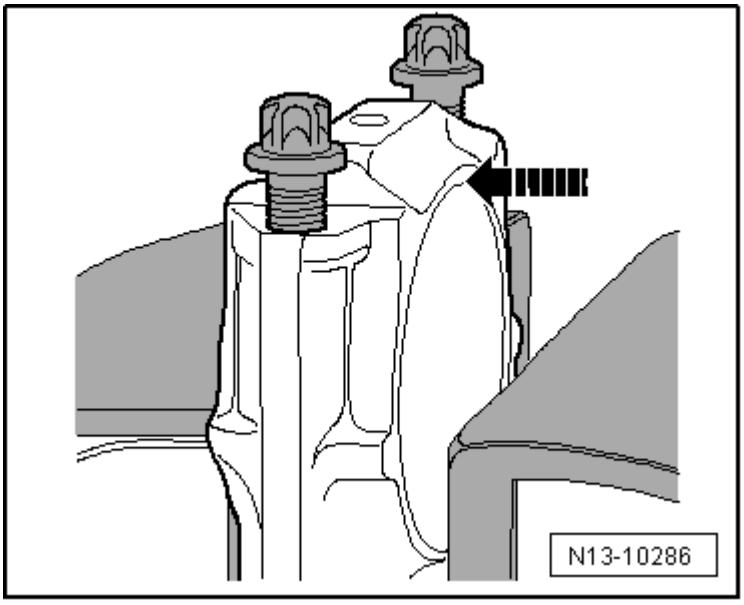

Fig. 127: Lubrication System Components, Assembly Overview - Part II
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Locking bolt, 40 Nm

2 - Seal

- If sealing ring is leaking cut open and replace.

3 - Spring

- For pressure relief valve, approx. 4 bar

4 - Piston

- For pressure relief valve, approx. 4 bar

5 - Gasket

- Replace

6 - Return flow check valve, 8 Nm

7 - Seal

- Slide up to collar of tube
- Replace if damaged

8 - Connecting pipe

- For crankcase ventilation

9 - Retaining clip

- Check for secure seat

10 - Locking bolt, 15 Nm

11 - Seal

- If sealing ring is leaking cut open and replace.

12 - 20 Nm

13 - Oil supply pipe

- To turbocharger

14 - Banjo bolt, 30 Nm

15 - Gasket

- Replace

16 - 1.4 bar Oil Pressure Switch F1 , 25 Nm

- Black
- Checking, refer to **Oil pressure and oil pressure switch, checking**

17 - Seal

- If sealing ring is leaking cut open and replace.

18 - 15 Nm plus an additional $^{1}/_{4}$ turn (90 °)

- Replace

19 - Gasket

- Replace
- Snaps into tabs of oil cooler

20 - Oil filter element

- Remove with tension strap

- Fasten by hand
- Observe installation instructions for oil filter

21 - 25 Nm

22 - Oil cooler

- Ensure sufficient clearance to surrounding components
- See note, refer to **Lubrication system components**
- Coat contact surfaces to oil filter bracket outside seal with *sealant AMV 188 100 02* . (Part numbers are for reference only. Always check with your Parts Department for the latest part number information).

23 - Oil filter bracket

- With pressure relief valve, approx. 4 bar

Oil pan, removing and installing

Special tools, testers and auxiliary items required

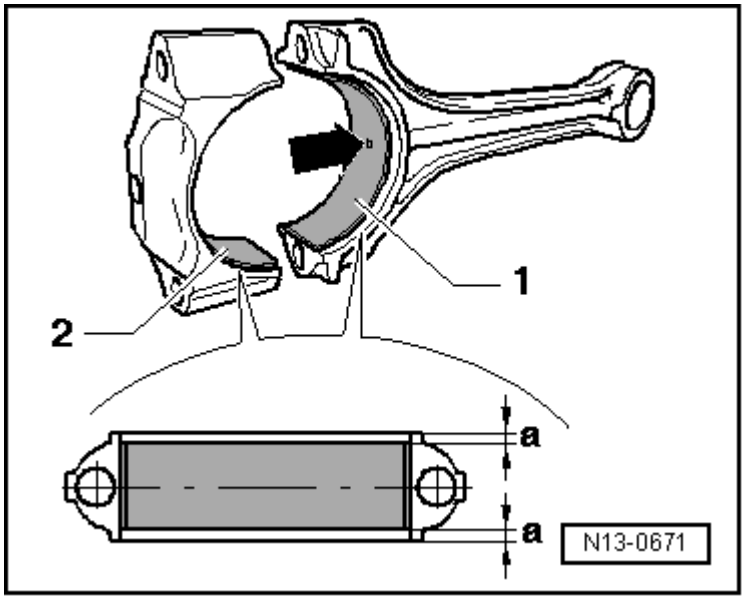

Fig. 128: T Bar And Socket 3185
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- T Bar and Socket 10 mm 3185

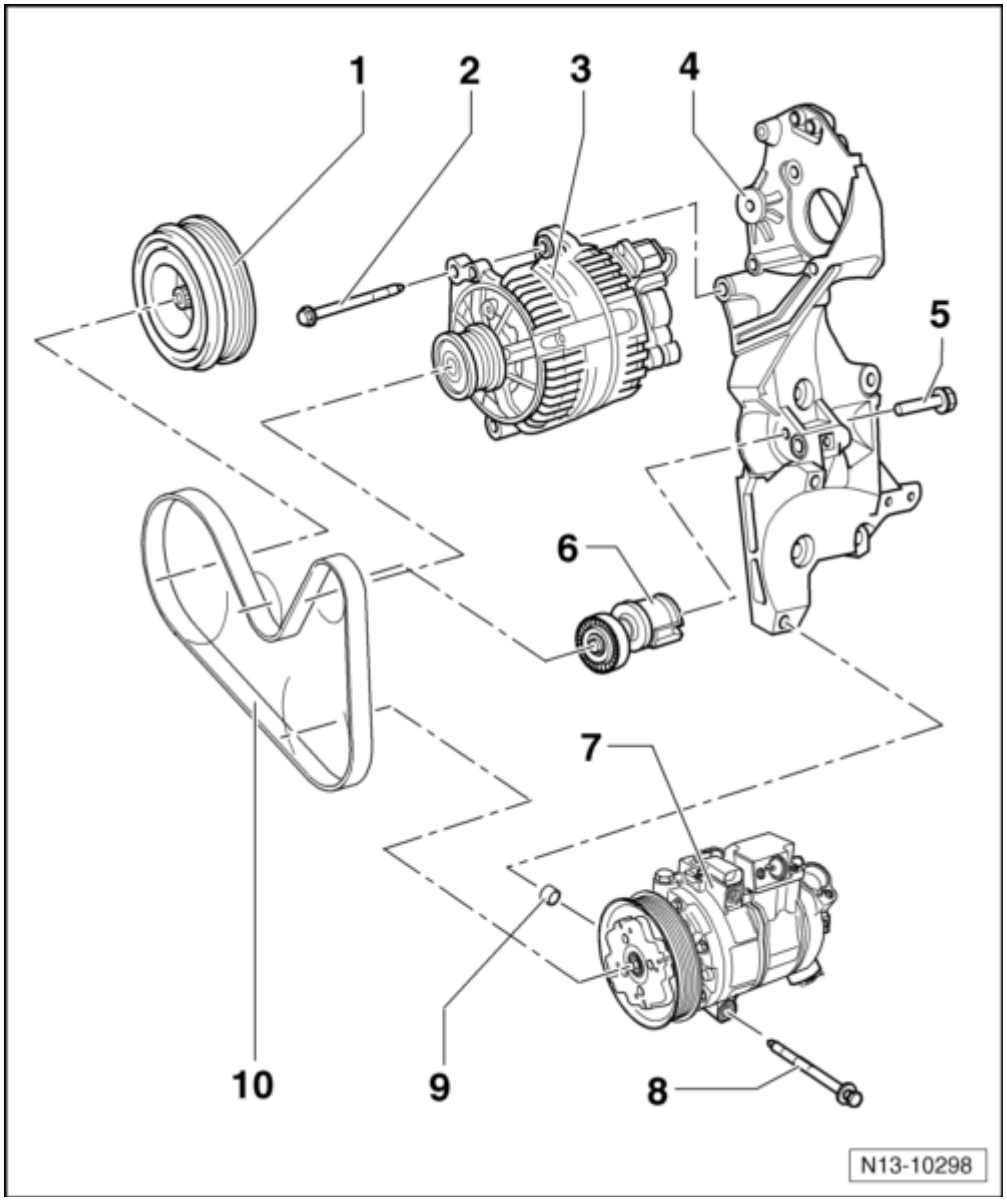

Fig. 129: Multi-Point Socket 3249
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Multi-point socket 3249
- Torque wrench V.A.G 1331
- *Silicone sealant D 176 404 A2* (Part numbers are for reference only. Always check with your Parts Department for the latest part number information).
- Hand drill with plastic brush attachment
- Protective glasses
- Flat scraper

Removing

- Remove sound insulation tray, refer to **NOISE INSULATION (GASOLINE ENGINES), ASSEMBLY OVERVIEW** or **NOISE INSULATION (DIESEL ENGINES), ASSEMBLY OVERVIEW** .
- Drain engine oil.

NOTE:

- **Observe disposal regulations!**

- Remove turbocharger oil return pipe from oil pan.
- Loosen oil pan bolts with T Bar and Socket 10 mm 3185. (Remove with Socket 3249.)
- Remove oil pan. Loosen oil pan with light blows using a rubber headed hammer if necessary.
- Remove sealant residue from cylinder block with a flat scraper.

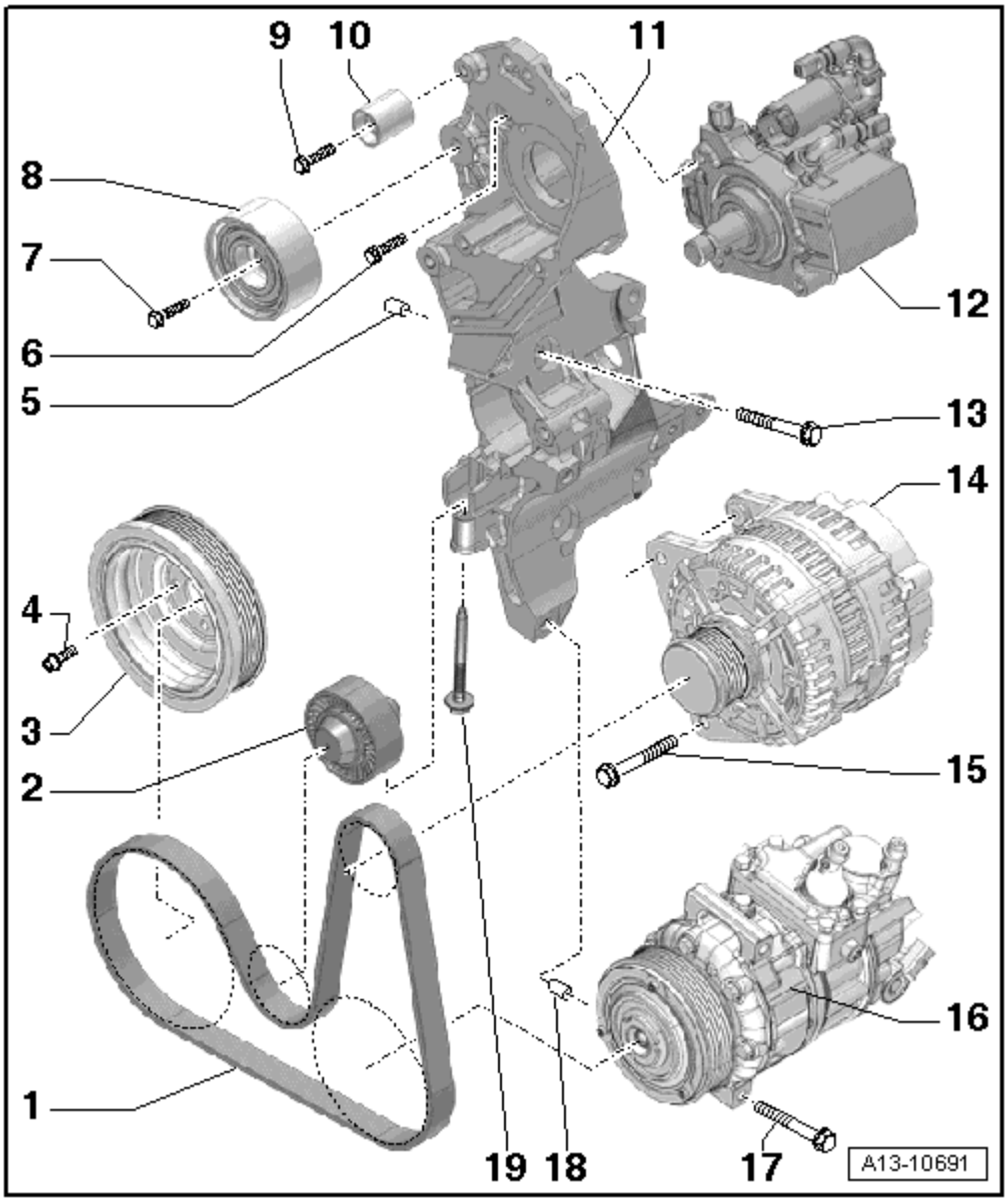

Fig. 130: Removing Sealant Residue From Oil Pan With A Rotating Brush

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove remaining sealant at oil pan using a rotating brush, e.g. a drill with plastic brush attachment (wear protective glasses).
- Clean sealing surfaces. They must be free of oil and grease.

Installing

NOTE:

- **Note the expiration date of the sealing compound.**
- **The oil pan must be installed within 5 minutes after application of silicone sealant.**

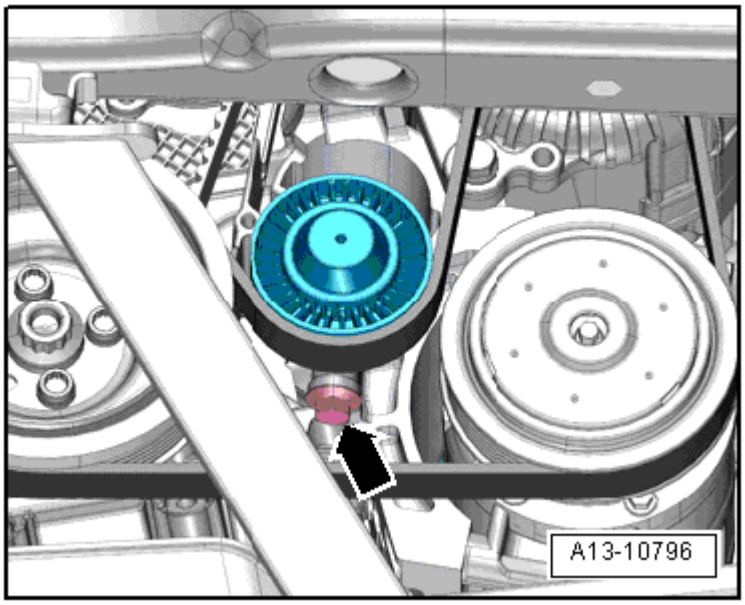

Fig. 131: Cutting Off Tube Nozzle & Applying Silicone Sealing Compound To Oil Pan Sealing Surface
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Cut off nozzle on tube of sealant at front mark (dia. of nozzle approx. 3 mm).
- Apply silicone sealant to clean sealing surfaces of oil pan as shown. Sealing compound bead must be:

- 2 to 3 mm thick
- and run on inside of bolt holes - **arrows** -

NOTE:

- **Sealant bead must not be thicker than specified. Otherwise, excess sealant could get into oil pan and clog strainer in intake line of oil pump.**

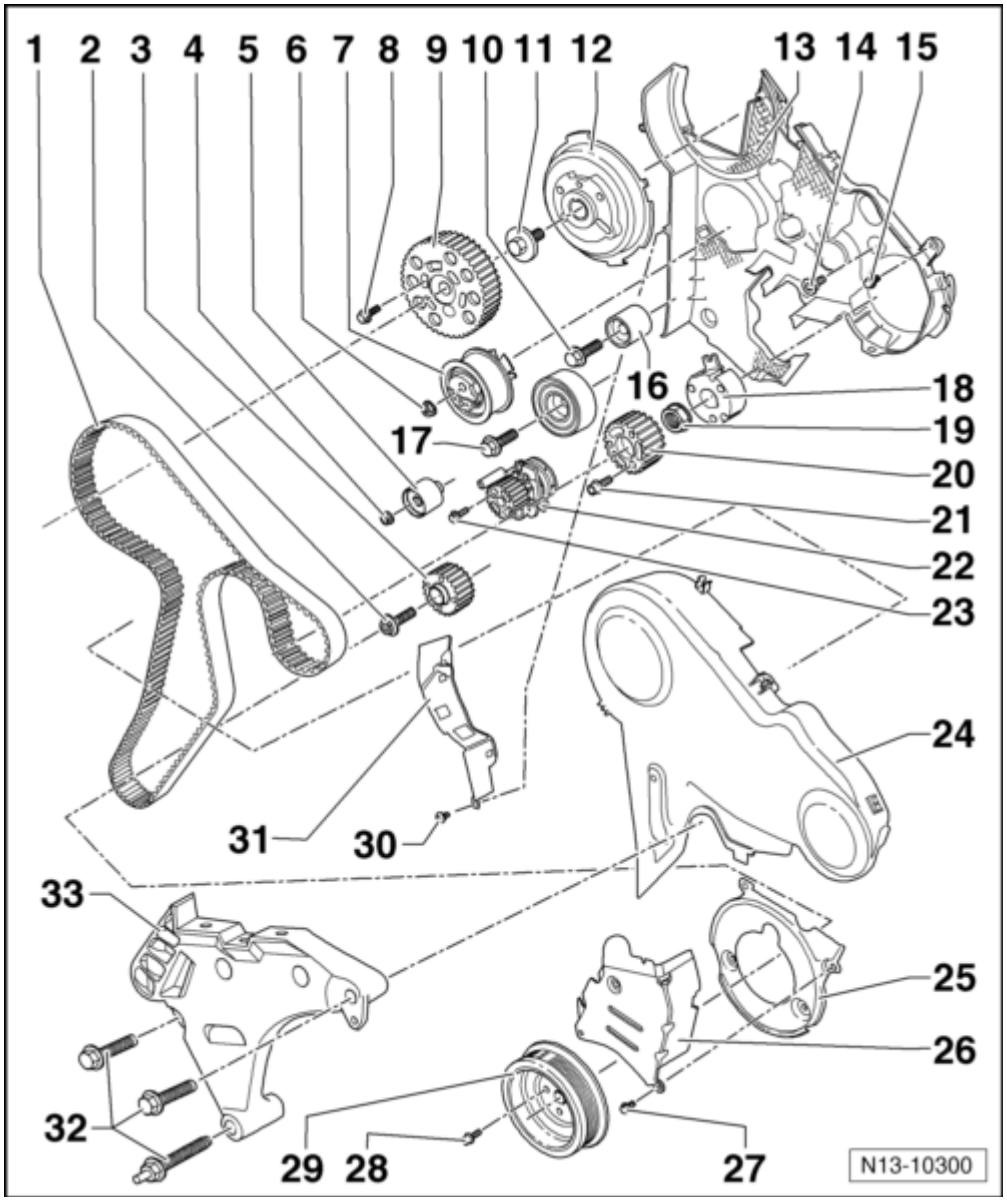

Fig. 132: Identifying Clean Sealing Surfaces Sealant Application Areas
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Apply *silicon sealant D 176 404 A2* to clean sealing surface as indicated in illustration. (The fig. shows the location of the sealant bead on the cylinder block). (Part numbers are for reference only. Always check with your Parts Department for the latest part number information).
- Install oil pan immediately and tighten all oil pan bolts lightly.

NOTE:

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

- Tighten oil pan bolts to 15 Nm.
- Tighten oil pan/transmission bolts to 45 Nm.

The rest of assembly is in reverse order of disassembling.

- Tighten oil pan/oil return line bolts to 10 Nm.

Oil pressure and oil pressure switch, checking

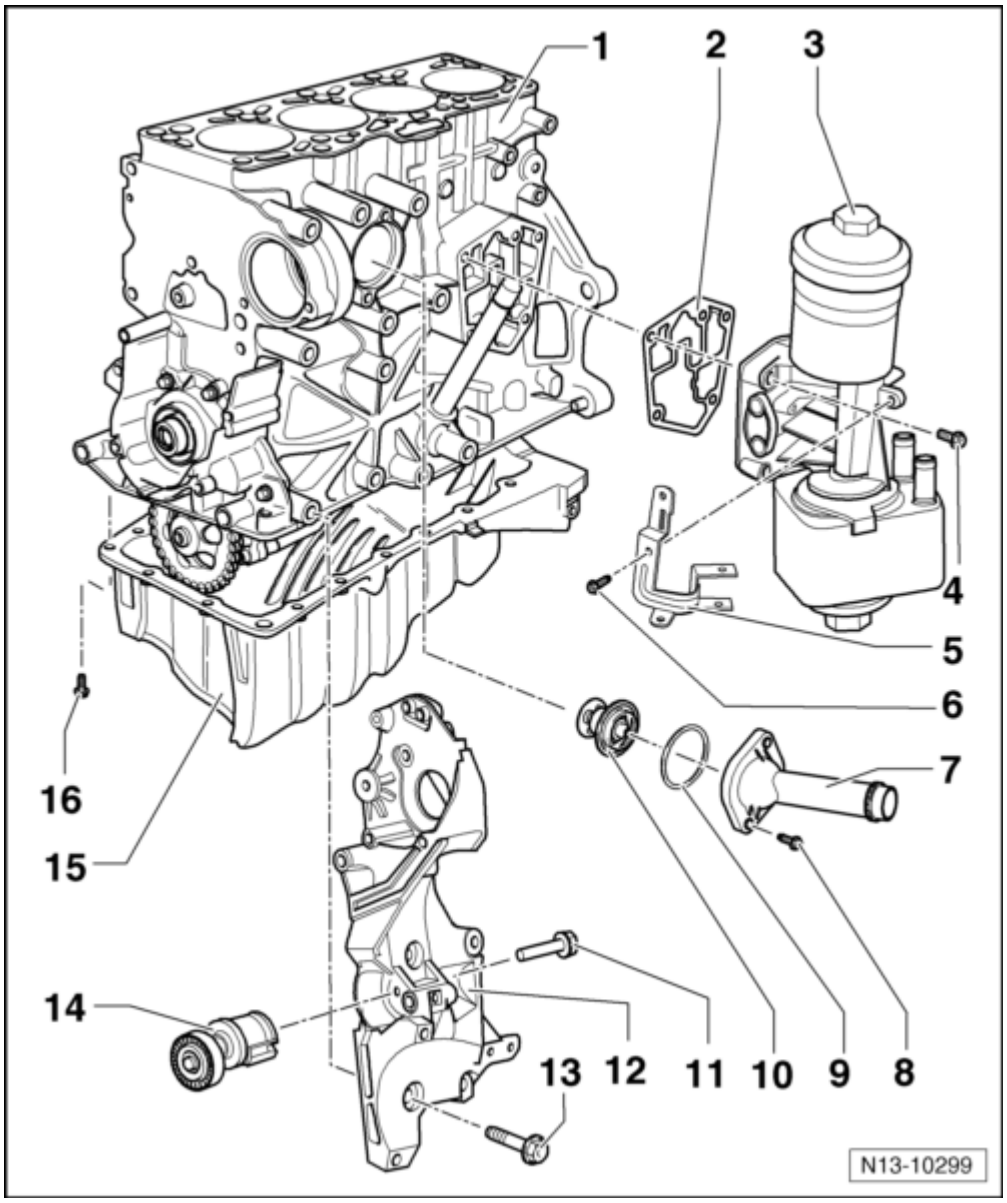

Fig. 133: Identifying Special Tools - Oil Pressure And Oil Pressure Switch, Checking
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

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

Test conditions:

- Engine oil level OK, checking *Markings on oil dipstick* under **Lubrication system components, assembly overview** .
- Engine oil temperature at least 80 ° C (radiator fan must start up once)

NOTE:

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

Test sequence:

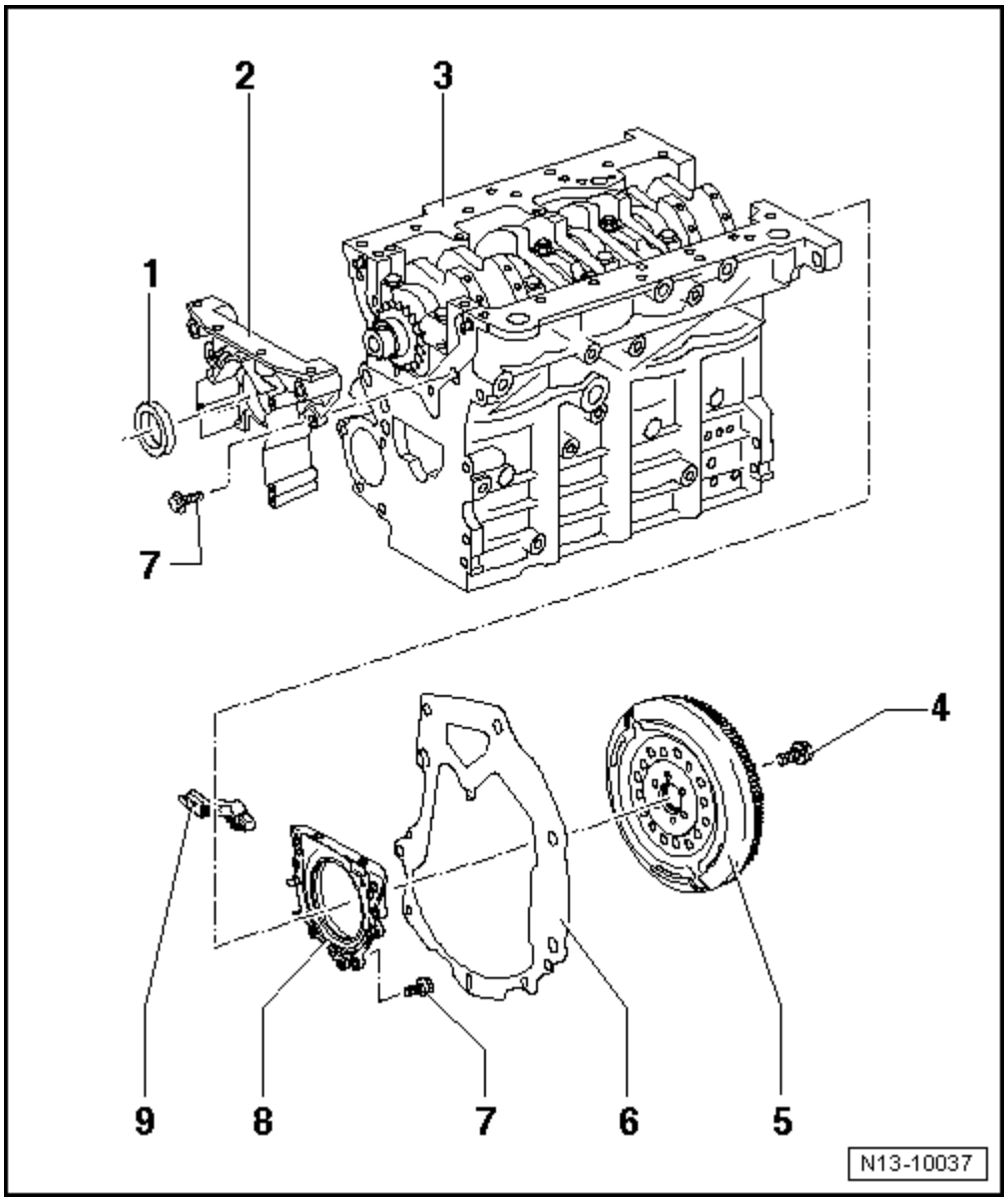

Fig. 134: Identifying V.A.G 1342 Oil Pressure Tester

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove oil pressure switch F1 and install into oil pressure gauge.
- Install oil pressure gauge V.A.G 1342 into oil filter bracket in place of oil pressure switch.
- Connect brown wire of tester to Ground (GND).
- Connect voltage tester V.A.G 1527 B using adapter cables from connector test kit V.A.G 1594 C to B+ and oil pressure switch. LED must not light up.
- If LED lights up, replace 1.4 bar Oil Pressure Tester V.A.G 1342.

If LED does not light up:

- Start engine and let run at idle: LED must light up at 1.2 to 1.6 bar positive pressure, otherwise replace oil pressure switch.
- Check oil pressure at different speeds:

2000 RPM: 2.7 to 4.5 bar

Above 2000 RPM: maximum 7.0 bar

If specifications are not obtained:

- Correct mechanical damage, e.g. bearing damage.
- Replace oil filter bracket with pressure relief valve or oil pump.

At higher engine speeds oil pressure must not exceed 7.0 bar

If specification is exceeded:

- Check oil channels.
- If necessary, replace oil filter bracket with pressure relief valve.

19 - ENGINE - COOLING SYSTEM

COOLING SYSTEM COMPONENTS

Cooling system components

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 canister system, coolant and refrigerant, brake fluid, vacuum) and electrical wiring so that the original path is followed.**
- **Ensure sufficient clearance to all moving or hot components.**

CAUTION: Hot steam may escape when opening expansion tank. Wear protective goggles and protective clothing to prevent damage to eyes and scalding. Cover the cap with a rag and open very carefully.

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.**
- **Hose clamp pliers V.A.G 1921 or pliers for spring clamps VAS 5024 A are recommended for installing spring clamps.**
- **When installing coolant hoses, make sure they are free of stress and do not come into contact with other components (observe markings on coolant connections and hoses).**

Perform cooling system leakage test with Cooling System Tester V.A.G 1274 and Adapter V.A.G 1274/8 and Adapter V.A.G 1274/9.

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

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

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

Coolant, draining and refilling, refer to **Cooling system, draining and filling**

Coolant mixture specifications, refer to **Cooling system, draining and filling**

Cooling system components (on body), assembly overview

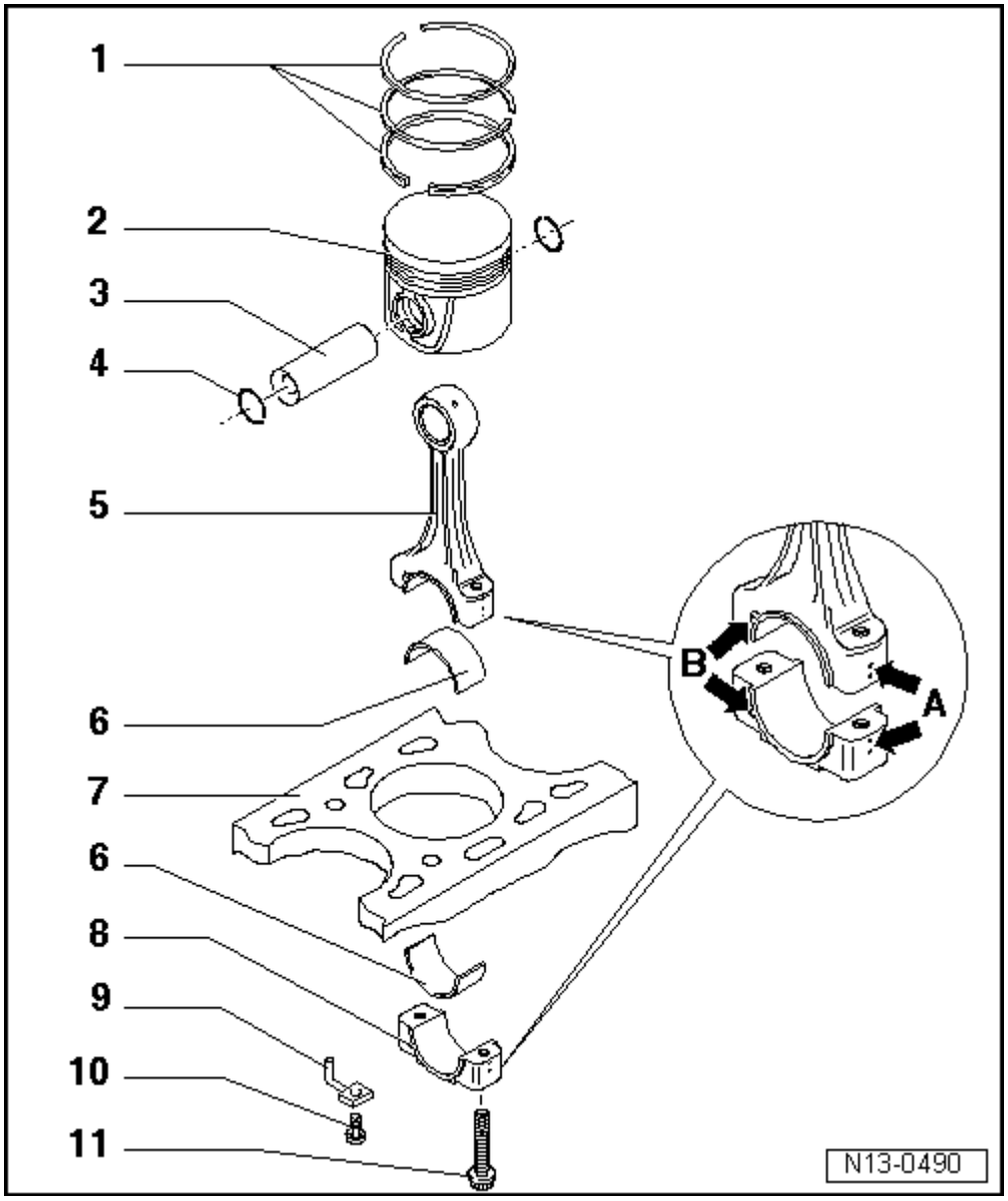

Fig. 135: Cooling System Components (On Body), Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

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 retaining clip
- Ensure seated tightly
- Coolant hose connection diagram, refer to **Coolant hose connection diagram**

4 - Air shroud

5 - 10 Nm

6 - Auxiliary fan

- Only vehicles with optional equipment

7 - Fan ring

8 - Retaining clip

- Check for secure seat

9 - Connector

10 - Radiator fan

11 - Bracket

- For fan connector

12 - Lower coolant hose

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

13 - O-ring

- Replace

14 - 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, off: 91 to 98 ° C

15 - Bracket

- For radiator
- Note installation position

16 - 15 Nm

Cooling system components (on engine), assembly overview

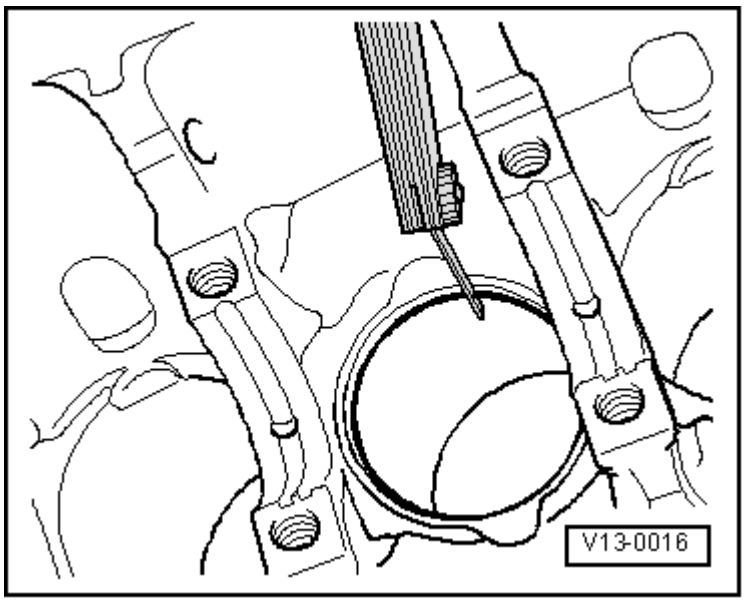

Fig. 136: Cooling System Components (On Engine), Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 15 Nm

2 - Toothed belt

- Mark direction of rotation before removing
- Check for wear
- Do not kink
- Removing and installing, tensioning, refer to **Toothed belt, removing, installing and tensioning**

3 - Coolant pump

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

4 - O-ring

- Replace

5 - Coolant thermostat

- Checking: Heat up thermostat in water
- Opening begins approx. 87 ° C
- Ends approx. 102 ° C
- Opening lift min. 7 mm

6 - O-ring

- Replace

7 - Connecting piece

8 - To heat exchanger

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

9 - O-ring

- Replace

10 - Connector

- 4-pin

11 - Engine Coolant Temperature (ECT) Sensor G62

- With Engine Coolant Temperature (ECT) Gauge Sensor G2
- For engine control module
- If necessary, release pressure in cooling system before removing
- Checking

12 - Retaining clip

- Check for secure seat

13 - Upper coolant hose

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

14 - Lower coolant hose

- Secured to radiator with a retaining clip

- Ensure seated tightly
- Coolant hose connection diagram, refer to **Coolant hose connection diagram**

15 - Oil cooler

16 - From heat exchanger

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

17 - Lower coolant line

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

18 - 10 Nm

19 - Cap

- Check using cooling system tester V.A.G 1274 and adapter V.A.G 1274/9
- Test pressure 1.4 to 1.6 bar positive pressure

20 - Seal

- Replace if damaged

21 - 10 Nm

22 - Expansion tank

- Perform cooling system leakage test with cooling system tester V.A.G 1274 and adapter V.A.G 1274/8.

23 - To turbocharger

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

24 - 15 Nm

25 - To top coolant hose

- Only engine code AWP with automatic transmission
- Coolant hose connection diagram, refer to **Coolant hose connection diagram**

26 - After-run coolant pump V51

- Only engine code AWP with automatic transmission
- Coolant hose connection diagram, refer to **Coolant hose connection diagram**
- Checking, refer to **After-Run Coolant Pump V51 , checking**

27 - From turbocharger

- Only engine code AWP with automatic transmission
- Coolant hose connection diagram, refer to **Coolant hose connection diagram**

Coolant hose connection diagram

Vehicles with engine code AWD

Vehicles with engine code AWP (manual transmission), AWW (manual and automatic transmission)

Vehicles with engine code AWP (automatic transmission)

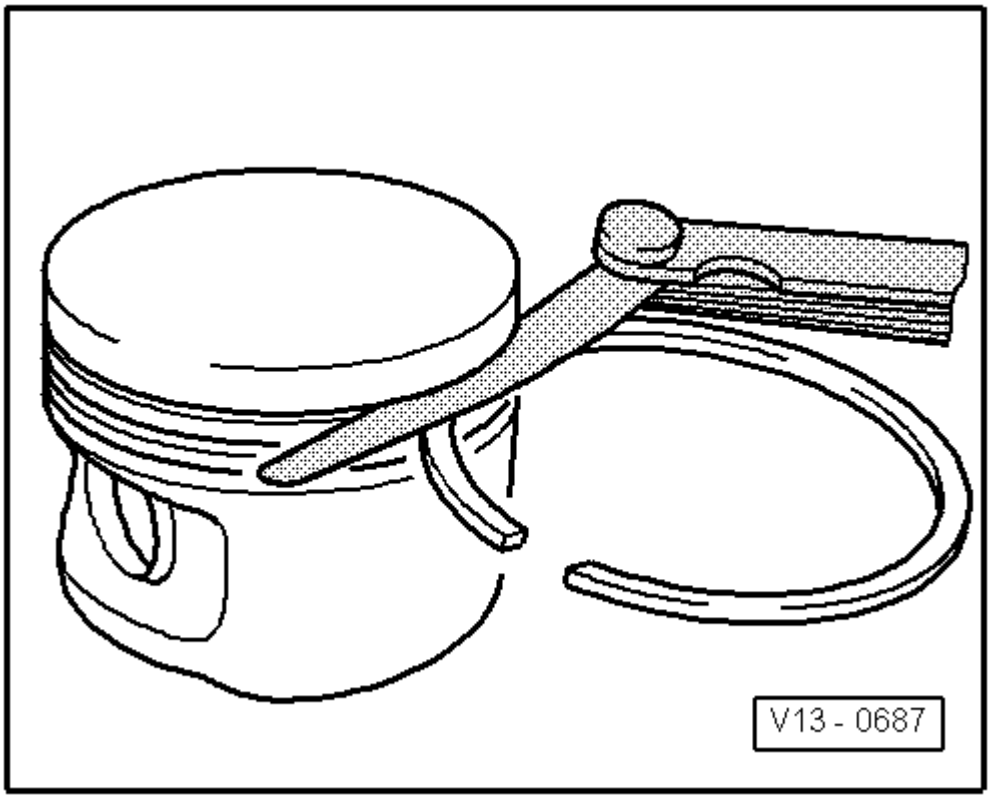

Fig. 137: Coolant Hose Connection Diagram - Vehicles With Engine Code AWD
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Radiator

2 - Oil cooler

3 - Coolant thermostat housing

4 - Cylinder head/cylinder block

5 - Expansion tank

6 - Turbocharger

7 - Heating system heat exchanger

8 - Connecting piece

9 - Transmission oil cooler

- Only with automatic transmission

10 - Lower coolant pipe

11 - Intake manifold

12 - Drain plug

Vehicles with engine code AWP (manual transmission), AWW (manual and automatic transmission)

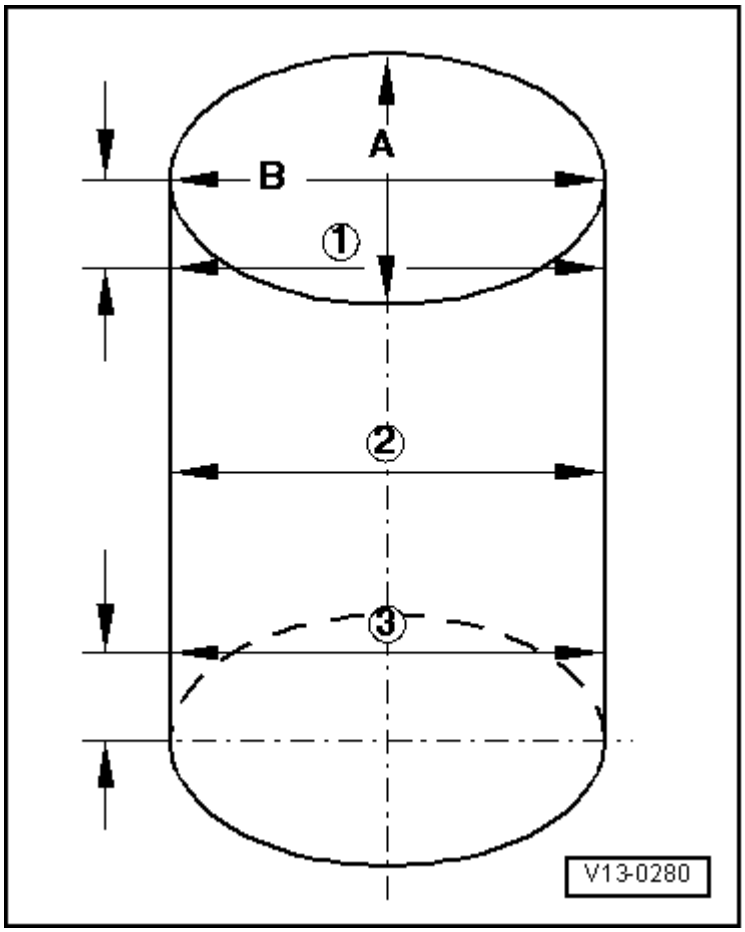

Fig. 138: Coolant Hose Connection Diagram - Vehicles With Engine Code AWP (Manual Transmission), AWW (Manual And Automatic Transmission)

Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Expansion tank

2 - Turbocharger

3 - Intake manifold

4 - Cylinder head/cylinder block

5 - Connecting piece

6 - Heating system heat exchanger

7 - Lower coolant line

8 - Transmission oil cooler

- Only engine code AWW with automatic transmission

9 - Upper coolant hose

10 - Drain plug

11 - Radiator

12 - Lower coolant hose

13 - Oil cooler

14 - Coolant thermostat housing

15 - Coolant pump

16 - Coolant line

Vehicles with engine code AWP (automatic transmission)

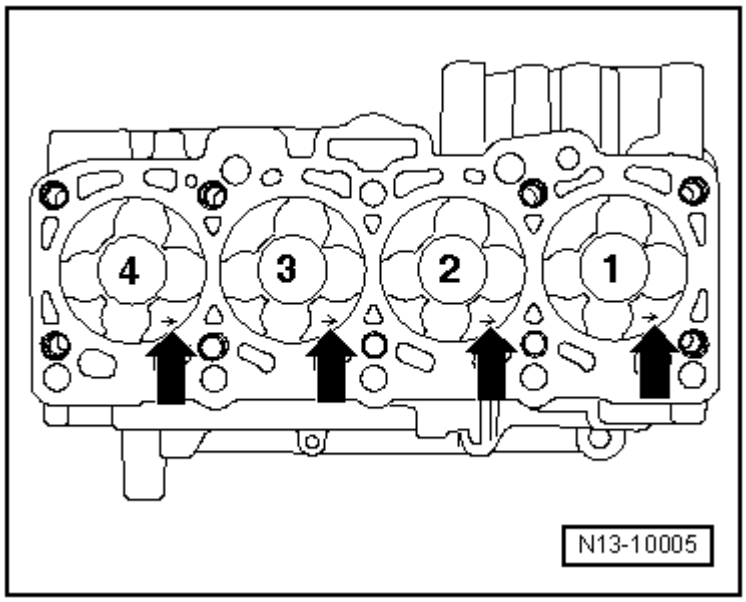

Fig. 139: Coolant Hose Connection Diagram - Vehicles With Engine Code AWP (Automatic Transmission)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Expansion tank

2 - Turbocharger

3 - Intake manifold

4 - Cylinder head/cylinder block

5 - Coolant line

6 - Connecting piece

7 - Heating system heat exchanger

8 - Transmission oil cooler

- Only with automatic transmission

9 - Lower coolant line

10 - Oil cooler

11 - Upper coolant hose

12 - Radiator

13 - Lower coolant hose

14 - After-run coolant pump V51

15 - Coolant thermostat housing

16 - Coolant pump

Cooling system, draining and filling

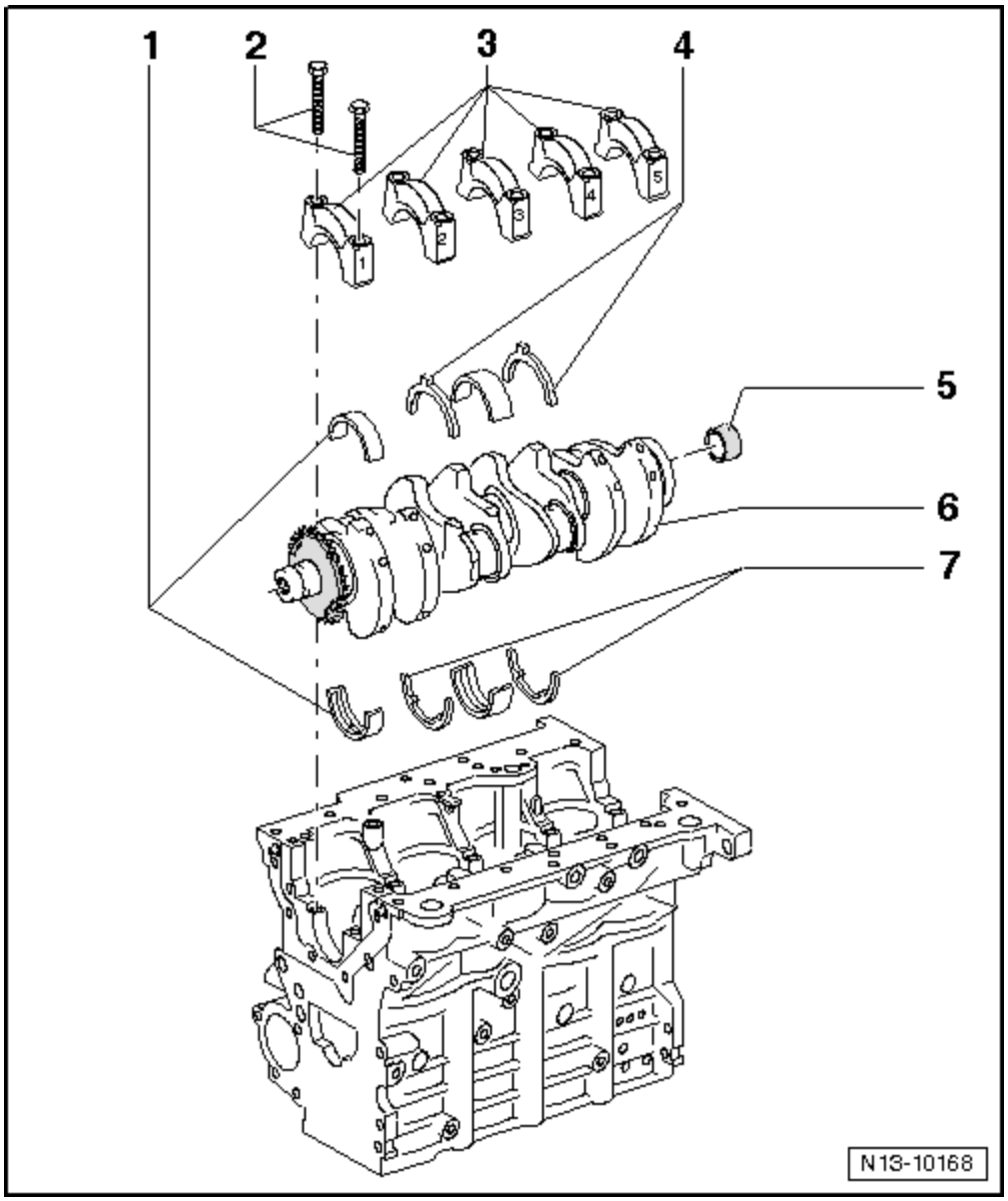

Fig. 140: Identifying Special Tools - Cooling System, Draining And Filling
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Refractometer T10007
- Drip Tray V.A.G 1306 or Drip Tray for VAS 6100 VAS 6208
- 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 the cap with a rag and open very carefully.

- Open cap for coolant expansion tank.
- Remove sound insulation tray, refer to **NOISE INSULATION (GASOLINE ENGINES), ASSEMBLY OVERVIEW** or **NOISE INSULATION (DIESEL ENGINES), ASSEMBLY OVERVIEW** .

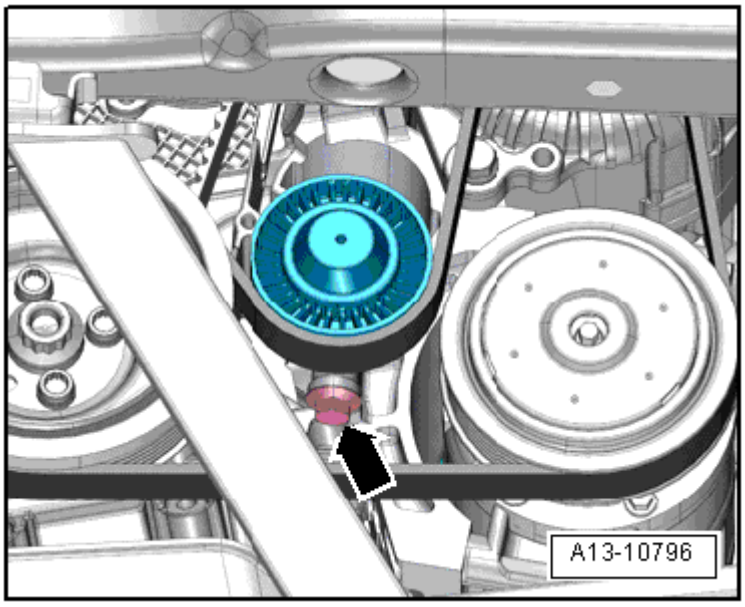

Fig. 141: Locating Radiator Drain Plug
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove drain plug - **arrow** - to drain coolant from radiator.

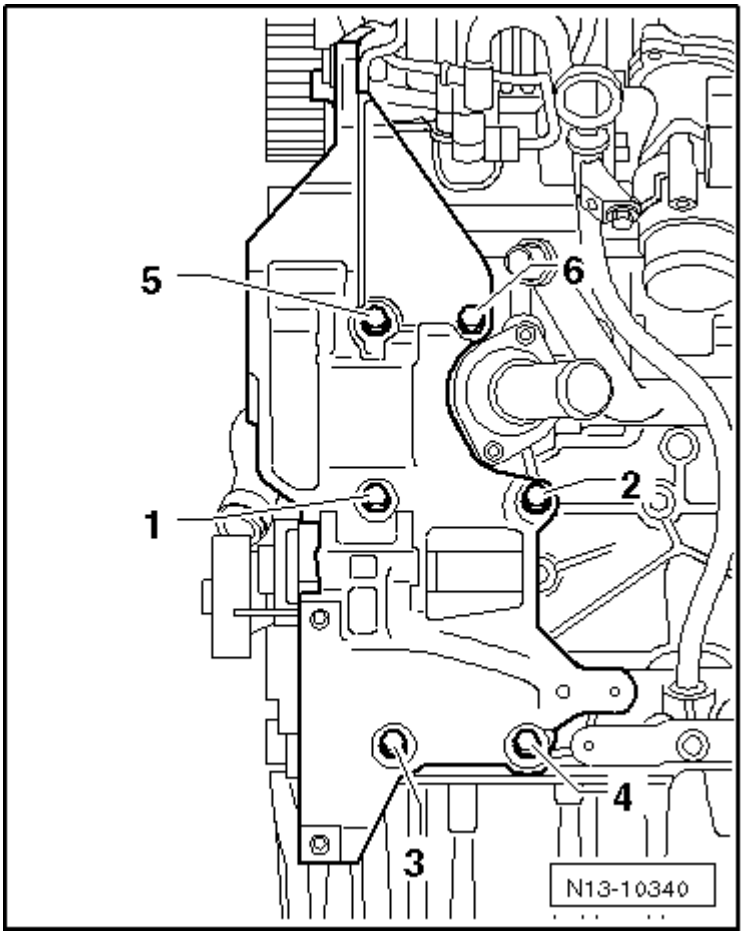

Fig. 142: Locating Oil Cooler Coolant Hose
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- 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 D). Distinguishing feature: red color**
- **G 12 must not be mixed with any other coolant additives under any circumstances!**
- **The fluid in the reservoir is brown, G12 was mixed with another coolant. In this case, the coolant must be replaced.**
- **G 12 and coolant additives marked in accordance with "TL VW 774 D" 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.**

- 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 clean water even in warmer seasons and in warmer countries. The coolant additive portion must be at least 40%.
- 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.

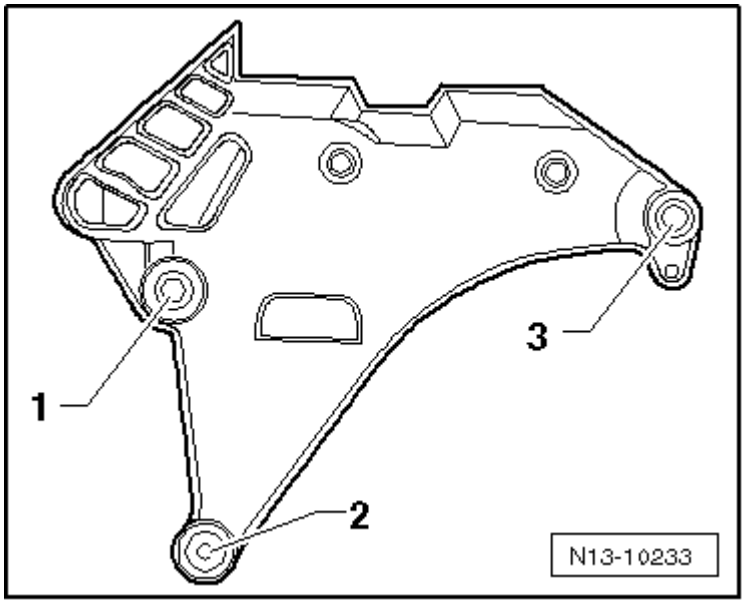

Fig. 143: Refractometer T10007
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- The Refractometer T10007 is recommended for determining anti-freeze density.
- If radiator, heat exchanger, cylinder head or cylinder head gasket is replaced, do not reuse old coolant.

Recommended mixture ratios:

Frost protection to	Anti-freeze portion	G 12 * See note	Clean water * See note
-25 ° C -35 ° C	40% 50%	2.0 l 2.5 l	3.0 l 2.5 l

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

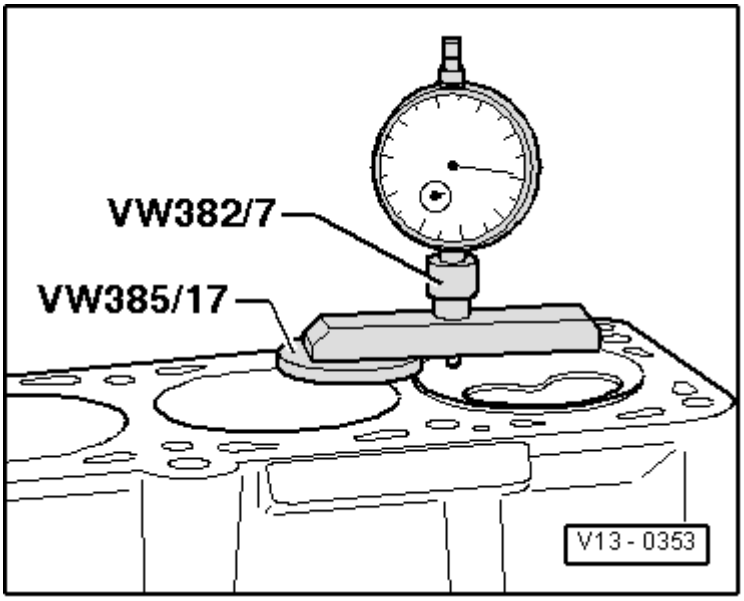

Fig. 144: Locating Radiator Drain Plug
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install drain plug in radiator.

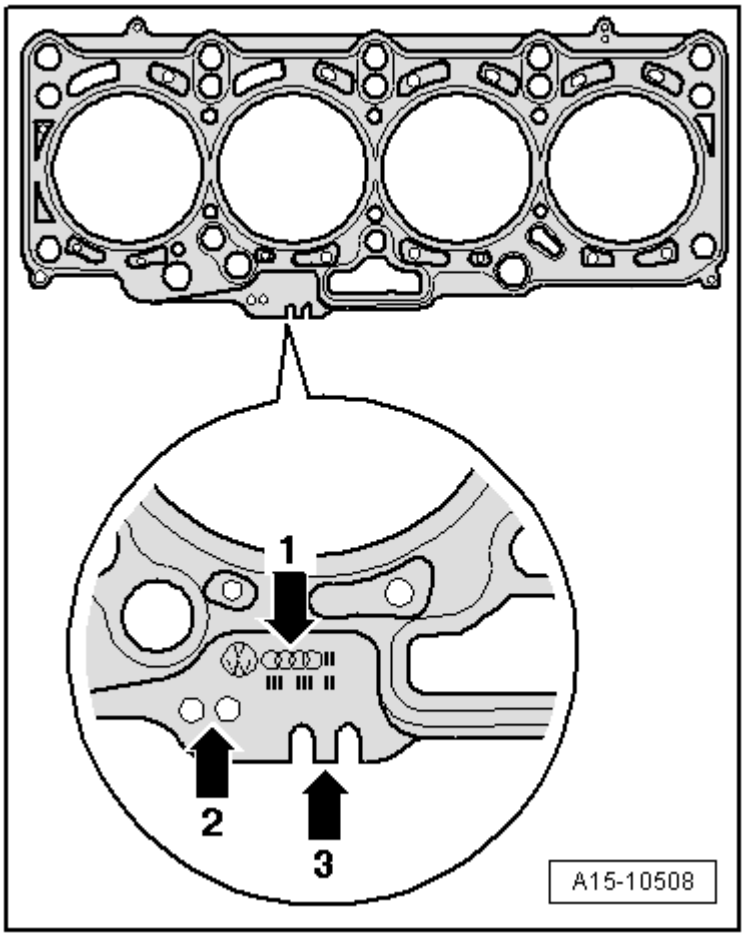

Fig. 145: Locating Oil Cooler Coolant Hose
Courtesy of VOLKSWAGEN UNITED STATES, INC.

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

Using cooling system filler unit VAS 6096 :

- Install adapter from Cooling System Tester V.A.G 1274 that is appropriate for vehicle on reservoir.
- Fill coolant circuit using cooling system filling unit VAS 6096 Operating instructions for cooling system filling unit VAS 6096.

Without cooling system filler unit VAS 6096 :

Model year --> 2001 vehicles

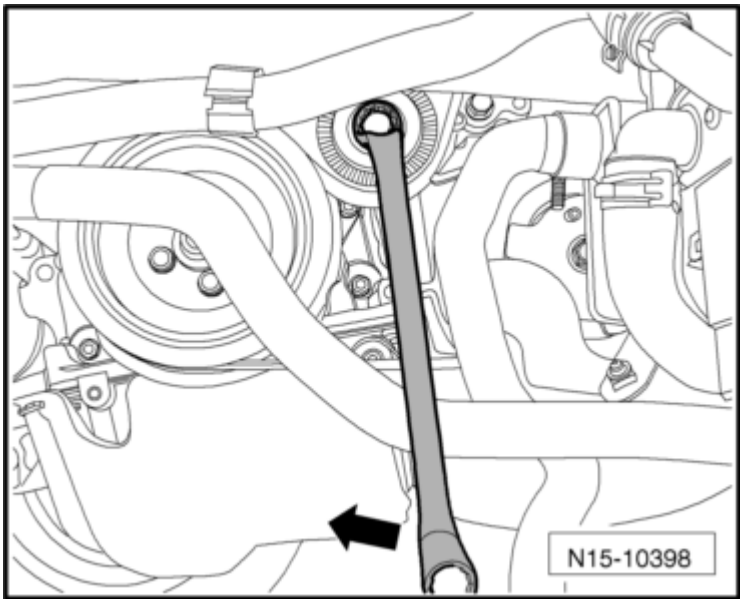

Fig. 146: Markings On Coolant Expansion Tank
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Fill coolant to Max marking on expansion tank.

Model year 2002 --> vehicles

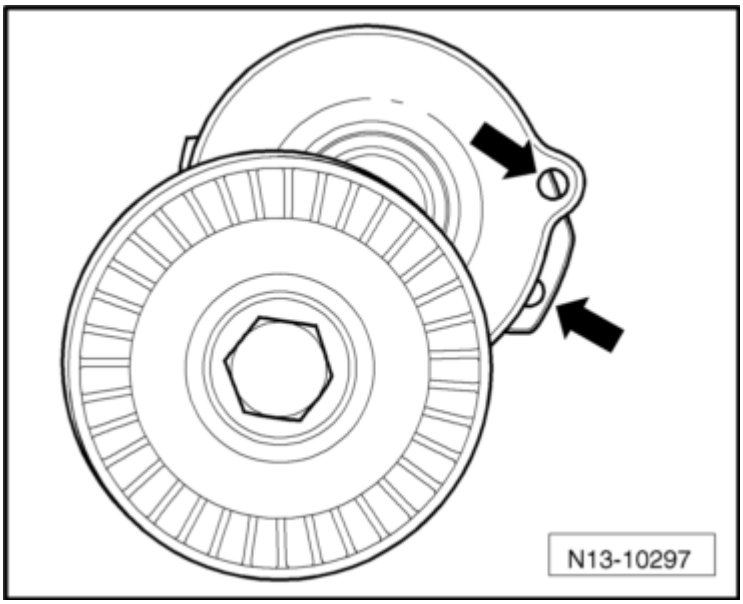

Fig. 147: Identifying Expansion Tank
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Slowly fill coolant up to top marking of hatched area on expansion tank.

Continuation for all vehicles

- Seal 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 until fan turns on.

CAUTION: Hot steam may escape when opening expansion tank. Wear protective goggles and protective clothing to prevent damage to eyes and scalding. Cover the cap with a rag and open very carefully.

Model year --> 2001 vehicles

- Check coolant level and top off if necessary. With engine at operating temperature, coolant level must be at max. marking, with engine cold, it must be between min. and max. marking.

Model year 2002 --> vehicles

With engine at operating temperature, coolant level must lie at top marking of hatched area.

When engine is cold, the coolant level should be somewhere in the middle of hatched area.

Radiator, removing and installing

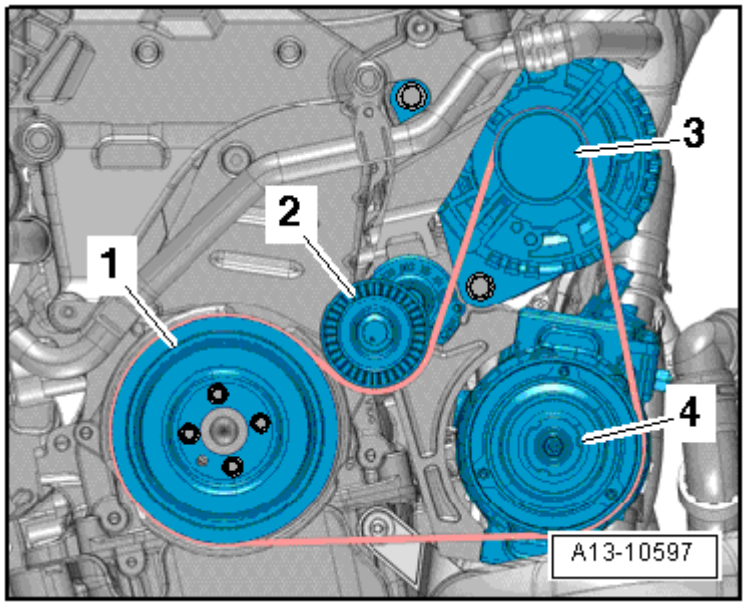

Fig. 148: Identifying Special Tools - Radiator, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Refractometer T10007

- Drip Tray V.A.G 1306 or Drip Tray for VAS 6100 VAS 6208
- Torque wrench V.A.G 1331
- Spring-type clip pliers VAS 5024A

Removing

- Drain coolant, refer to **Cooling system, draining and filling** .
- Remove front bumper, refer to **FRONT BUMPER** .
- Pull off coolant hoses from radiator.
- Disconnect harness connector from thermal switch.
- Bring lock carrier into service position, refer to **LOCK CARRIER SERVICE POSITION** .
- Remove bolts from radiator and remove radiator with fans downward.

Vehicles with air conditioning:

- Observe additional information and removal work *Additional information and assembly work on vehicles with air conditioning* under **Radiator, removing and installing** .

Installing

Installation is in reverse order of removal, note the following:

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

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 lines and hoses are not stretched, kinked or bent.**

- Remove retaining clamp(s) from refrigerant lines.
- Remove condenser from radiator and fasten to lock carrier.

Coolant pump, removing and installing

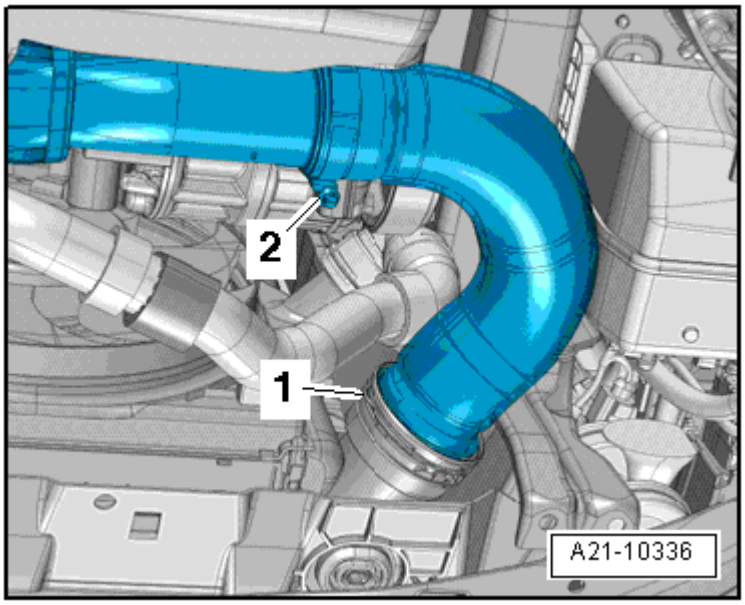

Fig. 149: Special Tools - Coolant Pump, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Refractometer T10007
- Drip Tray V.A.G 1306 or Drip Tray for VAS 6100 VAS 6208
- Torque wrench V.A.G 1331
- Spring-type clip pliers VAS 5024A

NOTE:

- **Always replace gaskets and seals.**
- **The lower part of the toothed belt cover can remain installed.**
- **The toothed belt remains in position on the crankshaft sprocket.**
- **Cover the toothed belt with a cloth to protect it from coolant before removing the coolant pump.**

Removing

- Drain coolant, refer to **Cooling system, draining and filling** .
- Remove ribbed belt, refer to **Ribbed belt, removing and installing** .
- Remove upper and lower parts of toothed belt guard, refer to **Toothed belt, removing, installing and tensioning** .
- Remove toothed belt from coolant pump toothed belt gear, refer to **Toothed belt, removing, installing and tensioning** .

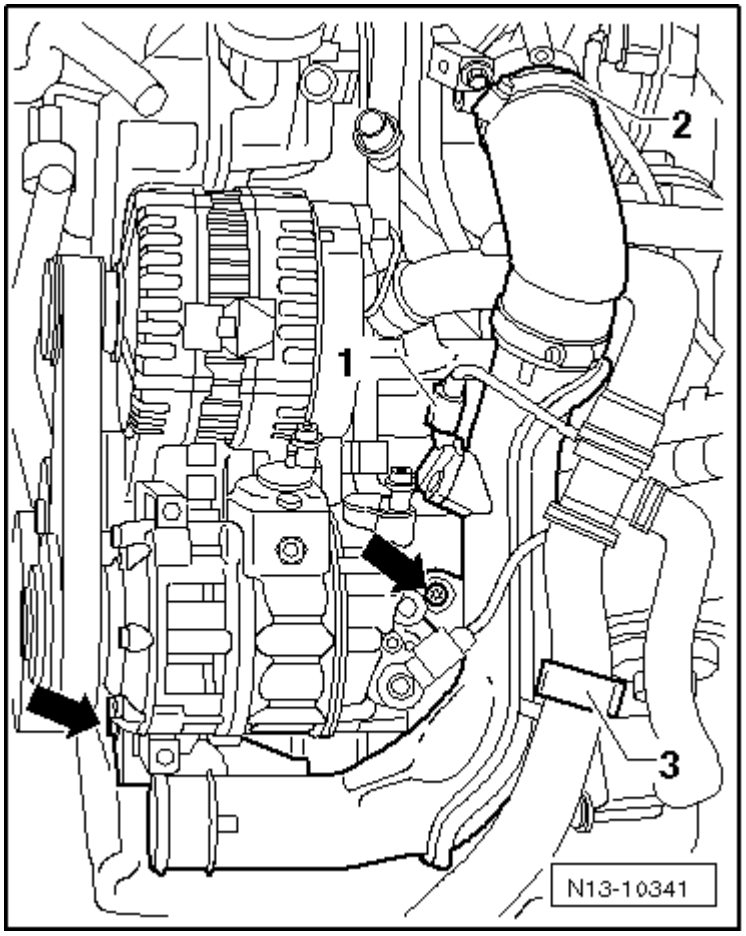

Fig. 150: Coolant Pump & Securing Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

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

Installing

Installation is 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: 15 Nm

NOTE:

- **The coolant pump sealing plug faces downward.**

- Install toothed belt and adjust valve timing, refer to **Toothed belt, removing, installing and tensioning**
- Install ribbed belt, refer to **Ribbed belt, removing and installing** .

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

Coolant thermostat, removing and installing

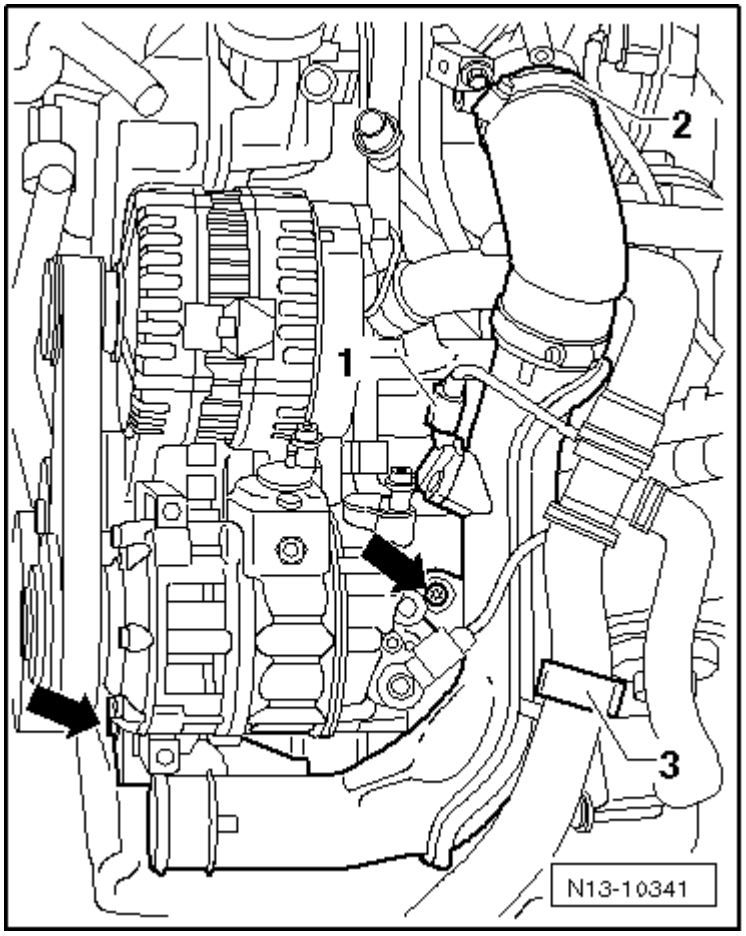

Fig. 151: Special Tools - Coolant Pump, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Refractometer T10007
- Drip Tray V.A.G 1306 or Drip Tray for VAS 6100 VAS 6208
- Torque wrench V.A.G 1331
- Spring-type clip pliers VAS 5024A

Removing

NOTE:

- **Always replace gaskets and seals.**

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

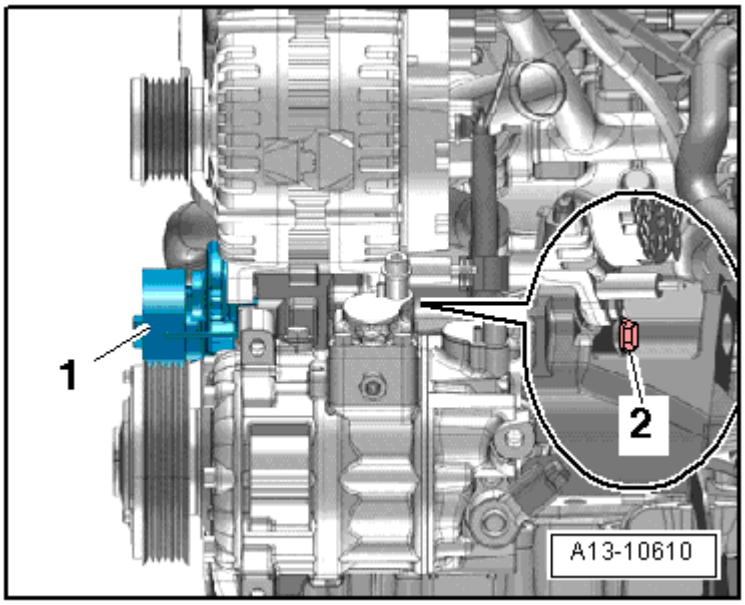

Fig. 152: Identifying Thermostat & Fasteners
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect coolant hose from connecting piece - **3** -.
- Remove bolts - **4** - from connecting piece - **3** - and remove connecting piece - **3** - with thermostat - **1** -.

Installing

Installation is in reverse order of removal, note the following:

- Moisten new O-ring - **2** - with coolant.
- Insert thermostat in - **1** - connecting piece - **3** - and turn $^{1}/_{4}$ (90 °) to right.
- Insert connection - **3** - with thermostat - **1** - into engine block.

NOTE:

- **The clip of the thermostat must be positioned at approx. right angle.**

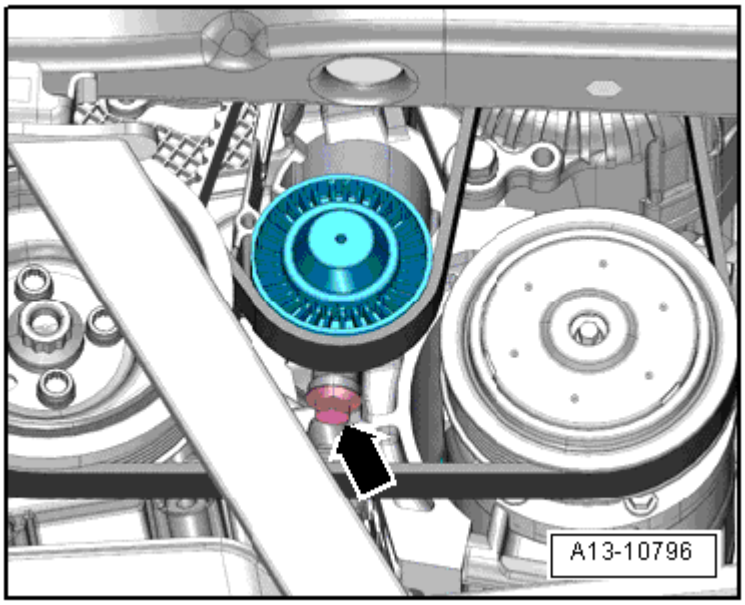

Fig. 153: Identifying Thermostat & Fasteners
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tighten mounting bolts - **4** -. Torque specification: 15 Nm

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

After-Run Coolant Pump V51 , checking

Special tools, testers and auxiliary items required

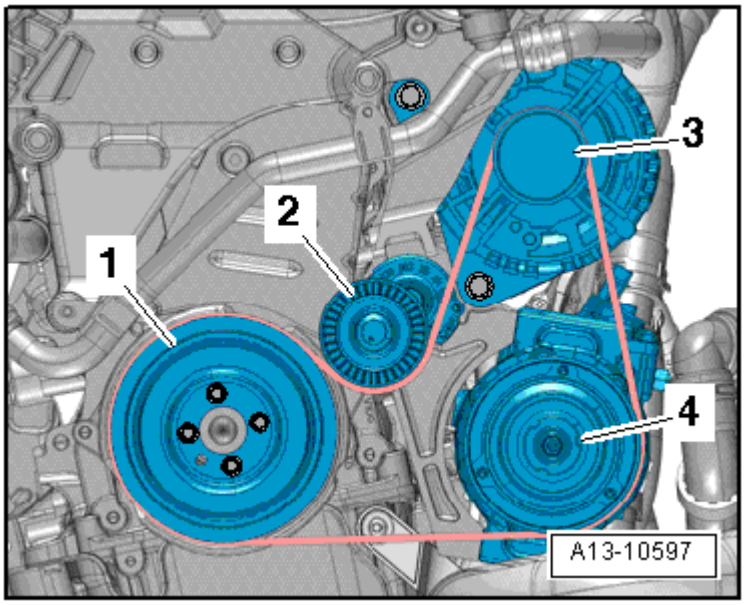

Fig. 154: Voltage Tester V.A.G 1527B
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Voltage tester V.A.G 1527B

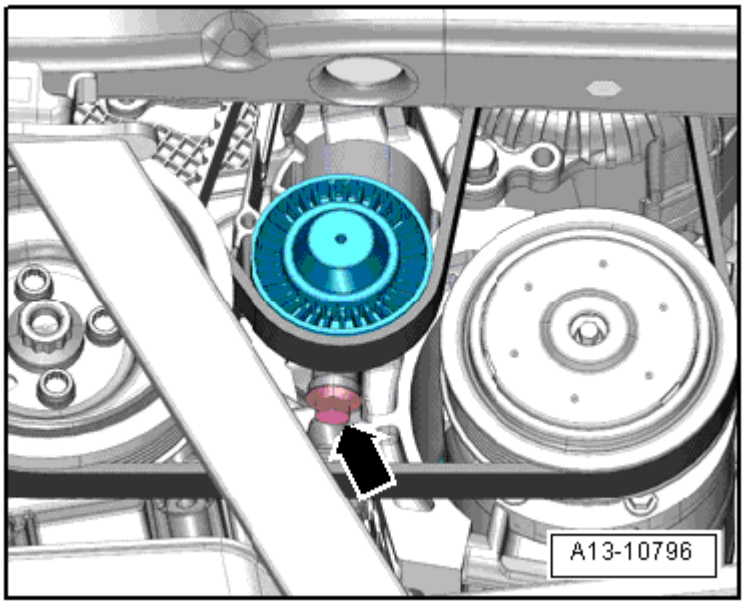

Fig. 155: Connector Test Set V.A.G 1594C
Courtesy of VOLKSWAGEN UNITED STATES, INC.

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

Test conditions

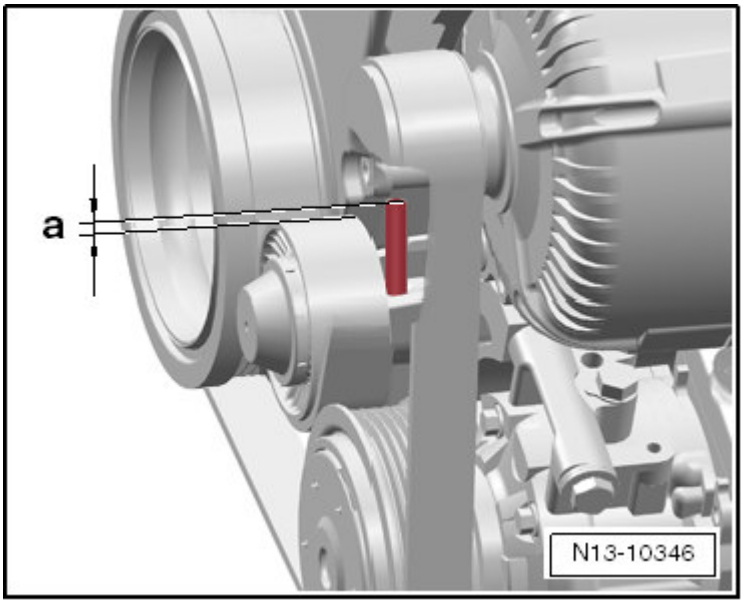

Fig. 156: Identifying Main Fuse Panel
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- All fuses must be OK.

Test sequence

- Pull off 2-pin connector from After-Run Coolant Pump V51.

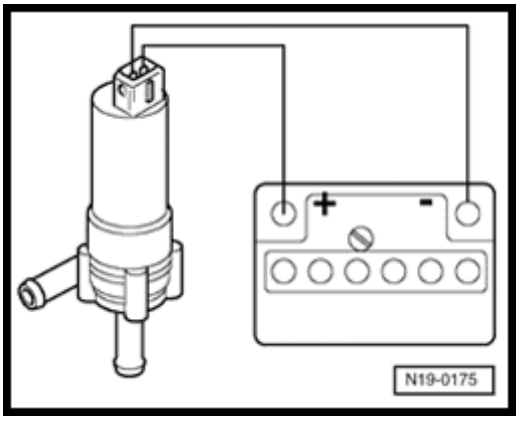

Fig. 157: Contacts Of After-Run Coolant Pump V51 Connected To Battery
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- 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 V51 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 ignition off and then on again.

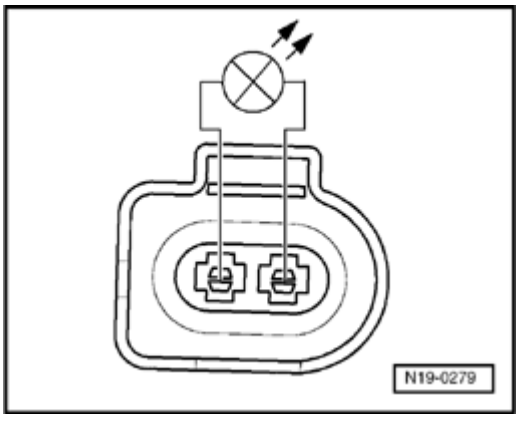

Fig. 158: After-Run Coolant Pump V51 Connector
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- 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 5 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

20 - FUEL SUPPLY

FUEL SUPPLY SYSTEM COMPONENTS

Fuel supply system components

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.**
- **Pliers for spring clamps VAS 5024 A or Hose clamp pliers V.A.G 1921 are recommended for installing spring clamps.**

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**

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

Electronic engine power control (EPC), checking, refer to **Electronic Engine Power Control (EPC)**

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

Fuel tank with attachments and fuel filter, assembly overview

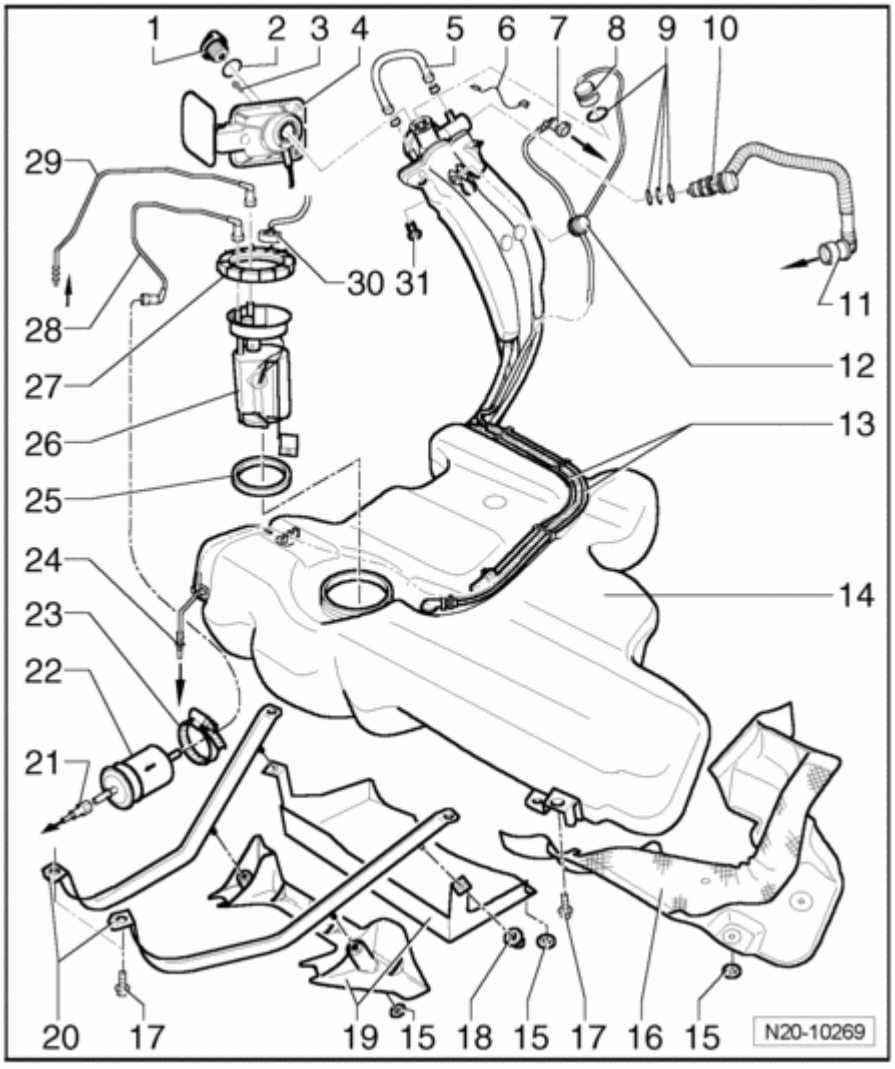

Fig. 159: Fuel Tank With Attachments And Fuel Filter, Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Cap

2 - Seal

- Replace if damaged

3 - Bolt

4 - Tank flap unit

- With rubber gasket

5 - Vent line

- Black
- Ensure seated tightly
- Clipped in at top of fuel tank

6 - Ground (GND) connection

- Ensure seated tightly

7 - Vent line

- White
- Ensure seated tightly

8 - Gravity valve

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

9 - Seal

- Replace if damaged

10 - Switch-over valve

- To remove valve unclip sideways out of support
- Checking *Checking switch-over valve* under **Checking switch-over valve**

11 - Vent line

- Black
- Ensure seated tightly

12 - Pressure retention valve

- Checking *Checking pressure retaining valve* under **Fuel tank with attachments and fuel filter, assembly overview**

13 - Vent line

- Black
- Ensure seated tightly

14 - Fuel tank

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

15 - Lock washer

16 - Heat shield

- For fuel tank

17 - 25 Nm

18 - Lock nut, 2 Nm

19 - Fuel tank cover

20 - Securing strap

- Observe varying lengths
- Installed location: Locating point (hole) points in driving direction

21 - Supply line

- Black
- Ensure seated tightly
- To remove from fuel filter, press release buttons on connecting piece
- To fuel supply line at fuel rail, refer to **FUEL RAIL WITH INJECTORS, DISASSEMBLING AND ASSEMBLING** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE (S): AWD or **FUEL RAIL WITH INJECTORS, DISASSEMBLING AND ASSEMBLING** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION IGNITION, ENGINE CODE(S): AWW, AWP

22 - Fuel filter

- Installed location: Arrow points in direction of flow

23 - Screw clamp

24 - Vent line

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

25 - Seal

- Replace if damaged

- To install, place into opening of fuel tank dry
- Only coat with fuel for installing fuel delivery unit flange

26 - Fuel delivery unit

- Installation location on fuel tank *Installation position of fuel delivery unit flange* under **Installation position of fuel delivery unit flange**
- Removing and installing refer to **Fuel delivery unit, removing and installing**
- Fuel level sensor, removing and installing refer to **Fuel Level Sensor G , removing and installing**
- Check fuel pump refer to **Fuel pump, checking**

- Clean strainer if dirty

27 - Union nut, 75 Nm

- Use ring nut wrench 3217 for removal and installation

28 - Supply line

- Black
- Ensure seated tightly
- Clipped to side of fuel tank
- To remove from flange and fuel filter, press release buttons on connecting piece

29 - Return line

- Blue or with blue marking
- Clipped to side of fuel tank
- Ensure seated tightly
- To remove from flange, press release buttons on connecting piece

- From fuel return line at fuel rail, refer to **FUEL RAIL WITH INJECTORS, DISASSEMBLING AND ASSEMBLING** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE (S): AWD or **FUEL RAIL WITH INJECTORS, DISASSEMBLING AND ASSEMBLING** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION IGNITION, ENGINE CODE(S): AWW, AWP

30 - Connector

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

31 - 10 Nm

Installation position of fuel delivery unit flange

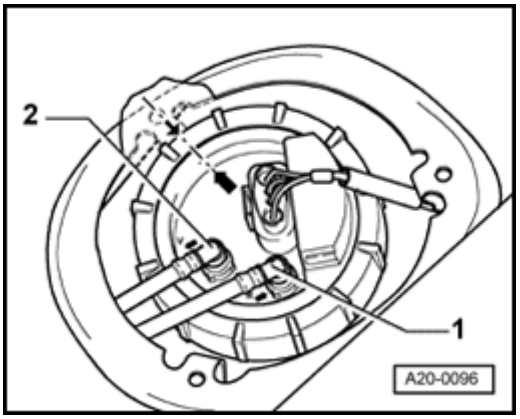

Fig. 160: Installed Position Of Flange Of Fuel Delivery Unit
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Marking on sensor must align with marking on fuel tank - **arrows** -.

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

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

NOTE:

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

Checking switch-over valve

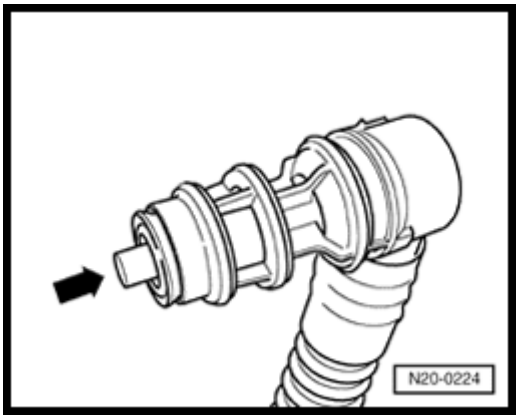

Fig. 161: Checking Switch Valve
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Lever in rest position: Closed

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

NOTE:

- **Before installing change-over valve, remove cover from fuel tank.**

Checking pressure retaining valve

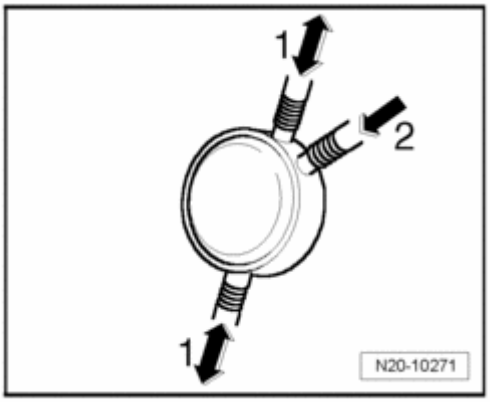

Fig. 162: Checking Pressure Retaining Valve
Courtesy of VOLKSWAGEN UNITED STATES, INC.

The pressure retaining valve is opened for flow in both directions - **arrow 1** - by the EVAP canister and Evaporative Emission (EVAP) Canister Purge Regulator Valve N80.

It is only opened in one flow direction - **arrow 2** - on side of gravity valve.

Safety precautions when working on fuel supply system

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 canister 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.**

Always observe the following when removing and installing the fuel gauge sensor or the fuel pump (fuel delivery unit) from full or partially filled fuel tanks:

CAUTION: Fuel supply line is under pressure! Wear protective goggles and protective clothing to prevent injuries and contact with skin. Before removing from hose connection wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

- Before starting work, switch on exhaust extraction system and place an extraction hose close to the 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 m^3 /h can be used.
- Prevent fuel from contacting skin! Wear fuel-resistant gloves!

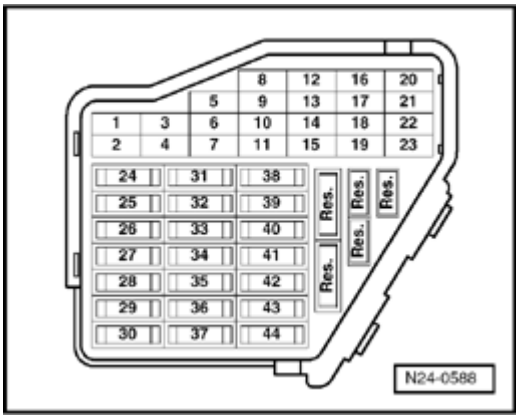

Fig. 163: Identifying Main Fuse Panel
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- 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.

Rules for cleanliness

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

- 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.

Fuel delivery unit, removing and installing

Special tools, testers and auxiliary items required

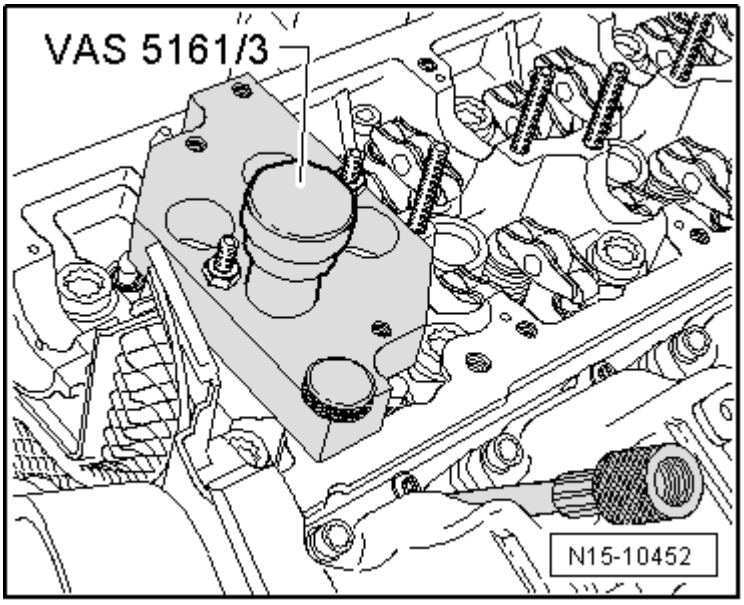

Fig. 164: 3217 Ring Nut Spanner
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Ring nut wrench 3217

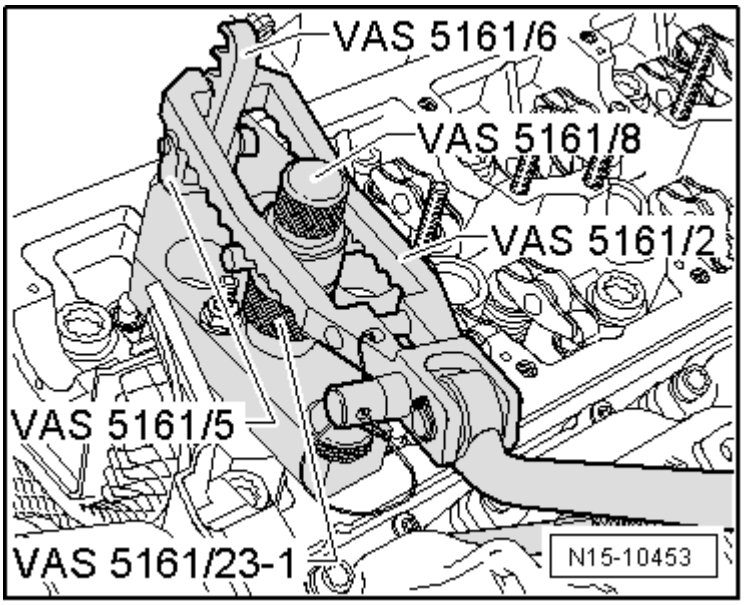

Fig. 165: Torque Wrench V.A.G. 1332 (40 To 200 Nm)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Torque wrench V.A.G 1332

Removing

- Read safety precautions before beginning work refer to **Safety precautions when working on fuel supply system** .

- First, check whether a coded radio is installed. If necessary, obtain the anti-theft coding.
- With ignition switched off disconnect battery ground (GND) strap.
- Remove cover under bench seat.
- Pull off 4-pin connector such as supply and return lines from flange.

NOTE:

- **Press buttons together on hose connections to do this.**

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

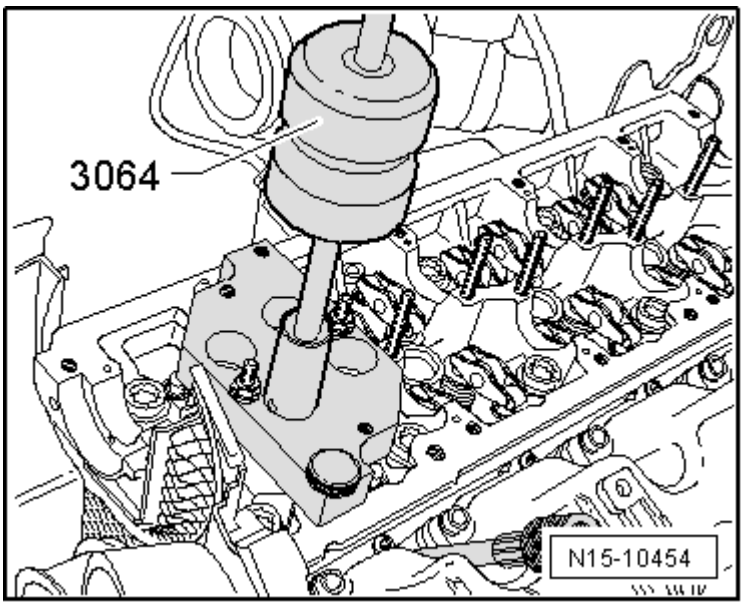

Fig. 166: Removing/Installing Union Nut With Wrench 3217
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Use ring nut spanner 3217 to remove union nut.
- 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 fuel delivery unit is in reverse order of removal.

NOTE:

- **When inserting fuel delivery unit, be sure not to bend fuel gauge sensor.**

- **Insert dry flange seal of fuel pump into opening of fuel tank.**
- **Only coat seal with fuel when installing fuel delivery unit.**
- **Ensure fuel hoses are seated securely.**

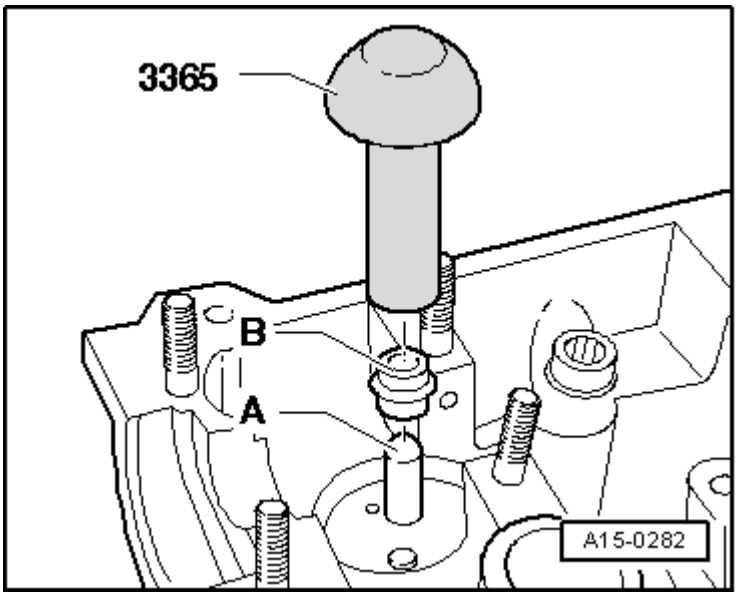

Fig. 167: Installed Position Of Flange Of Fuel Delivery Unit
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Note installation position of fuel delivery unit flange: Marking on flange must align with marking on fuel tank - **arrows** -.
- After installing fuel delivery unit, check that the supply, return and breather lines are still clipped onto the fuel tank.

- Perform "Procedure after interrupting voltage supply", refer to **PROCEDURE AFTER VOLTAGE SUPPLY OPEN CIRCUIT** .

Fuel Level Sensor G , removing and installing

Removing

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

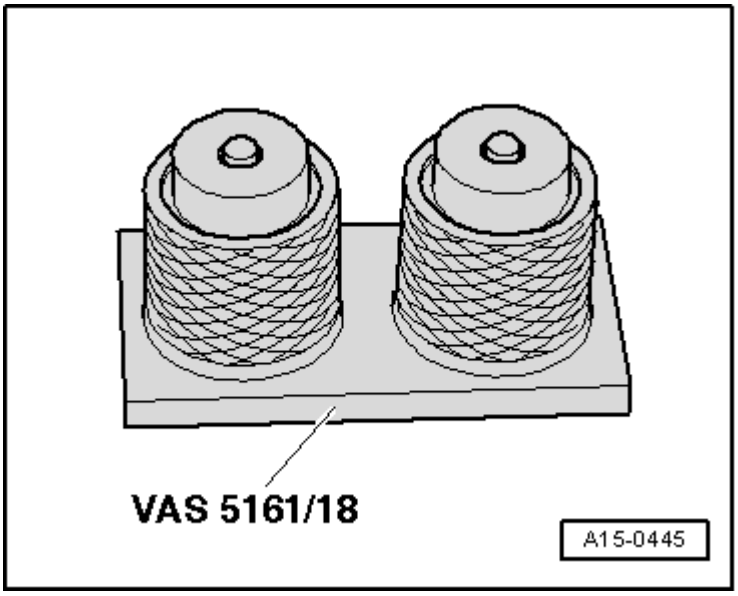

Fig. 168: Fuel Gauge Sender Connectors & Retaining Tabs
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disengage connector prongs of wires - **3** - and - **4** - and disconnect.
- Pry off retaining straps - **1** - and - **2** - using screwdriver and remove fuel gauge sensor towards bottom - **arrows** -.

Installing:

- Insert fuel level sensor in guides on fuel delivery unit and push up until it engages.
- Install Fuel Pump (FP) refer to **Fuel delivery unit, removing and installing** .

Fuel tank, removing and installing

Special tools, testers and auxiliary items required

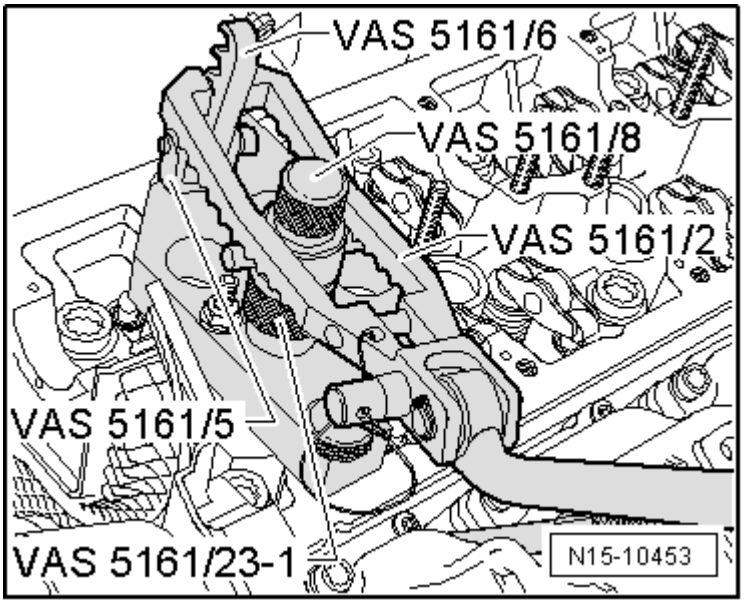

Fig. 169: Special Tool - Torque Wrench V.A.G 1331
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Torque wrench V.A.G 1331

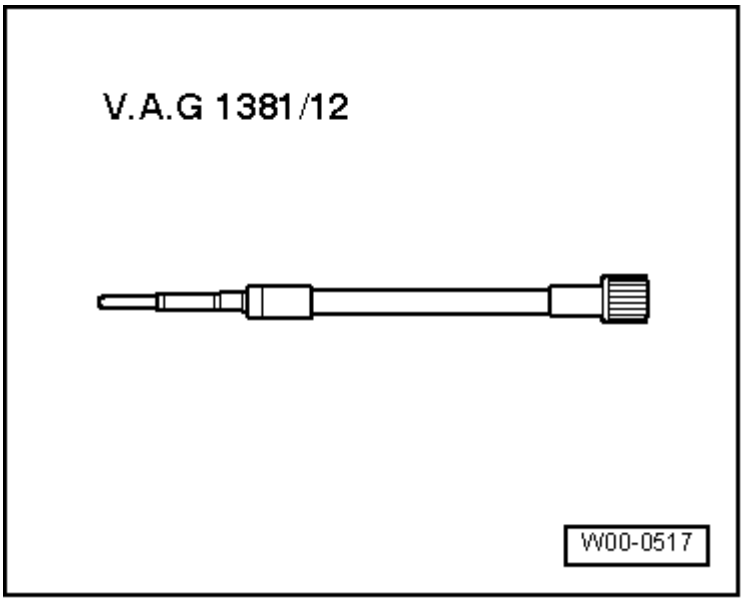

Fig. 170: Engine & Transmission Jack VAG 1383 A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Engine/transmission jack V.A.G 1383 A

Removing

- Read safety precautions before beginning work refer to **Safety precautions when working on fuel supply system** .

- First, check whether a coded radio is installed. If necessary, obtain the anti-theft coding.
- With ignition switched off disconnect battery Ground (GND) strap.
- Open fuel tank flap.

- Remove right rear wheel housing liner, refer to **REAR WHEEL-HOUSING LINER** .
- Remove rear axle, refer to **REAR AXLE, REMOVING AND INSTALLING** or **REAR AXLE WITH FOUR WHEEL DRIVE, OVERVIEW** .
- Drain fuel tank and clean fuel filler tube and surrounding area.
- Remove mounting bolt and remove fuel flap unit with rubber gasket.

- Remove securing bolt on filler neck.
- Fold rear seat bench forward.
- Remove cover plate from fuel gauge sensor and disconnect connector.
- Remove covers under fuel tank.

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

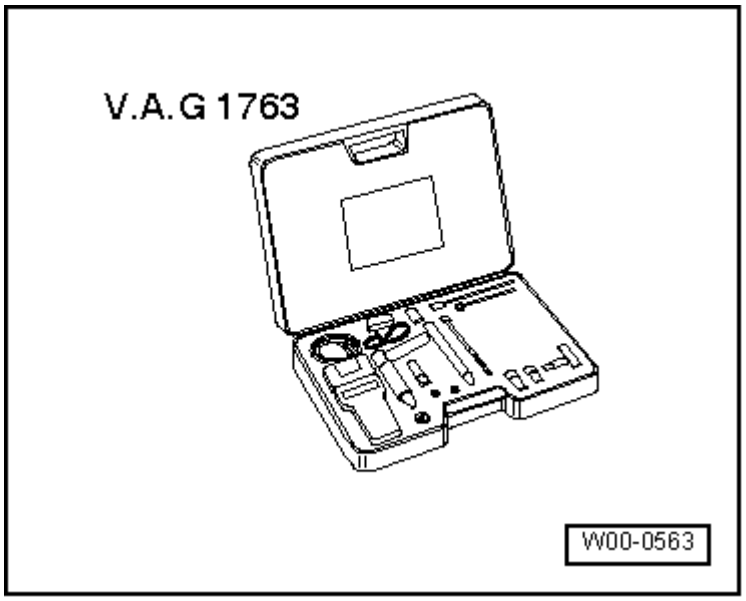

Fig. 171: Fuel Supply Hose, Return Hose & Breather Hose
Courtesy of VOLKSWAGEN UNITED STATES, INC.

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

NOTE:

- **Press buttons together on hose connections to do this.**

- Remove tensioning strap. While doing so, support fuel tank using engine/transmission jack V.A.G 1383 A
- Lower fuel tank.

Installing

Installation is in reverse order of removal, note the following:

- Make sure ventilation and fuel lines are not kinked when installed.
- Route fuel hoses kink-free.
- Ensure fuel hoses are seated securely.
- Secure fuel hoses with spring-type clamps.
- 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.**

- Perform "Procedure after interrupting voltage supply", refer to **PROCEDURE AFTER VOLTAGE SUPPLY OPEN CIRCUIT** .

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 fuel system:

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

- Check fuel pump relay according to wiring diagram with Test System V.A.G 1466 A, refer to Electrical Wiring Diagrams, Troubleshooting and Component Locations.

Fuel pump, checking

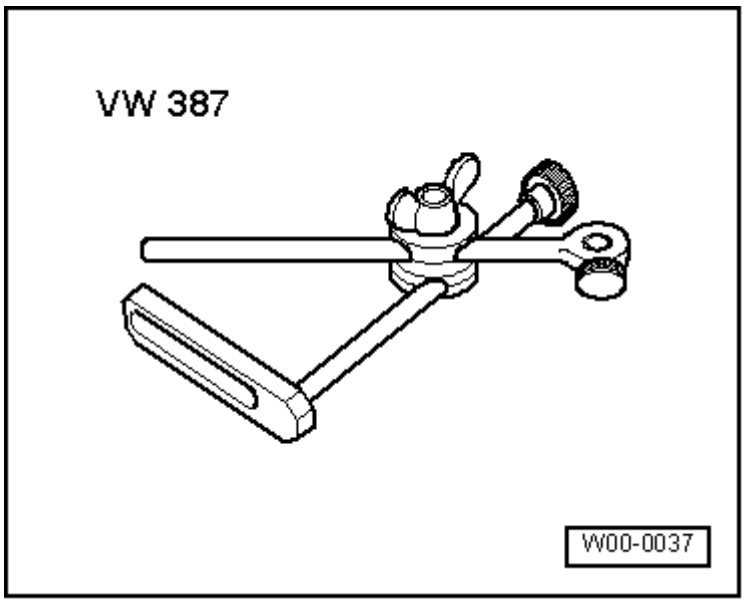

Fig. 172: Identifying Special Tools - Fuel Pump, Checking (1 Of 2)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Ring nut wrench 3217
- Pressure gauge V.A.G 1318
- Adapter V.A.G 1318/1
- Adapter V.A.G 1318/11
- Pressure gauge adapter V.A.G 1318/17
- Double connection V.A.G 1318/23

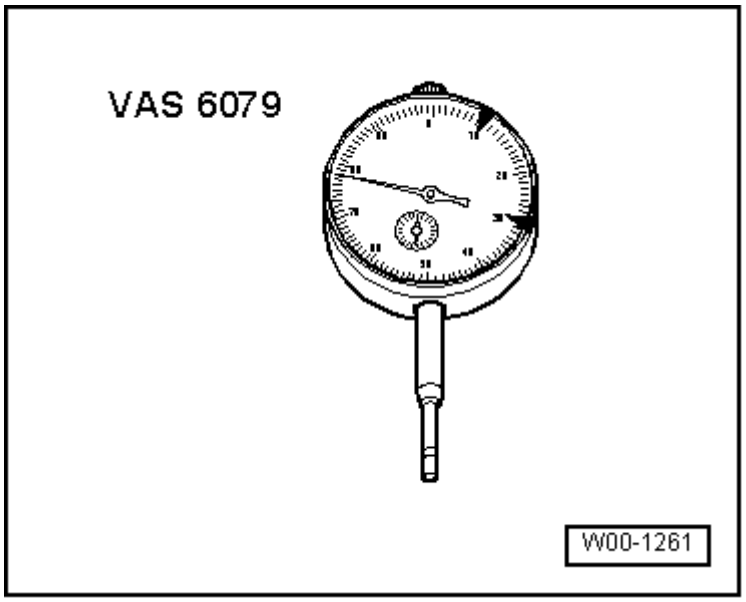

Fig. 173: Identifying Special Tools - Fuel Pump, Checking (2 Of 2)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Torque wrench V.A.G 1332
- Injection Rate Comparison Meter V.A.G 1348
- Test System V.A.G 1466 A
- Voltage tester V.A.G 1527B
- Connector test set V.A.G 1594 A or connector test set V.A.G 1594C
- Multimeter V.A.G 1715
- Measuring container
- Wiring diagram

Test conditions

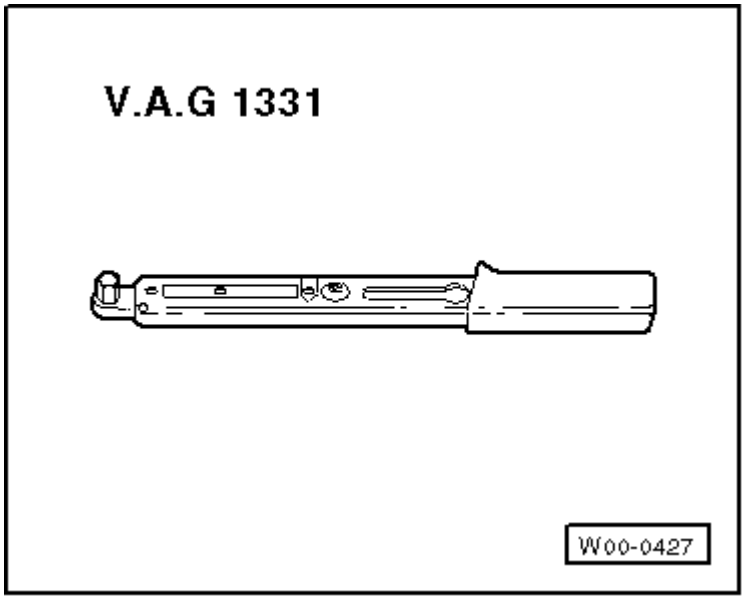

Fig. 174: Identifying Main Fuse Panel
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Fuse No. 28 is OK
- Battery voltage must be at least 11.5 Volts.
- All electrical consumers such as, e.g. lights and rear window heater, must be switched off.
- If vehicle is equipped with an A/C system, it must be switched off.

NOTE:

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

Function and voltage supply, checking

NOTE:

- **In the continuing work procedure, it is possibly necessary to disconnect the battery Ground (GND) strap. Check whether a coded radio is installed. If so, obtain anti-theft coding beforehand.**

- Remove cover from fuel delivery unit.
- Briefly operate starter. Fuel Pump (FP) must run audibly.
- Switch off ignition.

If fuel pump does not activate:

- Remove cover in front of fuse holder.

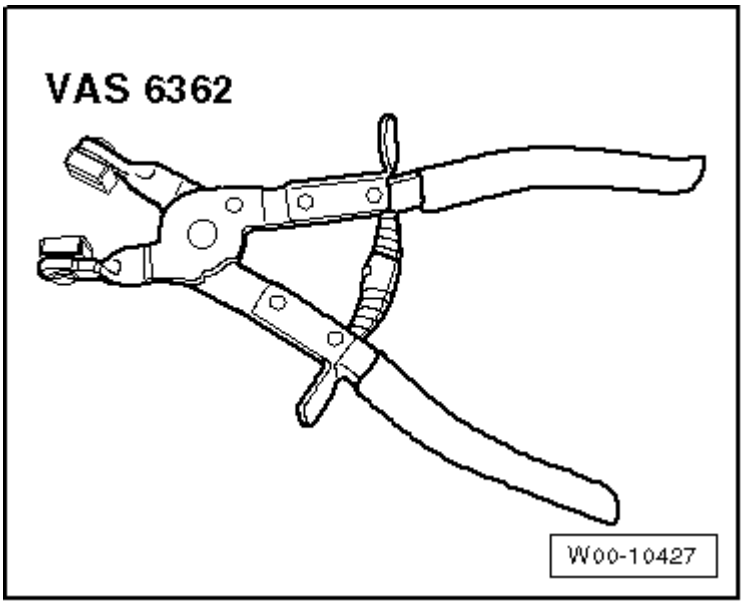

Fig. 175: Connecting VAG 1348/3A With Adapter Cable VAG 1348/3-2 To Contact And Battery Positive
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull fuse No. 28 from 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 V.A.G 1348/3A.

If fuel pump is activated:

- Check fuel pump relay according to wiring diagram with Test System V.A.G 1466 A, refer to Electrical Wiring Diagrams, Troubleshooting and Component Locations.

If fuel pump is not activated:

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

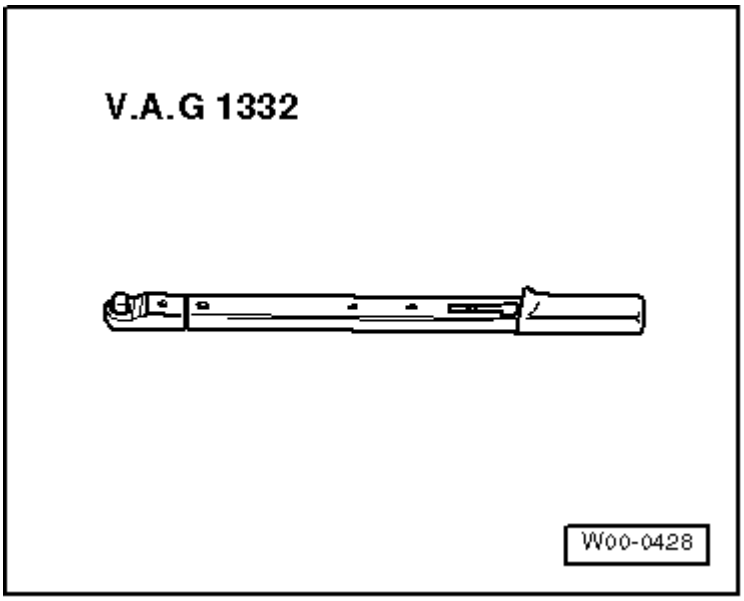

Fig. 176: Connecting Voltage Tester V.A.G 1527B Using Adapter Cables From Connector Test Kit V.A.G 1594C To Outer Terminals Of Connector
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- 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:

- Locate and repair open circuit in wiring using wiring diagram, refer to Electrical Wiring Diagrams, Troubleshooting and Component Locations.

LED lights up (voltage supply OK):

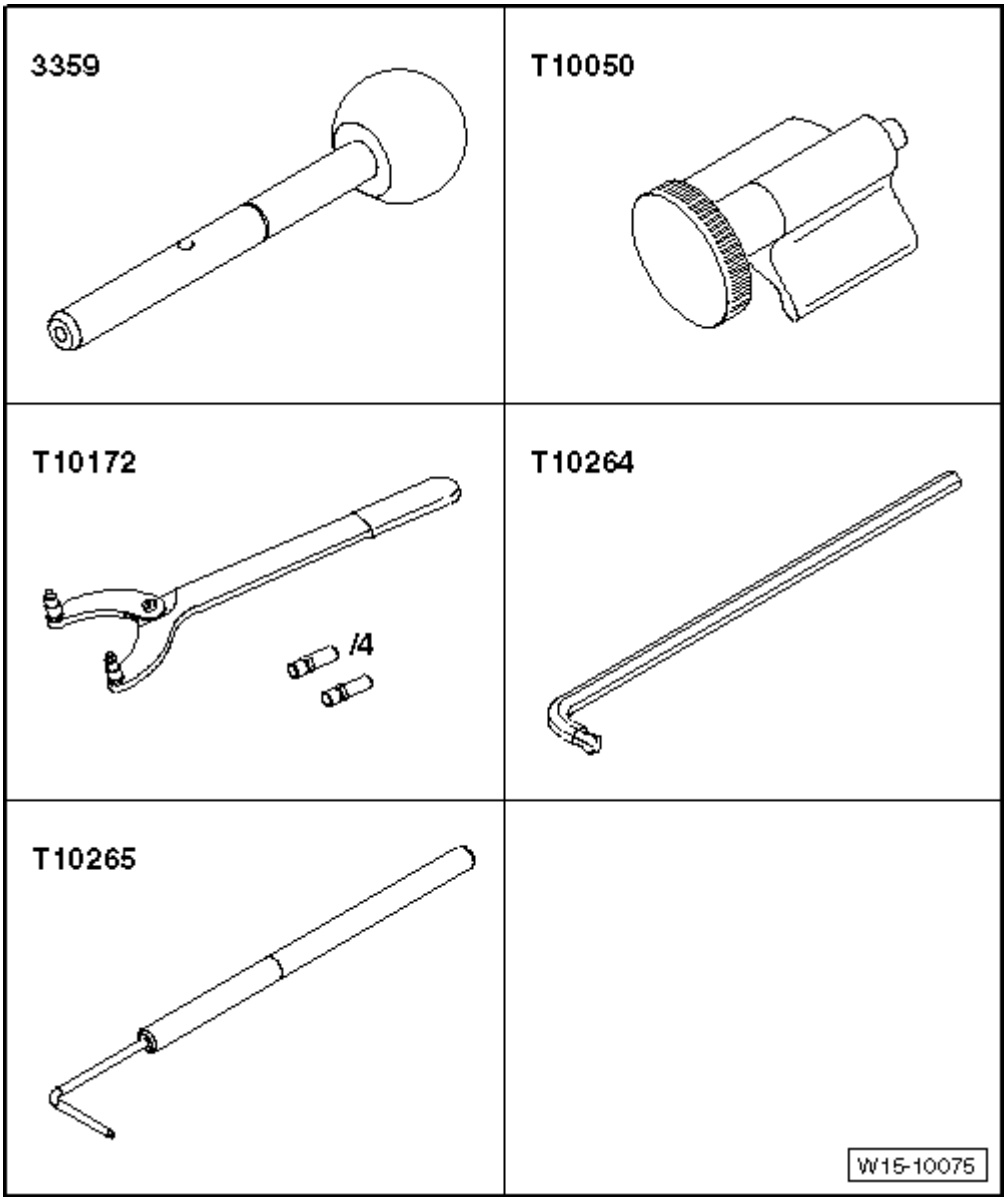

Fig. 177: Removing/Installing Union Nut With Wrench 3217
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- 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 line is under pressure! Wear protective goggles and protective clothing to prevent injuries and contact with skin. Before removing from hose connection wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

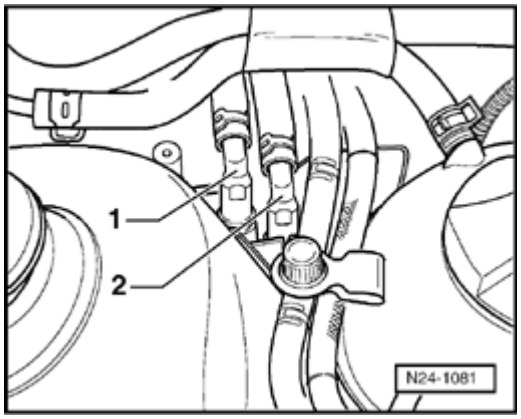

Fig. 178: Identifying Supply Line And Return Line
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect fuel supply line - **1** - and catch escaping fuel using a rag.

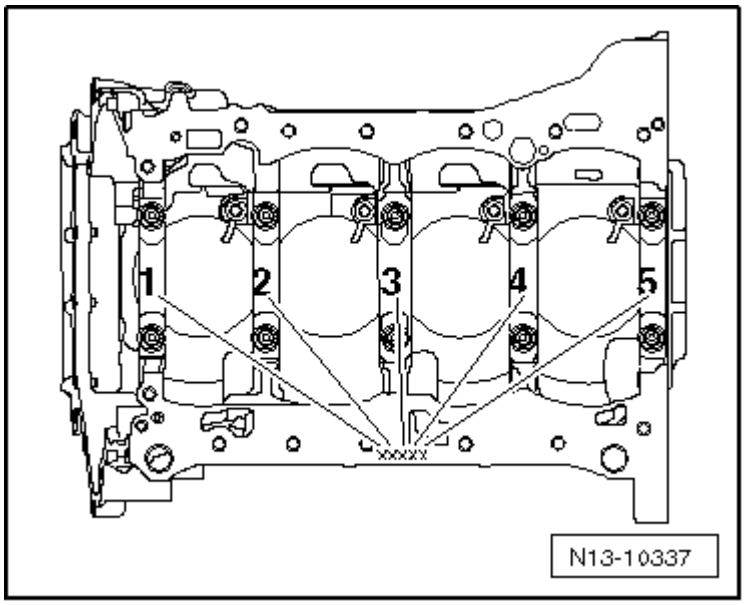

Fig. 179: Pressure Gauge V.A.G 1318 Connections (1 Of 2)

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect pressure gauge V.A.G 1318 with double connection V.A.G 1318/23 and adapter set V.A.G 1318/17 to fuel supply line.
- Connect adapter V.A.G 1318/1 to adapter V.A.G 1318/11 of pressure gauge V.A.G 1318 and hold it in a measuring container.
- Open shut-off valve of pressure gauge V.A.G 1318. Lever will point in direction of flow - **A** -.
- Operate remote control for VAG 1348 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 measuring container.
- Delivery rate of Fuel Pump (FP) is dependent on battery voltage. Therefore, connect multimeter to vehicle battery using adapter cables from connector test kit V.A.G 1594C.
- Operate remote control for 30 seconds and measure battery voltage.

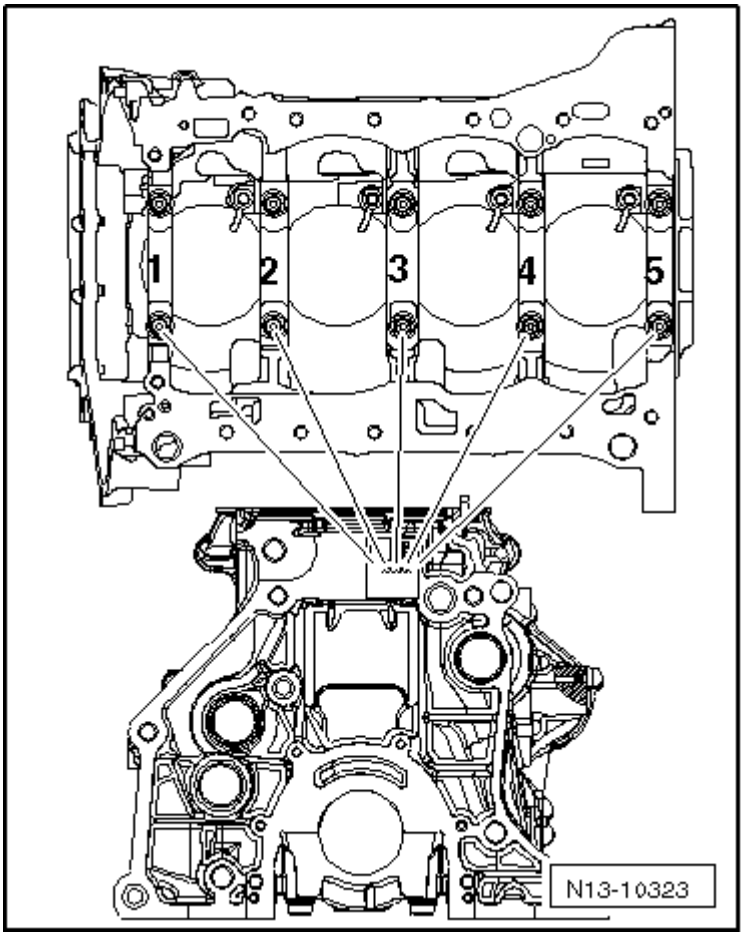

Fig. 180: Fuel Delivery Rate Graph
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Compare quantity of fuel delivered with specification.

*) Minimum delivery rate cm ^{3} /30 s

**) Voltage at fuel pump with engine off and pump running (approx. 2 Volts less than battery voltage).

Example:

During the test, a voltage of 12.5 volts is measured at the battery. Since voltage at the pump is approx. 2 Volts less than battery voltage, there is a minimum delivery rate of 200 cm ^{3} /30 s.

If minimum delivery rate is not attained:

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

CAUTION: Fuel supply line is under pressure! Wear protective goggles and protective clothing to prevent injuries and contact with skin. Before removing from hose connection wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

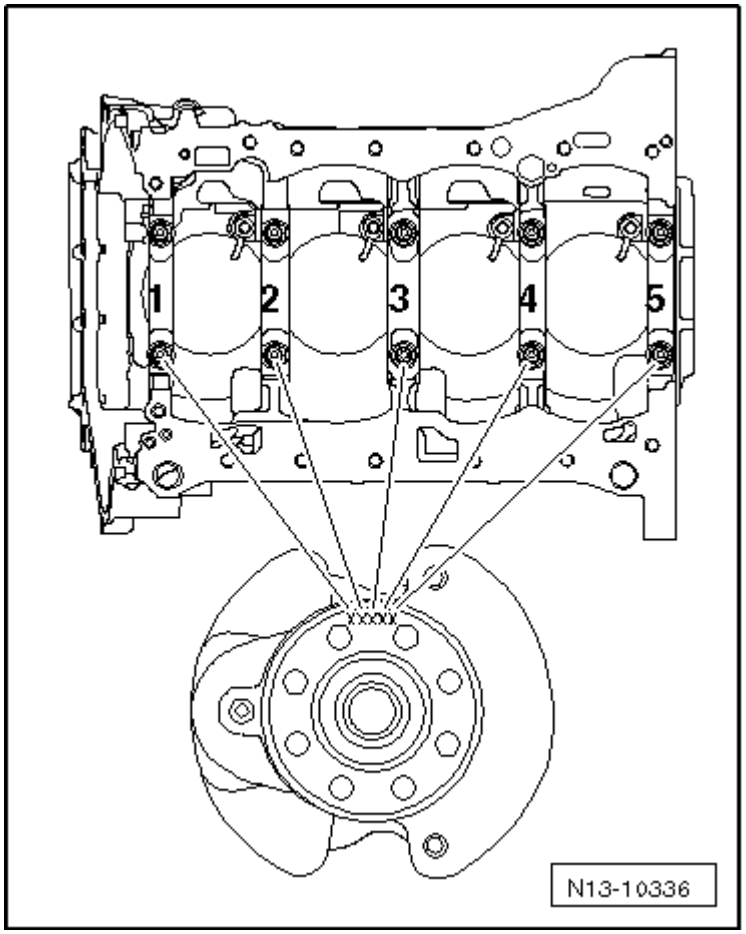

Fig. 181: Pressure Gauge V.A.G 1318 Connections (2 Of 2)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull supply hose - **1** - from inlet to fuel filter.
- Connect Pressure Gauge V.A.G 1318 with Adapters V.A.G 1318/17 to fuel supply line.
- Repeat delivery rate check.

If minimum delivery rate is now obtained:

- Replace fuel filter:

If minimum delivery rate is again not obtained:

- Remove fuel delivery unit and check filter strainer for dirt.

Only when up to now no malfunction has been detected:

- Fuel Pump (FP) faulty, replace fuel delivery unit refer to **Fuel delivery unit, removing and installing** .
- Check DTC memory.
- Read readiness code.
- If DTC memory was cleared or engine control module disconnected from voltage supply, readiness code must be regenerated.

Delivery rate has been obtained, but malfunctions are still suspected in fuel supply, for example sporadic loss of fuel supply:

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

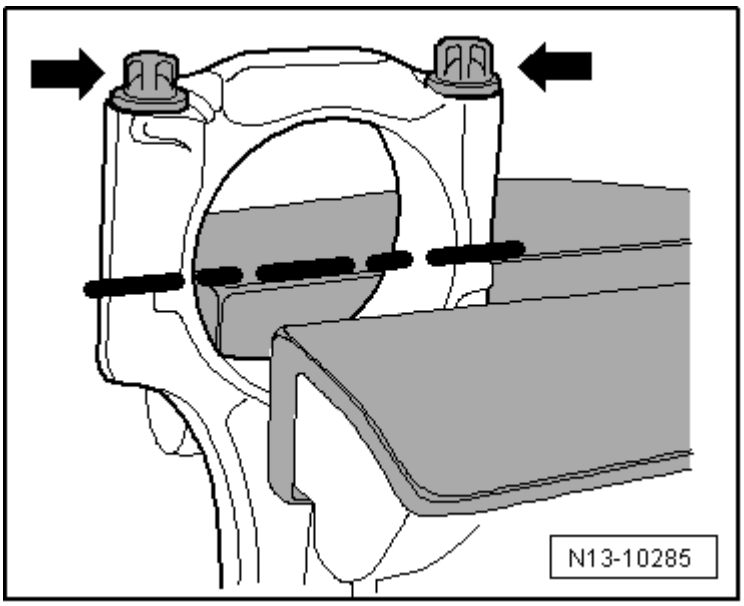

Fig. 182: Measuring Current Draw Of Fuel Pump Using VAG 1715
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect Multimeter V.A.G 1715 with current clamp to wire for 4-pin connector terminal 1 - **arrow** - on wiring harness.
- Start engine and run at idle speed.
- Measure current draw of fuel pump. Specified value: 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** .
- Check DTC memory.
- Read readiness code.
- If DTC memory was cleared or engine control module disconnected from voltage supply, readiness code must be regenerated.

Fuel Pump (FP) check-valve, checking

Test conditions

- Remote control V.A.G 1348/3A connected
- Fuel Inj. 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.**

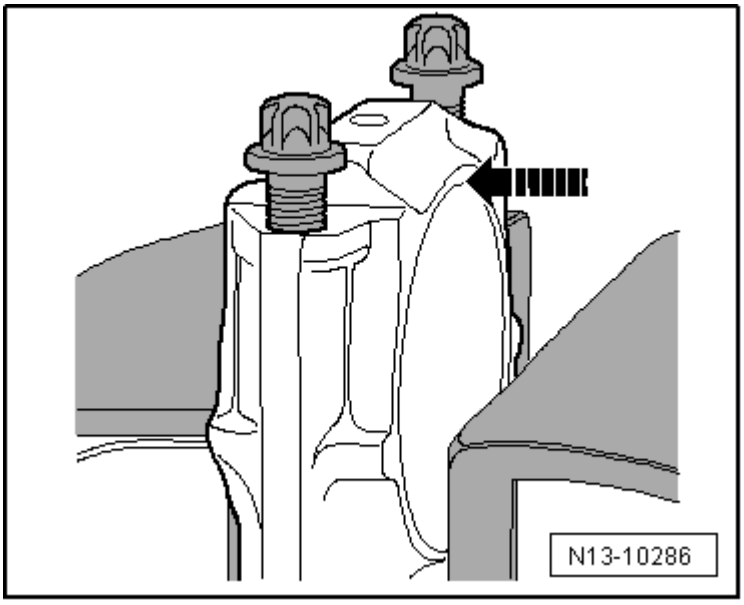

Fig. 183: Pressure Gauge V.A.G 1318 Connections
Courtesy of VOLKSWAGEN UNITED STATES, INC.

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

CAUTION: Danger of spraying when opening shut-off valve; wear protective goggles and protective clothing to prevent injuries and contact with skin. Hold container in front of free connection of pressure measuring device V.A.G 1318.

- If pressure builds up too high, lower excess pressure by carefully opening 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** .
- Check DTC memory.
- Read readiness code.
- If DTC memory was cleared or engine control module disconnected from voltage supply, readiness code must be regenerated.

ELECTRONIC ENGINE POWER CONTROL (EPC)

EPC system, function

For EPC, the throttle valve is not operated by a cable from the accelerator pedal. There is no mechanical connection between the gas pedal and the throttle valve.

The position of the accelerator pedal is transmitted to the engine control module via two accelerator pedal position sensors (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.

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 can open and close the throttle valve independently of the accelerator pedal position sensor.

This means, for example, that the throttle valve could be fully opened even though the accelerator pedal has only been depressed half way. This has the advantage of preventing torque losses at the throttle valve.

Aside from that, it results in clearly better pollutant output and consumption values under certain load conditions.

The necessary engine torque can be produced by the engine control module (ECM) via the optimal combination of throttle valve profile and charge pressure.

It would be incorrect to think that "EPC" consists of only one or two components. EPC is much more of a system containing all components that contribute to recognizing, controlling and monitoring the position of the throttle valve, e.g. sensor for accelerator pedal position, throttle valve control module, EPC warning lamp, Engine Control Module (ECM).

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

Observe rules for cleanliness refer to **Rules for cleanliness** .

Electronic engine power regulation (EPC) components, assembly overview

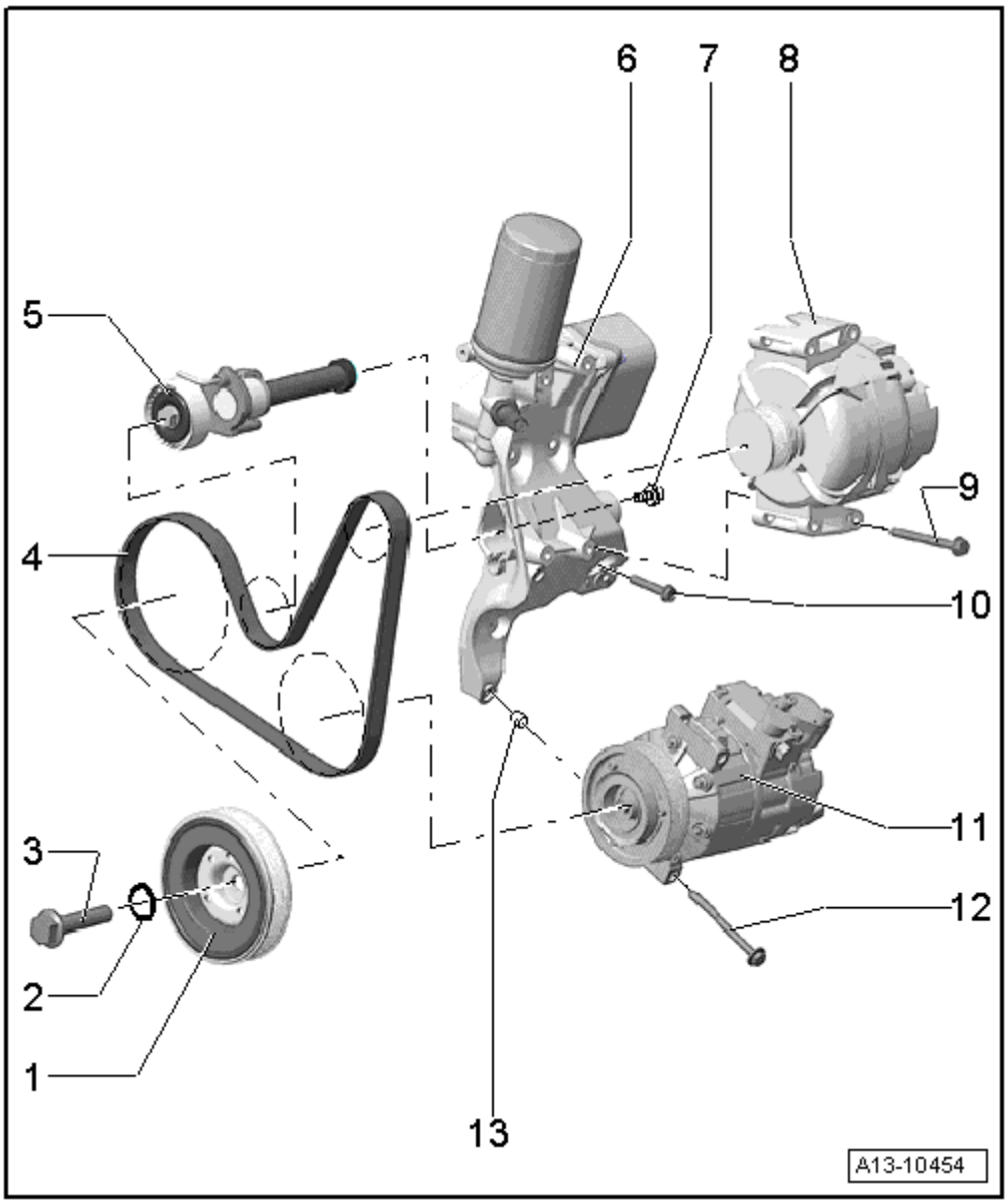

Fig. 184: Electronic Engine Power Regulation Components, Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Bracket

- Removing and installing, refer to **BRAKE PEDAL - ASSEMBLY OVERVIEW**

2 - Connector

- Black, 6-pin

3 - 10 Nm

4 - Throttle Position (TP) Sensor G79 with Accelerator Pedal Position Sensor 2 G185

- Not adjustable
- The throttle position sensor transmits driver control to engine control module
- To remove, remove instrument panel and pedal assembly cover.
- Checking, refer to **Throttle Position (TP) Sensor G79 and Accelerator Pedal Position Sensor 2 G185 , checking**

- Vehicles with automatic transmission 01M
- If replaced, adapt automatic transmission control module
- Vehicles with automatic transmission 09A
- If replaced, adapt automatic transmission control module

5 - Bracket

- For footwell cover
- Version through model year 2001 is illustrated
- Clipped onto throttle position sensor

Electronic Power Control (EPC) Warning Lamp in instrument cluster, meaning

"EPC" is an abbreviation and stands for Electronic Power Control, also known as electronic performance regulation (EPC).

After switching on ignition, ECM checks function of all components used by EPC system.

If malfunctions are detected in the EPC system during engine operation, the ECM switches on the EPC warning lamp. (These DTCs are identified in the DTC tables). The malfunction is stored in DTC memory of ECM at the same time.

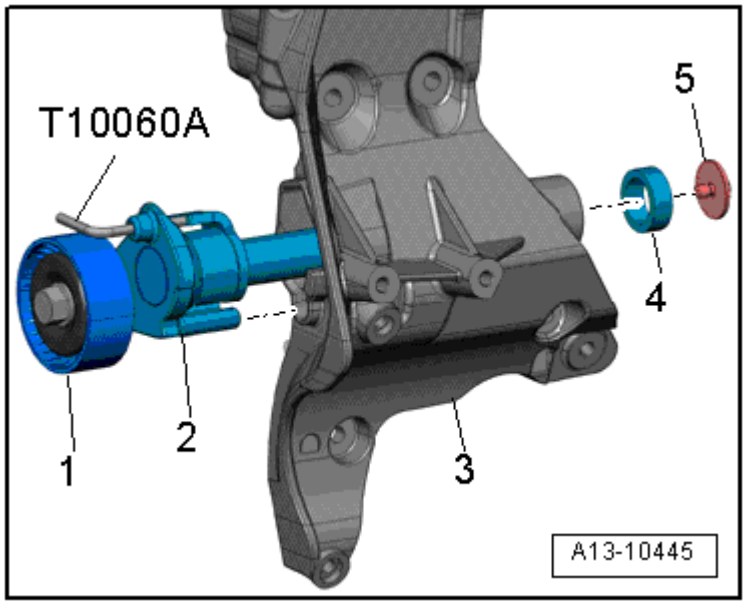

Fig. 185: Locating EPC Warning Lamp
Courtesy of VOLKSWAGEN UNITED STATES, INC.

EPC warning lamp location

Warning lamp, function check:

Throttle Position (TP) Sensor G79 and Accelerator Pedal Position Sensor 2 G185 , checking

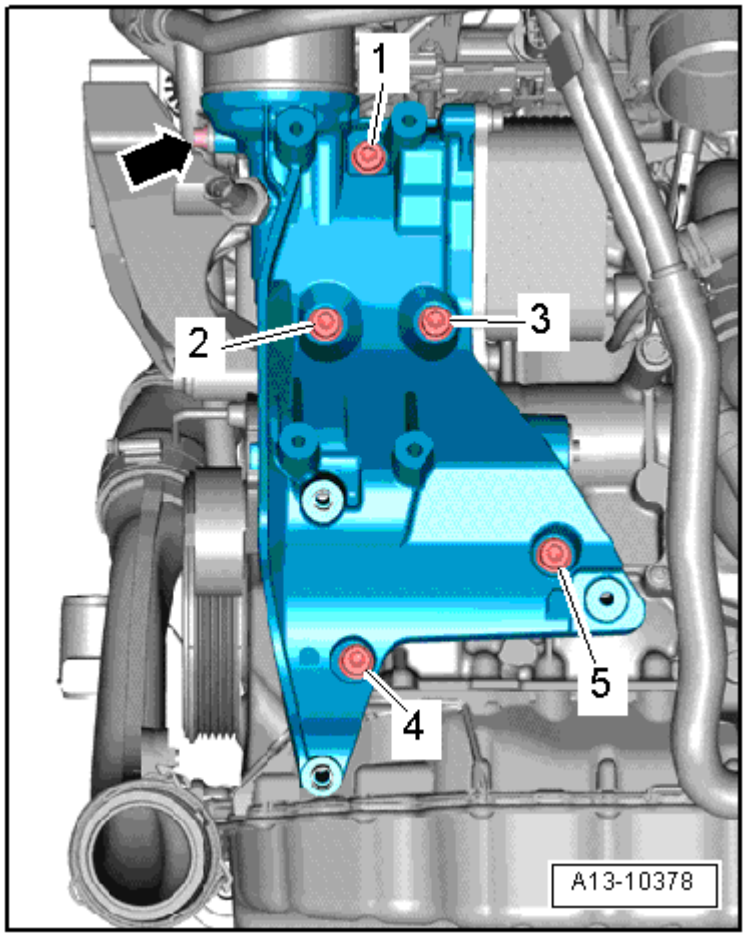

Fig. 186: Identifying Special Tools - Throttle Position Sensor G79 And Accelerator Pedal Position Sensor 2 G185 , Checking
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Multimeter V.A.G 1526A or Multimeter V.A.G 1526C
- Connector Test Set V.A.G 1594A or Connector Test Set V.A.G 1594C
- Adapter cable, 121-pin V.A.G 1598/31
- Fault Read Out Device V.A.G 1551 or Vehicle Diagnosis, Testing and Information System VAS 5051

- Wiring diagram

Function

The Throttle Position (TP) Sensor G79 and Accelerator Pedal Position Sensor 2 G185 are located on accelerator pedal and transmit drivers intentions to engine control module completely independent of one another. Both sensors are integrated into one housing.

Test conditions

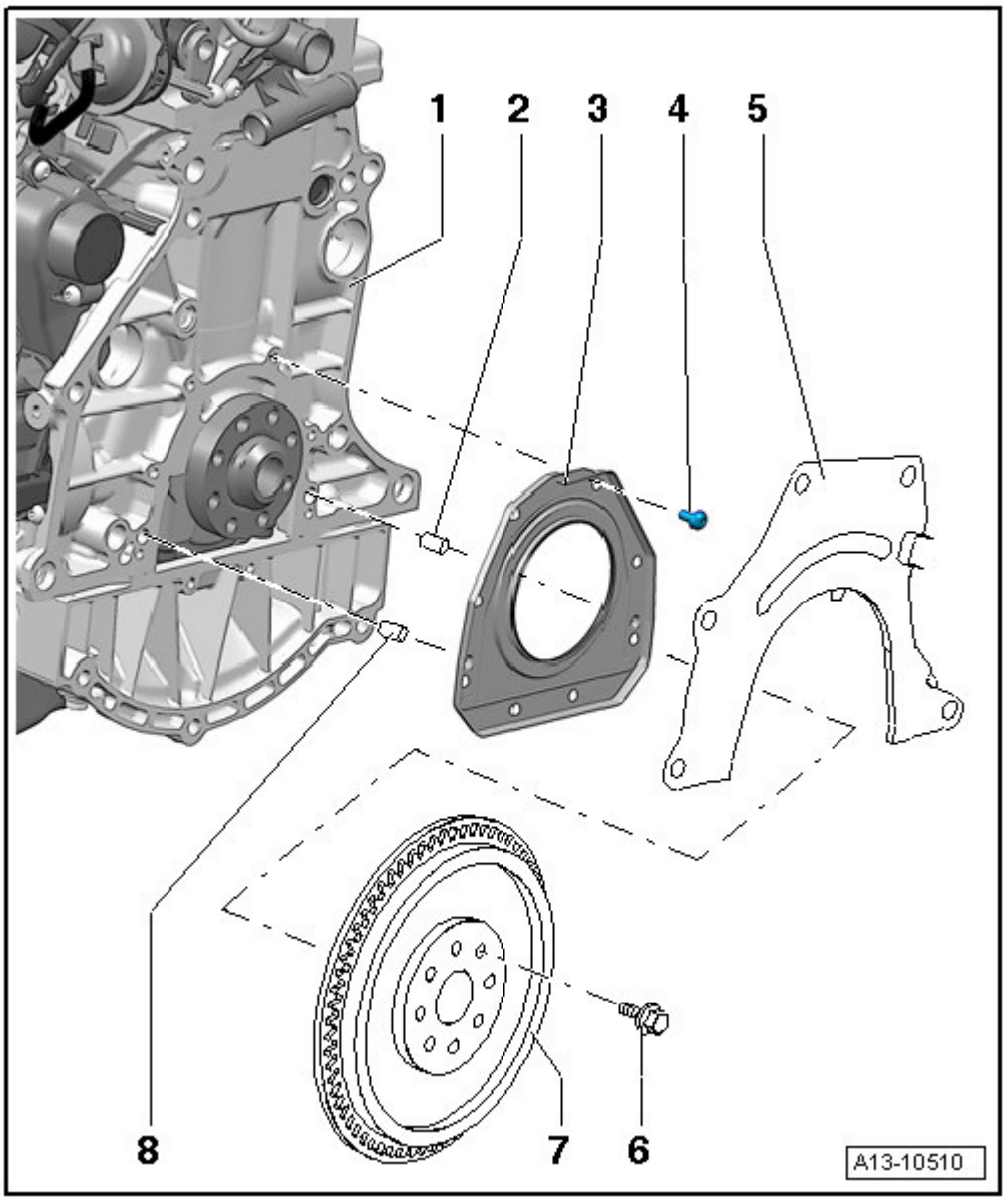

Fig. 187: Identifying Main Fuse Panel
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- The fuses must be OK.
- Battery voltage must be at least 11.5 Volts.

Test sequence

- Connect Fault Read Out Device V.A.G 1551 and select engine electronics control module with "Address word 01". For this, the ignition is switched on. Connect fault read out device and select engine control module.

Scan tool display:

Quick data transfer HELP Select function XX

- Press buttons 0 and 8 for function "Reading measuring value blocks" and press Q button to confirm input.

Scan tool display:

Read measuring value block Enter display group number XXX

- Press buttons 0 6 and 2 for "Display group number 62" and press Q button to confirm input.

Scan tool display: (14 = display fields)

Read measured value block 62 ->> 1 2 3 4

- Check specified value of Throttle Position (TP) Sensor G79 at idle stop in display field 3.

Specified value: 6 to 96%

- Check specified value of Accelerator Pedal Position Sensor 2 G185 at idle stop in display field 4.

Specified value: 3 to 48%

NOTE:

- **The engine control module converts the angle sensor voltage values based on 5 Volts and shows these in percentage values. (5 Volt voltage supply corresponds to 100%).**

- Slowly press accelerator pedal to wide open throttle (WOT) position, when doing so, observe percentage display in display fields 3 and 4:

The percentage displays in display field 3 must increase evenly. Specified range 6 to 96% is not completely utilized during this.

The percentage displays in display field 4 must increase evenly. Specified range 3 to 48% is not completely utilized during this.

NOTE:

- **Displayed value in display field 3 must always be approximately twice as large as value in display field 4.**

- Press --> key.
- Press buttons 0 and 6 for function "End output" and press Q button to confirm input.
- Switch off ignition.

If readings do not result as described:

- Check voltage supply and sensor wiring connections:

Voltage supply and wiring to control module, checking

- Remove driver-side storage compartment, refer to **STORAGE COMPARTMENTS, COVERS AND TRIM** .
- Remove 6-pin connector from Throttle Position (TP) Sensor G79 and Accelerator Pedal Position Sensor 2 G185.
- Switch ignition on.

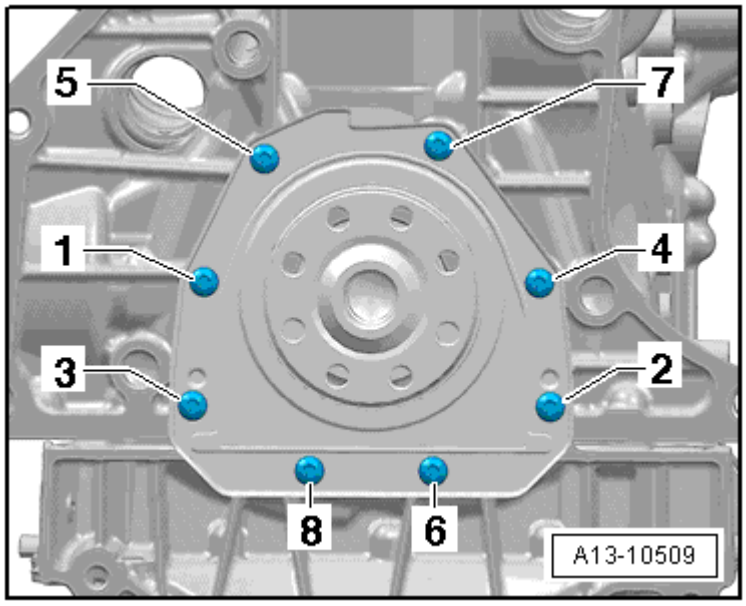

Fig. 188: Identifying Control Module Wiring Harness Pins
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect Multimeter V.A.G 1526C for voltage measurement to following connector terminals with adapter cables from Connector Test Set V.A.G 1594C.

Terminal 1 + Ground

Terminal 1 + 5

Terminal 2 + Ground

Terminal 2 + 3

Specified value: at least 4.5 V

- Switch ignition off.

If no voltage is present:

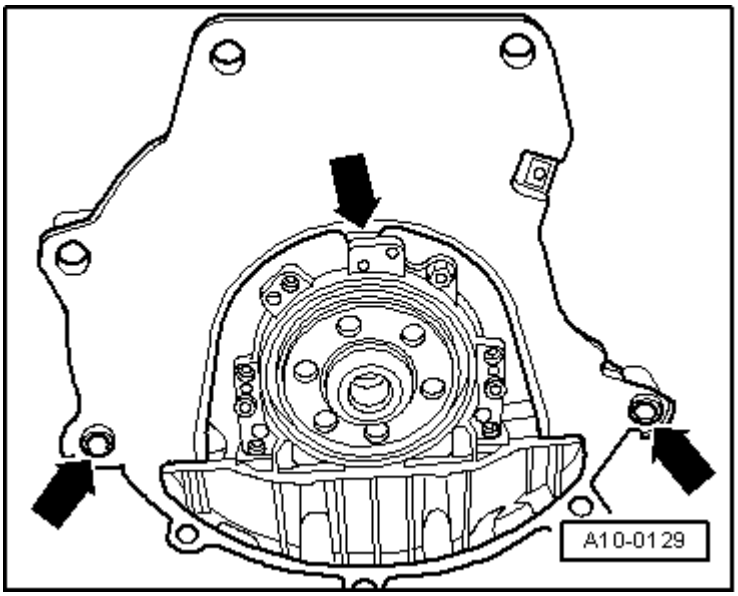

Fig. 189: Identifying Test Box V.A.G 1598/31 Connect To Control Module Wiring Harness
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect adapter cable, 121-pin V.A.G 1598/31 to engine control module (ECM) wiring harness. The engine control module remains disconnected.

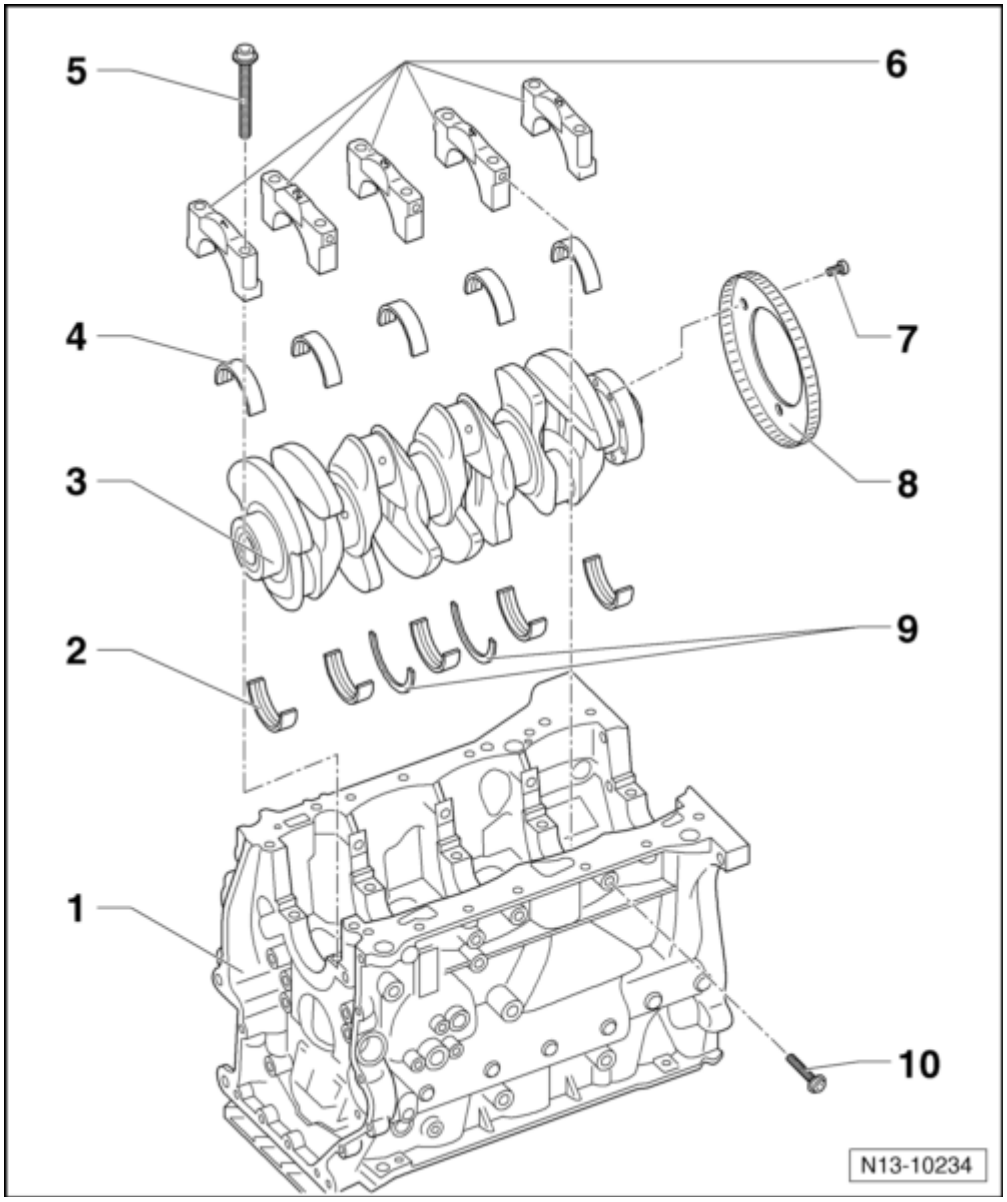

Fig. 190: Identifying Control Module Wiring Harness Pins
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Check wires between adapter cable, 121-pin V.A.G 1598/31 and connector for open circuit according to wiring diagram.

Terminal 1 + socket 72

Terminal 2 + socket 73

Terminal 3 + socket 36

Terminal 4 + socket 35

Terminal 5 + socket 33

Terminal 6 + socket 34

Wiring resistance: max. 1.5 ohms

- Also check wires for short circuit to B+ or Ground.
- Also check wires for short circuit to each other.

If no malfunction is detected in the wiring:

- Replace throttle position sensor.

Vehicles with automatic transmission 01M

- Adapt automatic transmission control module.

Vehicles with automatic transmission 09A

- Adapt automatic transmission control module.

Continuation for all vehicles

- Check DTC memory.
- Read readiness code.
- If DTC memory was cleared or engine control module disconnected from voltage supply, readiness code must be regenerated.

EVAPORATIVE EMISSIONS (EVAP) SYSTEM

Evaporative emissions (EVAP) system

NOTE:

- **Hose connections are secured with either spring-type or clamp-type clips.**
- **Always replace clamp-type clips with spring-type clips.**
- **Hose clamp pliers V.A.G 1921 or pliers for spring clamps VAS 5024 A are recommended for installing spring clamps.**

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

Observe rules for cleanliness refer to **Rules for cleanliness** .

Function description of evaporative emissions (EVAP) system

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

The EVAP canister system prevents these HC emissions from entering the atmosphere.

With quantity restrictions, fuel vapors travel from the highest point of the tank via the gravity valve (closed at a tilt of 45 °) and the pressure retention valve to the EVAP canister.

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

While driving, with oxygen sensor control active (engine warm), the Evaporative Emission (EVAP) Canister Purge Regulator Valve N80 , is activated by the Engine Control Module (ECM) in pulses dependent on load and engine speed. The opening time is dependent on input signals.

When purging (recovery of the activated charcoal), the suction tube vacuum sucks fresh air in through the ventilation opening on the underside of the EVAP canister. The fuel vapors stored amongst the activated charcoal and fresh air are proportionately supplied to be burned.

The pressure retention valve prevents fuel vapors from being sucked out of the tank when the Evaporative Emission (EVAP) canister purge regulator valve is opened and an intake manifold vacuum is present. It therefore ensures that the evacuation of the EVAP canister has priority.

When no voltage is applied (e.g. wiring open circuit), the solenoid valve is closed. The EVAP canister is not purged.

The vacuum line from throttle valve control module to EVAP canister is also connected with crankcase ventilation valve via a bypass. The check-valve integrated there prevents intake air from entering the crankcase in certain partial throttle ranges. Thereby the crankcase ventilation is altogether improved. The bypass ensures crankcase ventilation.

Leak diagnosis, function description

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.

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

EVAP canister system, assembly overview

NOTE:

- **Components marked with * are checked via On Board Diagnostic (OBD).**
- **Components marked with ** are checked via output Diagnostic Test Mode.**

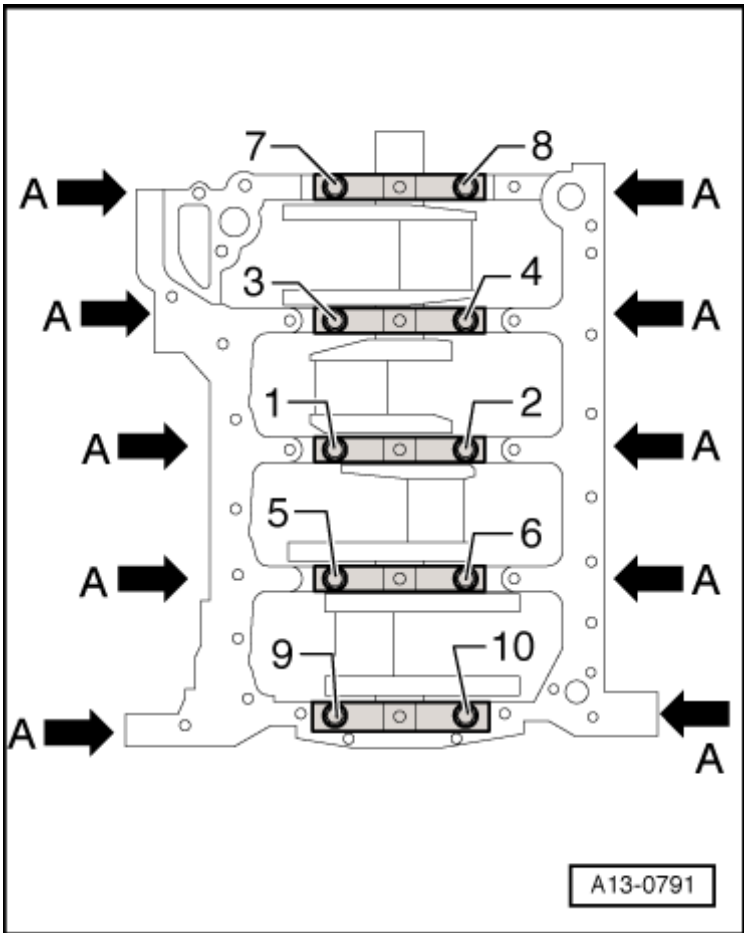

Fig. 191: EVAP Canister System, Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - From Evaporative Emission (EVAP) Canister Purge Regulator Valve N80 */**

2 - Seal

- Replace if damaged

3 - Vent line

4 - Connection piece

5 - Connector

- 3-pin

6 - Vacuum line

7 - Leak Detection Pump (LDP) V144 */**

- Under wheel housing liner in right rear wheel housing
- Checking refer to **Leak Detection Pump (LDP), checking**

8 - Connecting hose

- Pressure side

9 - 3 Nm

10 - Air filter for Leak detection pump (LDP) V144

11 - Connecting hose

- Suction side

12 - Bracket

13 - 10 Nm

14 - EVAP canister

- Under wheel housing liner in right rear wheel housing

Evaporative emissions (EVAP) system, overview

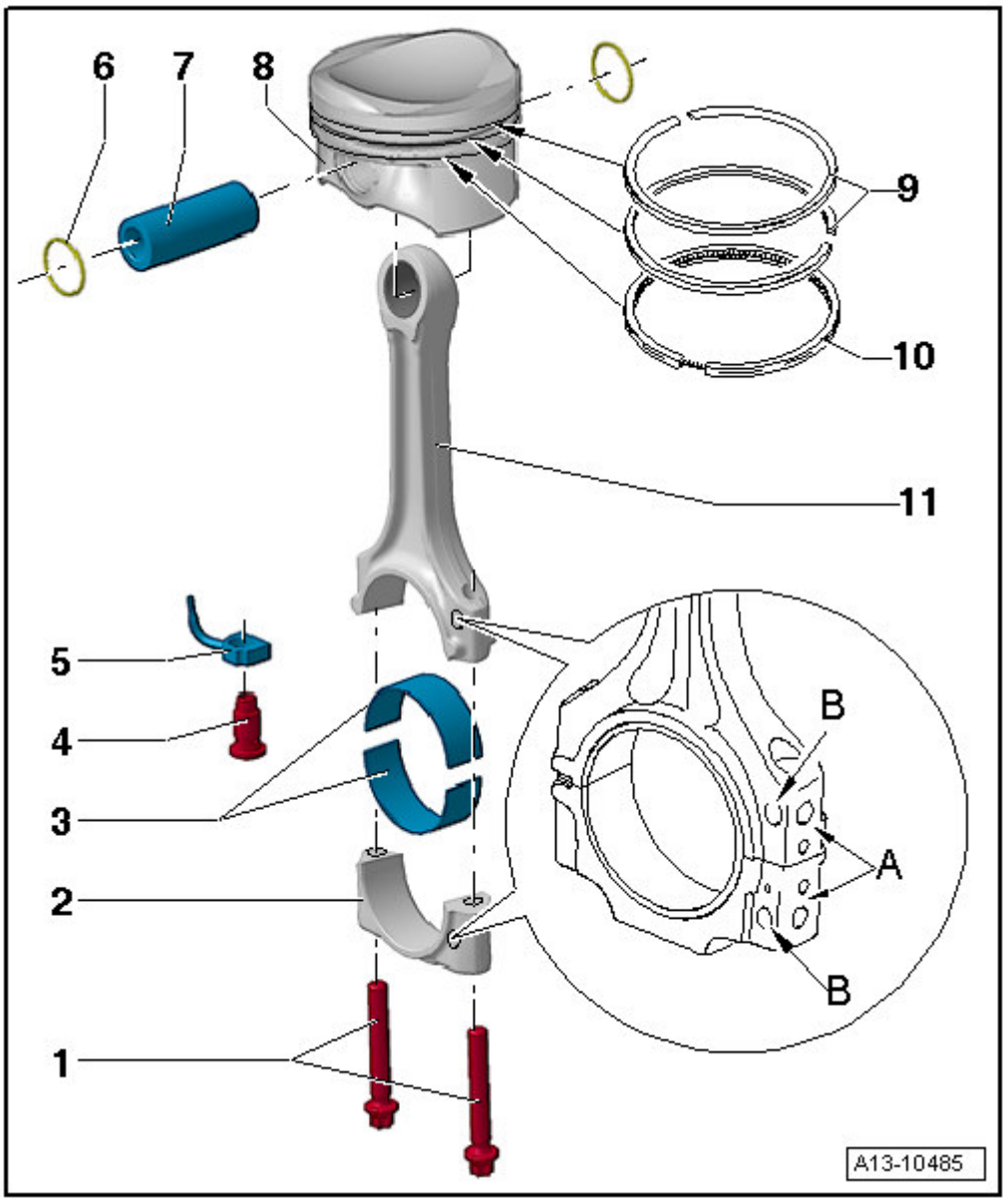

Fig. 192: Evaporative Emissions System, Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Tank flap unit

2 - Fuel tank

3 - Fuel delivery unit

4 - Intake tube

5 - Throttle valve control module J338

6 - Intake manifold

7 - Fuel distributor with fuel injectors

8 - Fuel pressure regulator

9 - Fuel filter

- Installed location: Arrow points in direction of flow

10 - Evaporative Emission (EVAP) Canister Purge Solenoid Valve 1 N80

- Check activation
- Function, checking refer to **Evaporative Emission (EVAP) Canister Purge Regulator Valve N80 , checking**

11 - Test connection

12 - Gravity/expansion valve

13 - Pressure retention valve

14 - Switch-over valve

15 - EVAP canister

- Under wheel housing liner in right rear wheel housing

16 - Leak detection pump (LDP) V144

- Check activation

17 - Air filter for diagnosis pump

Evaporative Emission (EVAP) Canister Purge Regulator Valve N80 , checking

Solenoid valve is closed when no voltage is present.

Check activation.

Special tools, testers and auxiliary items required

- Fault Read Out Device V.A.G 1551 or Vehicle Diagnosis, Testing and Information System VAS 5051

Test conditions

- Coolant temperature must be at least 80 ° C,, refer to Display group 04, display field 3

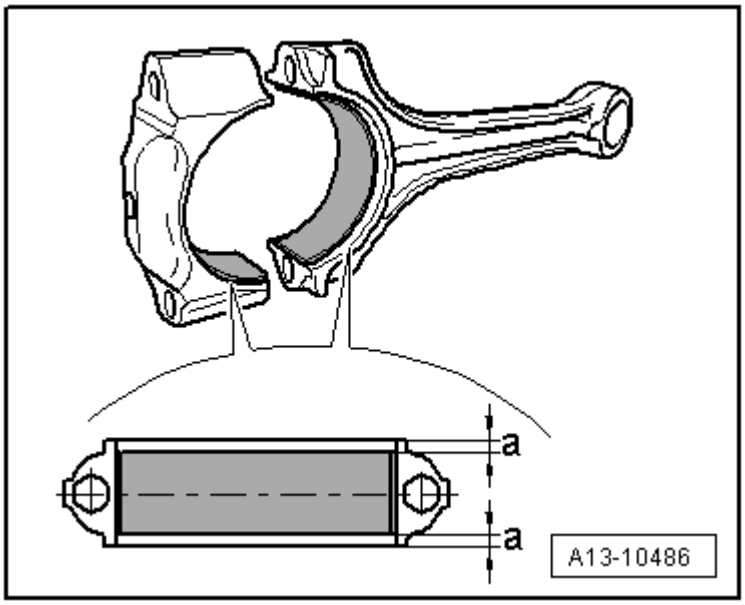

Fig. 193: Identifying Main Fuse Panel
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Fuse no. 43 must be OK.

Function test

- Connect Fault Read Out Device V.A.G 1551 and select engine electronics control module with "Address word 01". Engine must run at idle for this. Connect fault read out device and select engine control module.

Scan tool display:

Quick data transfer HELP Select function XX

- Press buttons 0 and 8 for function "Reading measuring value blocks" and press Q button to confirm input.

Scan tool display:

Read measuring value block Enter display group number XXX

- Press buttons 0 7 and 0 for "Display group number 70" and press Q button to confirm input.

Scan tool display: (1 to 4 = display fields)

Read measured value block 70 ->> 1 2 3 4

- Press button 4 for "Basic Setting" function ("Tank ventilation valve diagnosis" is initiated)

NOTE:

- **During this diagnosis, engine load must not be generated or diagnosis will be terminated and can only be re-initiated after pressing accelerator pedal.**

Scan tool display: (1 to 4 = display fields)

System in basic setting 70 -> 1 2 3 4

If diagnosis is initiated by engine control module, display in display field 4 goes from "Test OFF" to "Test ON".

- Allow engine to continue running at idle until specified value "TEV OK" is shown in display field 4.

NOTE:

- **TEV means (tank ventilation valve) (solenoid valve 1 for EVAP canister)**

If "TEV not OK" is shown in display field 4:

- Initiate diagnostic output mode (DTM) and activate Evaporative Emission (EVAP) Canister Purge Regulator Valve N80.
- Check DTC memory.
- Read readiness code.
- If DTC memory was cleared or engine control module disconnected from voltage supply, readiness code must be regenerated.

If specified value "TEV OK" is reached:

- Press the --> key.

Scan tool display:

Quick data transfer HELP Select function XX

- Press buttons 0 and 6 for function "End output" and press Q button to confirm input.
- Switch off ignition.

EVAP system, checking for leaks

Special tools, testers and auxiliary items required

- Fault Read Out Device V.A.G 1551 or Vehicle Diagnosis, Testing and Information System VAS 5051

Test conditions

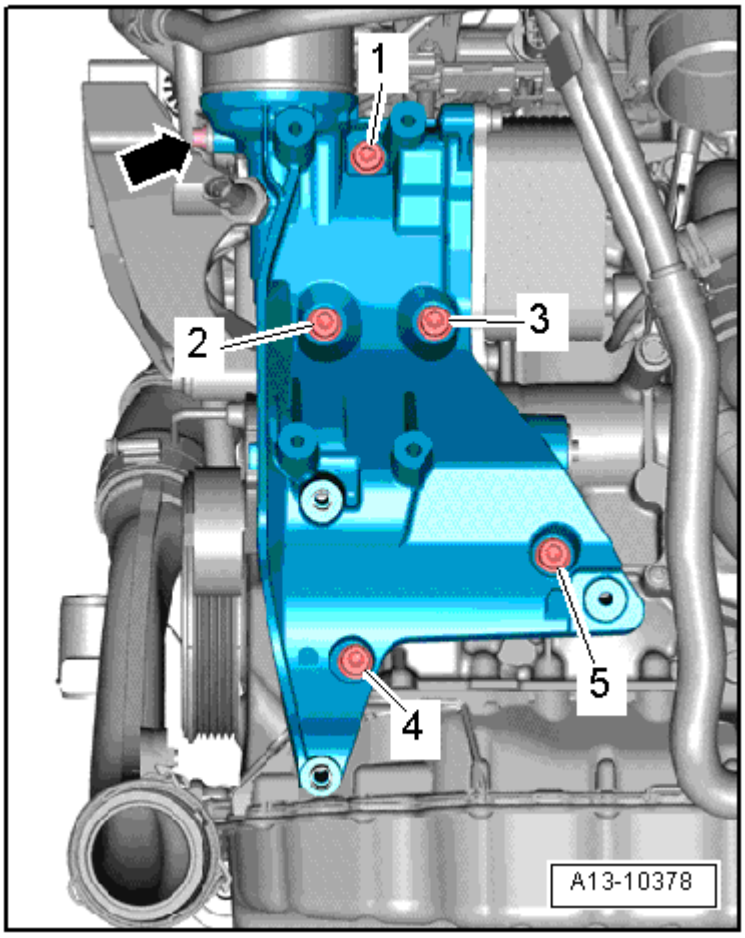

Fig. 194: Identifying Main Fuse Panel
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Fuse no. 43 must be OK.
- No DTCs in DTC memory.
- All electrical consumers such as, e.g. lights and rear window heater, must be switched off
- If vehicle is equipped with an A/C system, it must be switched off.

- Throttle valve angle less than 10 ° --> Display group 03, display field 3.
- Coolant temperature less than 99 ° C --> Display group 04, display field 3.
- Intake air temperature less than 95 ° C --> Display group 04, display field 4

Function test

- Connect Fault Read Out Device V.A.G 1551 and select engine electronics control module with "Address word 01". Engine must run at idle for this. Connect fault read out device and select engine control module.

Scan tool display:

Quick data transfer HELP
Select function XX

- Press buttons 0 and 8 for function "Reading measuring value blocks" and press Q button to confirm input.

Scan tool display:

Read measuring value block
Enter display group number XXX

- Press buttons 0 7 and 1 for "Display group number 71" and press Q button to confirm input.

Scan tool display

Read measured value block 71 ->
Reed open Test OFF

- Press button 4 for "Initiate basic setting" function

Scan tool display

System in basic setting 71 ->
Reed open Test ON

Scan tool display

System in basic setting 71 ->
Reed closed Test ON

EVAP canister system test is initiated. First, function of reed contact (in Leak Detection Pump (LDP) V144) is checked by control module.

Scan tool display

System in basic setting 71 ->
Reed closed Syst. Test Test ON

After approx. 10 seconds, Leak Detection Pump (LDP) V144 is activated and generates pressure in fuel system.

Scan tool display

System in basic setting 71 ->
Reed open Syst. Test Test ON

After approx. 50 seconds, the test is initiated (this can take up to 120 seconds if there is insufficient pressure in

the fuel system).

Scan tool display

System in basic setting 71 ->
Reed open Measurement Test ON

The Leak Detection Pump (LDP) V144 switches off and the time until the reed contact closes is measured by the control module.

Scan tool display

System in basic setting 71 ->
Reed closed END of measurement Syst. OK

- Check display in display fields 3 and 4:

Display field 3 specified value: END of measurement

Display field 4 specified value: Syst. OK

If the specifications are not obtained:

- Checking for leaks.

If specified values are achieved:

- Press --> key.
- Press buttons 0 and 6 for function "End output" and press Q button to confirm input.
- Switch off ignition.

Checking for leaks

If a small or large leak was recognized during the EVAP canister system function test, proceed as follows.

- Switch off ignition.
- Check whether the fuel filler cap is completely closed or whether the seal leaks, replace if necessary.
- Repeat function test.

If malfunction persists:

- Fold rear seat bench forward.
- Remove cover under bench seat.
- Check whether fuel delivery unit locking ring is tight or seal is faulty, replace if necessary. Tighten locking ring with Ring Nut Spanner 3217. Check supply and return line to fuel delivery unit for leaks.

- Repeat function test.

If malfunction persists:

- Remove right rear wheel housing liner, refer to **REAR WHEEL-HOUSING LINER** .
- Check pressure hose between diagnostic pump and EVAP canister for leaks , replace if necessary.
- Check lines and line connections between EVAP canister and tank flap unit or tank ventilation valve for leaks refer to **Evaporative emissions (EVAP) system, overview** .
- Repeat function test.

If malfunction persists:

- Remove EVAP canister and check for tears and leaks, replace if necessary.
- Repeat function test.

Leak Detection Pump (LDP), checking

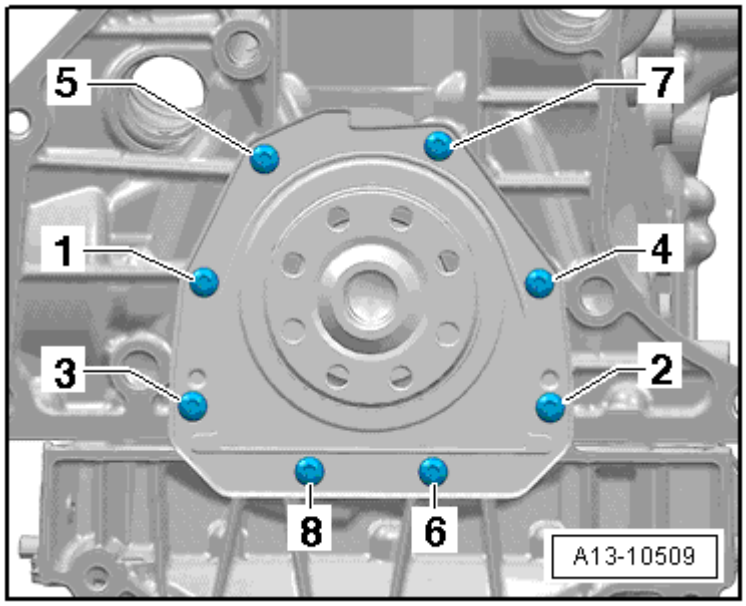

Fig. 195: Identifying Special Tools - Leak Detection Pump, Checking
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Multimeter V.A.G 1526A or Multimeter V.A.G 1526C
- Voltage tester V.A.G 1527B
- Connector Test Set V.A.G 1594A or Connector Test Set V.A.G 1594C
- Adapter cable, 121-pin V.A.G 1598/31
- Wiring diagram

Diagnostic pump, checking electrically

- Remove right rear wheel housing liner, refer to **REAR WHEEL-HOUSING LINER** .

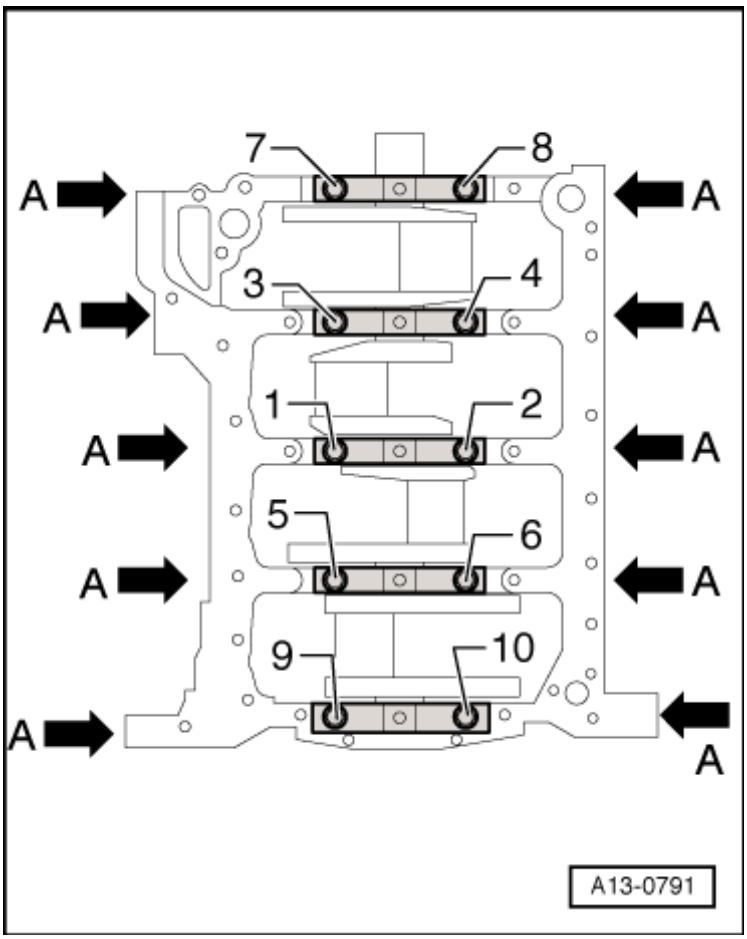

Fig. 196: Locating 3-Pin Connector At Fuel System Leak Detection Pump V144
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove 3-pin connector from fuel system Leak Detection Pump (LDP) V144.
- Connect Multimeter V.A.G 1526C for resistance measurement between terminals 1 and 3 on Leak Detection Pump (LDP) V144. Specified value: 640 to 720 ohms.
- Connect Multimeter V.A.G 1526C for resistance measurement between terminals 2 and 3 on Leak Detection Pump (LDP) V144. Specified value: 12.5 to 19.5ohms.

If specifications are not obtained:

- Replace Leak Detection Pump (LDP) V144.
- Check DTC memory.
- Read readiness code.
- If DTC memory was cleared or engine control module disconnected from voltage supply, readiness code must be regenerated.

Checking voltage supply

Test conditions

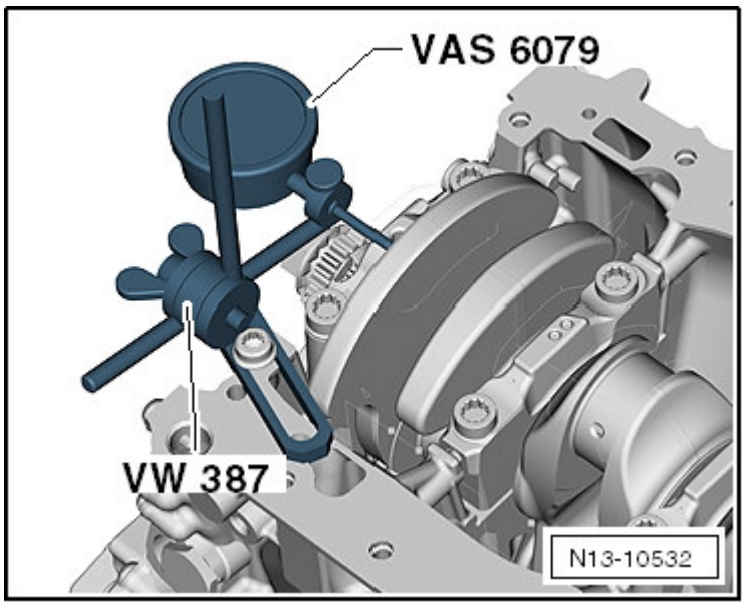

Fig. 197: Identifying Main Fuse Panel
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Fuse no. 43 must be OK.
- Battery voltage must be at least 11.5 Volts.

Test sequence

- Remove right rear wheel housing liner, refer to **REAR WHEEL-HOUSING LINER** 6.

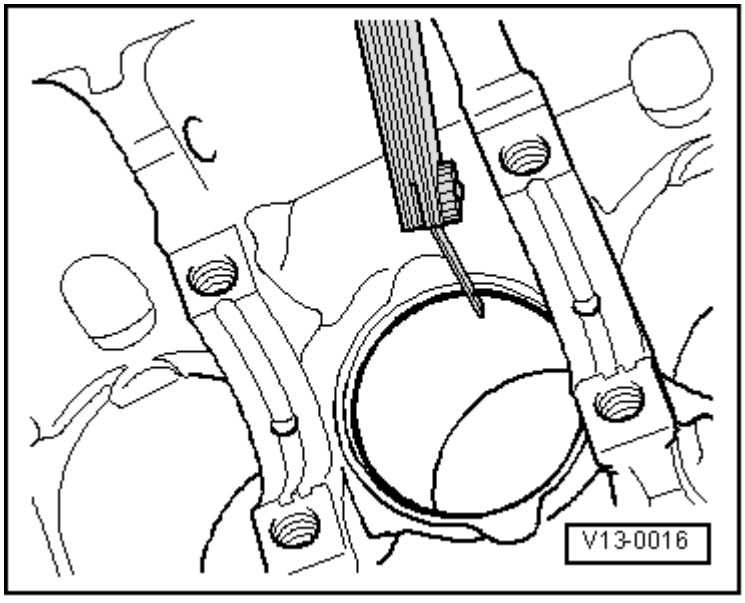

Fig. 198: Locating 3-Pin Connector At Fuel System Leak Detection Pump V144
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect 3-pin connector from fuel system Leak Detection Pump (LDP) V144.
- Connect Voltage Tester V.A.G 1527B between terminal 3 (positive) on connector and Ground (GND).
- Start engine and run at idle speed: LED must light up.

If LED does not light up:

- Switch off ignition.
- Check line between terminal 3 on connector and central electronics for open circuit according to wiring diagram. Wiring resistance: max. 1.5 ohms

LED lights up (voltage supply OK):

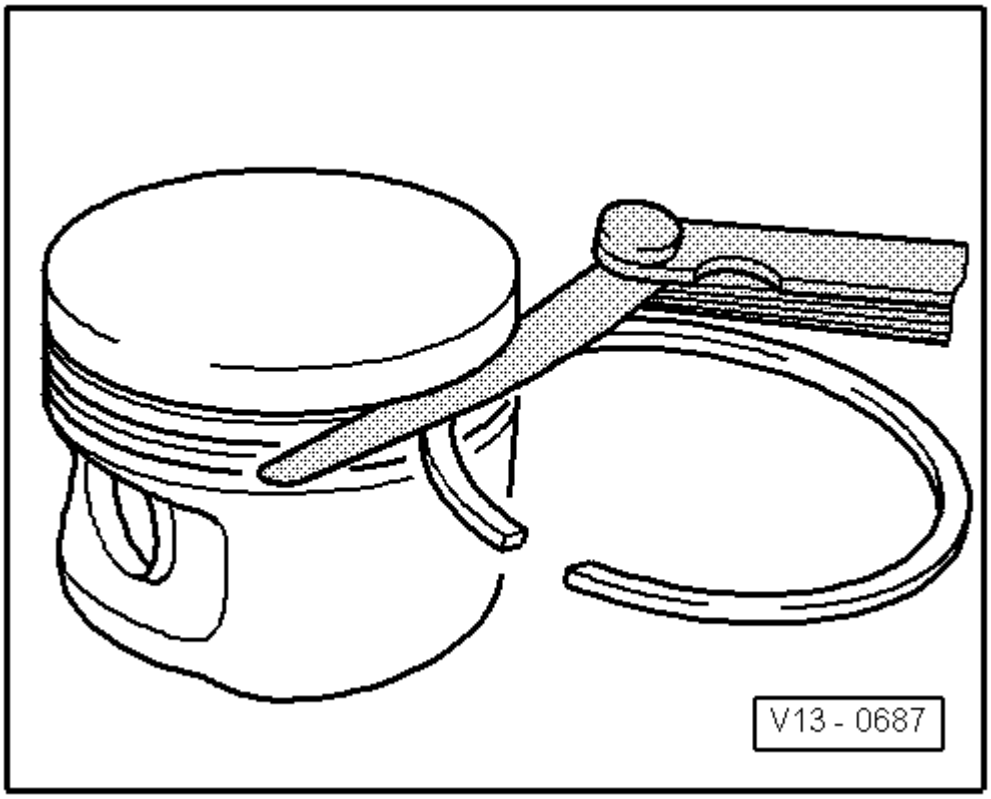

Fig. 199: Identifying Test Box V.A.G 1598/31 Connect To Control Module Wiring Harness
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect adapter cable, 121-pin V.A.G 1598/31 to engine control module (ECM) wiring harness. The engine control module remains disconnected.

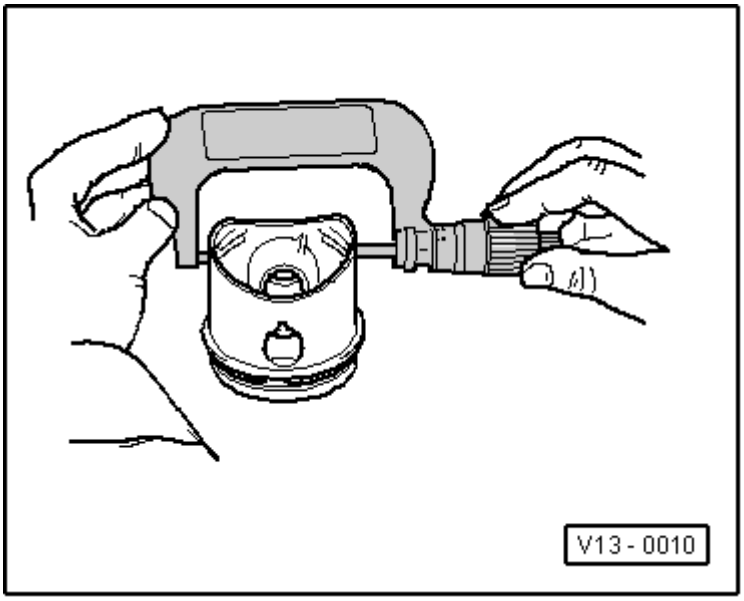

Fig. 200: Identifying 3-Pin Connector
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Check wiring between adapter cable, 121-pin V.A.G 1598/31 and 3-pin connector for open circuit according to wiring diagram.

Terminal 1 + socket 80

Terminal 2 + socket 25

Wiring resistance: max. 1.5 ohms

- Also check wires for short circuit to each other. Specified value: infinity ohms

If no malfunction is found in the wires and there was voltage between terminal 3 and Ground (GND):

- Replace Leak Detection Pump (LDP) V144.
- Check DTC memory.
- Read readiness code.
- If DTC memory was cleared or engine control module disconnected from voltage supply, readiness code must be regenerated.

EVAP system, checking using tester KILL 9210

Introduction

The KLI90210 EVAP tester allows testing using nitrogen to pressurize the EVAP system and a smoke generator or ultrasonic tester to locate the source of EVAP system concerns.

This procedure is intended as a general guide for the use of the EVAP tester. EVAP systems vary between

models.

Special tools, testers and auxiliary items required

- VAS 5051 or VAS 5052 diagnostic tester
- KLI90210 EVAP system tester (set to 14 in. H_2O)
- Light source (for viewing smoke)
- Hose Clamps up to 25mm dia. 3094 or equivalent

Using the KLI90210 EVAP system tester, refer to Tester operating instructions

Calibrating the KLI90210 tester

Determine the vehicle leak threshold:

- Up to and including M.Y. 1999 leak threshold = 0.040 in.
- From M.Y. 2000 leak threshold = 0.020 in.

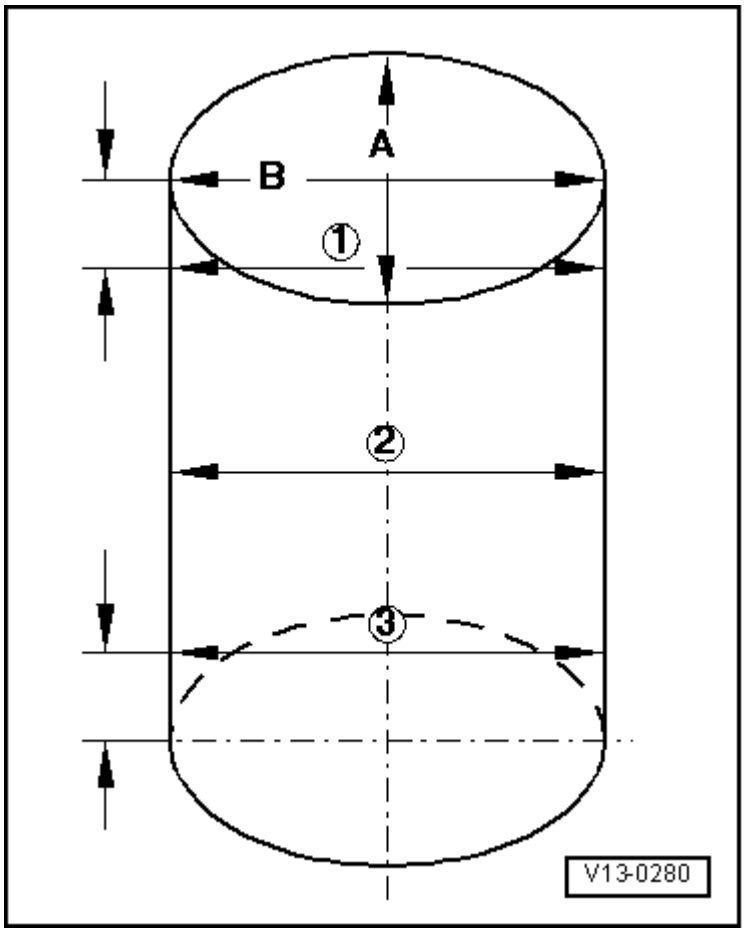

Fig. 201: Identifying Flow Meter Flag At Indicated Value On Flow Meter
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Attach test hose to appropriate pre-set port (black arrows).
- Turn control valve from "Hold" to "Test".
- Set flow meter flag (white arrow) at indicated value on flow meter.
- Turn control valve to "Hold" ; remove test hose.

Testing the fuel cap

- Remove fuel cap.

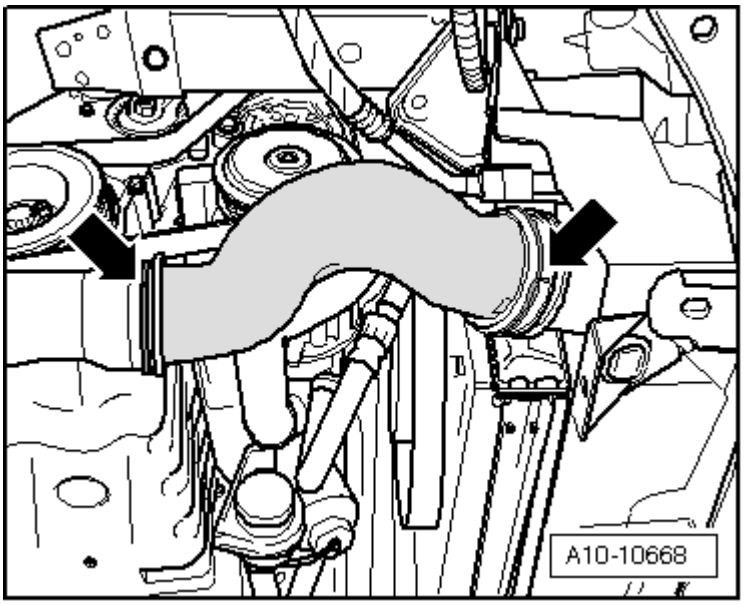

Fig. 202: Fuel Cap Receiver Connect To Hose
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect fuel cap receiver (arrow) to hose.
- Screw fuel cap tightly to cap receiver.
- Turn control valve to "Test" pressurizing cap.
- Turn valve to "Hold".
- Watch pressure gauge for drop in pressure from 14 inches H_2O.

If no pressure drop is indicated:

- Proceed to checking Leak Detection Pump (LDP) V144 for internal leaks.

If pressure drop is indicated:

- Replace fuel cap and re-test.
- Proceed to Checking Leak Detection Pump (LDP) V144 for internal leaks.

Checking Leak Detection Pump (LDP) V144 for internal leaks

Basically, in the following procedure the EVAP system will be filled with smoke, the engine started and the LDP activated using the VAS 5051 or VAS 5052. With the LDP activated, and after clearing initial smoke away from the LDP area using compressed air, the system is then filled with smoke again and rechecked for smoke at the LDP filter.

Conditions

- Ignition switched off
- LDP is visible, refer to Component Locations

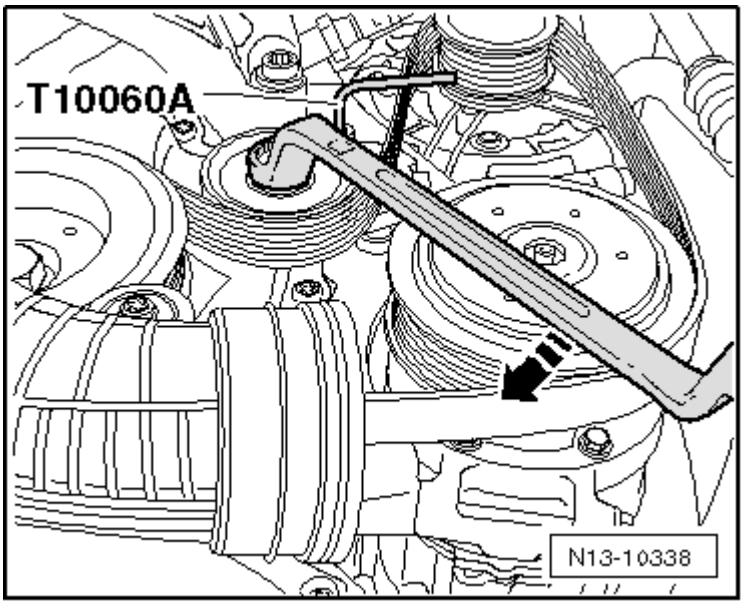

Fig. 203: Tester Hose Connected To Fuel Filler Neck
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tester hose connected to fuel filler neck
- VAS 5051 or VAS 5052 Diagnostic tool connected to vehicle
- Smoke generator connected to battery

- Turn KLI90210 valve to "Test" and use smoke generator trigger to fill system with smoke (wait until smoke is coming out of the LDP filter).
- Start engine.
- From VAS 5051 Start-up screen, select "Vehicle self diagnosis".

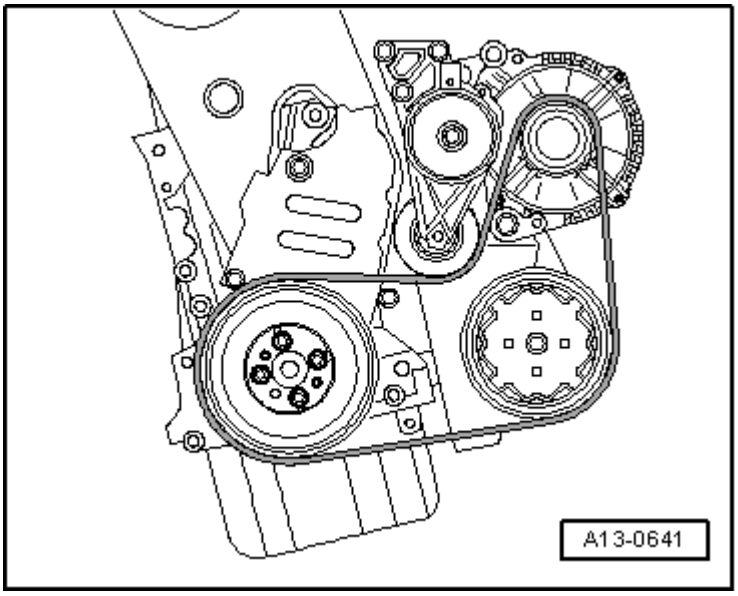

Fig. 204: Display Screen - Select Diagnostic Function
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Select vehicle system "01 - Engine electronics".

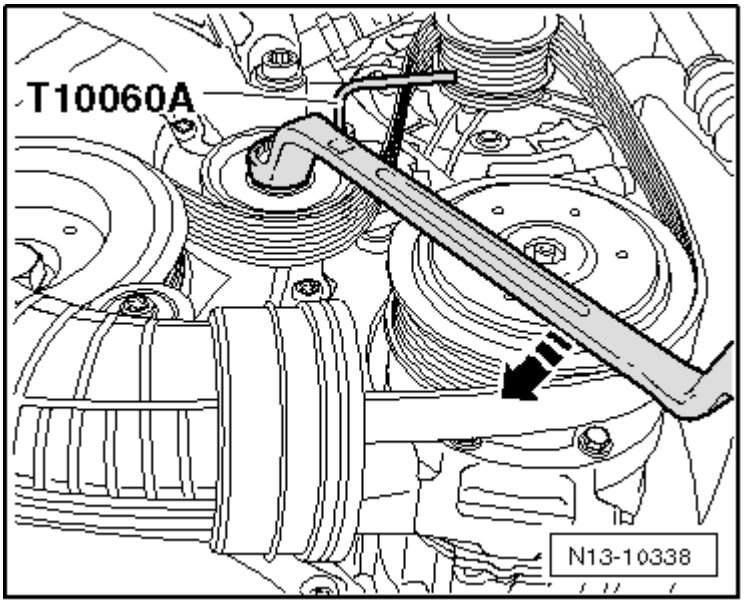

Fig. 205: Display Screen - 01 - Engine Electronics
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Select Diagnosis Function "04 - Basic settings".

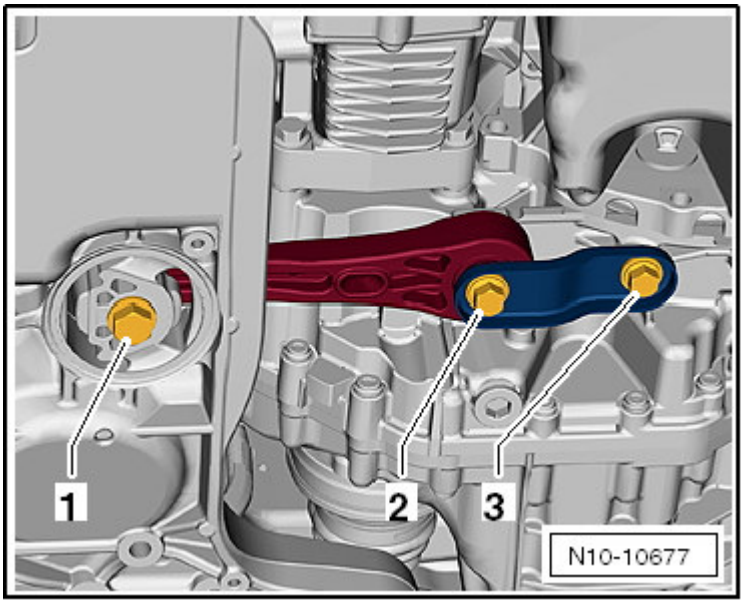

Fig. 206: Display Screen - 01 - Engine Electronics, Basic Settings
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Input appropriate display group from table below on keypad.

Engine code	Display group
AEB, AEG, AFP, AHA, APH, ATQ, ATW, AUG, AWD, AWM, AWP, AWV, AWW, BDC, BDF, BEV, BGD, BGJ	071
AVH, AZG, BAP, BBW, BDP	202

- Press "Q" on keypad to confirm.

LDP should activate

If LDP does not activate:

For some vehicles using Display group 202 a similar screen appears indicating "Test Off".

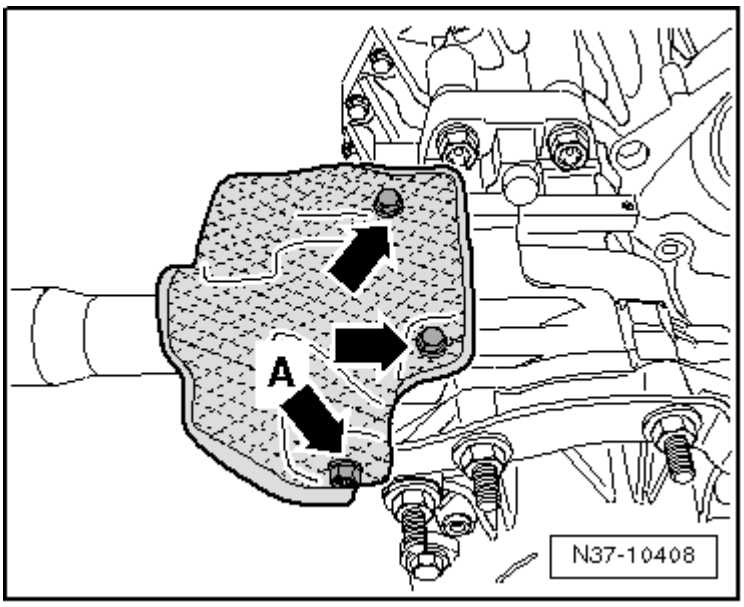

Fig. 207: Display Screen - 01 - Engine Electronics, Basic Settings, LDP Activated
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Select "Activating" button.

If LDP does not activate:

- Check electrical connections to LDP.
- Check vacuum source to LDP.

If LDP activates:

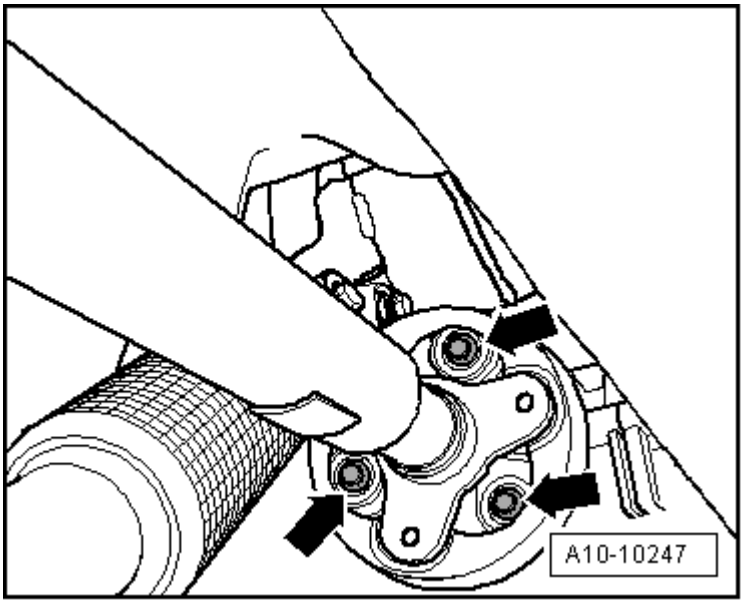

Fig. 208: IdentifyingDisplay Screen - 01 - Engine Electronics, Basic Settings, LDP Activated, "1" In Position 5

Courtesy of VOLKSWAGEN UNITED STATES, INC.

A similar screen appears, Test is "ON" (indicated by a "1" in position 5, - **arrow** -).

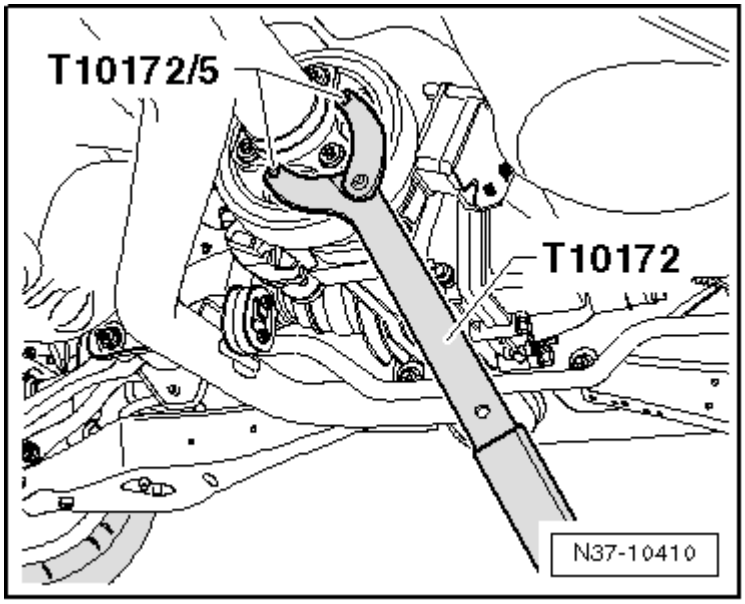

Fig. 209: IdentifyingDisplay Screen - 01 - Engine Electronics, Basic Settings, LDP Activated, Position 1
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Position 1 - **arrow** - alternates between "0" and "1" during pump operation.

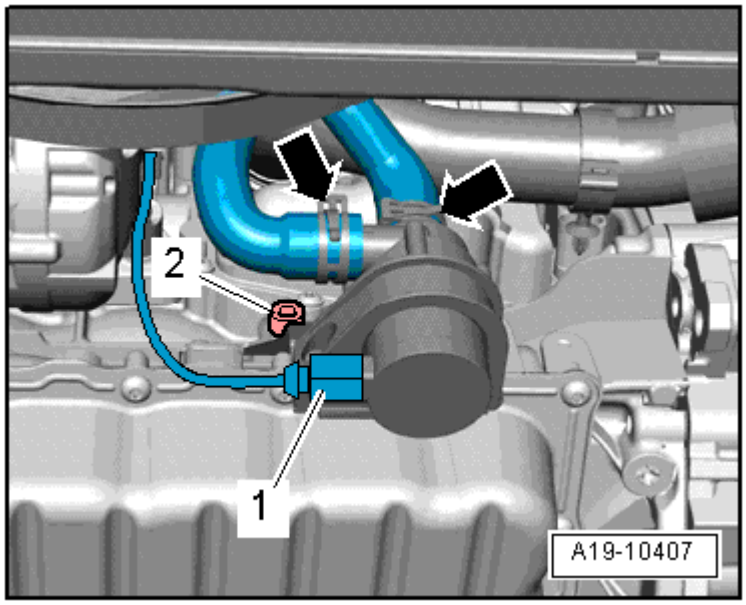

Fig. 210: IdentifyingDisplay Screen - 01 - Engine Electronics, Basic Settings, LDP Activated, "1" In Position 6 And "0" In Position 8
Courtesy of VOLKSWAGEN UNITED STATES, INC.

If test is OK:

Indicated by "1" in position 6 and a "0" in position 8 as shown.

LDP has activated and the system is pressurized.

- Using a compressed air blow gun, clear area near LDP and LDP filter of any residual smoke.

If the test aborts and DTCs other than for small or large leaks are stored:

- Check and repair according to DTC listed in DTC table for appropriate engine code.

When "Check end" is indicated on VAS 5051 or VAS 5052 :

NOTE:

- **Only check LDP during "Check end" phase when "Test OK" was indicated.**

- Use smoke generator trigger to fill system with smoke again.
- Check for smoke doming from LDP filter and LDP hose connections.

- Smoke coming from filter indicates a faulty LDP
- Smoke coming from LDP outlet or hose indicates a faulty hose or clamp

- Make repairs as necessary and check with smoke again.

- No smoke coming from filter indicates LDP is OK and leak is somewhere else in EVAP system

NOTE:

- **If the KLI90210 EVAP system tester is connected in "Test" mode and Basic settings (using Self Diagnosis) and Fault finding are activated, a false "System OK" message may be generated.**

If the LDP is OK and a DTC was stored for the EVAP system:

- Switch ignition off.
- Continue checking EVAP system as follows:

Checking EVAP system for leaks

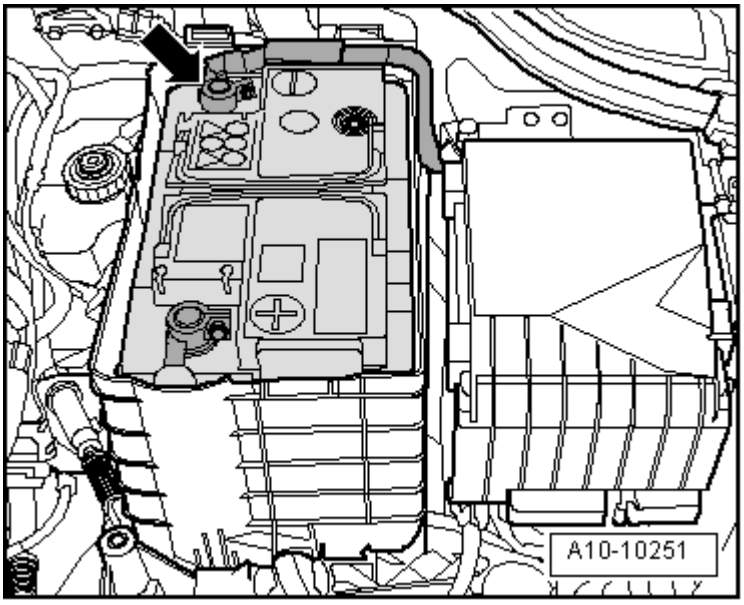

Fig. 211: Identifying LDP Outlet EVAP Side
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Clamp off LDP outlet (EVAP side) - **1** - using Hose Clamps up to 25 mm dia. 3094 or equivalent.

CAUTION: Clamp only soft rubber lines when isolating a leak. To avoid risk of damage, never clamp hard plastic lines!

- Turn control valve from "Hold" to "Test".
- Allow fuel system to pressurize.

NOTE:

- **Fuel system pressurization depends on volume of fuel system and amount of fuel in tank.**

If fuel system pressurization does not stabilize:

- Verify that all fuel system outlets have been sealed before continuing.

NOTE:

- **Any flow shown on flow meter indicates a leak. Flow below flow meter flag set at vehicle leak standard may indicate a sporadic DTC.**

If flow meter on tester registers flow near or above pre-set pressure:

- Clamp off hose leading from EVAP canister purge regulator valve N80 to intake manifold.

If flow stops:

- Replace EVAP canister purge regulator valve N80 and repeat test before continuing.

If meter indicates no flow after test:

- Perform quality check and return vehicle to customer.

If flow continues:

- Use smoke generator trigger to charge fuel system with smoke again.
- Inspect complete EVAP system for escaping smoke.

NOTE:

- **It may be necessary to move, twist, or wiggle EVAP components around to reproduce leak.**

If leak cannot be found using smoke:

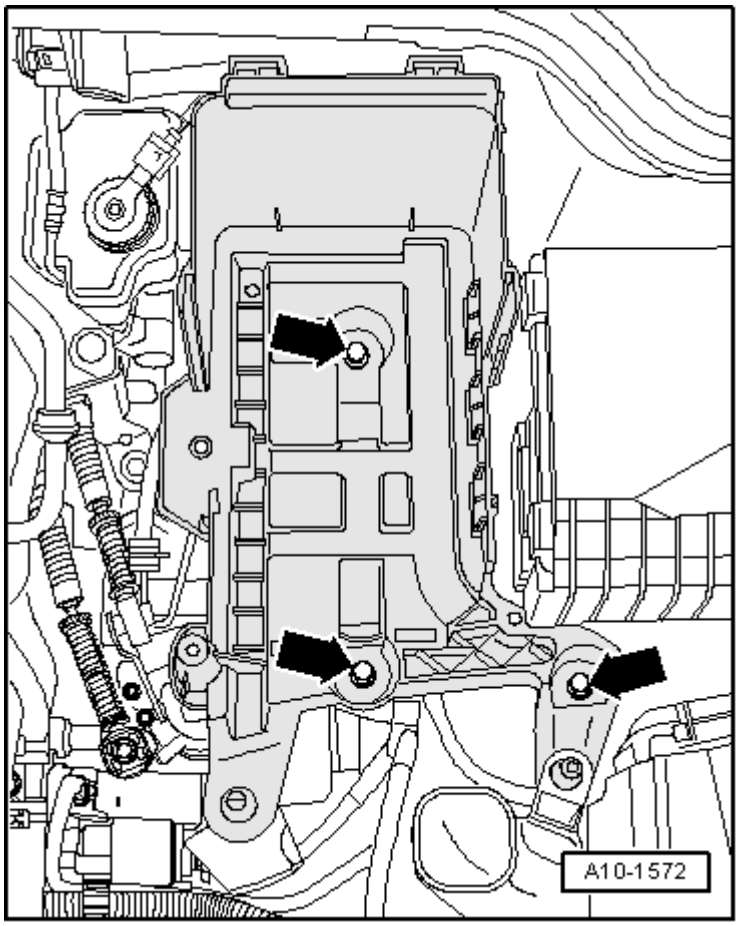

Fig. 212: Identifying Ultrasonic Tester
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Locate leak with ultrasonic tester.

- General search: tester only
- Localized search: tester with extension wand (left)

If leak cannot be located:

- Disconnect and plug or clamp shut EVAP lines to isolate fuel tank using Hose Clamps up to 25 mm dia. 3094 or equivalent before continuing.

CAUTION: Clamp only soft rubber lines when isolating a leak. To avoid risk of damage, never clamp hard plastic lines!

If flow stops:

- Reconnect EVAP lines and search area that was isolated.

When leak has been located:

- Repair leak and repeat EVAP system test.

NOTE:

- **Because leak may be at top of fuel tank, it may not be possible to locate through fuel pump/sending unit access plate.**
- **Lower fuel tank if necessary to locate leak.**

CAUTION: Do not return vehicle to the customer without having performed a proper diagnosis and repair.

21 - TURBOCHARGER, G-CHARGER

CHARGE AIR SYSTEM WITH TURBOCHARGER

Charge air system with turbocharger

NOTE:

- **Various hose connections are secured with clamps.**
- **Charge air system must be properly sealed.**
- **Replace self-locking nuts.**
- **Vacuum hoses and connectors must be free of grease when reinstalling.**

- Pliers for spring clamps VAS 5024 A or Hose clamp pliers V.A.G 1921 are recommended for installing spring clamps.

Turbocharger with attachments, assembly overview, refer to **Turbocharger with attachments, assembly overview**

Charge air cooling system components, assembly overview, refer to **Charge air cooler components, assembly overview**

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

Observe safety precautions refer to **Safety precautions** .

Charge pressure system, checking, refer to **Charge pressure system, checking**

Turbocharger with attachments, assembly overview

Part I

Part II

Part I

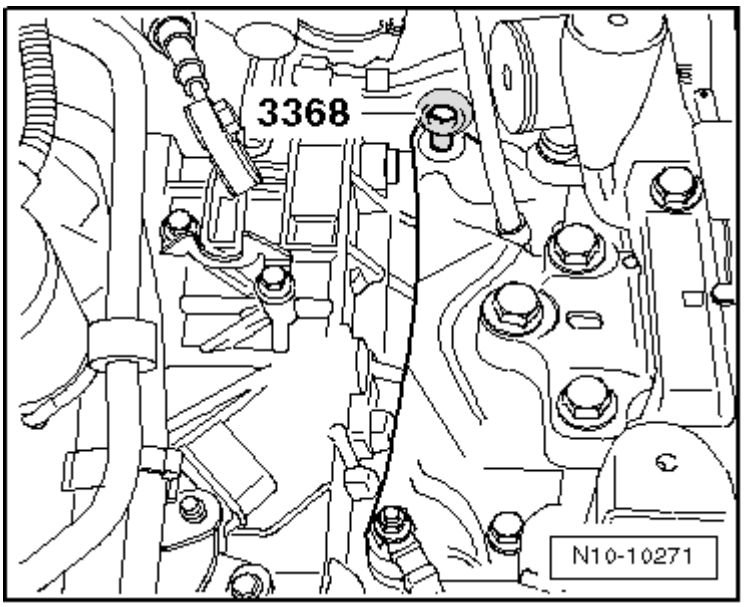

Fig. 213: Turbocharger With Attachments, Assembly Overview - Part I
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 40 Nm

- Coat threads with *hot bolt paste G 052 112 A3*

2 - Seal

- Replace

3 - 10 Nm

- Must not be loosened

4 - Vacuum diaphragm

- For boost pressure regulator valve
- Can only be replaced as together with turbocharger
- Charge pressure regulation, checking refer to **Boost pressure regulation, checking**

5 - Fuse

6 - Turbocharger

- Charge pressure regulation, checking refer to **Boost pressure regulation, checking**
- The boost pressure regulator valve and vacuum diaphragm for boost pressure regulator valve are part of the exhaust turbocharger and cannot be replaced individually.
- Before connecting oil supply line, fill turbocharger with oil at filler tube
- After installing turbocharger, let engine idle for approx. 1 minute without increasing engine speed. This ensures adequate oil supply to the turbocharger.

7 - O-ring

- Replace

8 - 10 Nm

9 - Intake manifold

10 - Gasket

- Replace
- Note installation position

11 - 20 Nm

12 - Heat shield

13 - 10 Nm

14 - Banjo bolt, 30 Nm

15 - Oil supply line

16 - 30 Nm

- Replace
- Coat threads and bolt head contact surfaces with *Hot Bolt Paste G 052 112 A3* (Part numbers are for reference only. Always check with your Parts Department for the latest part number information).

17 - Exhaust manifold

18 - Gasket

- Replace
- Note installation position

19 - 20 Nm

20 - Banjo bolt, 30 Nm

21 - 25 Nm

- Replace
- Coat threads with *hot bolt paste G 052 112 A3* (Part numbers are for reference only. Always check with your Parts Department for the latest part number information).

22 - Banjo bolt, 35 Nm

23 - Coolant return line

24 - 25 Nm

25 - Spacer sleeve

26 - Banjo bolt, 35 Nm

27 - 10 Nm

28 - Coolant supply line

29 - Banjo bolt, 35 Nm

30 - 30 Nm

- Only use original bolt from parts catalog

31 - Bracket

- Between turbocharger and cylinder block

32 - 25 Nm

33 - Gasket

- Replace

34 - Gasket

- Replace

35 - 10 Nm

36 - Oil return line

- To oil pan

37 - 10 Nm

38 - 10 Nm

- Do not change adjustment
- Must not be loosened

Part II

NOTE:

- **Components marked with * are checked via On Board Diagnostic (OBD).**
- **Components marked with ** are checked via output Diagnostic Test Mode (DTM).**
- **Note installation position of heat shield mats**

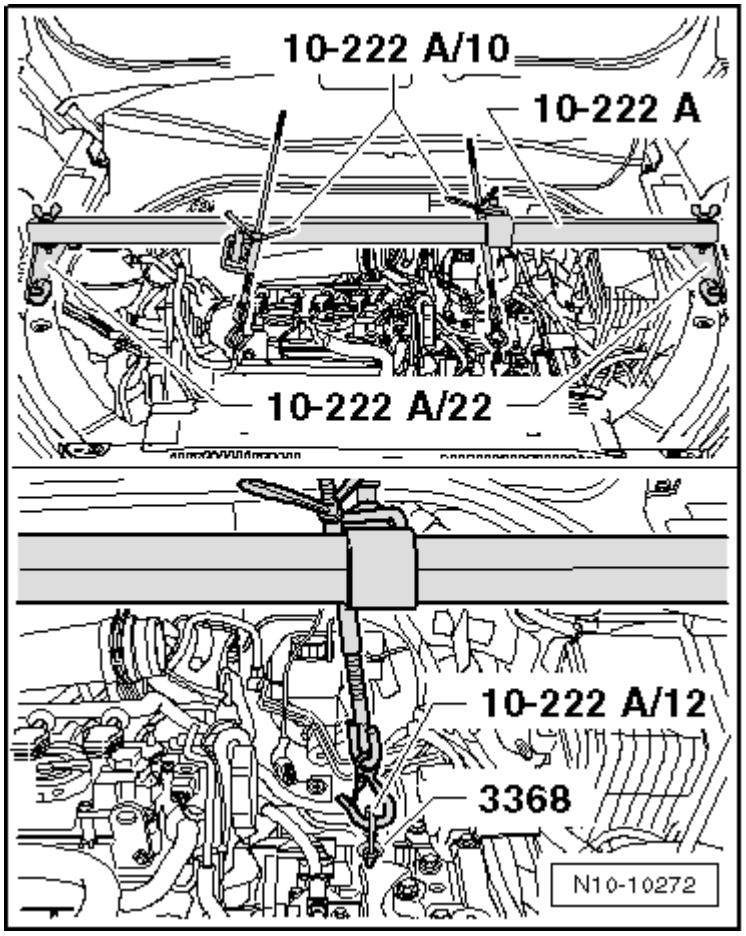

Fig. 214: Turbocharger With Attachments, Assembly Overview - Part II
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Deceleration shut-off valve

- Checking refer to **Deceleration shut-off valve, checking**

2 - Connecting hose

- To Recirculating valve for turbocharger N249 */**

3 - Pressure regulator valve

- For crankcase ventilation

4 - Connecting hose

- From deceleration shut-off valve to upper air guide pipe

5 - To crankcase housing ventilation

6 - From air filter

7 - Upper air guide pipe

- Note installation position of heat shield mat
- Vehicles with engine code AWP, AWW with quick-release connection (with O-ring and retaining clip)
- Vehicles with engine code AWD with screw-type clamps

8 - Bracket

9 - 40 Nm

10 - 25 Nm

11 - To connection hose for lower connection sleeve/charge air cooler

12 - O-ring

- Replace
- Only vehicles with engine code AWP, AWW

13 - Retaining clip

- Check for secure seat
- Only vehicles with engine code AWP, AWW

14 - 10 Nm

15 - From turbocharger exhaust connection

16 - Connecting hose

17 - Connecting hose

- To vacuum diaphragm for boost pressure regulator valve

18 - Retaining clip

- Check for secure seat

19 - O-ring

- Replace

20 - Intake tube

- To intake tube of turbocharger

21 - Wastegate Bypass Regulator Valve N75 */**

- Valve is activated (pulsed) by engine control module
- Check activation.

Charge air cooler components, assembly overview

NOTE:

- **Various hose connections are secured with clamps.**
- **Charge air system must be properly sealed.**
- **When installing, follow installation marks on hoses and components.**
- **Note installation position of heat shield mats**

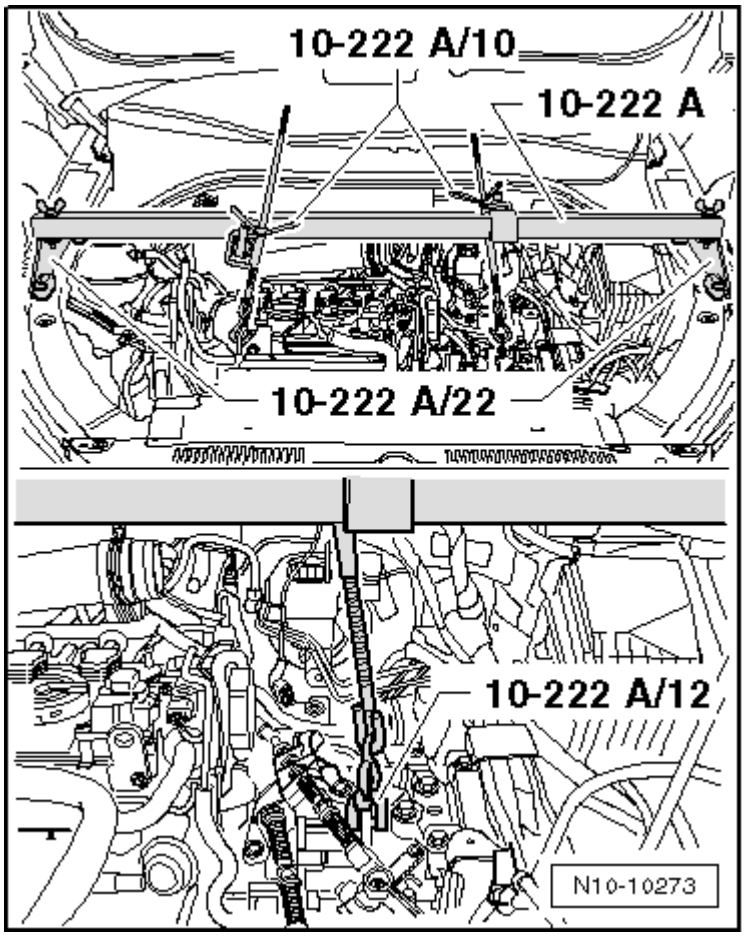

Fig. 215: Charge Air Cooler Components, Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Air duct

2 - 10 Nm

3 - Charge Air Pressure Sensor G31

- Checking refer to **Charge Air Pressure Sensor G31 , checking**

4 - O-ring

- Replace

5 - Rubber grommet

- With sleeve

6 - 10 Nm

7 - Intake tube

- Between intake manifold and charge air cooler

8 - Heat shield mats

- Note installation position

9 - Screw clamp

- Only vehicles with engine code AWD
- Vehicles with engine code AWP, AWW with quick-release connection (with O-ring and retaining clip)

10 - Connecting hose

11 - Air guide pipe

12 - Bracket

13 - Connecting hose

14 - Air charge cooler

Exhaust turbocharging system (engine code AWD), overview

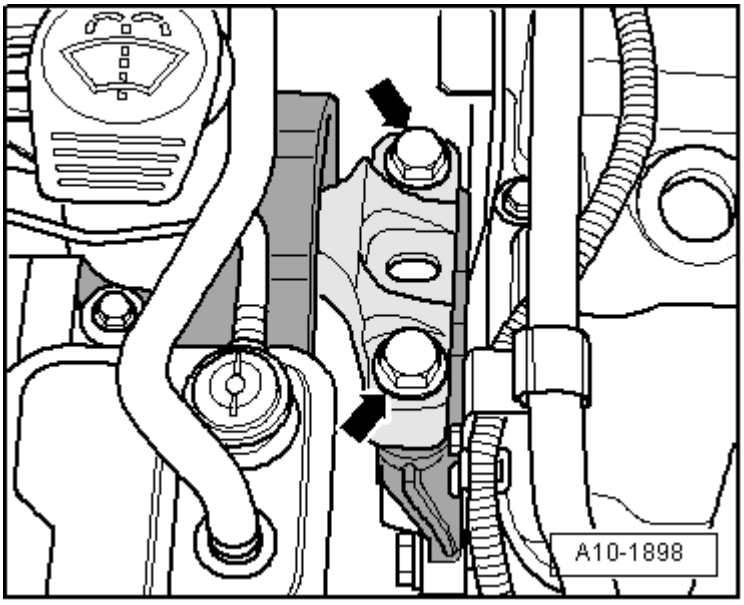

Fig. 216: Exhaust Turbocharging System (Engine Code AWD), Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Connecting hose

- From Leak Detection Pump (LDP) V144

2 - To vacuum reservoir

- Below front right wheel housing liner

3 - Non-return valve

4 - Turbocharger

5 - Non-return valve

6 - Vacuum diaphragm

- For boost pressure regulator valve

7 - Deceleration shut-off valve

8 - Wastegate Bypass Regulator Valve N75

- Valve is activated (pulsed) by engine control module
- Check activation.

9 - Brake booster

10 - Non-return valve

- For brake booster

11 - Air filter with Mass Air Flow (MAF) Sensor G70

12 - Crankcase housing ventilation pressure regulator valve

13 - Combi-valve

- For Secondary Air Injection (AIR) system
- Checking, refer to **Combi-valve, checking** **Combi-valve, checking**

14 - Fuel pressure regulator

15 - Non-return valve

16 - Turbocharger Recalculating Valve N249

17 - Secondary air injection (AIR) solenoid valve N112

- Checking, refer to **Secondary Air Injection (AIR) Solenoid Valve N112 , checking**

18 - Crankcase ventilation

19 - Non-return valve

20 - Charge Air Pressure Sensor G31

- Replace O-ring if damaged

21 - Secondary Air Injection (AIR) Pump Motor V101

- Function, checking refer to **Secondary Air Injection (AIR) Pump Motor V101 , checking**

22 - Air charge cooler

23 - To vacuum reservoir

24 - Evaporative Emission (EVAP) Canister Purge Solenoid Valve 1 N80

- Check activation
- Function, checking refer to **Evaporative Emission (EVAP) Canister Purge Regulator Valve N80 , checking**

25 - Connecting hose

- To EVAP canister

Exhaust turbocharging system (engine code AWP, AWW), overview

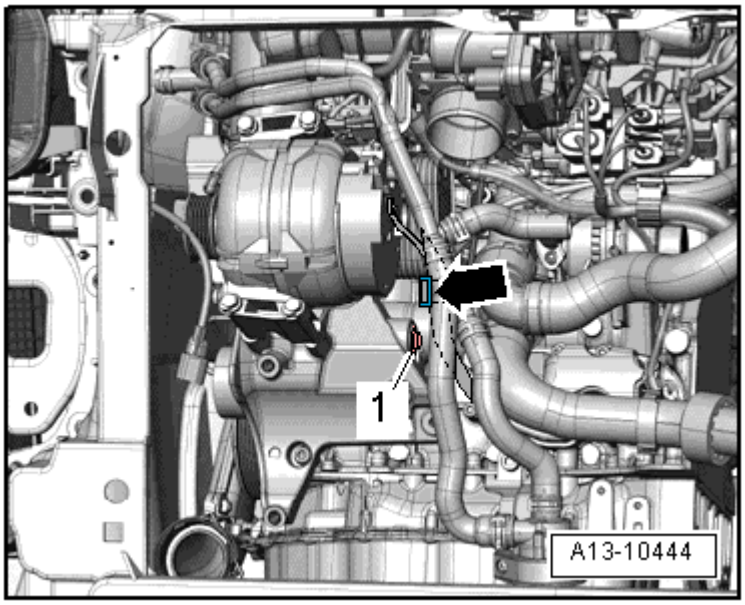

Fig. 217: Exhaust Turbocharging System (Engine Code AWP, AWW), Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Connecting hose

- From the Leak Detection Pump (LDP) V144

2 - To vacuum reservoir

- Below front right wheel housing liner

3 - Non-return valve

4 - Turbocharger

5 - Vacuum diaphragm

- For boost pressure regulator valve

6 - Deceleration shut-off valve

7 - Brake booster

8 - Non-return valve

- For brake booster

9 - Wastegate Bypass Regulator Valve N75

- Valve is activated (pulsed) by engine control module
- Check activation.

10 - Air filter with Mass Air Flow (MAF) Sensor G70

11 - Crankcase housing ventilation pressure regulator valve

12 - Combi-valve

- For Secondary Air Injection (AIR) system
- Checking, refer to **Combi-valve, checking**

13 - To vacuum reservoir

14 - Fuel pressure regulator

15 - Crankcase ventilation

16 - Non-return valve

17 - Turbocharger Recalculating Valve N249

18 - Secondary air injection (AIR) solenoid valve N112

- Checking, refer to **Secondary Air Injection (AIR) Solenoid Valve N112 , checking**

19 - Suction jet pump

20 - Secondary Air Injection (AIR) Pump Motor V101

- Function, checking refer to **Secondary Air Injection (AIR) Pump Motor V101 , checking**

21 - Intake manifold

22 - Charge Air Pressure Sensor G31

23 - Air charge cooler

24 - Non-return valve

25 - Evaporative Emission (EVAP) Canister Purge Solenoid Valve 1 N80

- Check activation.
- Function, checking refer to **Evaporative Emission (EVAP) Canister Purge Regulator Valve N80 ,**

checking

26 - Connecting hose

- To EVAP canister

Rules for cleanliness

When working on turbocharger, carefully observe the following "5 rules" of cleanliness:

- 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 the system is open: Avoid working with compressed air if possible. Do not move vehicle unless absolutely necessary.

Safety precautions

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 canister system, coolant and refrigerant, brake fluid, vacuum) and electrical wiring so that the original path is followed.**
- **Ensure sufficient clearance to all moving or hot components.**

CAUTION: Observe the following if test and measuring instruments are required during a test drive:

- **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 passengers 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.

CHARGE PRESSURE SYSTEM, CHECKING

Boost pressure regulation, checking

Special tools, testers and auxiliary items required

- Fault Read Out Device V.A.G 1551 or Vehicle Diagnosis, Testing and Information System VAS 5051

Test conditions

- There must be no malfunctions stored in DTC memory.
- No leaks on intake or exhaust side.
- Engine oil temperature at least 80 ° C

Test sequence

- Charge pressure is measured under Wide Open Throttle (WOT) while driving or on the roller type test stand.

Observe safety precautions that apply to road tests refer to **Safety precautions** .

- Connect Fault Read Out Device V.A.G 1551 and select engine electronics control module with "Address word 01". Engine must run at idle for this. Connect fault read out device and select engine control module.

Scan tool display:

```
Quick data transfer HELP
Select function XX
```

- Press buttons 0 and 8 for function "Reading measuring value blocks" and press Q button to confirm input.

Scan tool display:

```
Read measuring value block
Enter display group number XXX
```

- Press buttons 1 1 and 4 for the "Display group number 114" and press Q button to confirm input.

Scan tool display: (1 to 4 = display fields)

```
Read measured value block 114 ->
1 2 3 4
```

- During a road test or on a test stand, check (at full throttle between 1800 and 2300 RPM) duty cycle of Wastegate Bypass Regulator Valve N75 in display field 4. Specified value: 5.0 to 95.0%

If specified value is not achieved:

- Switch to display group 15 as follows: Press 3 button.

Scan tool display: (1 to 4 = display fields)

Read measured value block 115 -> 1 2 3 4

- Check charge air pressure actual value with wide open throttle (WOT) in display field 4:

While driving

Vehicles with manual transmission

- Accelerate vehicle at Wide Open Throttle (WOT) in 2nd gear.

Vehicles with automatic transmission

- Manually shift vehicle in 4th gear and accelerate vehicle from low speed at Wide Open Throttle (without kick down, transmission does not downshift any more).

Engine code AWD, AWW

- Press print button between 1800 and 2300 RPM and read out charge air pressure actual value in display field 4. Specified value: 1350 to 1750 mbar

Engine code AWP

- Press print button between 1800 and 2300 RPM and read out charge air press actual value in display field 4. Specified value: 1700 to 2000 mbar

Continuation for all vehicles

- Compare charge air pressure actual value with specified value in display field 3. Difference: max. 100 mbar

NOTE:

- **Repeat measurement if full charge air pressure had not been reached yet or difference between specified and actual value is too large.**

- Press --> key.
- Press buttons 0 and 6 for function "End output" and press Q button to confirm input.
- Switch off ignition.

If boost pressure is exceeded:

- Test the Charge Air Pressure Sensor G31 refer to **Charge Air Pressure Sensor G31 , checking** .
- Check Wastegate Bypass Regulator Valve N75. (Throughput in hose from turbocharger via valve to vacuum diaphragm with connector disconnected)

- Check that vacuum diaphragm for charge pressure regulator valve is securely seated on turbocharger.
- Check vacuum diaphragm, refer to **Vacuum diaphragm for boost pressure regulator valve, checking** .
- Check the mounting of the boost pressure regulator valve shaft in the turbocharger for ease of movement. If rusted in place, replace turbocharger.

If boost pressure is exceeded:

- Test Charge Air Pressure Sensor G31 refer to **Charge Air Pressure Sensor G31 , checking** .
- Check Wastegate Bypass Regulator Valve N75.
- Check mounting of the boost pressure regulator valve shaft in the turbocharger for ease of movement. If rusted in place, replace turbocharger.
- Exhaust turbocharger faulty, replace it, refer to **Turbocharger with attachments, assembly overview** .
- Check DTC memory.
- Read readiness code.
- If DTC memory was cleared or engine control module disconnected from voltage supply, readiness code must be regenerated.

Wastegate Bypass Regulator Valve N75 , checking

Special tools, testers and auxiliary items required

- Fault Read Out Device V.A.G 1551 or Vehicle Diagnosis, Testing and Information System VAS 5051B
- Portable multimeter V.A.G 1526C
- Connector test set V.A.G 1594C

Test conditions

- Output diagnostic test performed:
- Ignition switched off.

Test sequence

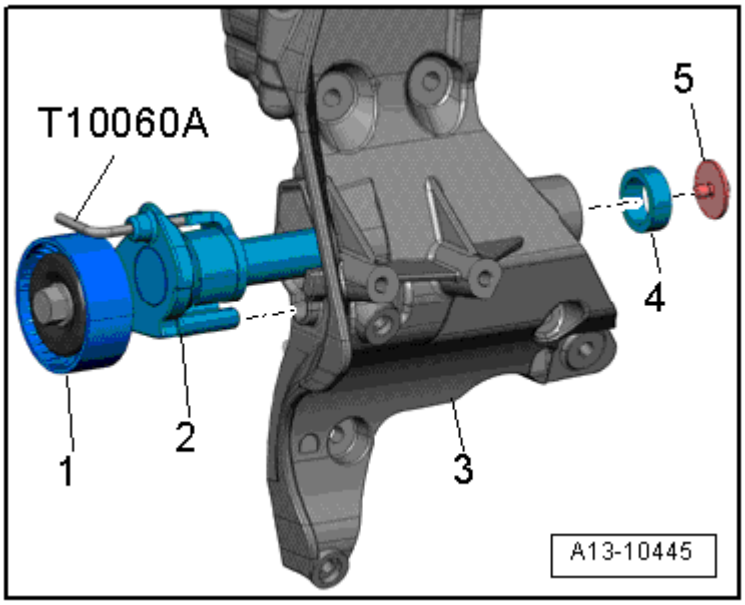

Fig. 218: Identifying Connector At Wastegate Bypass Regulator Valve N75
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect connector - **2** - at Wastegate Bypass Regulator Valve N75 - **1** -.

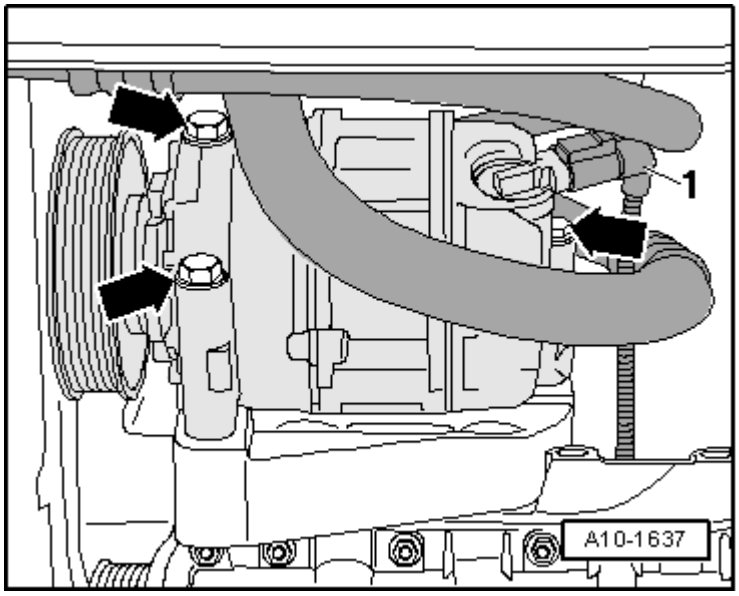

Fig. 219: Measuring Resistance Between Terminals Of Valve
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Measure resistance between terminals of valve. Specified value: 25 to 35 ohms

If specification is not obtained:

- Replace Wastegate Bypass Regulator Valve N75.

- Check DTC memory.
- Read readiness code.
- If DTC memory was cleared or engine control module disconnected from voltage supply, readiness code must be regenerated.

If specified value is not achieved:

- Check specified values in measured value blocks for charge pressure regulation: Display groups 110 to 119.

Charge Air Pressure Sensor G31 , checking

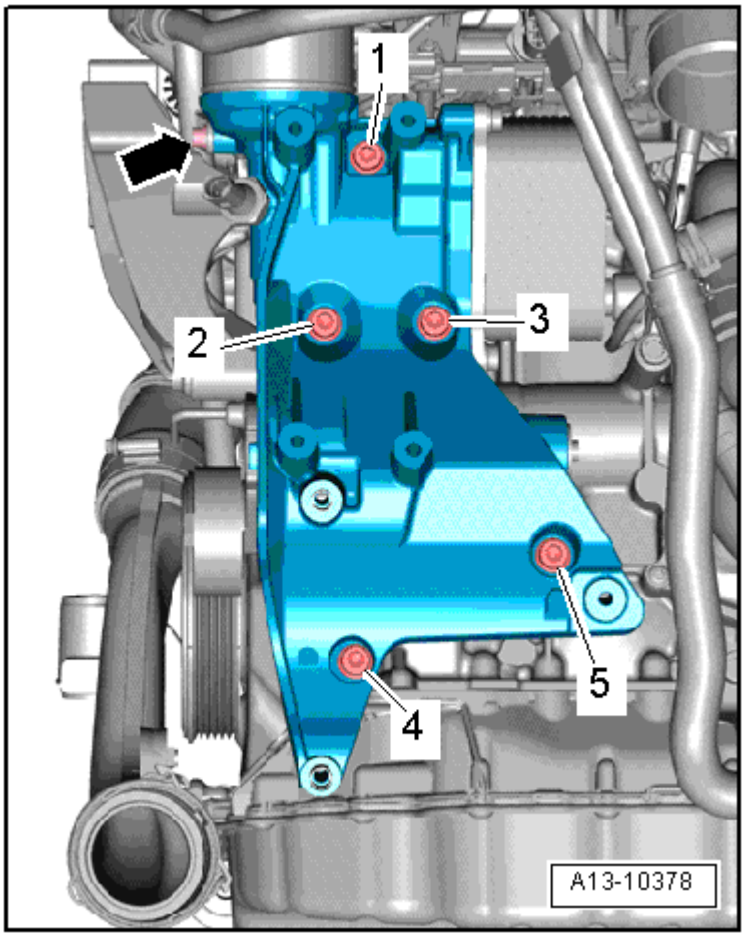

Fig. 220: Identifying Special Tools - Charge Air Pressure Sensor G31 , Checking
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Multimeter V.A.G 1526A or Multimeter V.A.G 1526C
- Connector Test Set V.A.G 1594A or Connector Test Set V.A.G 1594C
- Adapter cable, 121-pin V.A.G 1598/31

- Wiring diagram

Test conditions

- A malfunction in charge air pressure sensor was detected by On Board Diagnostic (OBD).
- Ignition switched off.

Voltage supply and wiring to control module, checking

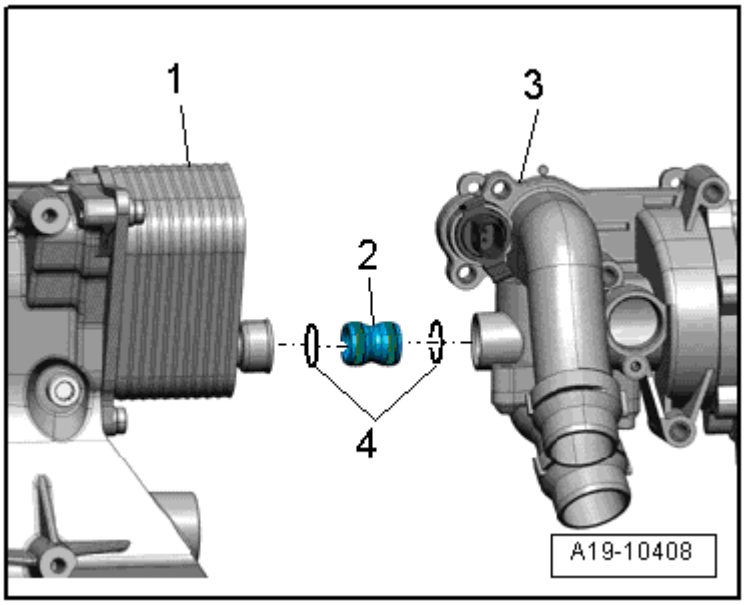

Fig. 221: Identifying 4-Pin Connector At Charge Air Pressure Sensor G31
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove 4-pin connector - **2** - from Charge Air Pressure Sensor G31 - **1** -.

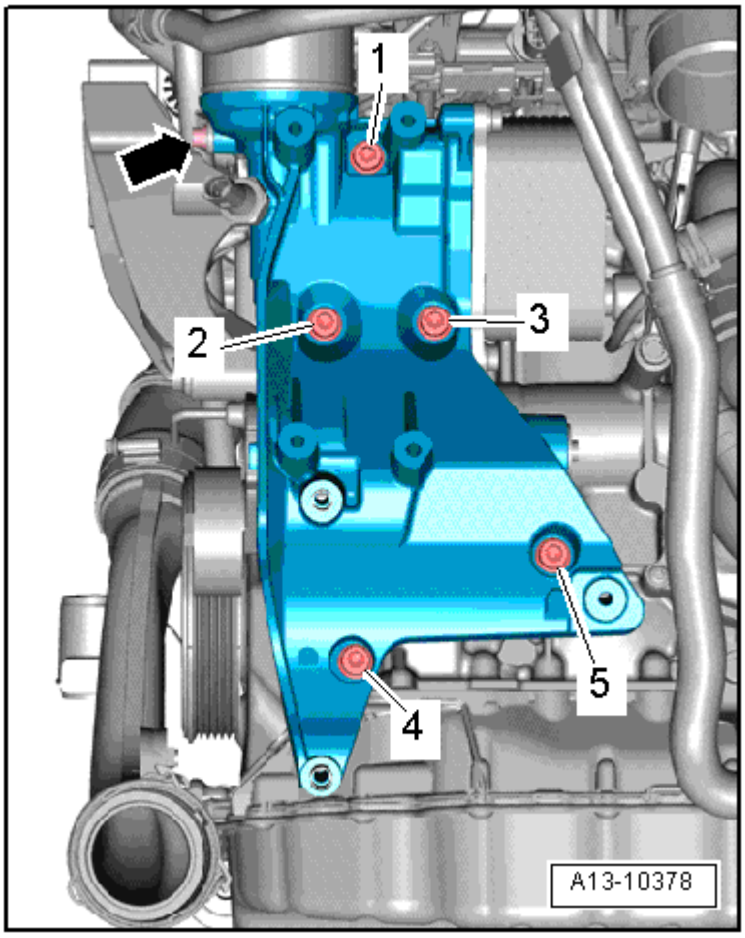

Fig. 222: Measuring Voltage Between Termainal 1(Ground) And 3 (Positive) On Connector
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect multimeter for voltage measurement with adapter cables from Connector Test Set V.A.G 1594C to terminal 1 (Ground) + 3 (positive) on Charge Air Pressure Sensor G31 connector.
- Switch ignition on. Specified value: at least 4.5 V
- Switch off ignition.

If no voltage is present:

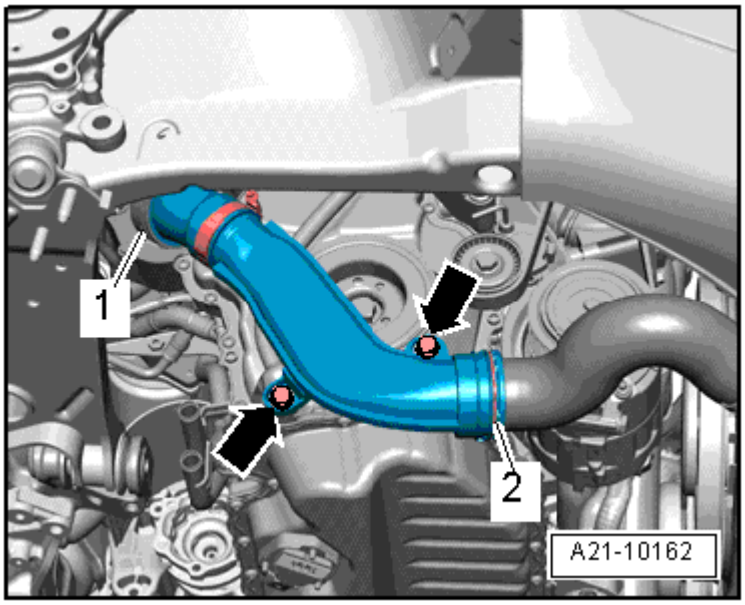

Fig. 223: Identifying Test Box V.A.G 1598/31 Connect To Control Module Wiring Harness
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect adapter cable, 121-pin V.A.G 1598/31 to engine control module (ECM) wiring harness. The engine control module remains disconnected.
- Check wires between adapter cable, 121-pin V.A.G 1598/31 and connector for open circuit according to wiring diagram.

Terminal 1 + socket 108

Terminal 3 + socket 98

Terminal 4 + socket 101

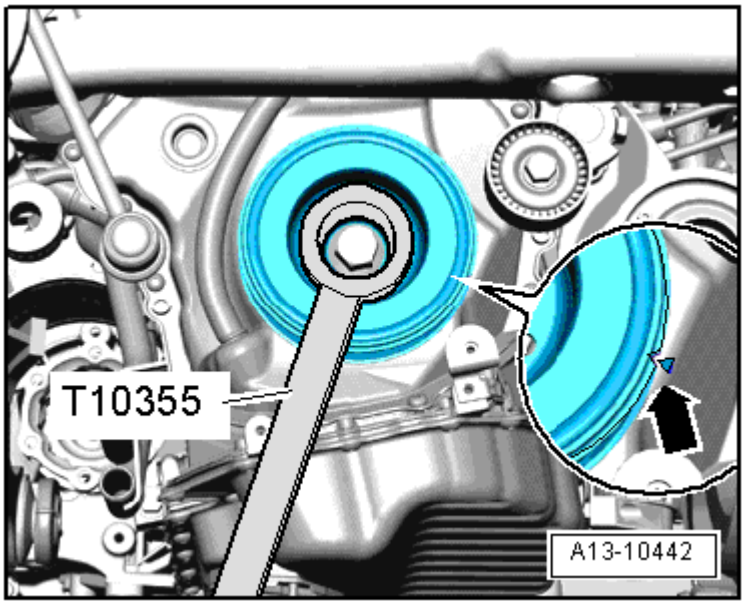

Fig. 224: Identifying Connector Terminals 1 And 4
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Wiring resistance: max. 1.5 ohms

- Check wires for short circuit to each other.

If no malfunction is found in the wires and there was voltage between terminals 1 + 3:

- Check function.

If no malfunction is found in the wires and there was no voltage between terminals 1 + 3:

- Replace Engine Control Module (ECM), refer to **ENGINE CONTROL MODULE (ECM), REPLACING** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE (S): AWD or **ENGINE CONTROL MODULE, REPLACING** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION IGNITION, ENGINE CODE(S): AWW, AWP .

Checking function

- Connect adapter cable, 121-pin V.A.G 1598/31 to engine control module wiring harness and engine control module.
- Reconnect connector on Charge Air Pressure Sensor G31.
- Use adapter cables from Connector Test Set V.A.G 1594C to connect multimeter to sockets 101 (B+) + 108 (Ground (GND)) for voltage measurement.
- Start engine and measure voltage. Specified value: 1.80 to 2.00 V
- Increase engine speed by pressing gas pedal suddenly. Specified value: 2.00 to 3.00 V

If specifications are not obtained:

- Replace Charge Air Pressure Sensor G31.
- Check DTC memory.
- Read readiness code.
- If DTC memory was cleared or engine control module disconnected from voltage supply, readiness code must be regenerated.

Turbocharger Recirculating Valve N249 , checking

Special tools, testers and auxiliary items required

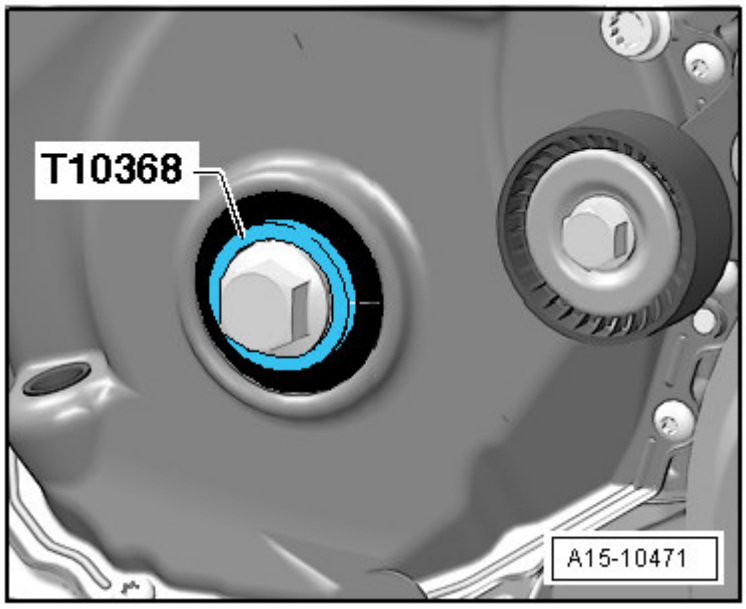

Fig. 225: Portable Multimeter V.A.G 1526C
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Portable multimeter V.A.G 1526C

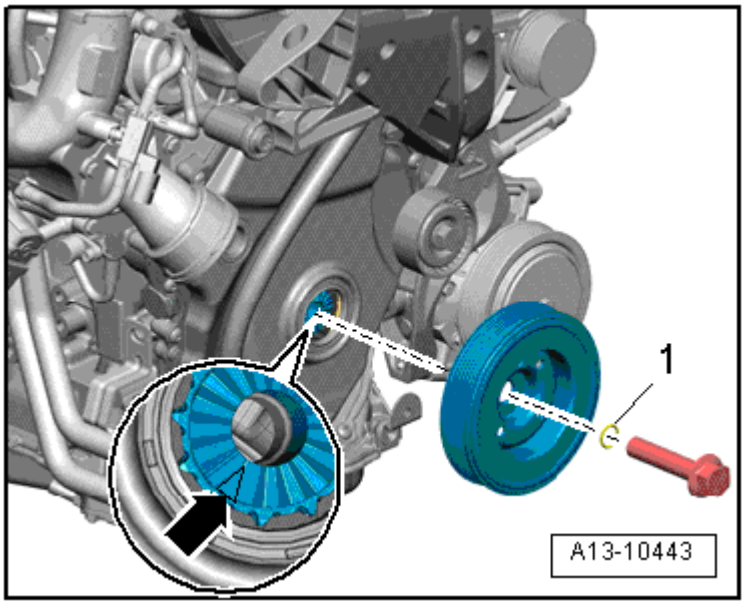

Fig. 226: Connector Test Set V.A.G 1594C
Courtesy of VOLKSWAGEN UNITED STATES, INC.

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

Test conditions

- Output diagnostic test performed.

Test sequence

- Switch off ignition.
- Remove connector from Turbocharger Recirculating Valve N249.
- Measure resistance between terminals of valve. Specified value: 27 to 30 ohms

If specification is not obtained:

- Replace Turbocharger Recirculating Valve N249.
- Check DTC memory.
- Read readiness code.
- If DTC memory was cleared or engine control module disconnected from voltage supply, readiness code must be regenerated.

Vacuum diaphragm for boost pressure regulator valve, checking

Special tools, testers and auxiliary items required

- Fault Read Out Device V.A.G 1551 or Vehicle Diagnosis, Testing and Information System VAS 5051B

Test conditions

- Engine oil temperature at least 60 ° C
- No leaks on intake or exhaust side.

Test sequence

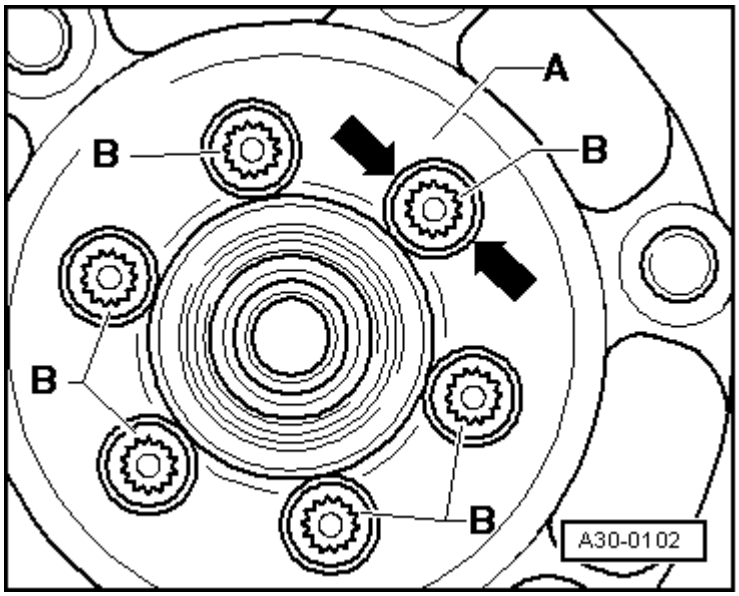

Fig. 227: Identifying Connector At Wastegate Bypass Regulator Valve N75
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect connector - **2** - at Wastegate Bypass Regulator Valve N75 - **1** -.

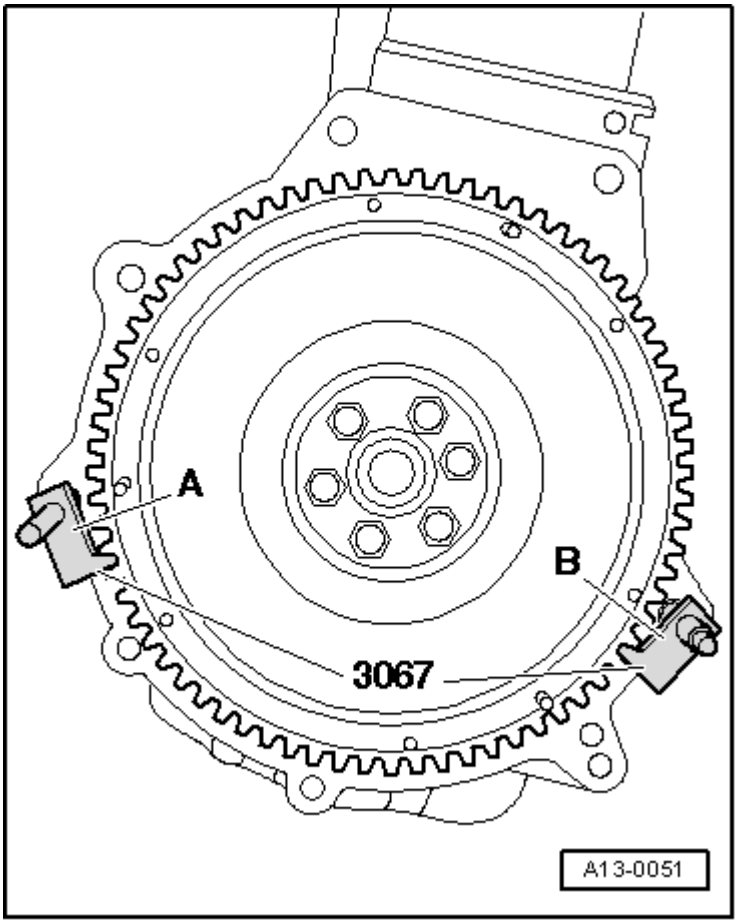

Fig. 228: Boost Pressure Regulator Valve And Actuator Rod
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Start engine and increase speed to maximum RPM by depressing accelerator pedal suddenly. Actuator rod - **2** - for boost pressure regulator valve must move.

If actuator rod does not move:

- Check lever for boost pressure regulator valve - **1** - for ease of movement. If rusted in place, replace turbocharger.

If actuator rod does not move through light prying:

- Exhaust turbocharger faulty, replace it, refer to **Turbocharger with attachments, assembly overview** .
- Check DTC memory.
- Read readiness code.
- If DTC memory was cleared or engine control module disconnected from voltage supply, readiness code must be regenerated.

Deceleration shut-off valve, checking

Special tools, testers and auxiliary items required

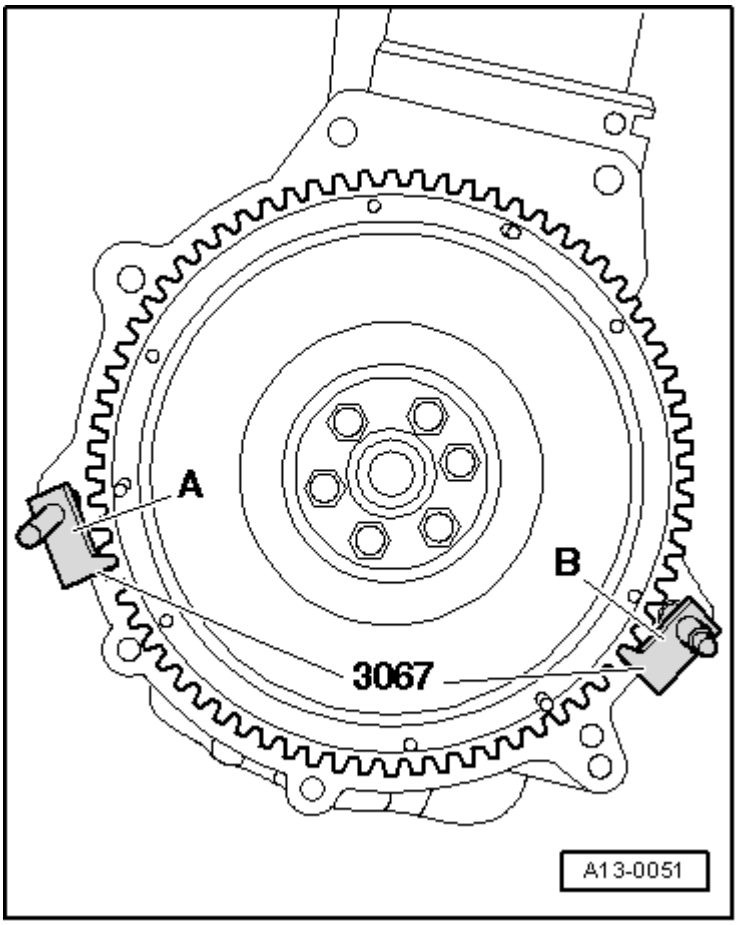

Fig. 229: Hand Vacuum Pump V.A.G 1390
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Hand vacuum pump V.A.G 1390

Test conditions

- Performance deficiency or load change shocks

Test sequence

NOTE:

- **Deceleration shut-off valve is located in front of turbocharger. It is opened by vacuum during deceleration and at idle.**

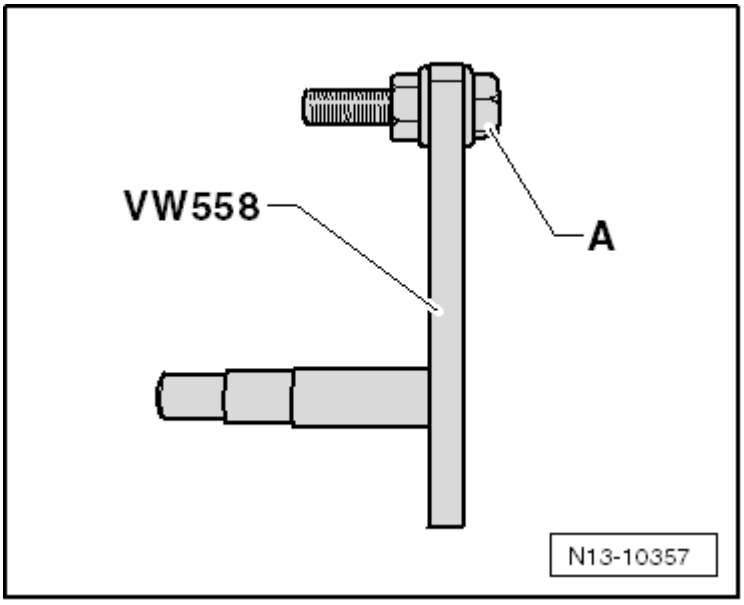

Fig. 230: Hand Vacuum Pump V.A.G 1390 Connect To Vacuum Connection Of Deceleration Shut-Off Valve In Proper Direction
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect Hand vacuum pump V.A.G 1390 to vacuum connection of deceleration shut-off valve.
- Operate Hand vacuum pump V.A.G 1390. Deceleration shut-off valve must open in direction of - **arrow** - .
- Operate ventilation valve at Hand vacuum pump V.A.G 1390. Deceleration shut-off valve must close

If deceleration shut-off valve does not open or does not close, replace valve.

NOTE:

- **Connections of deceleration shut-off valve are to be fastened with screw-type clamps.**

Charge air system, checking for leaks

Special tools, testers and auxiliary items required

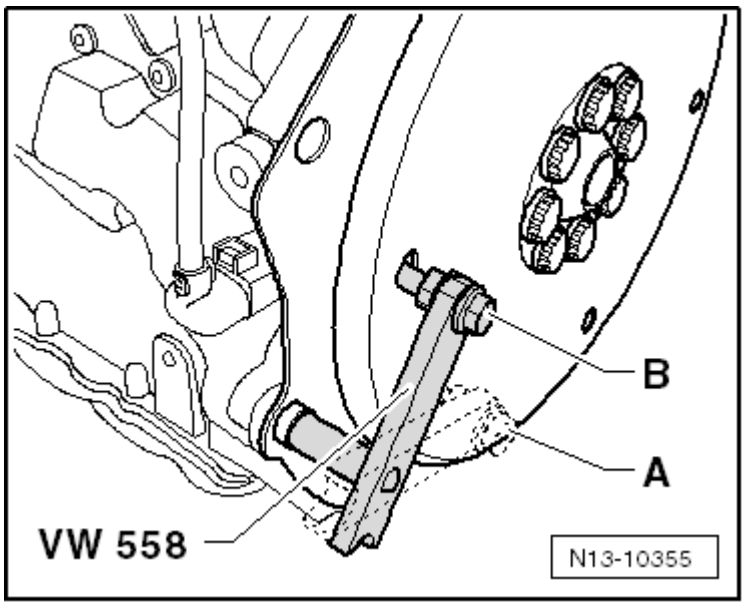

Fig. 231: Testing Unit For Turbo Charger V.A.G 1687
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Testing unit for turbo charger V.A.G 1687
- Accessory adapter V.A.G 1687/1

- Remove intake hose from air filter.
- Remove crankcase ventilation pressure regulator valve from intake hose.

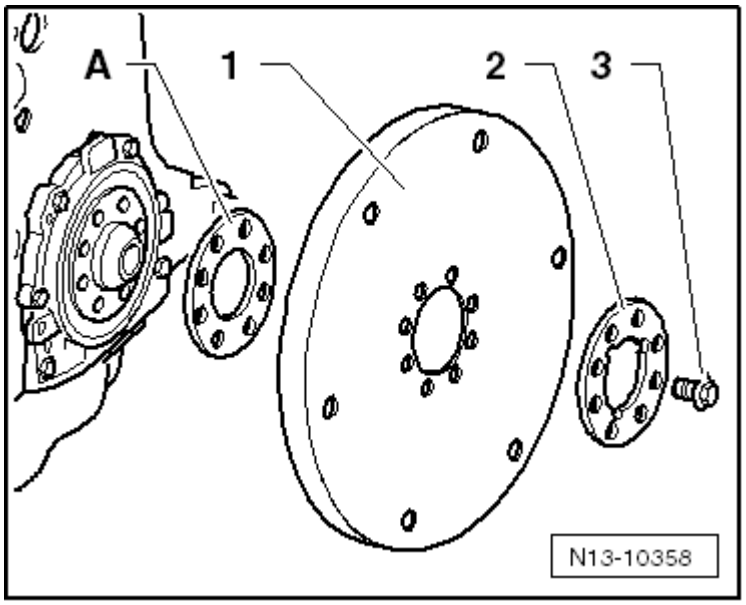

Fig. 232: Accessory Adapter 1687/1 Inserted Into Intake Hose And Connection For Pressure Regulator Valve Sealed Using Adapter V.A.G 1687/4
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert accessory adapter 1687/1 into intake hose and seal connection for pressure regulator valve using adapter V.A.G 1687/4. Tighten hose clamps.

Prepare testing unit for turbo charger V.A.G 1687 as follows:

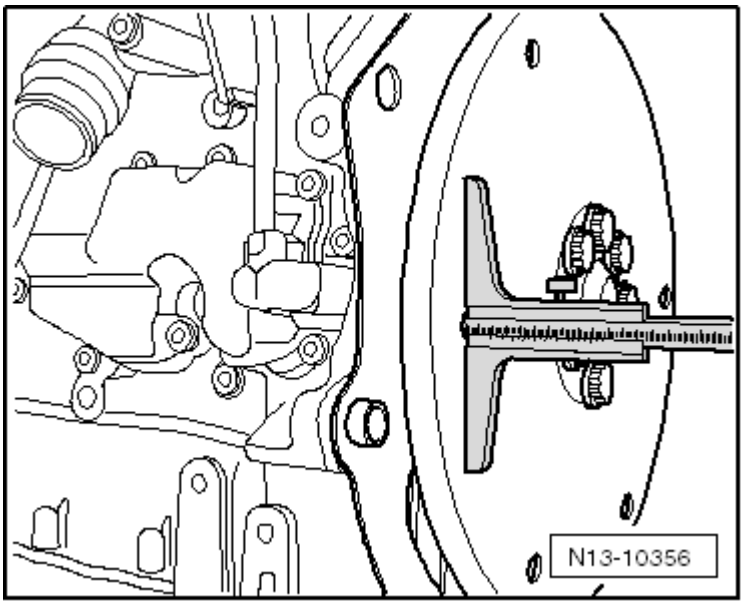

Fig. 233: Pressure Regulator Valve Completely Removed And Locating Valves And V.A.G 1687
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove pressure regulator valve - **2** - completely and close valves - **3** - and - **4** -.

NOTE:

- **In order to be able to turn pressure regulator valve - 2 - , rotary knob must be pulled upward.**

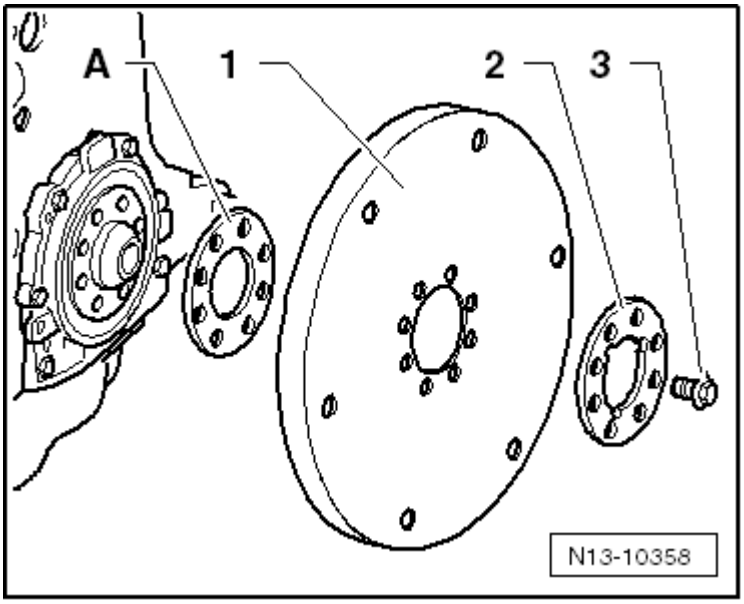

Fig. 234: Testing Unit For Turbo Charger V.A.G 1687 Connected
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect testing unit for turbo charger V.A.G 1687 as shown.

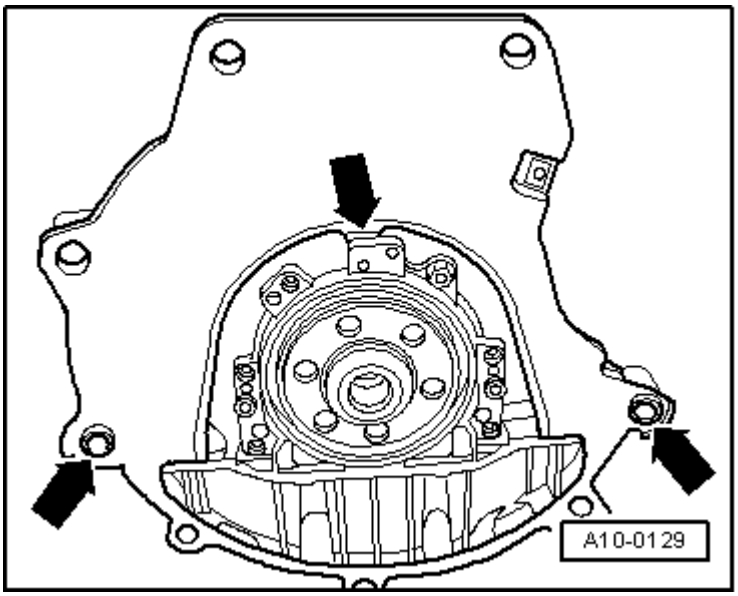

Fig. 235: Pressure Regulator Valve Completely Removed And Locating Valves And V.A.G 1687
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect pressurized air hose - **1** - (pressurized air supply) to testing unit for turbo charger V.A.G 1687.

NOTE:

- **If water is located in viewing glass, drain it via water drain plug - 6 -.**

- Open valve - **3** -.
- Set pressure to 0.5 bar using pressure regulator valve - **2** -.

CAUTION: Pressure must not exceed 0.5 bar! A pressure set too high may damage the engine.

- Open valve - **4** - and wait until testing circuit has filled. If necessary, continue to regulate pressure to 0.5 bar.
- Check charge air system for leaking areas by listening, touch, using leak detection spray or using ultrasonic measuring device V.A.G 1842.

NOTE:

- **A minimal amount of air will escape through the turbocharger into the oil pan. A retaining pressure test is not possible for this reason.**
- **Handling instructions of ultrasonic measuring device V.A.G 1842 Owners Manual.**
- **If a poorly sealed area is discovered, observe the notes for charge air**

system when repairing refer to Charge air system with turbocharger .

- **Before removing the adapter, release pressure from the test circuit by separating the connection from the accessory adapter 1687/1.**

26 - EXHAUST SYSTEM, EMISSION CONTROLS

EXHAUST SYSTEM COMPONENTS

Exhaust system components

NOTE:

- **After exhaust system repairs, make sure exhaust system is not under stress and that it has sufficient clearance from the bodywork. If necessary, loosen double clamps and clamp and align exhaust pipe so that sufficient clearance is maintained to the bodywork and support rings carry uniform loads.**
- **Replace self-locking nuts.**
- **Components marked with * are checked via On Board Diagnostic (OBD).**

Exhaust system components, assembly overview

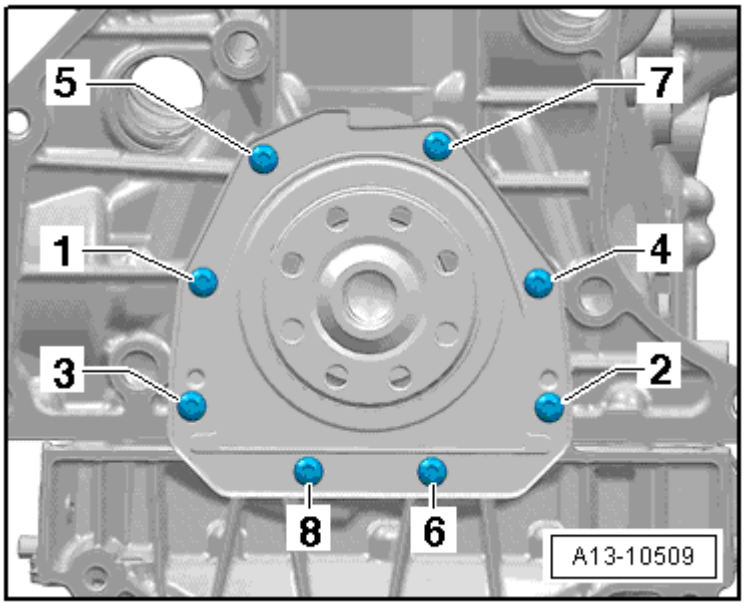

Fig. 236: Exhaust System Components, Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Tunnel bridge

2 - Center muffler

- As standard, center and rear mufflers are installed as a single component. In cases of repair, the center and

rear muffler are supplied individually and with a double clamp for connecting.

- Separating point *Separation point on exhaust pipe* under **Exhaust system components, assembly overview**

3 - Suspended mount

- Note installation position **Installed location of mounting**

4 - 25 Nm

5 - 40 Nm

- Replace

6 - Washer

7 - Gasket

- Replace

8 - Turbocharger

9 - Front exhaust pipe with catalytic converter

10 - Heated Oxygen Sensor (HO2S) G39 * , 50 Nm

- Grease only threads with *hot bolt paste G 052 112 A3* (anti-seize compound). *Hot bolt paste G 052 112 A3* must not get into slots on sensor body. (Part numbers are for reference only. Always check with your Parts Department for the latest part number information).
- Use ring spanner set for oxygen sensor 3337 for removal and installation
- If sealing ring is leaking cut open and replace.
- Checking, refer to **OXYGEN SENSOR HEATING FOR HEATED OXYGEN SENSOR (HO2S) - G39-, CHECKING**
- Connect with engine code AWD: 4-pin, contact gold-plated
- Connect with engine code AWP, AWW: 6-pin, contact gold-plated

11 - Oxygen sensor (O2S) behind three way catalytic converter (TWC) G130 * , 50 Nm

- Grease only threads with *hot bolt paste G 052 112 A3* (anti-seize compound). *Hot bolt paste G 052 112 A3* must not get into slots on sensor body. (Part numbers are for reference only. Always check with your Parts Department for the latest part number information).
- Use ring spanner set for oxygen sensor 3337 for removal and installation
- If sealing ring is leaking cut open and replace.
- Checking, refer to **OXYGEN SENSOR HEATING FOR OXYGEN SENSOR (O2S) BEHIND**

THREE WAY CATALYTIC CONVERTER (TWC) -G130-, CHECKING for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWD or **OXYGEN SENSOR HEATING FOR OXYGEN SENSOR (O2S) BEHIND THREE WAY CATALYTIC CONVERTER (TWC), CHECKING** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION IGNITION, ENGINE CODE(S): AWW, AWP

- Connector: 4-pin, terminals 3 and 4 gold-plated

12 - Double clamp

- Note installation position *Installation position of double clamp* under **Exhaust system components, assembly overview**

13 - 40 Nm

14 - Suspended mount

15 - 25 Nm

16 - Rear muffler

- As standard, center and rear mufflers are installed as a single component. In cases of repair, the center and rear muffler are supplied individually and with a double clamp for connecting.
- Separating point: *Separation point on exhaust pipe* under **Exhaust system components, assembly overview**
- Installing muffler free of tension **Installing muffler free of tension**

17 - Suspended mount

18 - 25 Nm

19 - Double clamp

20 - 40 Nm

21 - 25 Nm

Separation point on exhaust pipe

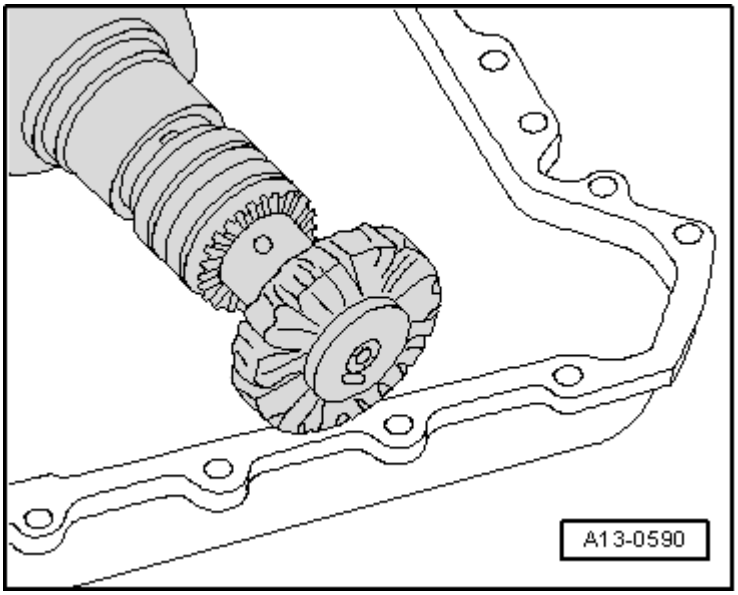

Fig. 237: Separation Point On Exhaust Pipe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Cut through exhaust pipe at right angle at separating point - **2** -.
- Position repair double clamp - **4** - between - **arrow 1** - and - **arrow 3** - during installation. Torque specification 40 Nm

Installing muffler free of tension

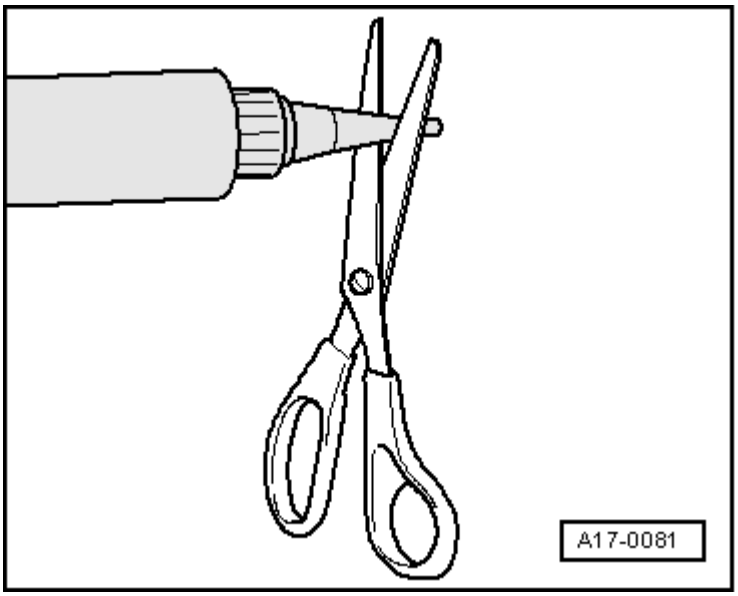

Fig. 238: Installing Muffler Free Of Tension
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Mounting bolt at exhaust pipe must be parallel to tunnel bridge (dimension - **x** - same at left and right).

Installation position of double clamp

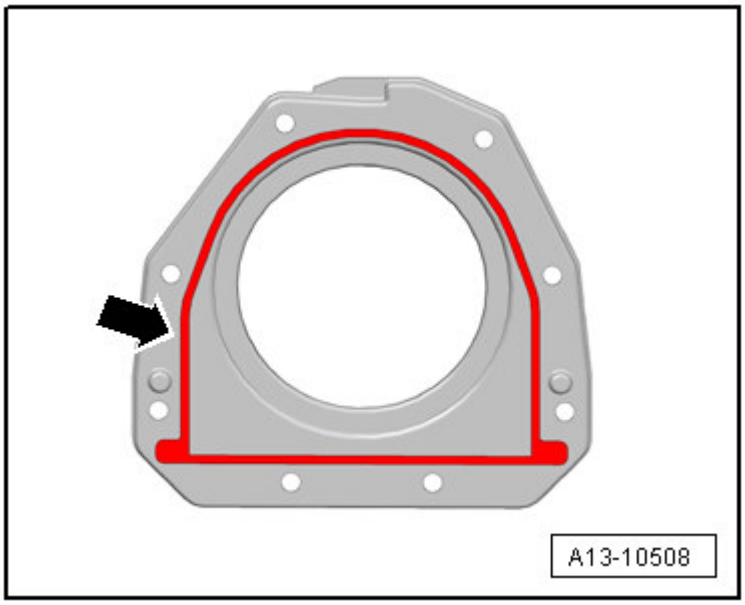

Fig. 239: Installation Position Of Double Clamp
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position double clamp approx. 5 mm from marking A - **arrow 1** -.

NOTE:

- **Marking - A - applies to vehicles with manual transmission and automatic transmission.**

Installed location of mounting

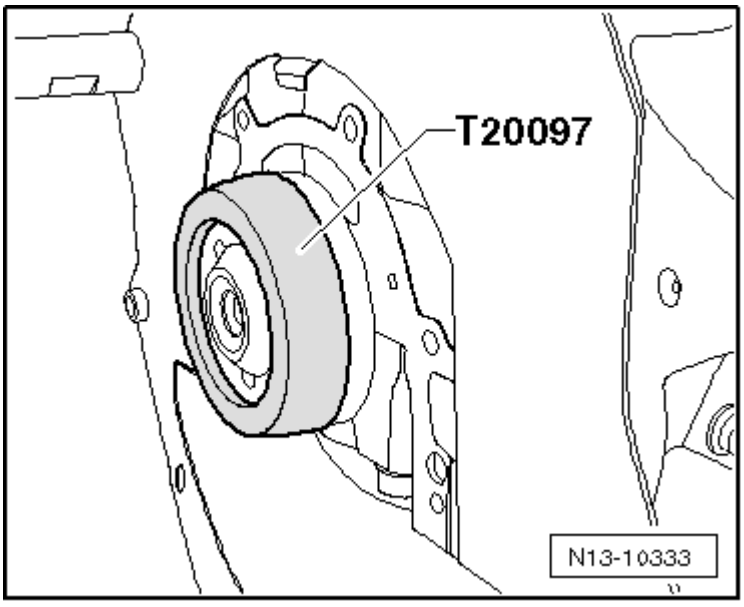

Fig. 240: Installed Location Of Mountings
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Angled side at foot of suspended mount - **arrow** - faces front of vehicle.

CATALYTIC CONVERTER

Three Way Catalytic Converter (TWC), checking

Special tools, testers and auxiliary items required

- Fault Read Out Device V.A.G 1551 or Vehicle Diagnosis, Testing and Information System VAS 5051B

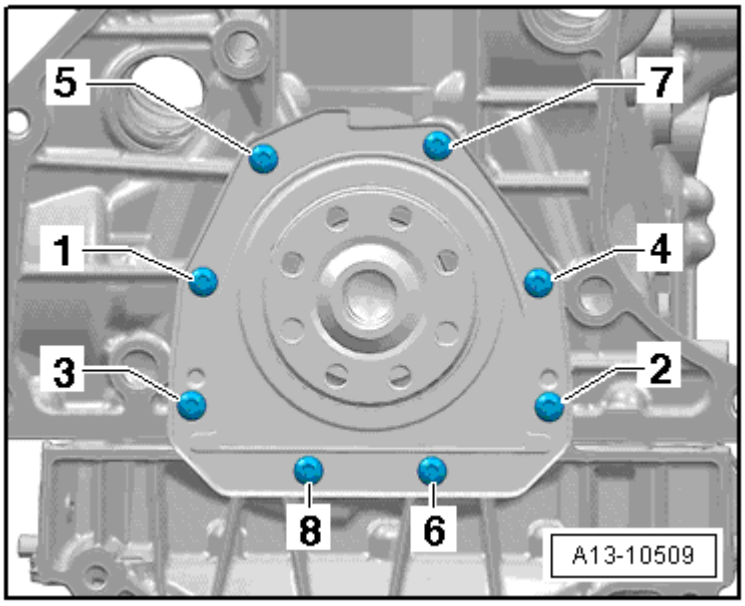

Fig. 241: V.A.G 1788/10 Speed Adjuster Tool
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Speed Adjuster Tool V.A.G 1788/10 (only engine code AWD, AWW)

Test sequence

- Connect Fault Read Out Device V.A.G 1551 and select engine electronics control module with "Address word 01". Engine must run at idle for this. Connect fault read out device and select engine control module.

Scan tool display:

Quick data transfer HELP Select function XX

- Press buttons 0 and 4 for function "Initiate basic setting" and press Q button to confirm input.

Scan tool display:

Initiate basic setting HELP Enter display group number XXX

- Press buttons 0 3 and 4 for the "Display group number 34" and press Q button to confirm input.

Scan tool display: (1 to 4 = display fields)

System in basic setting 34 ->   1 2 3 4

Engine code AWD, AWW

- Adjust engine speed with Speed Adjuster Tool V.A.G 1788/10 to 1800 to 2200 RPM:
- Hold speed at 1800 to 2200 RPM until display in display field 4 goes from "Test OFF" to "Test ON". Catalytic converter temperature in display field 2 must be between 350 and 500 ° C.
- Continue to hold speed at 1800 to 2200 RPM until specified value "B1S1 OK" is shown in display field 4.

Engine code AWP

- Press brake pedal and hold firmly.
- Press gas pedal into wide open throttle (WOT) position. The engine speed is raised to approx. 2300 RPM by engine control module.
- Hold brake and gas pedal down until display in display field 4 goes from "Test OFF" to "Test ON". Catalytic converter temperature in display field 2 must be between 350 and 500 ° C.
- Continue to hold brake and gas pedal until specified value "B1S1 OK" is shown in display field 4.
- Release brake and gas pedals.

Continued for all engine codes

If reading does not result as described:

- Check DTC memory.
- Read readiness code.
- If DTC memory was cleared or engine control module disconnected from voltage supply, readiness code must be regenerated.

Reading results as described:

- Press C key.
- Press buttons 0 4 and 6 for "Display group number 46" and press Q button to confirm input.

Scan tool display: (1 to 4 = display fields)

Basic setting 46 ->
1 2 3 4

Engine code AWD, AWW

- Hold speed at 1800 to 2200 RPM until display in display field 4 goes from "Test OFF" to "Test ON". Catalytic converter temperature in display field 2 must be at least 440 ° C.
- Continue to hold speed at 1800 to 2200 RPM until specified value "Catalytic convert B1 OK" is shown in display field 4.
- Remove Speed Adjuster Tool V.A.G 1788/10 from gas pedal.

Engine code AWP

- Press brake pedal and hold firmly.
- Press gas pedal into wide open throttle (WOT) position. The engine speed is raised to approx. 2300 RPM by engine control module.
- Hold brake and gas pedal down until display in display field 4 goes from "Test OFF" to "Test ON". Catalytic converter temperature in display field 2 must be at least 440 ° C.
- Continue to hold brake and gas pedal until specified value "Catalytic converter B1 OK" is shown in display field 4.
- Release brake and gas pedals.

Continued for all engine codes

"Catalytic converter B1 not OKB" shown in display field 4:

- Check DTC memory.
- Read readiness code.
- If DTC memory was cleared or engine control module disconnected from voltage supply, readiness code must be regenerated.

If specified value "Catalytic converter B1 OK" :

- Press --> key.

Scan tool display:

Quick data transfer HELP
Select function XX

- Press buttons 0 and 6 for function "End output" and press Q button to confirm input.
- Switch off ignition.

SECONDARY AIR INJECTION (AIR) SYSTEM

Secondary air injection (AIR) system

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 canister 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.**

Function

Air is blown behind the exhaust valves by the Secondary Air Injection (AIR) system for a maximum of 100 seconds following cold start (coolant temperature of +5 ° C to +33 ° C). 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 , (change-over valve) and combination valve.

Secondary air injection (AIR) system components, assembly overview

NOTE:

- **Components marked with * are checked via On Board Diagnostic (OBD).**
- **Components marked with ** are checked via output Diagnostic Test Mode (DTM).**
- **Secondary Air Injection (AIR) Pump Relay J299 ** *Secondary Air Injection (AIR) Pump Relay* under Secondary air injection (AIR) system components, assembly overview**

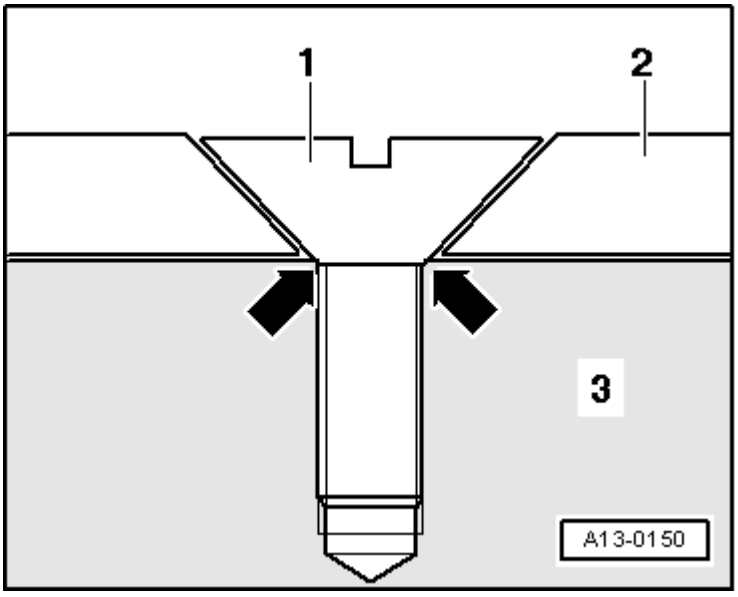

Fig. 242: Secondary Air Injection System Components, Assembly Overview

Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Combi-valve

- Checking, refer to **Combi-valve, checking**

2 - Gasket

- Replace

3 - Connecting piece

- Secured to cylinder head

4 - Bracket

5 - 10 Nm

6 - Bracket

- Fastened to intake manifold

7 - To vacuum reservoir

8 - Vacuum hose

9 - Connector

- 2-pin

10 - Secondary Air Injection (AIR) Solenoid Valve N112 */**

- Tightened to 6 Nm on bracket
- Resistance: 21 to 24 ohms
- Checking, refer to **Secondary Air Injection (AIR) Solenoid Valve N112 , checking**

11 - Intake tube

- For secondary air injection pump
- Ensure seated tightly
- Press together at front to release

12 - To air filter

13 - O-ring

- Replace

14 - Connector

- 2-pin
- For Secondary Air Injection (AIR) pump motor V101

15 - 10 Nm

16 - Secondary Air Injection (AIR) Pump Motor V101

- Function, checking refer to **Secondary Air Injection (AIR) Pump Motor V101 , checking**

17 - 10 Nm

18 - Pressure hose

- Ensure seated tightly
- Press together at front to release

19 - 10 Nm

20 - 10 Nm

21 - Gasket

- Replace

Secondary Air Injection (AIR) Pump Relay J299

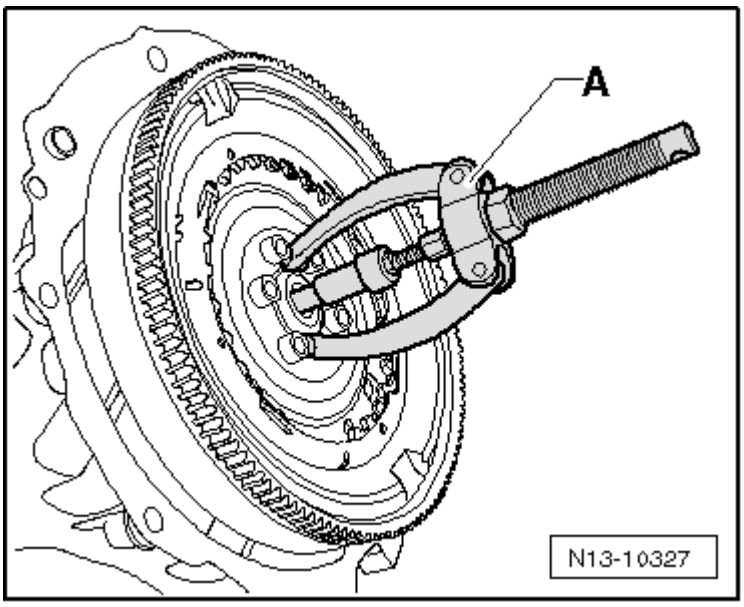

Fig. 243: Secondary Air Injection Pump Relay J299
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- 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

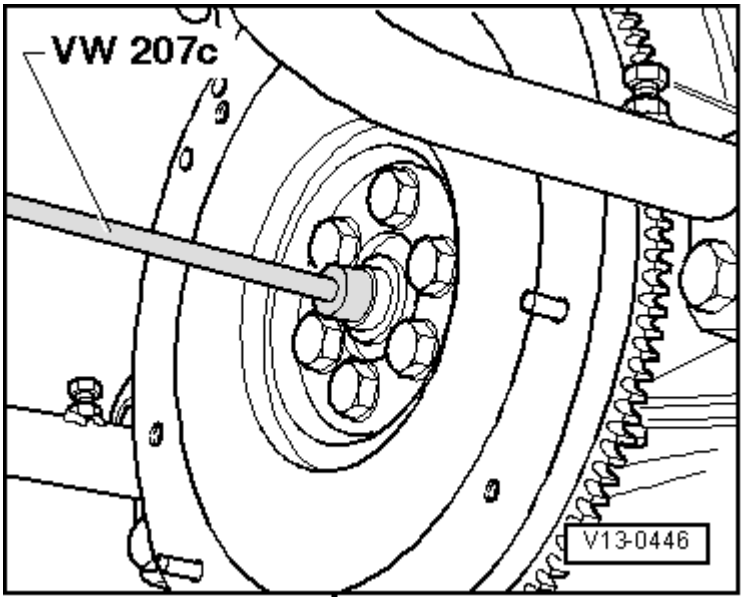

Fig. 244: Hand Vacuum Pump V.A.G 1390
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Hand vacuum pump V.A.G 1390

Test conditions

- There must be no malfunctions stored in DTC memory
- Output diagnostic test performed
- Vacuum lines and hose connections free of leaks
- Vacuum lines not blocked or kinked

Test sequence

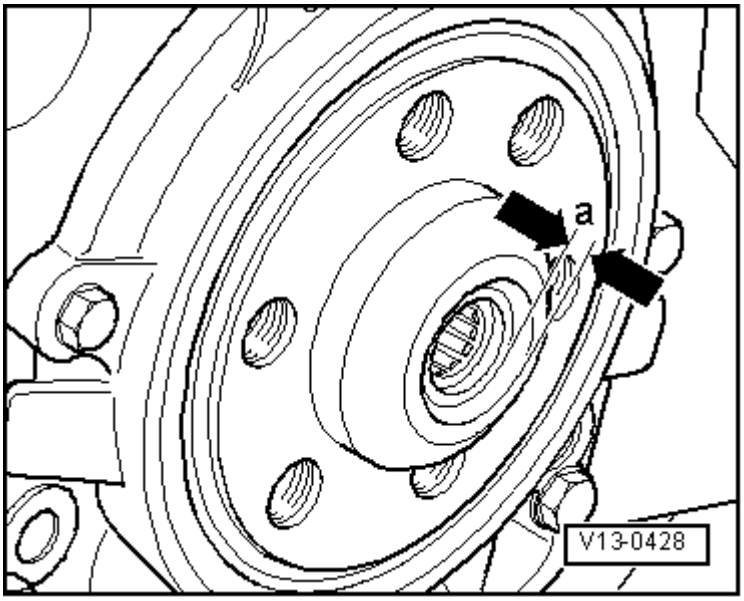

Fig. 245: Connecting Hand Vacuum Pump V.A.G 1390 To Vacuum Hose
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove vacuum hose - **1** - on Secondary Air Injection (AIR) Solenoid Valve N112 - **2** -.
- Connect Hand Vacuum Pump V.A.G 1390 to vacuum hose - **1** -.

NOTE:

- **Do not use compressed air during following check!**

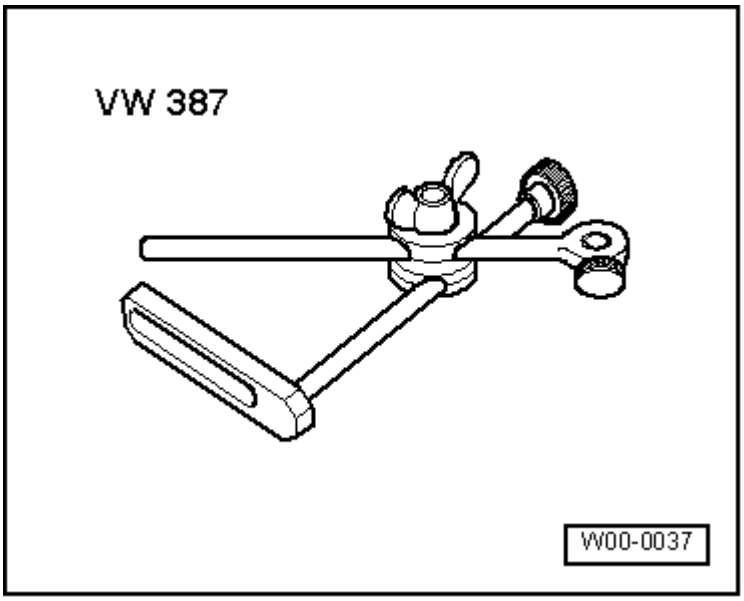

Fig. 246: Connecting Hand Vacuum Pump V.A.G 1390 To Vacuum Hose
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect pressure hose - **3** - at Secondary Air Injection (AIR) pump motor V101 and blow air in with light pressure - **arrow** -. Combination valve must be closed.

NOTE:

- **To disengage, compress the buttons at the hose coupling.**

- Operate Hand vacuum pump V.A.G 1390. Valve must open.

If combi-valve does not open:

- Replace combination valve.

Secondary Air Injection (AIR) Pump Motor V101 , checking

Special tools, testers and auxiliary items required

- Fault Read Out Device V.A.G 1551 or Vehicle Diagnosis, Testing and Information System VAS 5051B

Test conditions

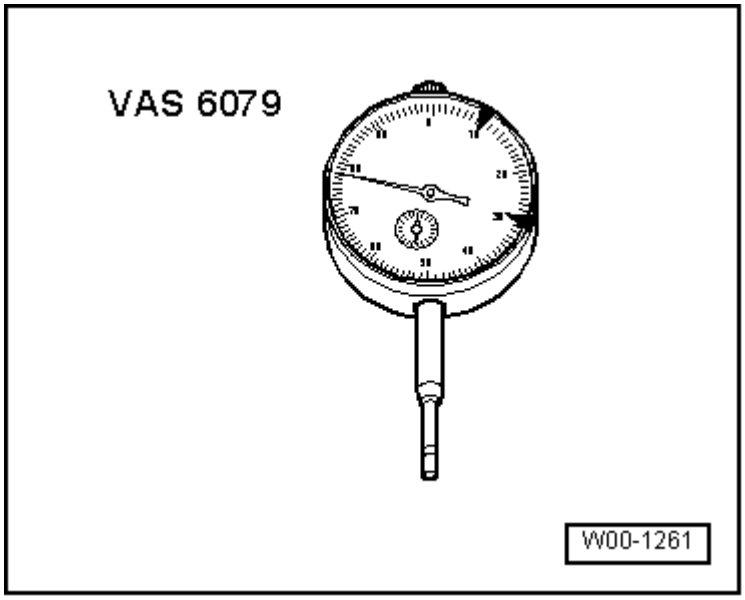

Fig. 247: Locating Secondary Air Injection Pump Relay J299 Fuse
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Secondary Air Injection (AIR) Pump Relay J299 fuse - **arrow** - in main fuse box on battery OK.
- There must be no malfunctions stored in DTC memory.
- Battery voltage must be at least 11.5 Volts.
- Secondary air injection (AIR) intake hose is not sealed or kinked.

Test sequence

- Remove engine cover.
- Install pressure hose on Secondary Air Injection (AIR) Pump Motor V101.

NOTE:

- **To disengage, compress the buttons at the hose coupling.**

- Activate Secondary Air Injection (AIR) Pump Relay J299 via output diagnostic test mode (DTM).
- The Secondary Air Injection (AIR) Pump Motor V101 must start in intervals and air must escape at exhaust connection.

If motor starts, but no air escapes:

- Continue with output diagnostic test mode to end.
- Press buttons 0 and 6 for function "End output" and press Q button to confirm input.
- Switch off ignition.
- Replace Secondary Air Injection (AIR) Pump Motor V101.

- Check DTC memory.
- Read readiness code.
- If DTC memory was cleared or engine control module disconnected from voltage supply, readiness code must be regenerated.

If Secondary Air Injection (AIR) pump motor does not start up in intervals:

- Check secondary air injection (AIR) pump motor activation.

Secondary Air Injection (AIR) Solenoid Valve N112 , checking

Test conditions

- Coolant temperature 5 to 33 ° C
- Secondary air injection (AIR) pump motor OK
- There must be no malfunctions stored in DTC memory.

Test sequence

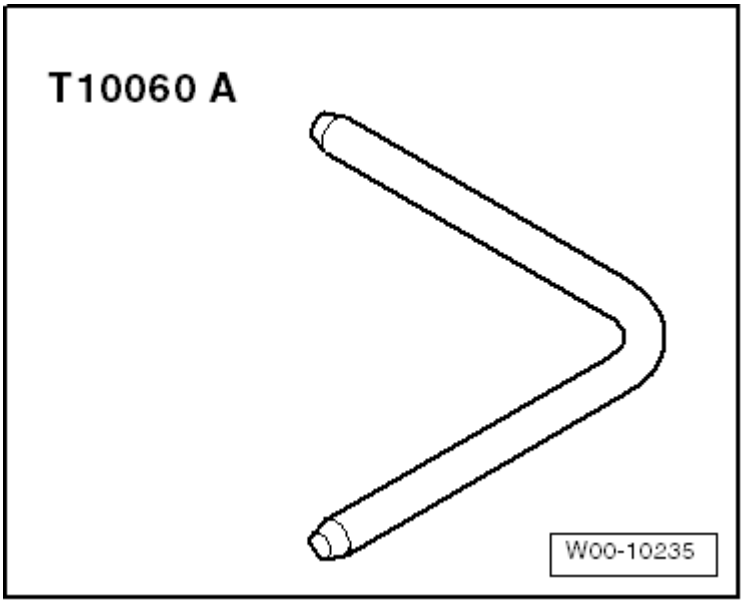

Fig. 248: Locating Vacuum Hose At Combination Valve
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect vacuum hose at combination valve - **arrow** -.
- Start engine and let run at idle. Vacuum must be present at vacuum hose (sense by touch) when Secondary Air Injection (AIR) Pump Motor V101 is running.

If no vacuum can be felt:

- Switch off engine.
- Check valve activation.

