ENGINE

2.0 Liter 4-Cyl. 2V TDI PD Engine Mechanical, Fuel Injection Glow Plug, Engine Code(s): BHW

00 GENERAL, TECHNICAL DATA

TECHNICAL DATA

Technical data

Location of engine number and engine code --> **Engine Number** .

Engine data --> **Engine Data** .

Engine number

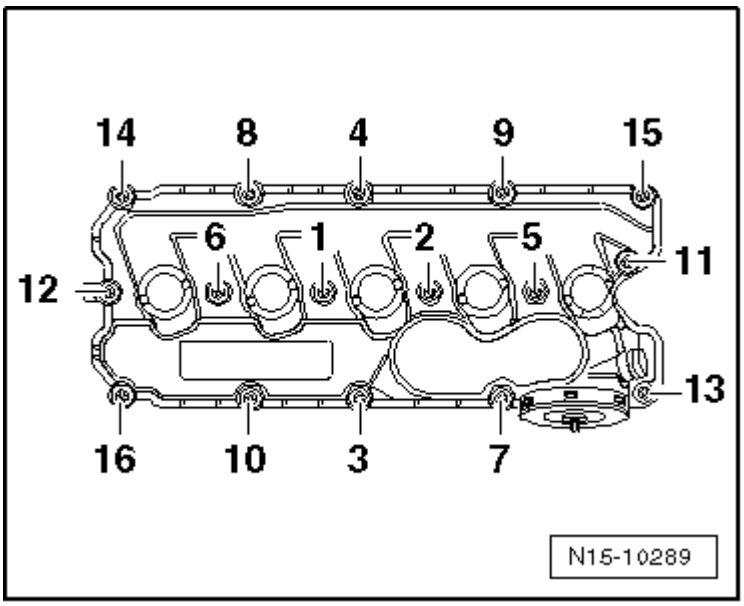

Fig. 1: Location Of Engine Code And Serial Number
Courtesy of VOLKSWAGEN UNITED STATES, INC.

The engine number "engine code" and "serial number" are located at 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.

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

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

Engine data

Code letters		BHW
Manufactured		01.04 -->
Emission values in accordance with		TIER 2
Displacement	ltr.	2.0
Output	kW at 1/rpm	100/4000
Torque	Nm at rpm	335/1900
Bore	diameter in mm	81.0
Stroke	mm	95.5
Valves per cylinder		2
Compression ratio		18.5
CZ	min.	49
Ignition sequence		1-3-4-2
Catalytic converter		yes
Particle filter		no
Exhaust gas recirculation		yes
Charging		yes
Charge air cooler		yes

10 ENGINE - ASSEMBLY

ENGINE, REMOVING AND INSTALLING

Engine, removing and installing

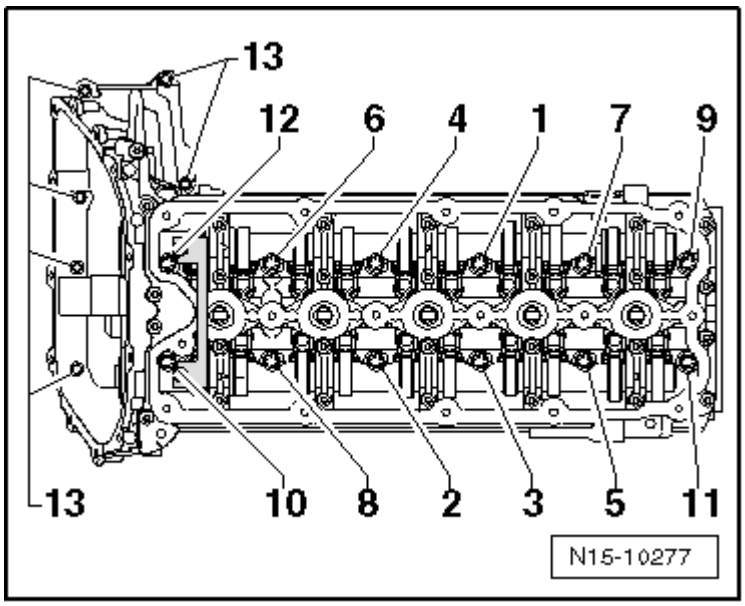

Fig. 2: Identifying Special Tools - Engine, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Engine support adapter 3147
- Lifting tackle 2024 A
- Engine support bridge 10-222 A
- Shop crane VAS 6100
- Engine and transmission holder VAS 6095

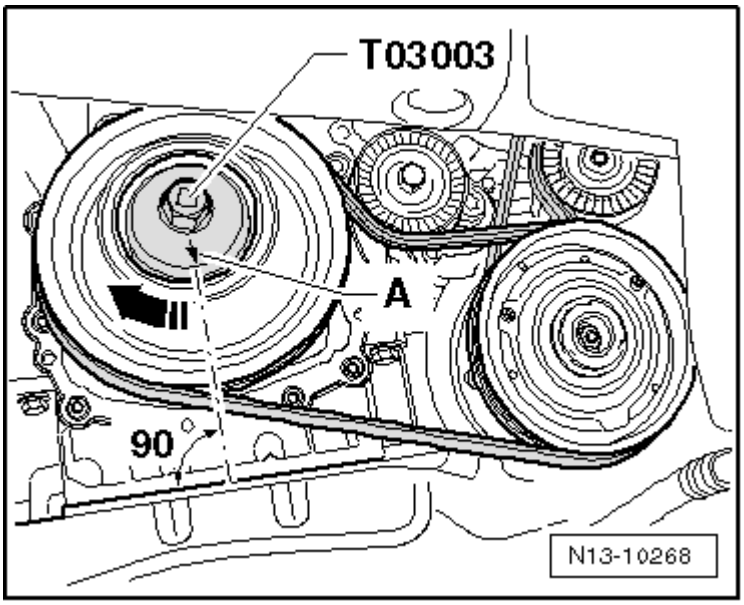

Fig. 3: Identifying Special Tools - Engine, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Drip tray V.A.G 1306
- Torque wrench (5 to 50 Nm) V.A.G 1331
- Torque wrench (40 to 200 Nm) V.A.G 1332
- Engine/transmission jack V.A.G 1383 A
- Support T10062
- Spring-type clip pliers VAS 5024A

Not illustrated:

Special tools, testers and auxiliary items required

- Container for removed components V.A.G 1698
- Engine plug set VAS 6122
- *Grease G 000 100*
- *Cable tie*

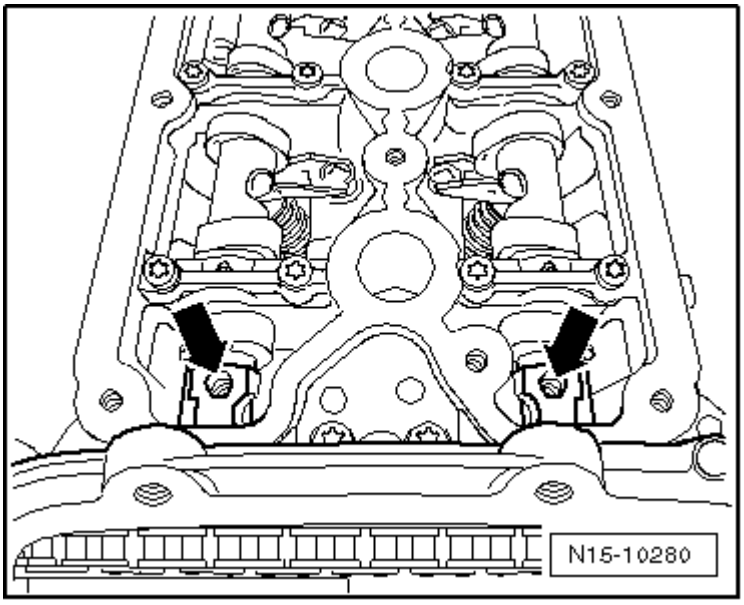

Fig. 4: Modifying Support T10062
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Modifying support T10062

- Drill an additional hole centered at height of lower hole if not yet present.

a = 8.5 mm

Notes on removing

NOTE:

- **To perform the work sequence, the Ground cable must be disconnected from the battery. Check whether a coded radio is installed. If so, obtain anti-theft coding beforehand.**
- **The engine is removed forward together with the transmission.**
- **Leave the key in the ignition lock to prevent the steering wheel lock from engaging.**
- **It is advisable to remove the front wheels before removing the engine/transmission assembly. The vehicle can be lowered on the hoist until the cover plates of the brake discs are just above the floor. This enables the most ergonomic work position possible regarding accessibility of components in the engine compartment.**
- **All cable ties which are opened or cut open when removing the engine, must be replaced in the same position when installing the engine.**
- **To prevent damage to removed components, use the container for removed components V.A.G 1698 for storage.**
- **When the engine is installed in the engine compartment some components cannot be removed or can only be removed with great difficulty. Therefore, determine which components are faulty before removing engine.**

- Check DTC memories of all control modules, before removing engine: Vehicle diagnosis, testing, and information system VAS 5051; Guided fault finding; Vehicle On Board Diagnosis (OBD)
- Disconnect battery Ground (GND) strap with ignition switched off.
- Remove engine cover.
- Remove connecting pipe between charge air cooler and Motor for intake flap V157.
- Pull off fuel supply hose (with white marking) and return hose (with blue marking) from fuel lines (clipped onto bulkhead) and catch any spilled fuel with a shop rag.
- Remove Motor for intake flap -V157-.
- Remove sound insulation pan: --> **50 BODY, FRONT**
- Remove front bumper: --> **63 BUMPER**

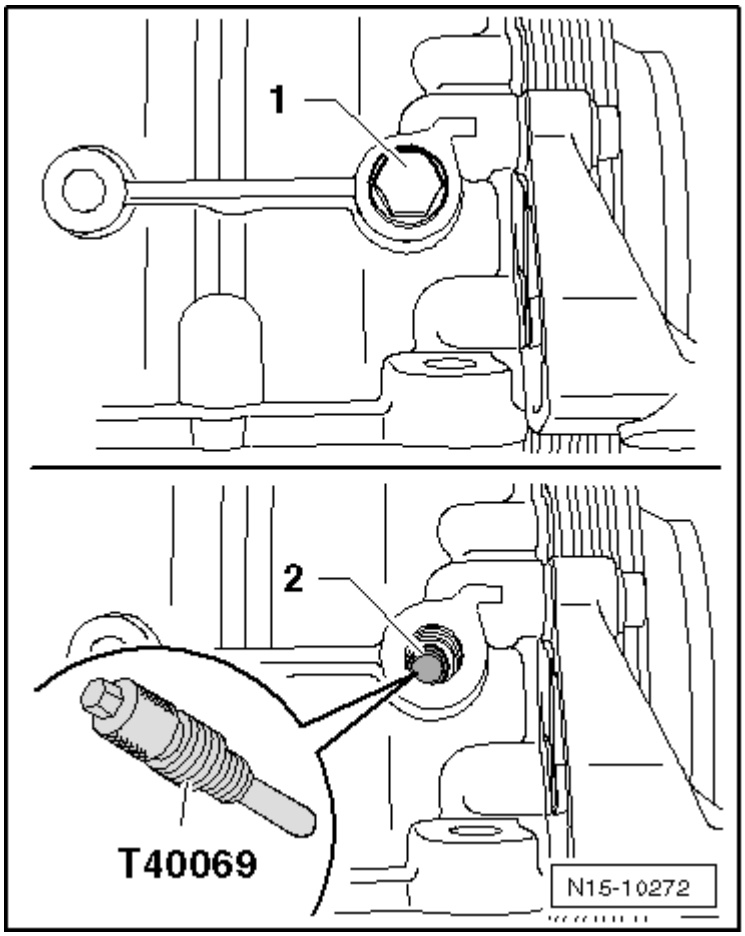

Fig. 5: Identifying Cooling Coil For Power Steering Fluid
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unbolt cooling coil for power steering fluid (arrows) and let hang free; Do not open hydraulic fluid circuit.
- Drain coolant --> **Cooling system, draining and filling** .
- Remove lock carrier with attachments: --> **50 BODY, FRONT**
- Remove ribbed belt --> **Ribbed belt, removing and installing** .

- Clamp off connections of coolant, vacuum and intake hoses from engine.
- Pull off/disconnect and lay aside all electrical harnesses from transmission, Generator, and starter.
- Pull off/disconnect all electrical connections as necessary from engine and lay aside.
- Pull vacuum and vent hoses off of engine.

- Unbolt front exhaust pipe from turbocharger. --> **Exhaust system components, removing and installing** .
- Unbolt engine coolant reservoir and lay aside.
- Remove power steering pump from bracket and place to side; hoses remain connected: --> **48 STEERING**

Vehicles with air conditioning

- Observe additional information and removal work --> **Additional information and assembly work on vehicles with air conditioning** .

Continued for all vehicles

- Remove starter: --> **27 - BATTERY, STARTER, GENERATOR, CRUISE CONTROL**
- Remove connecting bolts for engine/transmission, except for one.

NOTE:

- **Loosen, but do not remove, one of the connecting bolts.**

- Remove bolts for right and left motor mounts.

Vehicles with automatic transmission

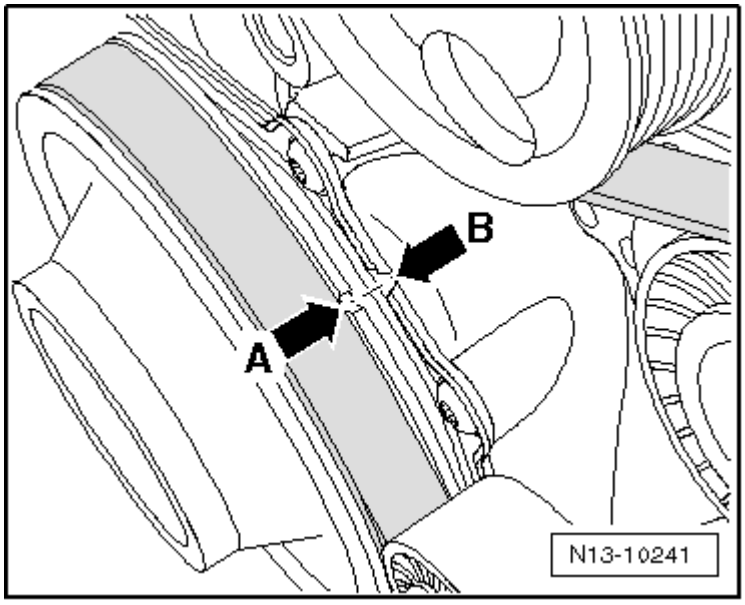

Fig. 6: Torque Converter-To-Drive Plate Screw

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect torque converter from drive plate (3 securing nuts).

NOTE:

- **After removing the engine, secure the torque converter to prevent it from falling out.**

Continued for all vehicles

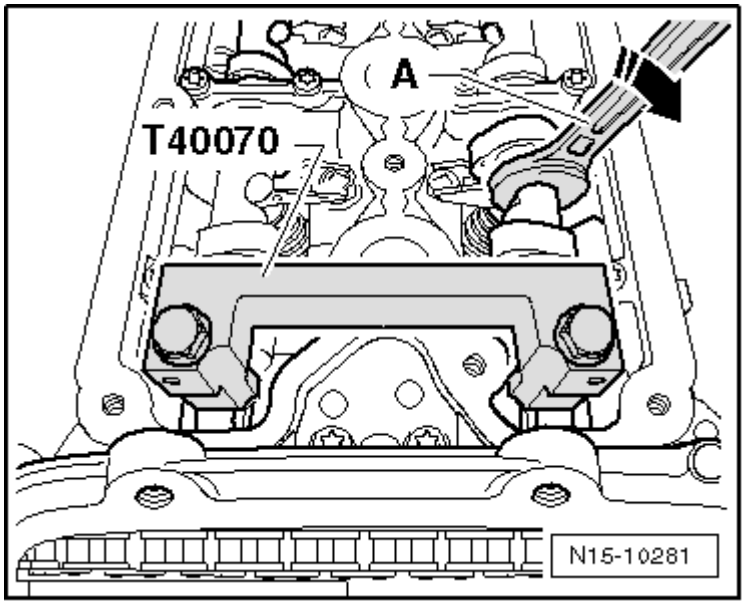

Fig. 7: Identifying Limit Stop
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unbolt limit stop - **1** - - **arrows** -.

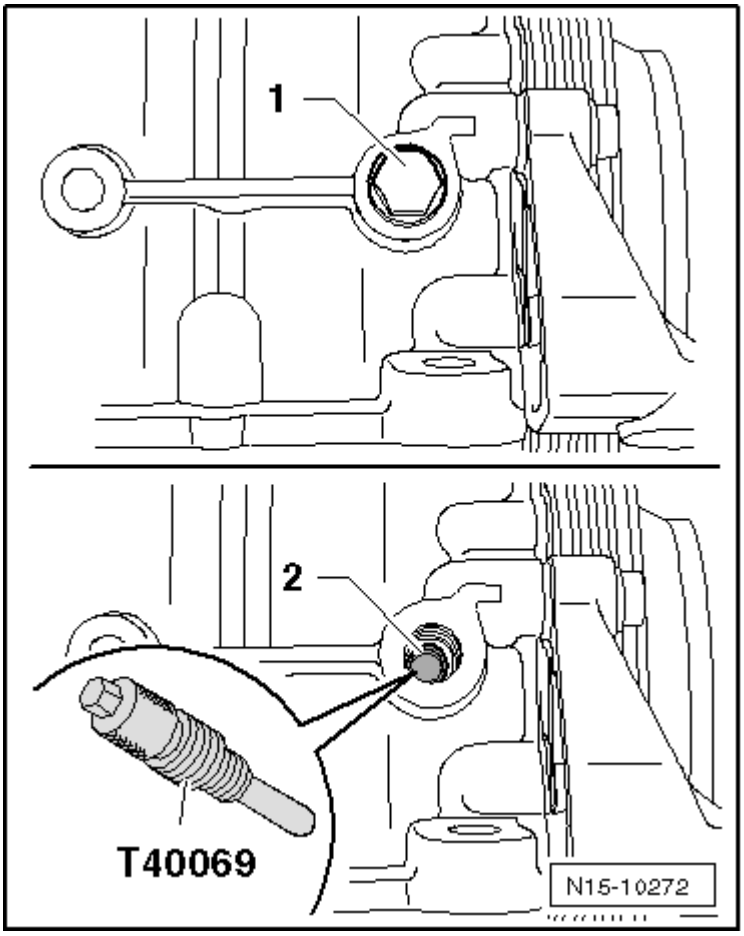

Fig. 8: Installing Modified Support T10062 In Center Hole At Right Side Of Oil Pan
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Secure changed support T10062 in center hole at right side of oil pan.
- Tighten original bolt with 3 original washers (each 4 mm thick) - **arrow** - to 30 Nm.
- Using support T10062 and engine/transmission jack V.A.G 1383 A, raise engine and transmission until lower connecting bolts for engine/transmission can be removed.
- Remove lower engine/transmission connecting bolts and lower subframe again.

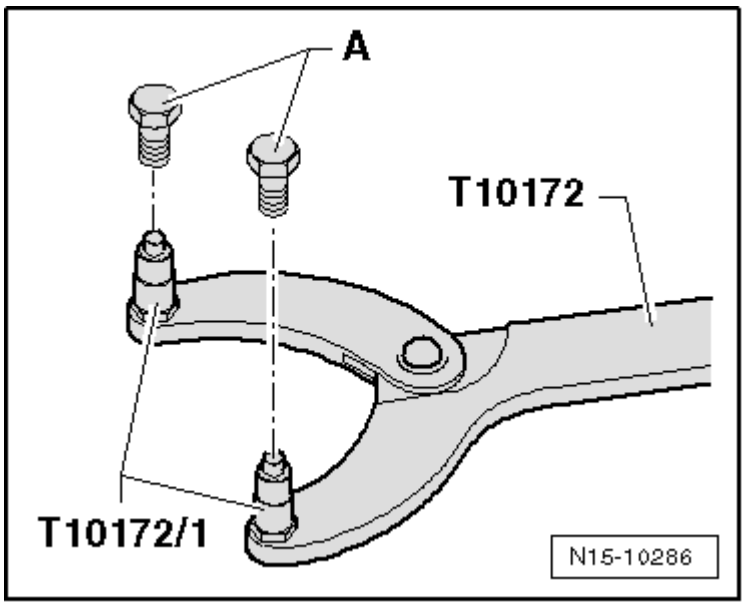

Fig. 9: Identifying Engine Support Bridge 10-222 And Engine Support Adapter 3147
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Attach engine support bridge 10-222 A with additional hooks 10-222 A/2 as shown.
- Hook engine support adapter 3147 into bolt holes of transmission bellhousing (shown in illustration with engine removed).

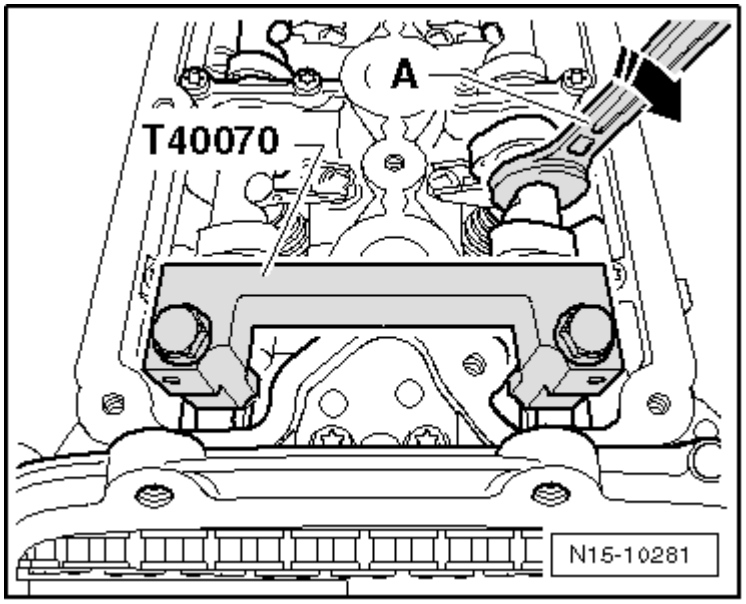

Fig. 10: Hooking In Lifting Tackle 2024 A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Hook in lifting tackle 2024 A as follows and raise slightly using workshop crane VAS 6100.

Belt pulley side: 1. Hole of lifting tackle bracket 2024 A/1 in position 1

Flywheel side: 3. Hole of rail in position 8

CAUTION: Use securing pins at hooks and pins - arrows -.

NOTE:

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

- Remove upper engine/transmission bolt.
- Remove engine toward front.

NOTE:

- **Engine must be guided carefully when lifting out, to prevent damage to the body.**

Secure engine on engine and transmission holder VAS 6095 when repairing.

Notes on installing

Installation is performed in the reverse sequence. Note the following:

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

- **Route all the various lines (e.g. for fuel, hydraulics, EVAP system, coolant, refrigerant, brake fluid, vacuum lines and hoses) and electrical wiring so that the original positions are restored.**
- **Ensure sufficient clearance to all moving or hot components.**

Vehicles with manual transmission

- Check clutch release bearing for wear and replace if necessary.
- Lightly grease clutch release bearing and input shaft splines with G 000 100 (do not grease guide sleeve for release bearing).
- Needle bearing must be installed in driveshaft; install needle bearing if necessary --> **Crankshaft needle bearings, pulling out and driving in** .

Vehicles with automatic transmission

- Fasten torque converter to drive plate using only original bolts.
- Before installing engine, turn torque converter and drive plate such that a hole is level with starter installation opening.

Continued for all vehicles

- Make sure intermediate plate is properly seated on engine.
- Make sure centering sleeves for engine to transmission are installed in cylinder block. Install if necessary.
- Replace self-locking nuts for securing engine mount.
- Align engine mount for stress-free installation through shaking movements.

- Install power steering pump: --> **48 STEERING** .
- Install ribbed belt --> **Ribbed belt, removing and installing** .
- Install Motor for intake flap -V157-.
- Install connecting pipe between charge air cooler and Motor for intake flap -V157-.

- Fasten front exhaust pipe to turbocharger --> **Exhaust system components, removing and installing** .
- Install starter: --> **27 - BATTERY, STARTER, GENERATOR, CRUISE CONTROL**
- Electrical connections and routing: --> **97 - WIRING**
- Install air conditioning compressor: --> **87 - AIR CONDITIONING**

- Remove lock carrier with attachments: --> **50 BODY, FRONT**
- Install front bumper: --> **63 BUMPER**
- Install sound insulation pan: --> **50 BODY, FRONT**
- Fill with coolant.

- Check headlight adjustment and adjust if necessary:
- Adapt Engine Control Module (ECM) --> **Adapting functions and components** .
- Test drive vehicle and check all Diagnostic Trouble Code (DTC) memories --> **Engine control module DTC memory, checking and erasing** .

Tightening torques

Bolted connections		Tightening torque
Bolts, nuts	M 6	10 Nm
	M 8	20 Nm
	M10	45 Nm
	M 12	60 Nm
Deviation from		
Stop/torque bracket		30 Nm
Front exhaust pipe to turbocharger		25 Nm
Starter to transmission		65 Nm

Front engine mount

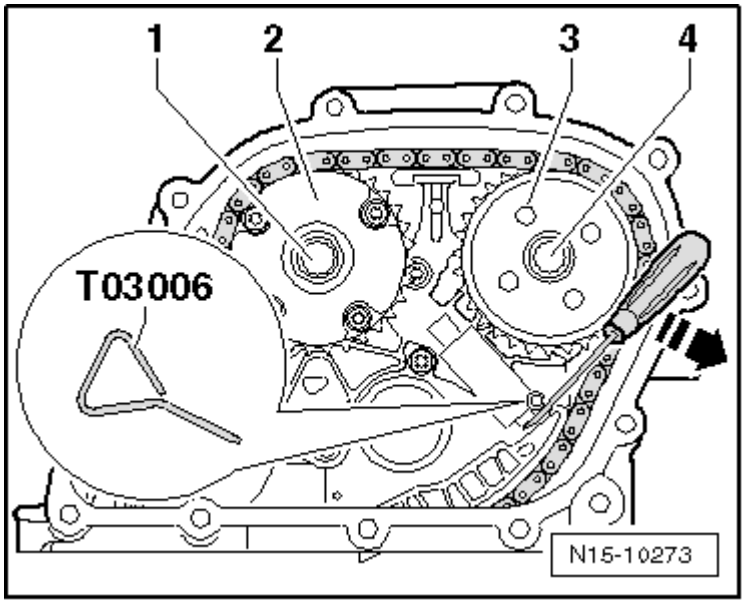

Fig. 11: Front Engine Mount
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Transverse pipe

- With torque bracket

2 - Bump stop

3 - Limit stop

- Rest it on bump stop under its own weight and fasten securing bolts

4 - 30 Nm

Additional information and assembly work on vehicles with air conditioning

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

NOTE:

- **Do not bend or stretch lines or hoses as condenser and/or refrigerant lines/hoses may be damaged.**

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

- Remove retaining clamp(s) from refrigerant lines.
- Remove ribbed belt.
- Remove air conditioning compressor: --> **87 - AIR CONDITIONING**
- Secure A/C compressor and condenser to body so that refrigerant lines/hoses are not stressed.

13 ENGINE - CRANKSHAFT, CYLINDER BLOCK

ENGINE, DISASSEMBLING AND ASSEMBLING

Engine, disassembling and assembling

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 insert**

Engine overview --> **Overview** .

Overview

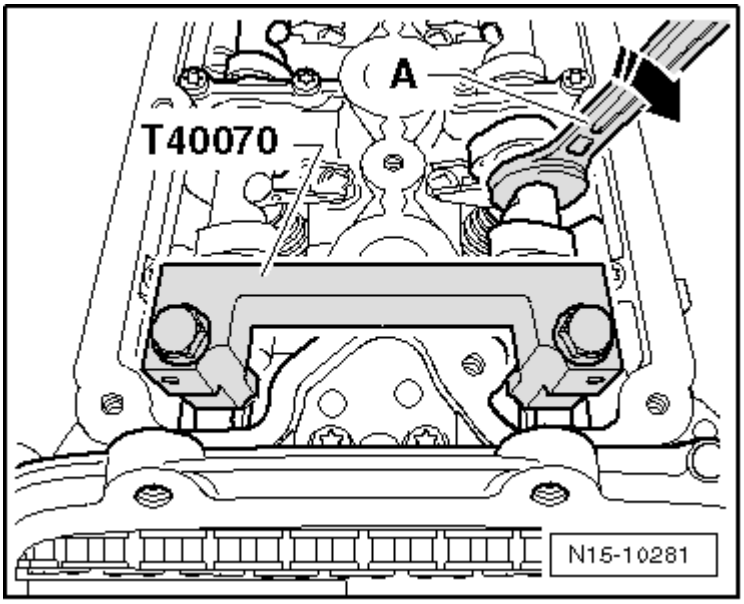

Fig. 12: Engine Overview (4 Parts)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Part I

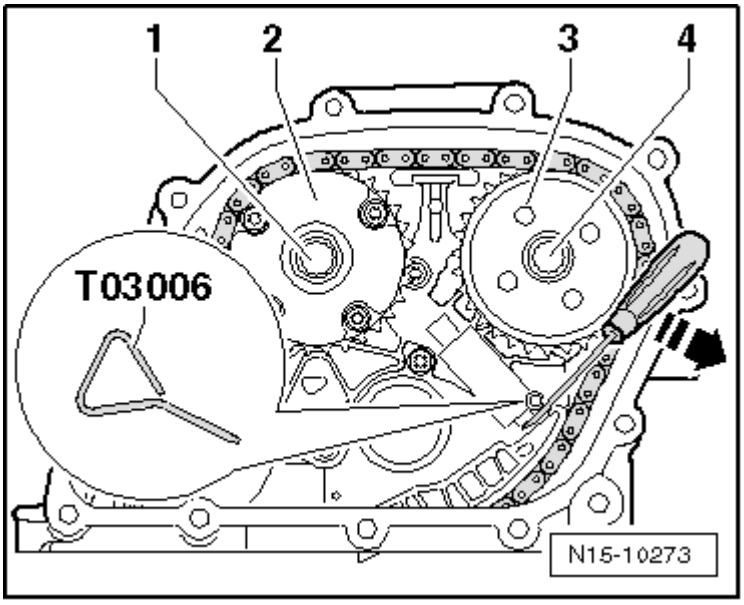

Fig. 13: Engine Overview (Part 1)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 25 Nm

2 - Generator

3 - 25 Nm

4 - Relay lever

5 - Spacer

- Note installed position

6 - Pulley

- For ribbed belt

7 - Tensioning element

- For ribbed belt
- Removing and installing ribbed belt --> **Ribbed belt, removing and installing**

8 - Bracket

- For Generator, ribbed belt tensioning element, viscous fan clutch and power steering pump

9 - 45 Nm

- Observe tightening sequence **Tightening sequence, bracket to cylinder block**

10 - 45 Nm

11 - Power steering pump

- Removing and installing: --> **48 STEERING**

12 - Banjo bolt

- Tighten to 30 Nm

13 - Oil seal

- Always replace

14 - Pressure line

15 - Pulley

- For power steering pump

16 - Bracket

- For tensioning element

17 - Pulley

- For viscous fan clutch

18 - Viscous fan clutch

- Removing and installing --> **Viscous fan clutch, removing and installing**

19 - 30 Nm

Part II

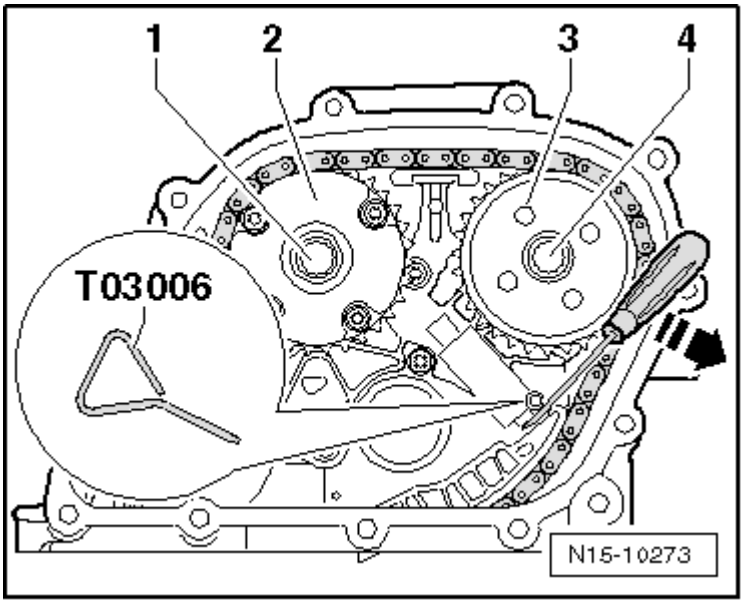

Fig. 14: Engine Overview (Part 2)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Toothed belt cover - upper part

2 - Toothed belt

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

3 - 20 Nm plus an additional $^{1}/_{8}$ turn (45°)

4 - Tensioning roller

5 - 100 Nm

6 - 25 Nm

7 - Camshaft sprocket

8 - Hub

- With sensor wheel
- Use counter-holder T10051 to loosen and tighten
- To remove, use pulling fixture T10052
- Removing and installing --> **Camshaft, removing and installing**

9 - 10 Nm

10 - Rear toothed belt cover

11 - Grommet

12 - Idler roller

13 - Coolant pump

- Removing and installing --> **Coolant pump, removing and installing**

14 - Crankshaft toothed belt sprocket

15 - 120 Nm plus an additional $^{1}/_{4}$ turn (90°)

- Always replace
- Use counter support 3415 to loosen and tighten
- Do not additionally oil or grease threads or collar
- Additional rotation can occur in several stages

16 - 15 Nm

17 - 20 Nm

18 - Toothed belt cover - lower part

19 - Belt pulley/harmonic balancer

- Only possible to install in one position - holes are offset

20 - 10 Nm plus an additional $^{1}/_{4}$ turn (90°)

21 - Toothed belt cover - center part

Part III

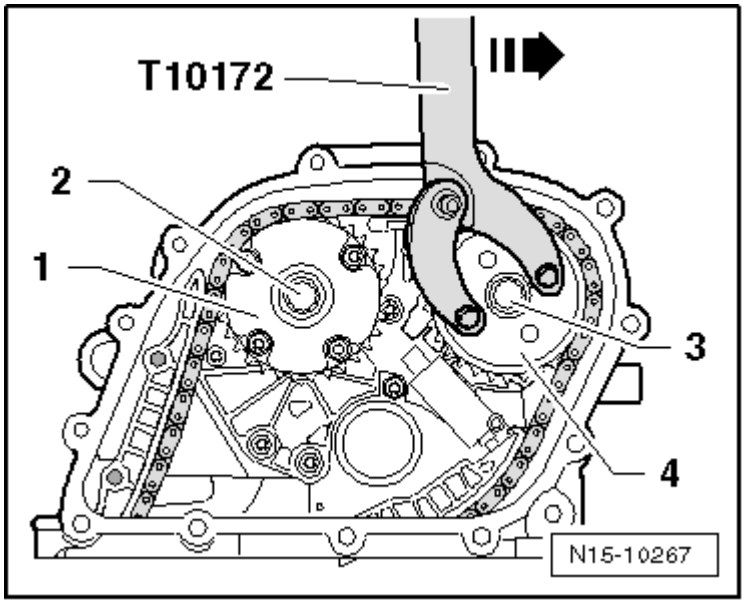

Fig. 15: Engine Overview (Part 3)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Cylinder head cover

- Before installing, clean contact surface of cylinder head with clean shop rag

2 - To turbocharger

3 - Pressure regulator valve

- For crankcase ventilation

4 - Cap

- Replace seal if damaged

5 - Sealing sleeve

- Replace if damaged

6 - 10 Nm

- First, fasten all bolts hand-tight

7 - Seal for cylinder head cover

- Only replace together with cylinder head cover
- Before installing, seal contact surfaces with *sealant AMV 174 004 01* .

8 - 20 Nm

9 - Lifting eye

10 - 10 Nm

11 - Central harness connector

- For Pump-Injector unit

12 - From brake booster

13 - Tandem pump

- For fuel and vacuum supply
- Removing and installing --> **Tandem pump, removing and installing**
- Checking --> **Tandem pump, checking**

14 - 25 Nm

15 - Supply hose

- White or with white markings
- Ensure seated tightly
- Secure with spring-type clips

16 - Return hose

- Blue or with blue marking
- Ensure seated tightly
- Secure with spring-type clips

17 - Seal

- Always replace

18 - Bolt

19 - Bracket

- For fuel filter

20 - Cylinder head

- Removing and installing --> **Cylinder head, removing and installing**

- After replacing replace entire amount of coolant

21 - Cylinder head gasket

- Replace
- Observe identification
- After replacing replace entire amount of coolant

22 - Camshaft Position (CMP) sensor -G40-

- For camshaft position
- To remove, remove grommet from rear of toothed belt cover

23 - Cylinder head bolt

- Replace
- Observe sequence for loosening and tightening --> **Cylinder head, removing and installing** , Cylinder head, removing and installing

24 - Pump-Injector unit

- Removing and installing --> **Pump-Injector unit, removing and installing**

Part IV

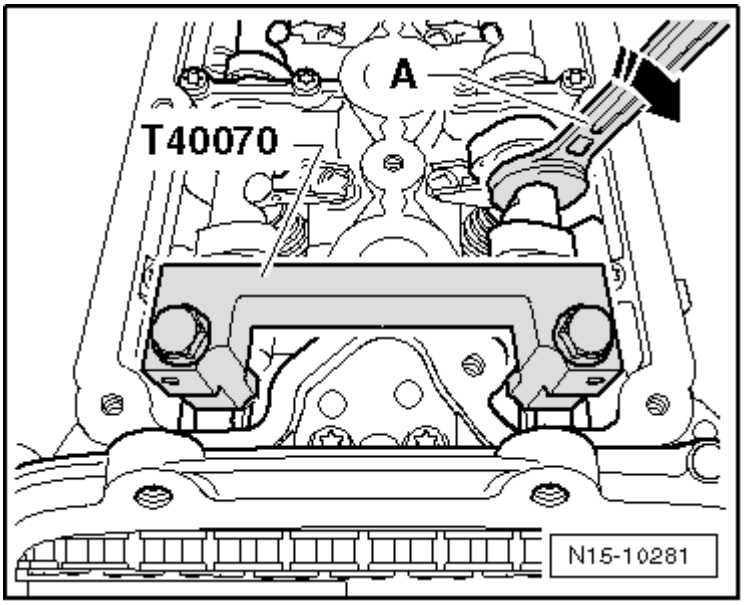

Fig. 16: Engine Overview (Part 4)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 45 Nm

2 - Hood

3 - Bracket

- For vacuum reservoir and Wastegate bypass regulator valve -N75-

4 - Cylinder block

- Sealing flanges and flywheel/drive plate, removing and installing --> **Sealing flanges and flywheel/drive plate, removing and installing**
- Removing and installing crankshaft --> **Crankshaft, removing and installing**
- Piston and connecting rod, disassembling and assembling --> **Piston and connecting rod, disassembling and assembling**
- With balance shaft module

- Balance shaft module, removing and installing --> **Balance shaft module, removing and installing**

5 - Bracket

- For fuel filter

6 - Bolt

7 - 10 Nm

8 - Seal

- Replace

9 - Oil filter bracket

- Assembly overview --> **Part II**

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

- Replace
- First, fasten upper left and lower right bolts, then tighten all four bolts in a diagonal sequence

11 - Engine speed (RPM) sensor

12 - Connection

- For thermostat

13 - 15 Nm

14 - O-ring

- Replace

15 - Coolant thermostat

- Removing and installing --> **Coolant thermostat, removing and installing**

16 - 45 Nm

17 - Bracket

- For Generator, ribbed belt tensioning element, viscous fan clutch and power steering pump

18 - Oil pan

- Clean sealing surface before installing
- Install with silicone sealant D 176 404 A2 --> **Oil pan, removing and installing**

19 - 15 Nm

- Use hex ball socket T10058 to remove and install two rear bolts on transmission

Tightening sequence, bracket to cylinder block

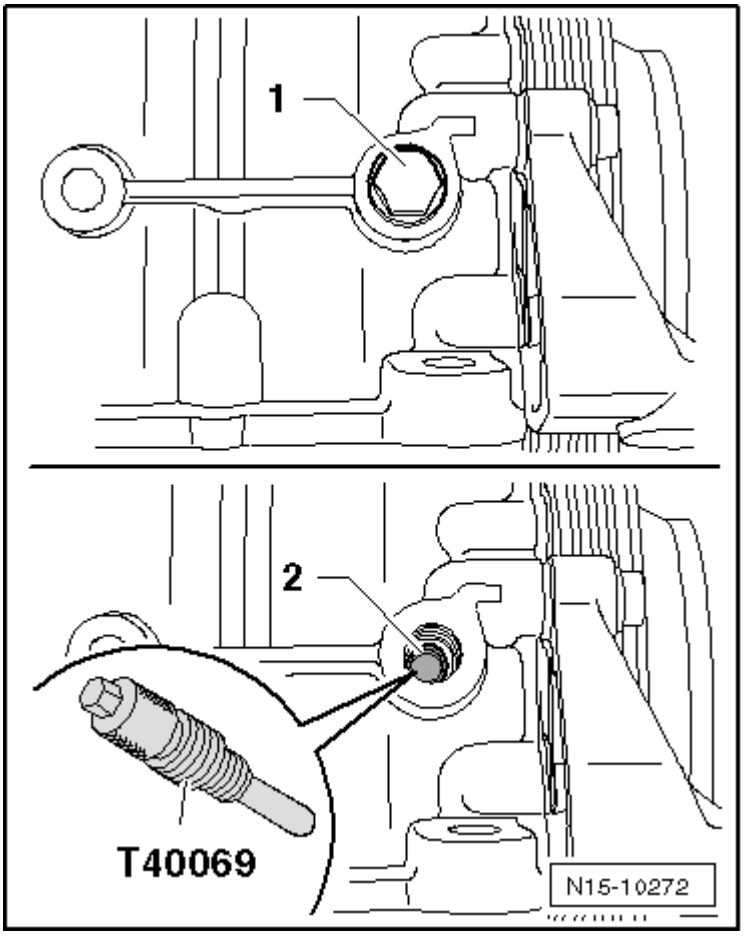

Fig. 17: Bracket To Cylinder Block Tightening Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place bracket on cylinder block (observe sleeve between compact bracket and cylinder block).
- Tighten compact bracket in tightening sequence as follows:

1 - Tighten bolt - **A** - , 45 Nm

2 - Tighten bolt - **B** - , 45 Nm

3 - Tighten bolt - **C** - , 45 Nm

4 - Tighten bolt - **D** - , 45 Nm

5 - Tighten bolt - **E** - , 45 Nm

6 - Tighten bolt - **F** - , 45 Nm

Ribbed belt for air conditioning compressor, removing and installing

Special tools, testers and auxiliary items required

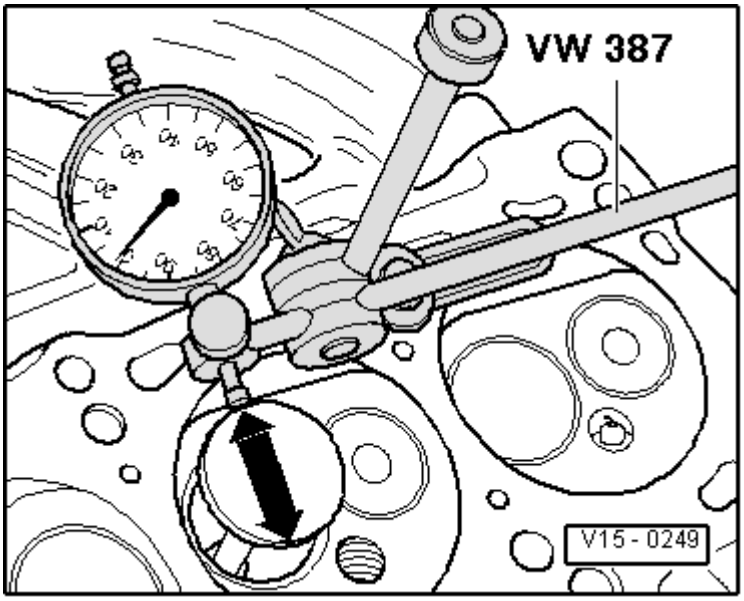

Fig. 18: Torque Wrench V.A.G 1331
Courtesy of VOLKSWAGEN UNITED STATES, INC.

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

Removing

- Bring lock carrier into service position: --> **50 BODY, FRONT**
- Mark direction of rotation of ribbed belt.

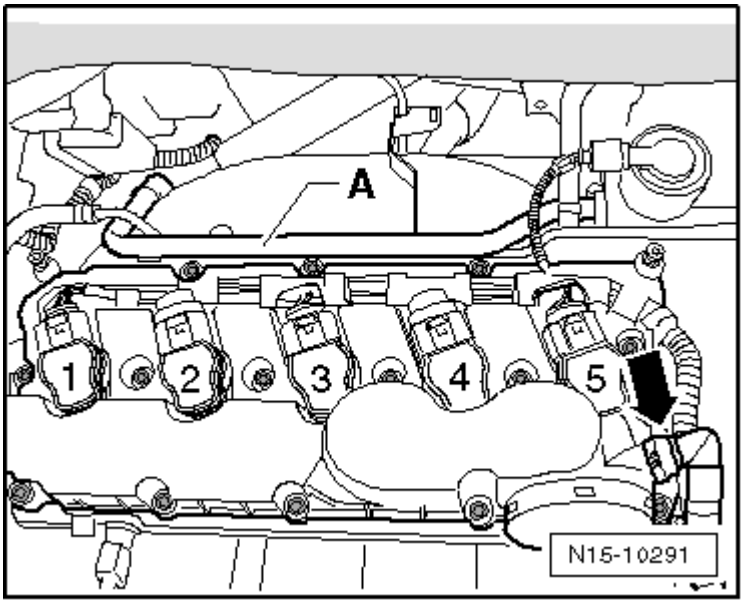

Fig. 19: Locating Securing Bolts For Ribbed Belt Tensioner For A/C Compressor
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen bolts of air conditioning compressor ribbed belt tensioner and take off ribbed belt.

Installing

NOTE:

- **Before installing the ribbed belt, make sure that the air conditioning compressor is securely fastened.**
- **When installing the ribbed belt observe belt direction of rotation and that the belt is seated correctly in the belt pulleys.**

- Set ribbed belt onto air conditioning compressor.

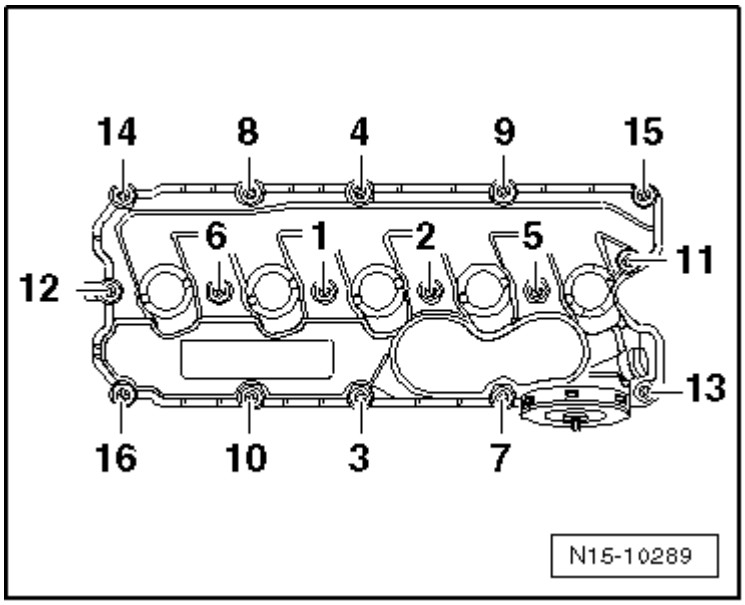

Fig. 20: Tightening Belt Tensioner
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place torque wrench in 7 o'clock position (30° from vertical) and tighten belt tensioner to 30 Nm.
- Hold torque wrench securely and tighten bolts - **A** - to 20 Nm.

After completing repairs always:

- Start engine and check belt running.

Ribbed belt, removing and installing

Work sequence

NOTE:

- **If the ribbed belt must be completely removed, the ribbed belt for the air conditioning compressor must be removed first on vehicles equipped with air conditioning --> Ribbed belt for air conditioning compressor, removing and installing .**

Work sequence

- Bring lock carrier into service position: --> **50 BODY, FRONT**
- Mark direction of rotation of ribbed belt.

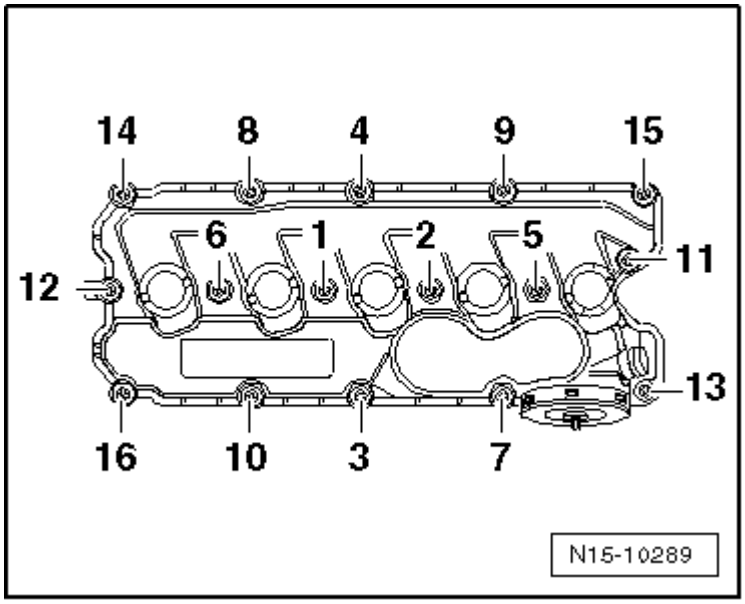

Fig. 21: Releasing Center Tensioner Belt Tension
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Using a straight box-end wrench, swing center tension roller in direction of - **arrow** -.
- Take off ribbed belt.

NOTE:

- **Ensure, before installing the ribbed belt, that all ancillaries (Generator, air conditioning compressor, power steering pump) are secured tightly.**
- **When installing the ribbed belt observe belt direction of rotation and that the belt is seated correctly in the belt pulleys.**

After completing repairs always:

- Start engine and check belt running.

SEALING FLANGES AND FLYWHEEL/DRIVE PLATE, REMOVING AND INSTALLING

Sealing flanges and flywheel/drive plate, removing and installing

NOTE:

- **Servicing clutch: --> 6 Spd. Manual Transmission 01E All Wheel Drive - 30 - CLUTCH**
- **Secure engine in engine and transmission holder VAS 6095 when working on the engine.**

Sealing flanges and flywheel/drive plate, assembly overview --> **Sealing flanges and flywheel/drive plate,**

assembly overview .

Sealing flanges and flywheel/drive plate, assembly overview

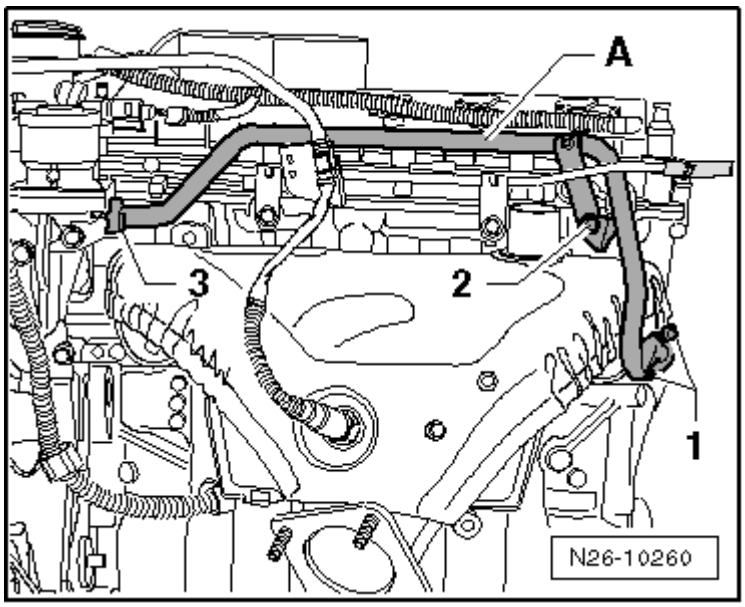

Fig. 22: Identifying Crankshaft Oil Seal
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Oil seal

- Do not additionally oil or grease sealing lip of seal
- Before installing, remove oil remains from crankshaft journal with a clean cloth
- Seal for crankshaft - belt pulley side, replacing --> **Seal for crankshaft - ribbed belt side, replacing**

2 - Sealing flange

- Must be located on dowel sleeves
- To remove, remove oil pan --> **Oil pan, removing and installing**
- Insert with silicone sealant D 176 404 A2 --> **Sealing flange - belt pulley side, removing and installing**
- Removing and installing --> **Sealing flange - belt pulley side, removing and installing**

3 - Cylinder block

- Removing and installing crankshaft --> **Crankshaft, removing and installing**
- Piston and connecting rod, disassembling and assembling --> **Piston and connecting rod, disassembling and assembling**
- With balance shaft module
- Balance shaft module, removing and installing --> **Balance shaft module, removing and installing**

4 - Flywheel/drive plate

- To remove and install flywheel, secure using flywheel retainer 3067
- Removing and installing drive plate --> **Drive plate, removing and installing**

5 - 60 Nm plus an additional $^{1}/_{4}$ turn (90°)

- Replace

6 - Intermediate plate

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

7 - 15 Nm

8 - Sealing flange with seal

- Only replaced as complete unit
- To remove, remove oil pan --> **Oil pan, removing and installing**
- Do not additionally oil or grease sealing lip of seal
- Before installing, remove oil remains from crankshaft journal with a clean cloth
- To install, use provided support sleeve
- Support sleeve may only be removed after sealing flange has been slid onto crankshaft pin.

Seal for crankshaft - ribbed belt side, replacing

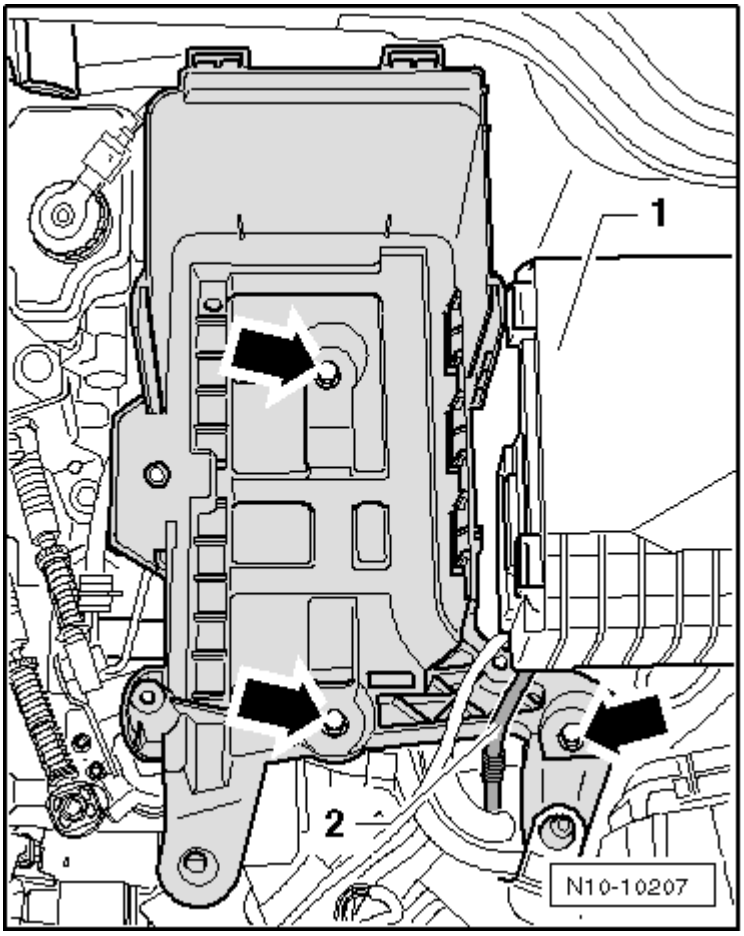

Fig. 23: Identifying Special Tools - Crankshaft Oil Seal - Belt Pulley End, Replacing (For PTFE Seals)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Seal remover 3203
- Counter support 3415
- Assembly tool T10053
- Torque wrench (5 to 50 Nm) V.A.G 1331
- Torque wrench (40 to 200 Nm) V.A.G 1332

Removing

- Remove ribbed belt --> **Ribbed belt, removing and installing**
- Remove toothed belt --> **Toothed belt, removing, installing and tensioning** .

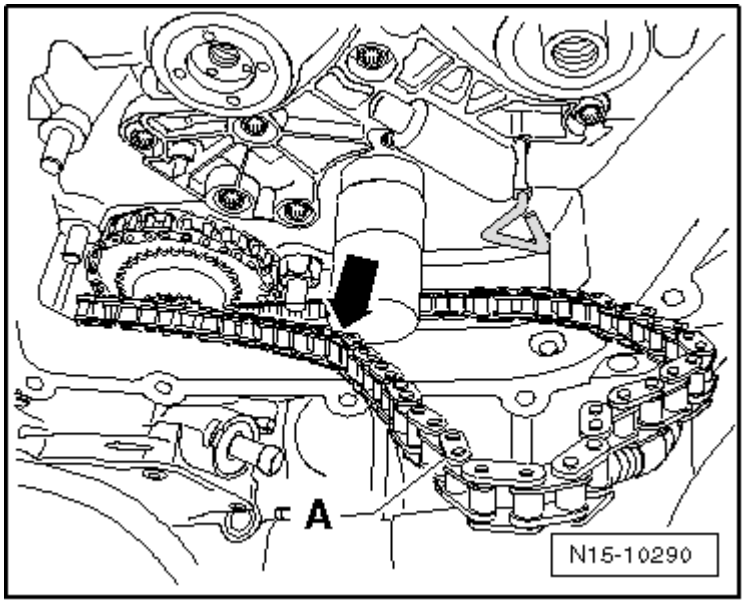

Fig. 24: Counter-Holding Crankshaft Toothed Belt Sprocket With 3415
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove toothed belt crankshaft sprocket. Lock toothed belt sprocket with counter support 3415.
- To guide seal remover 3203, screw in central bolt by hand up to limit stop in crankshaft.
- Turn inner portion of seal remover two revolutions (approx. 3 mm) out from outer portion and lock it with knurled bolt.
- Lubricate threaded head of seal remover.

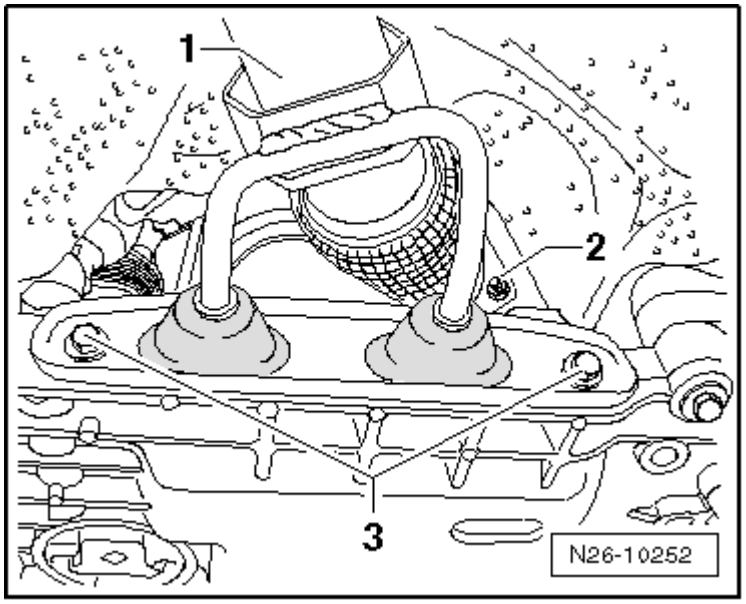

Fig. 25: Identifying Special Tool - Seal Puller 3203
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Using considerable force, screw seal remover as far as possible into seal.

- Loosen knurled screw and turn inner portion against crankshaft until oil seal is pulled out.

Installing

NOTE:

- **The sealing lip of the sealing ring must not be additionally oiled or greased.**

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

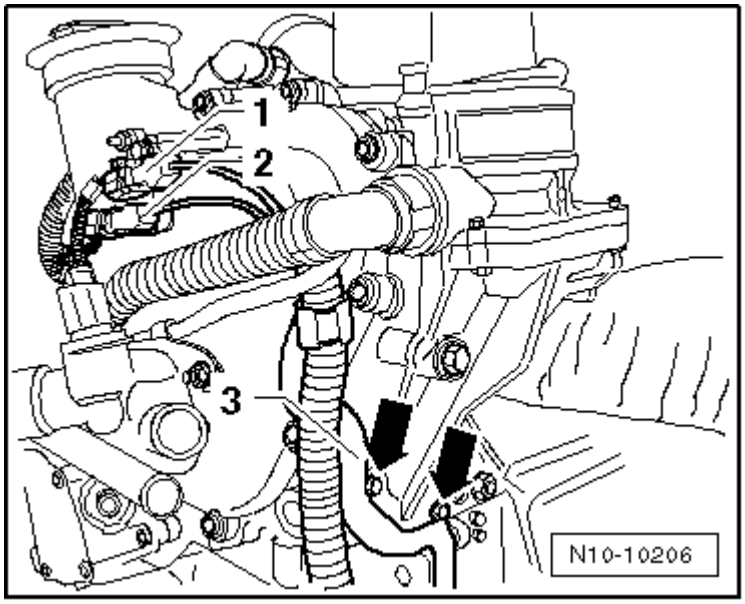

Fig. 26: Identifying Guide Sleeve From Assembly Tool T10053 Installed On Crankshaft Journal
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place guide sleeve T10053/1 on end of crankshaft.
- Push seal over guide sleeve onto end of crankshaft.

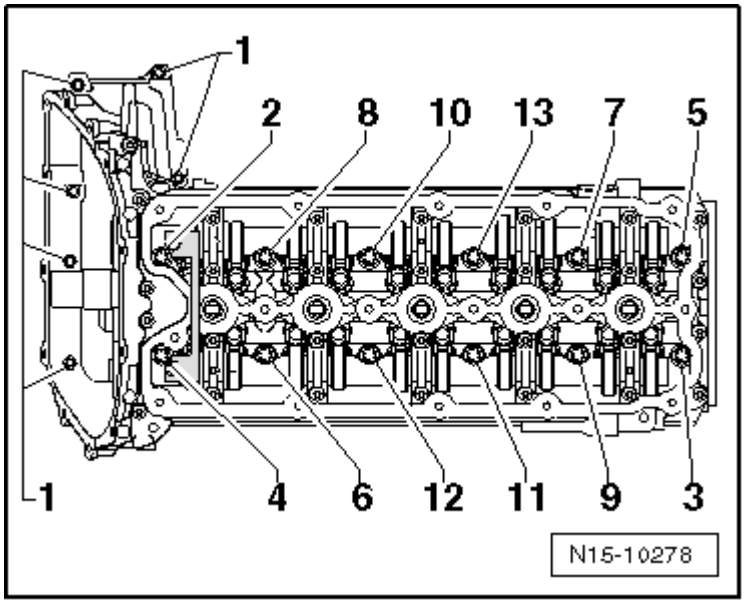

Fig. 27: Pressing In Oil Seal Using Assembly Tool T10053 And Bolt T10053/2
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press seal in to limit stop using assembly tool T10053 and central bolt.

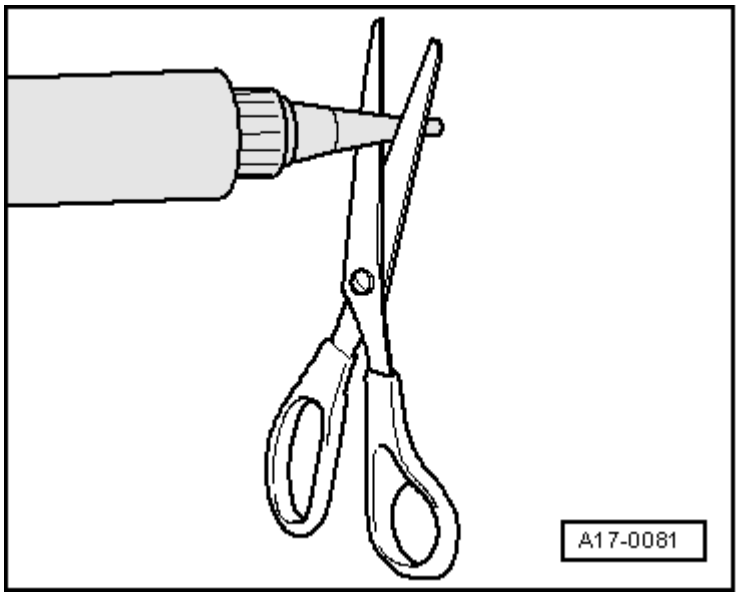

Fig. 28: Counter-Holding Crankshaft Toothed Belt Sprocket With 3415
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install toothed belt crankshaft sprocket and lock with counter support 3415.

NOTE:

- **There must be no oil on the contact surface between the toothed belt sprocket and crankshaft.**
- **Always replace the central bolt.**

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

- Tighten new central bolt to 120 Nm and turn an additional 90° ($^{1}/_{4}$ turn , additional turn may occur in several stages).

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

- Install and tension toothed belt --> **Toothed belt, removing, installing and tensioning** .
- Install ribbed belt --> **Ribbed belt, removing and installing** .

Drive plate, removing and installing

Special tools, testers and auxiliary items required

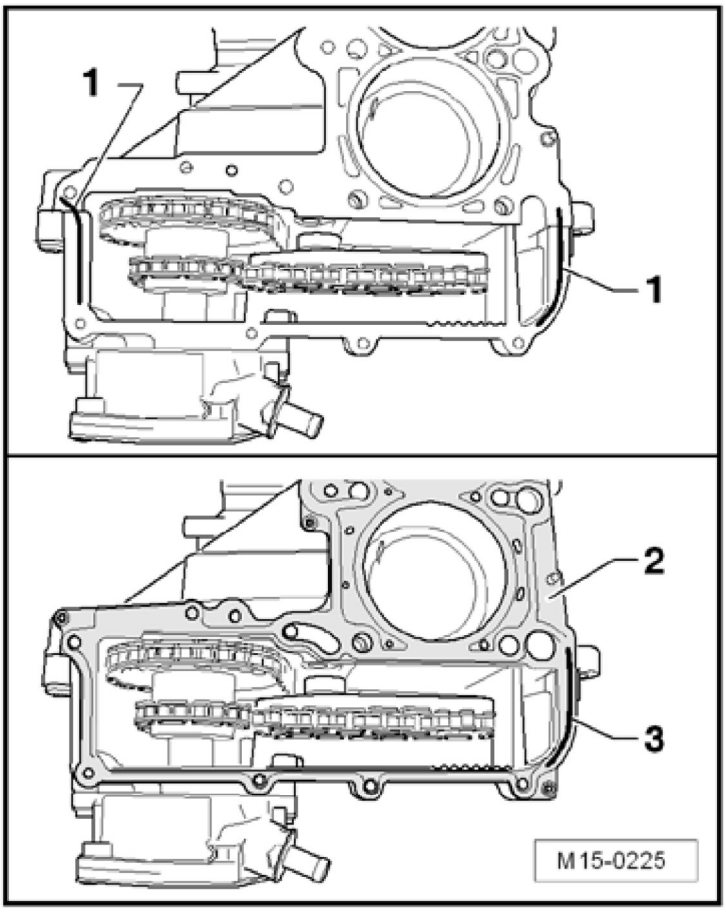

Fig. 29: Identifying Special Tools - Drive Plate, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Retainer 3067

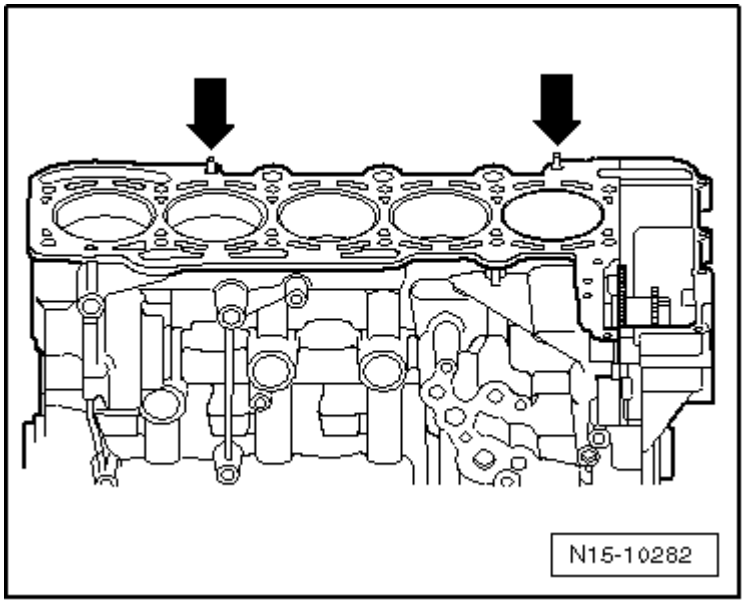

Fig. 30: Torque Wrench V.A.G. 1332
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Torque wrench (40 to 200 Nm) V.A.G 1332
- Caliper gauge

Drive plate, loosening and tightening

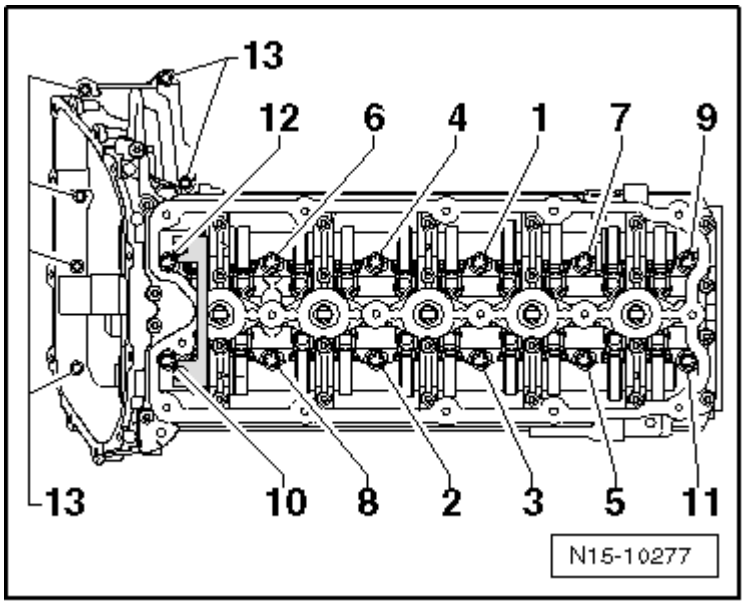

Fig. 31: Re-Position Retainer 3067 To Loosen And Tighten Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Re-position retainer 3067 to loosen and tighten bolts.

Installed location of retainer:

- A - to loosen
- B - to fasten

Installing

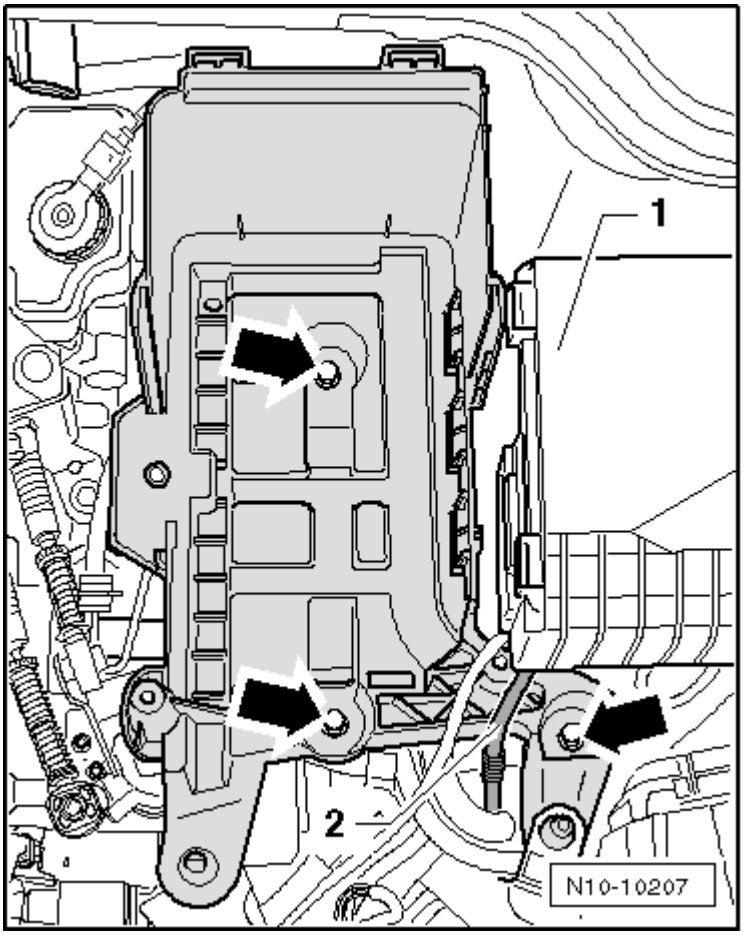

Fig. 32: Identifying Drive Plate, Grooved Washer And New Bolt
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position drive plate using washer - **1** - with grooves - **arrow** -.
- Install new bolts and tighten to 30 Nm.

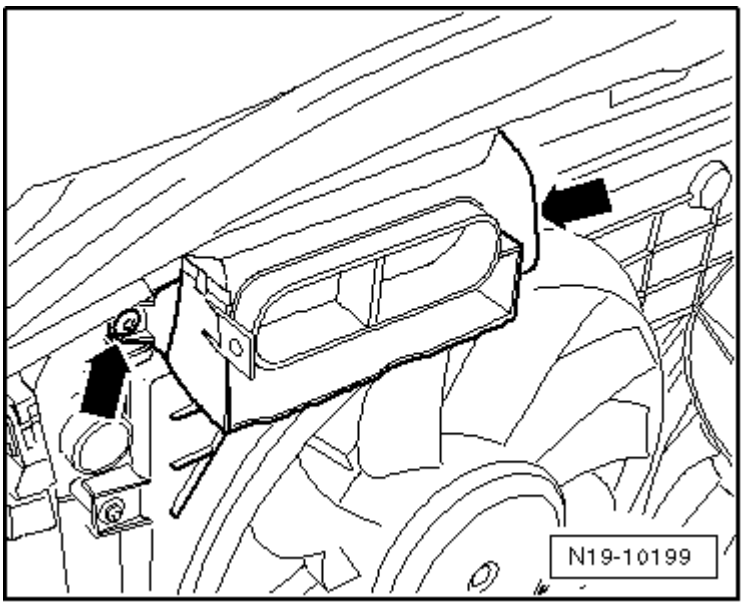

Fig. 33: Checking Distance Between Drive Plate And Cylinder Block
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert caliper gauge through three outer holes of drive plate and check distance between drive plate and cylinder block. Specified value, dimension -a-: 18.9... 20.5 mm

If the specification is not attained:

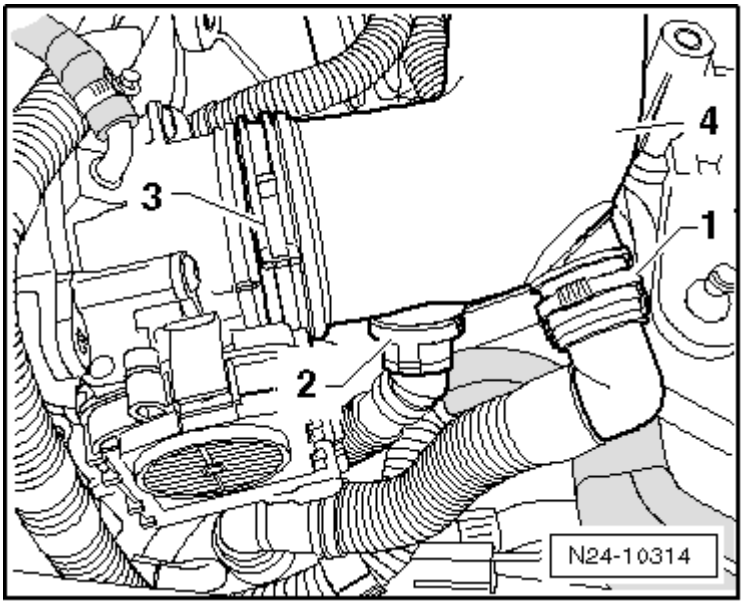

Fig. 34: Identifying Drive Plate, Grooved Washer And New Bolt
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove drive plate again and install appropriate shim - **2** -. Tighten bolts again to 30 Nm.

If the specification is attained:

- Tighten bolts to 60 Nm plus an additional 90° ($^{1}/_{4}$ turn, turning further may be performed in several steps).

Sealing flange - belt pulley side, removing and installing

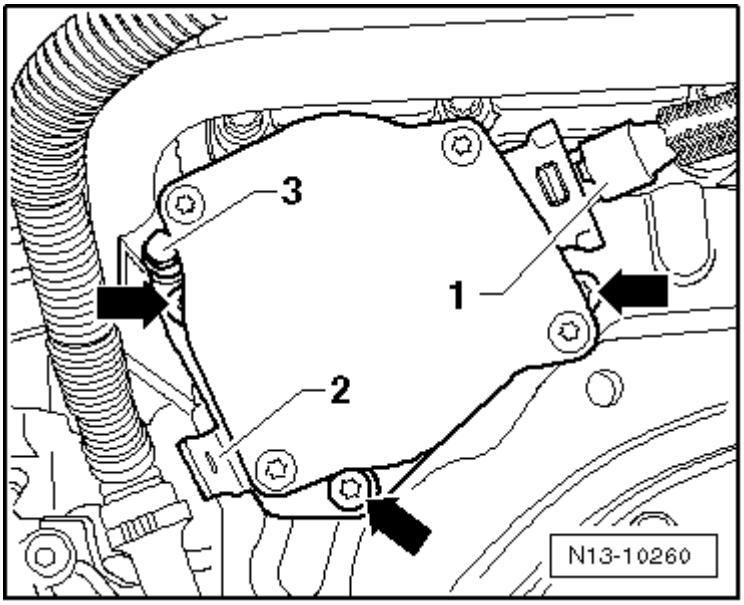

Fig. 35: Identifying Special Tools - Sealing Flange - Belt Pulley Side, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Counter support 3415
- Assembly tool T10053
- Torque wrench (5 to 50 Nm) V.A.G 1331
- Torque wrench (40 to 200 Nm) V.A.G 1332

Not illustrated:

Special tools, testers and auxiliary items required

- Hand drill with plastic brush attachment
- *Silicone sealant D 176 404 A2*
- Flat scraper
- Protective glasses

Removing

- Remove ribbed belt --> **Ribbed belt, removing and installing** .
- Remove toothed belt --> **Toothed belt, removing, installing and tensioning** .

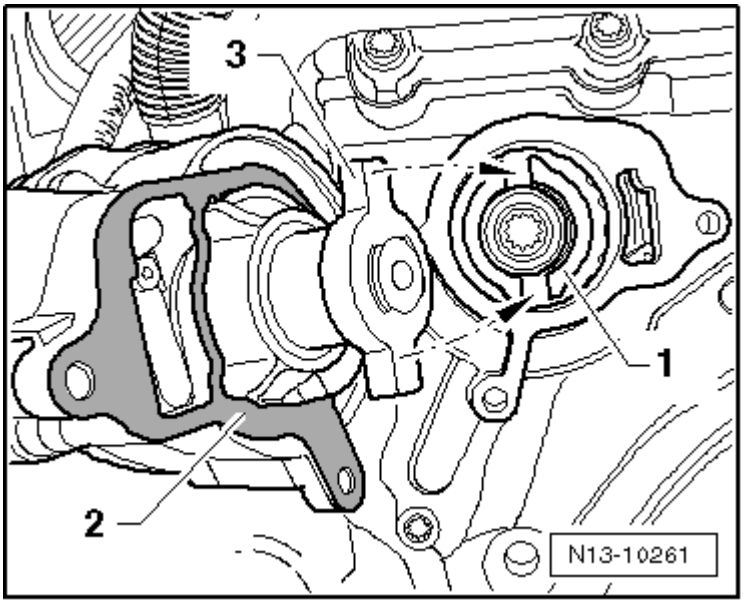

Fig. 36: Counter-Holding Crankshaft Toothed Belt Sprocket With 3415
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove toothed belt crankshaft sprocket. To do this, lock toothed belt sprocket with counter support 3415.
- Drain engine oil.
- Remove oil pan --> **Oil pan, removing and installing** .
- Unscrew front sealing flange.

- Remove sealing flange, loosening if necessary by applying light strikes with a rubber hammer.
- Remove sealant residue from cylinder block with a flat scraper.

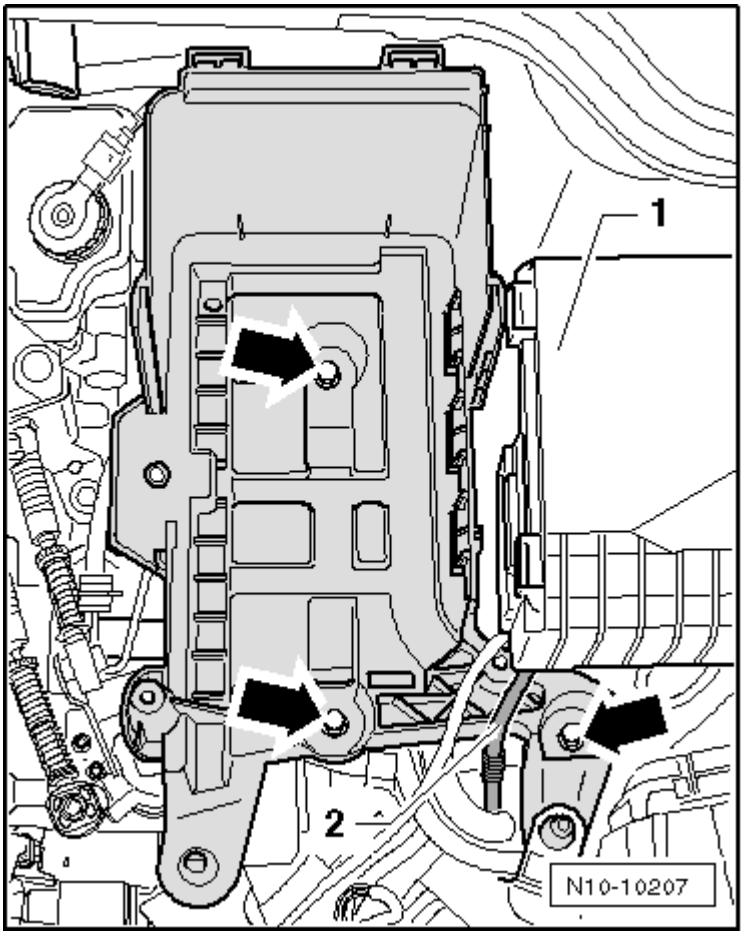

Fig. 37: Removing Sealant Remains On Sealing Flange With A Rotating Plastic Brush
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove sealant residue from sealing flange using a rotating plastic brush (wear safety glasses).
- Clean sealing surfaces. Sealing surfaces 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 silicone sealant.**

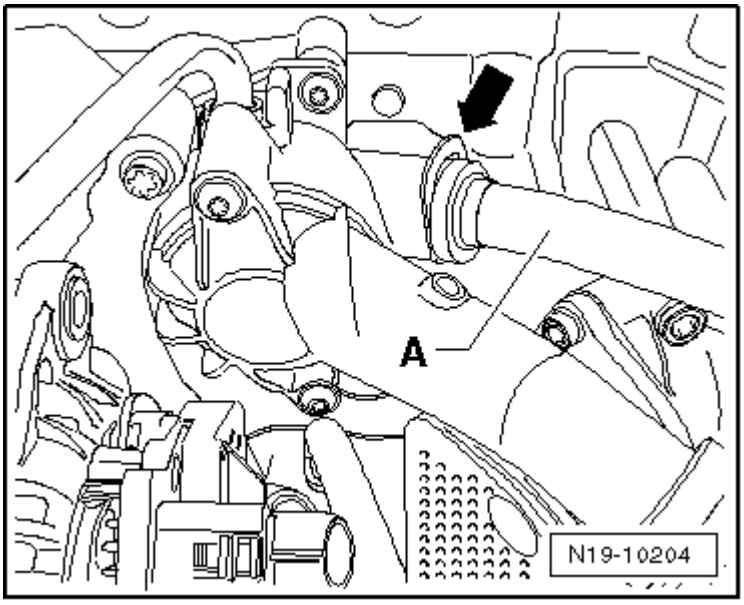

Fig. 38: Cut Tube Nozzle At Front Marking (Nozzle Diameter Approx. 3 Mm)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Cut off nozzle on tube of sealant at front mark (diameter of nozzle: approx. 3 mm).

NOTE:

- **The sealing compound bead must not be thicker than 2-3 mm, 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.**

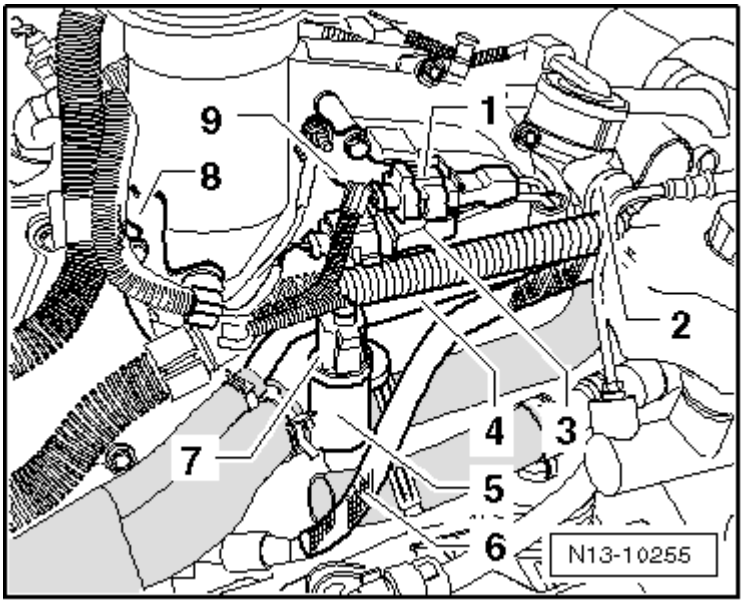

Fig. 39: Identifying Silicone Sealant Bead

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Apply silicone sealant as illustrated to clean sealing surface of sealing flange.
- Set sealing flange in place immediately and lightly tighten bolts.

NOTE:

- **To install the sealing flange with the seal already installed, use the guide sleeve T10053/1.**

- Fasten sealing flange bolts in a diagonal sequence: Tightening torque: 15 Nm
- Remove excess sealant.
- Install oil pan --> **Oil pan, removing and installing** .

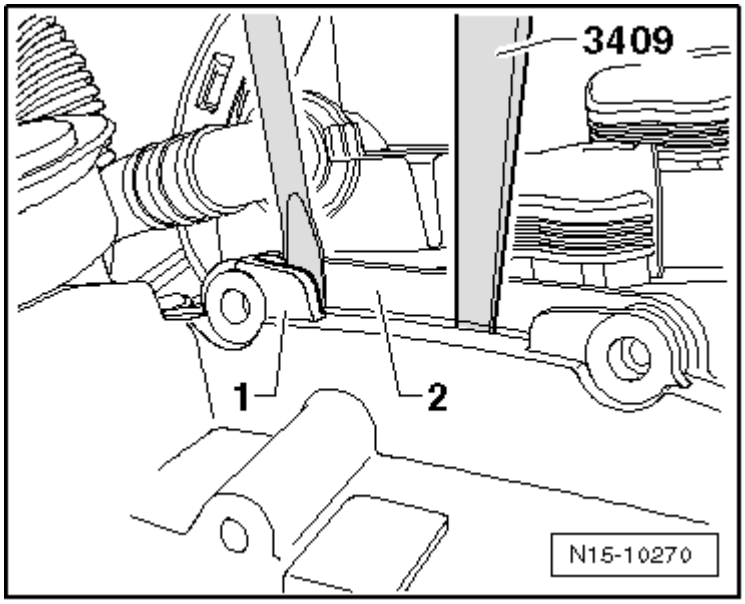

Fig. 40: Counter-Holding Crankshaft Toothed Belt Sprocket With 3415
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install toothed belt crankshaft sprocket and lock with counter support 3415.

NOTE:

- **There must be no oil on the contact surface between the toothed belt sprocket and crankshaft.**
- **Always replace the central bolt.**
- **The threads and shoulder must be free of oil and grease.**

- Tighten new central bolt to 120 Nm and turn an additional 90° ($^{1}/_{4}$ turn, additional turn may occur in several stages).

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

NOTE:

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

Installing the toothed belt --> **Toothed belt, removing, installing and tensioning** .

- Install ribbed belt --> **Ribbed belt, removing and installing** .

CRANKSHAFT, REMOVING AND INSTALLING

Crankshaft, removing and installing

NOTE:

- **Before removing the crankshaft, the balance shaft module must be removed from the cylinder block --> Balance shaft module, removing and installing .**

Secure engine in engine and transmission holder VAS 6095 when repairing.

Crankshaft, assembly overview --> **Crankshaft, assembly overview** .

Crankshaft, assembly overview

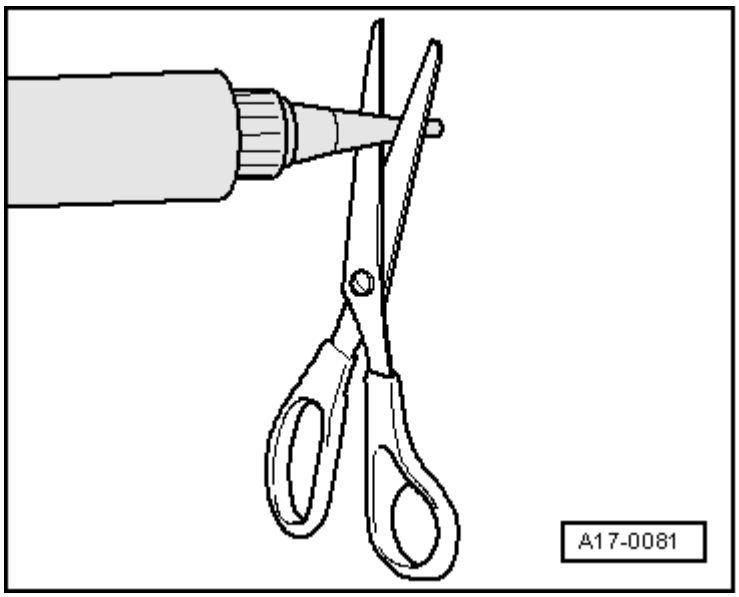

Fig. 41: Crankshaft, Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Bearing shells 1, 2, 4 and 5

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

2 - 65 Nm plus an additional $^{1}/_{4}$ turn (90°)

- Replace
- Tighten to 65 Nm to measure radial play, do not turn further

3 - Bearing cap

- Bearing cap 1: Belt pulley side
- Bearing cap 3 with notches for thrust washers
- Retaining tabs of bearing shells and cylinder block/bearing caps must lie above one another

4 - Bearing shell 3

- For bearing cap without oil groove

5 - Thrust washer

- For bearing cap 3
- Observe locating point

6 - Needle bearing

- Pulling out and driving in --> **Crankshaft needle bearings, pulling out and driving in**

7 - Sensor wheel

- Replace if damaged
- For Engine speed (RPM) sensor -G28-
- Replace sensor wheel every time bolts are loosened
- Removing and installing **Sensor wheel, removing and installing**

8 - 10 Nm plus an additional $^{1}/_{4}$ turn (90°)

- Replace

9 - Fitting pin

- Check projection from crankshaft **Checking projection of fitting pin from crankshaft**

10 - Crankshaft

- Axial play, New: 0.07 to 0.17 mm; Wear limit: 0.37 mm
- Check radial clearance with Plastigage: 0.03 to 0.08 mm; Wear limit: 0.17 mm
- Do not turn crankshaft when measuring radial play

- Crankshaft dimensions --> **Crankshaft dimensions**
- On vehicles with manual transmission, drive in needle bearing if necessary --> **Crankshaft needle bearings, pulling out and driving in**

11 - Thrust washer

- For cylinder block, bearing 3

12 - Bearing shell 3

- For cylinder block with oil groove

Checking projection of fitting pin from crankshaft

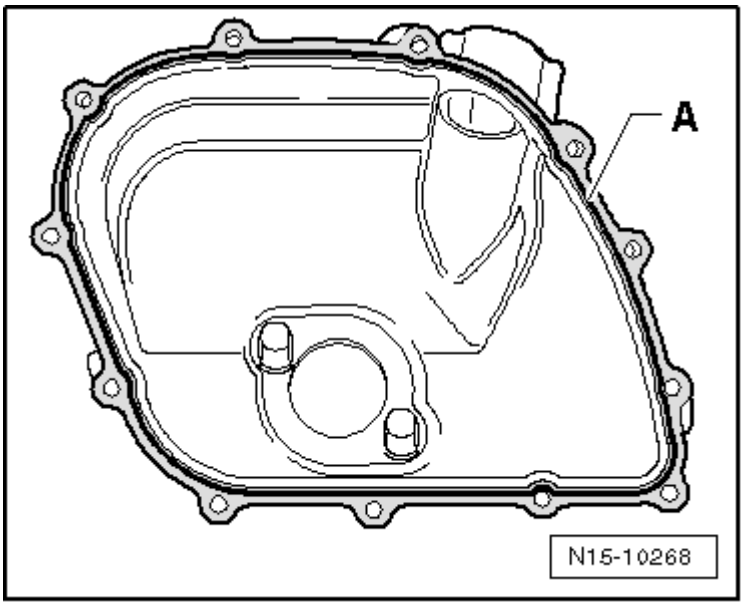

Fig. 42: Identifying Dowel Pin
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Checking projection of fitting pin from crankshaft

Special tools, testers and auxiliary items required

- Depth gauge

Work sequence

- Check projection - **a** - of fitting pin with sensor wheel - **1** - removed, using a depth gauge.

1 - Sensor wheel

2 - Bolt

3 - Fitting pin projection - **3** - from crankshaft a = 2.5 to 3.0 mm

Sensor wheel, removing and installing

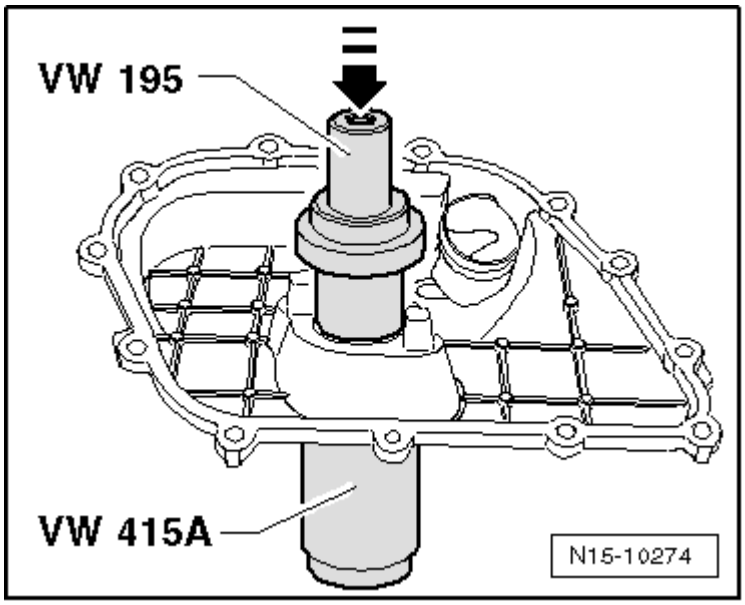

Fig. 43: Removing/Installing Sender Wheel
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Replace sensor wheel - **2** - any time bolts are loosened - **1** -. Tightening torque: 10 Nm plus an additional 90° ($^{1}/_{4}$ turn)

NOTE:

- **If a second tightening of the sensor wheel is performed, the fastening point of the countersunk screws in the sensor wheel is so far deformed that the screw heads line up - arrows - at the crankshaft - 3 - and the sensor wheel is loose under the screws.**

Crankshaft needle bearings, pulling out and driving in

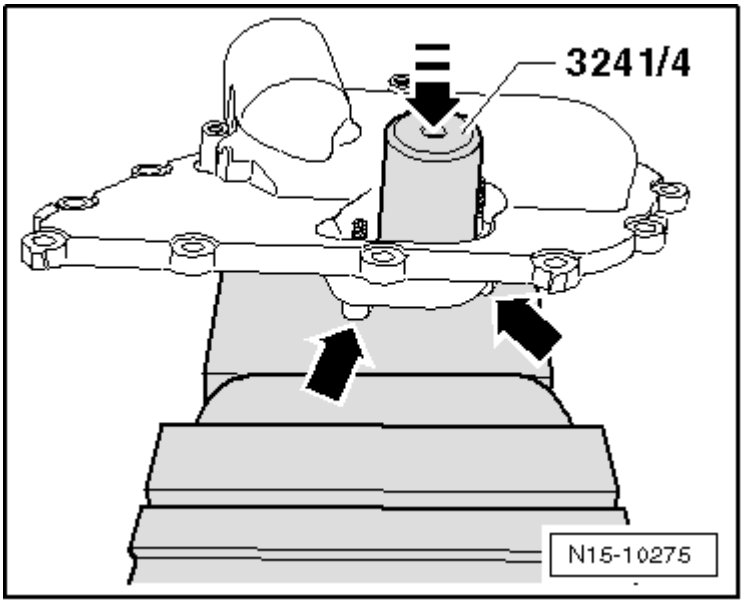

Fig. 44: Identifying Special Tools - Crankshaft Needle Bearings, Pulling Out And Driving In
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Kukko extractor 21/2 and Kukko support 22/1
- or
- Puller 10-202
- Centering mandrel 3176

- or
- Drift VW 207 C

NOTE:

- **When installing an engine into a vehicle with a manual transmission, check if the rear needle bearing is installed. If necessary, install the needle bearing.**

Removing

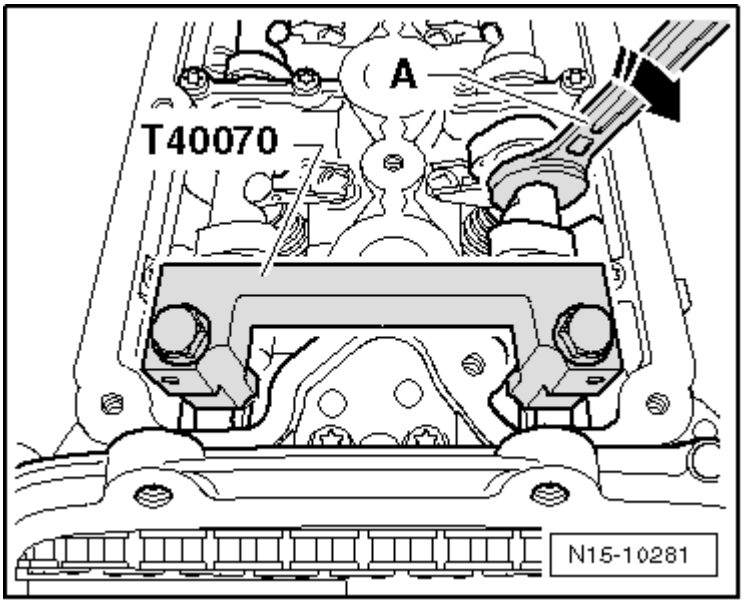

Fig. 45: Pulling Out Needle Bearing Using Puller
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull out using puller - **A** - , e.g. Kukko extractor 21/2 and Kukko support 22/1 or puller 10-202.

Installing

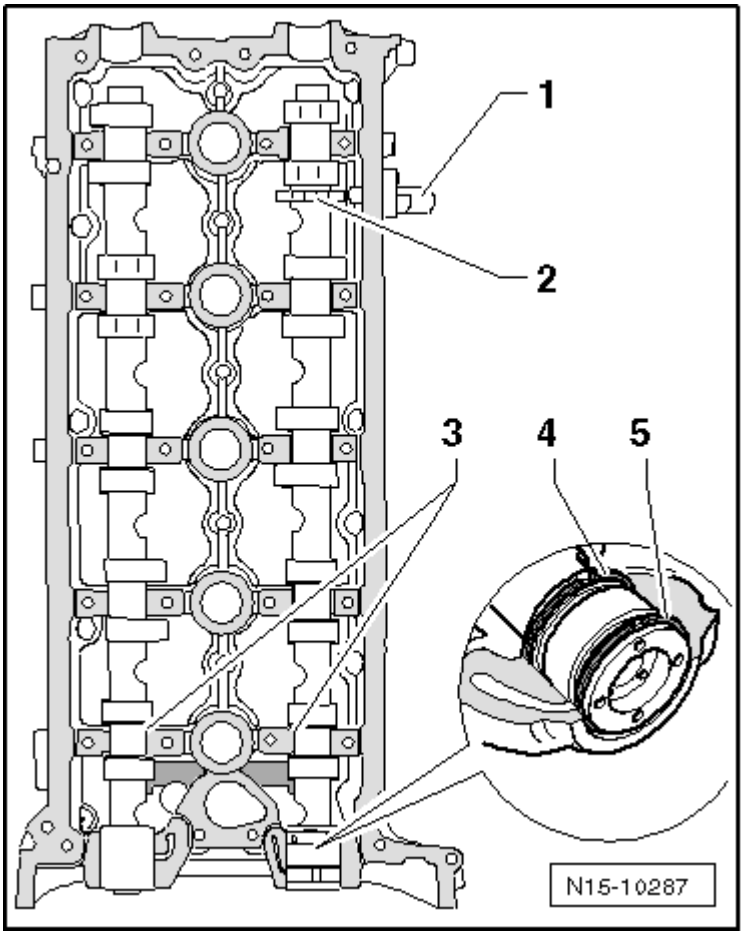

Fig. 46: Driving In Needle Bearing Using Drift VW 207 C
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Drive in using drift VW 207 C or centering mandrel 3176.
- Side of needle bearing with writing on it must be readable when installed.

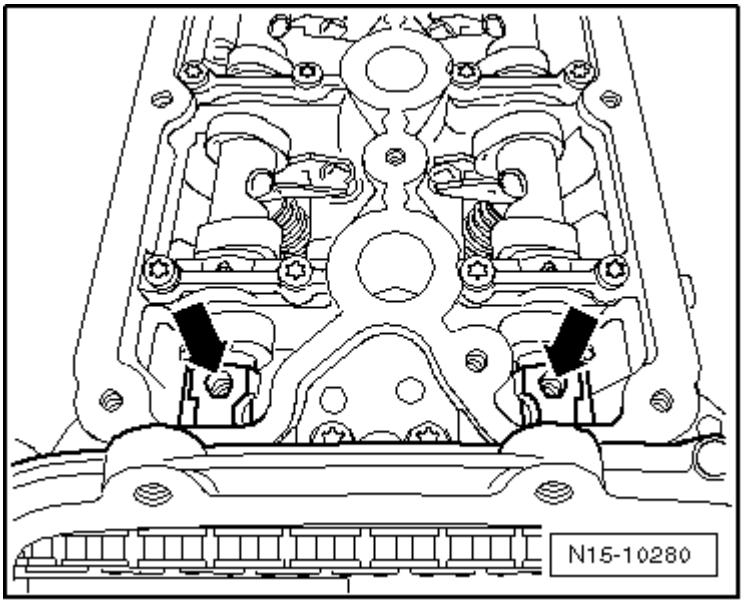

Fig. 47: Installation Depth Of Needle Bearing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Installed depth of needle bearing

- Dimension a = 1.5 mm

Crankshaft dimensions

(Dimensions in mm)

Honing dimension	Crankshaft bearing journal diameter		Connecting rod bearing journal diameter	
Basic dimension	54.00	-0.022-0.042	50.90	-0.022-0.042
1st oversize	53.75	-0.022-0.042	50.65	-0.022-0.042

PISTON AND CONNECTING ROD, DISASSEMBLING AND ASSEMBLING

Piston and connecting rod, disassembling and assembling

Secure engine in engine and transmission holder VAS 6095 when working on engine.

Pistons and connecting rods, assembly overview --> **Pistons and connecting rods, assembly overview**

Cylinder head gasket identification.

Pistons and connecting rods, assembly overview

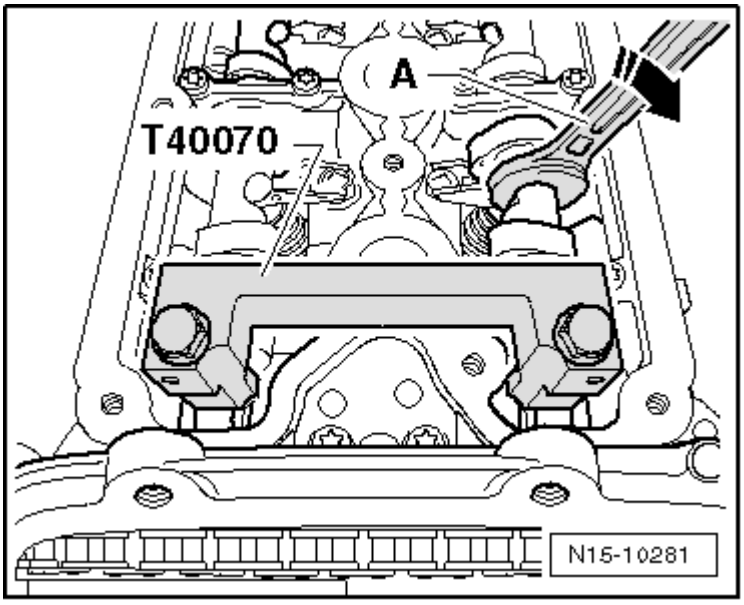

Fig. 48: Pistons And Connecting Rods, Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Piston rings

- Offset gaps by 120°
- Use piston ring pliers for removal and installation
- "TOP" faces toward piston crown
- Checking ring gap **Piston and cylinder**
- Check piston ring groove clearance **Checking ring to groove clearance**

2 - Piston

- With combustion chamber
- Mark installed position and cylinder allocation
- Installed position and allocation, piston/cylinder **Installed position of piston and piston/cylinder allocation**
- Arrow on piston face points toward belt pulley side
- Install with piston ring compressor
- Replace if piston skirt is cracked
- Checking piston position at TDC --> **Piston position at TDC, checking**

3 - Piston pin

- If difficult to move, heat piston to 60°C
- Use VW 222a for removal and installation

4 - Circlip

5 - Connecting rod

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

6 - Bearing shell

- Note installed position
- Observe design: upper bearing shell (toward piston) of wear-resistant material, Distinguishing feature: Black stripe on running surface in area of separating point
- Do not interchange used bearing shells
- Install bearing shells centrally
- Ensure seated tightly
- Axial play wear limit: 0.37 mm
- Measure radial play with Plastigage, Wear limit: 0.08 mm. Do not turn crankshaft when checking radial clearance

7 - Cylinder block

- Cylinder bore, checking **Checking cylinder bores**
- Piston and cylinder dimensions --> **Piston and cylinder dimensions**

8 - Connecting rod bearing cap

- Note installed position

9 - Oil spray jet

- For piston cooling

10 - 25 Nm

- Install without sealant

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

Piston and cylinder

Checking piston ring gap

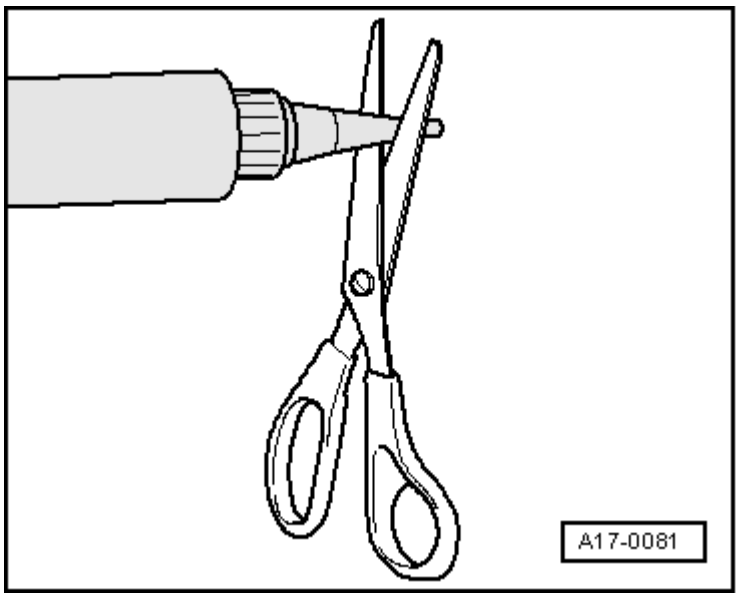

Fig. 49: Checking Piston Ring Gap
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Feeler gauge

- Push piston ring squarely from above down to approx. 15 mm from bottom end of cylinder.

Piston ring dimensions in mm	New	Wear limit
1. Compression ring	0.20...0.40	1.0
2. Compression ring	0.20...0.40	1.0
Oil scraping ring	0.25...0.50	1.0

Checking ring to groove clearance

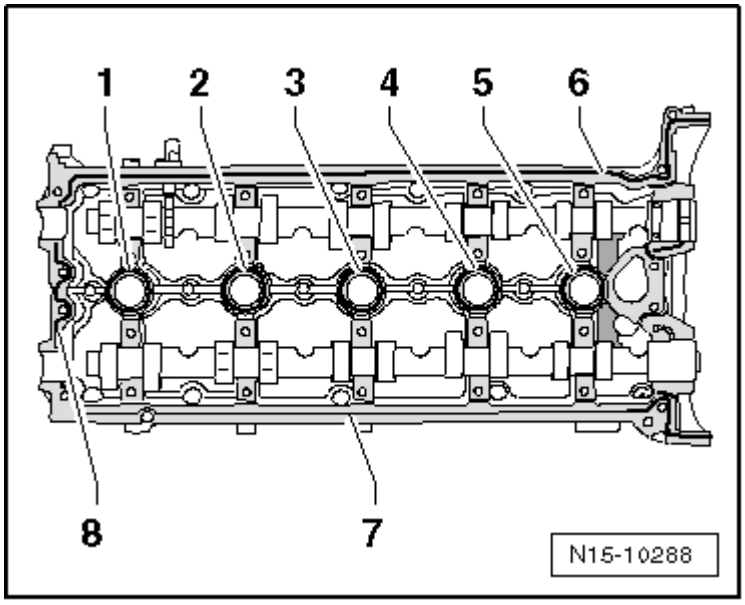

Fig. 50: Checking Ring To Groove Clearance
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Feeler gauge
  - Clean ring grooves before checking.

Piston ring dimensions in mm	New	Wear limit
1. Compression ring	0.06...0.09	0.25
2. Compression ring	0.05...0.08	0.25
Oil scraping ring	0.03...0.06	0.15

Checking cylinder bores

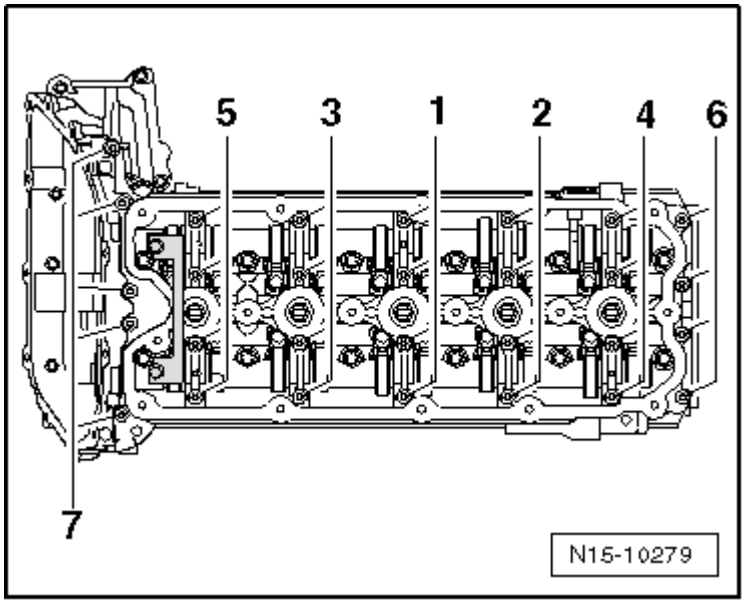

Fig. 51: Checking Cylinder Bores
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Internal dial gauge 50 - 100 mm
  - Measure bores at 3 locations in both directions - **A** - across engine and - **B** - in line with crankshaft.

Deviation from nominal dimension: max. 0.10 mm

NOTE:

- **Measurement of the cylinder bore must not be performed when the cylinder block is mounted in engine and transmission holder VAS 6095. The result of doing so would be false measurements.**

Installed position of piston and piston/cylinder allocation

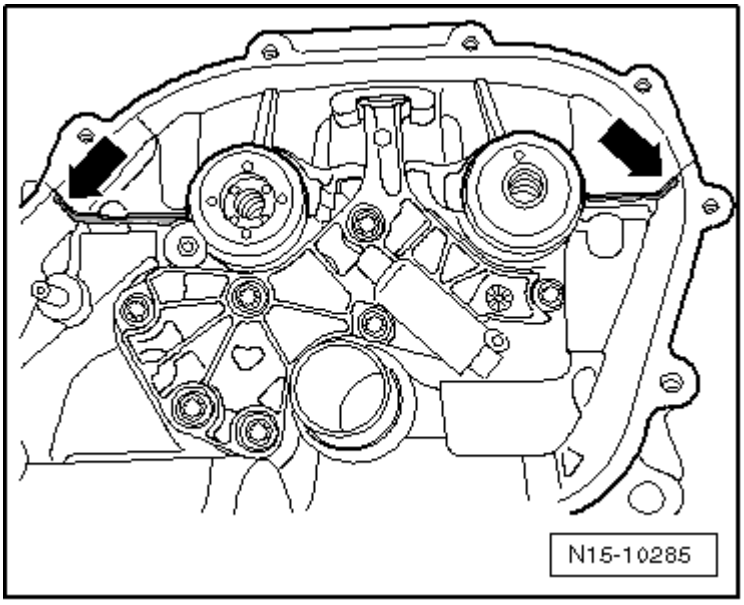

Fig. 52: Installed Position Of Piston And Piston/Cylinder Allocation
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Installed position of piston and piston/cylinder allocation

Pistons in cylinder 1 and 2:

Large valve pocket for intake valve toward flywheel side - **arrows** -

Pistons in cylinder 3 and 4:

Large valve pocket for intake valve toward belt pulley side - **arrows** -

NOTE:

- **On new pistons, the cylinder allocation is stamped on the piston face in paint.**
- **Pistons for cylinder 1 and 2: identification 1/2**
- **Pistons for cylinder 3 and 4: identification 3/4**

Piston position at TDC, checking

Special tools, testers and auxiliary items required

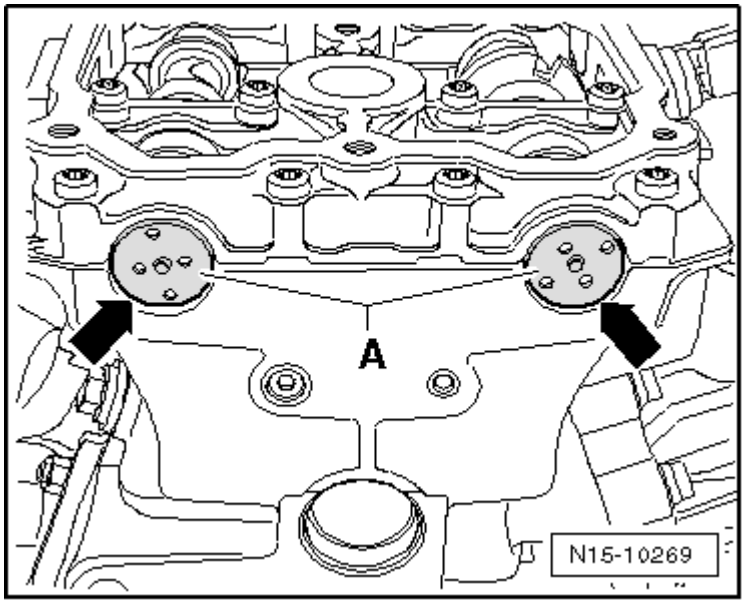

Fig. 53: Special Tool - VW 382/7
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Measuring bar VW 382/7

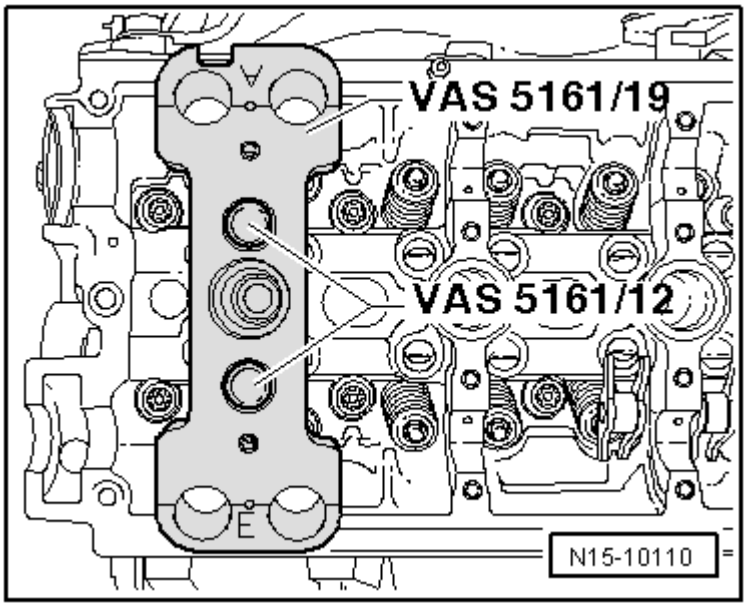

Fig. 54: Special Tool - VW 385/17 End Dimension Plate
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Magnetic plate 50 mm dia. VW 385/17
- Dial gauge

Work sequence

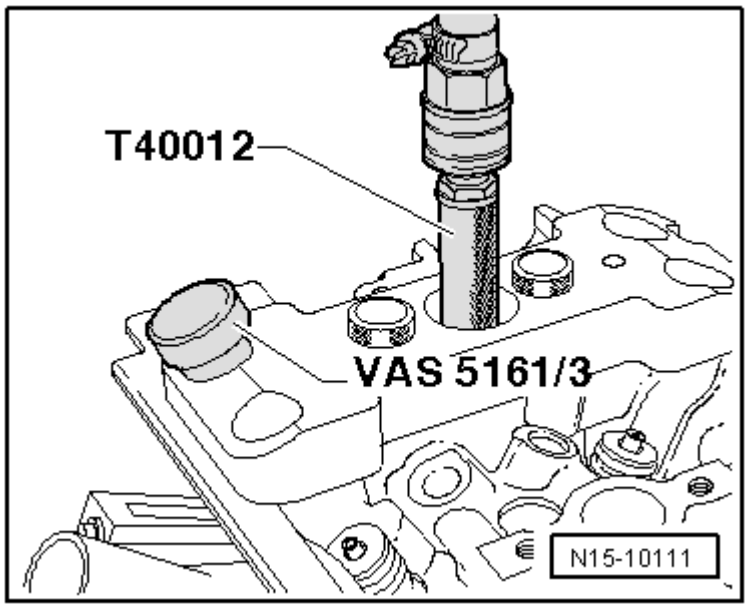

Fig. 55: Measuring Piston Projection At TDC
Courtesy of VOLKSWAGEN UNITED STATES, INC.

When installing new pistons or working with a partial motor, all of the pistons must be checked for piston position at TDC. Depending on the piston projection, install the corresponding cylinder head gasket according to the following table.

NOTE:

- **To measure the piston position at TDC, turn the engine in a clockwise direction.**

Piston projection	Identification Notches/Holes
0.91 mm to 1.00 mm	1
1.01 mm to 1.10 mm	2
1.11 mm to 1.20 mm	3

Cylinder head gasket identification

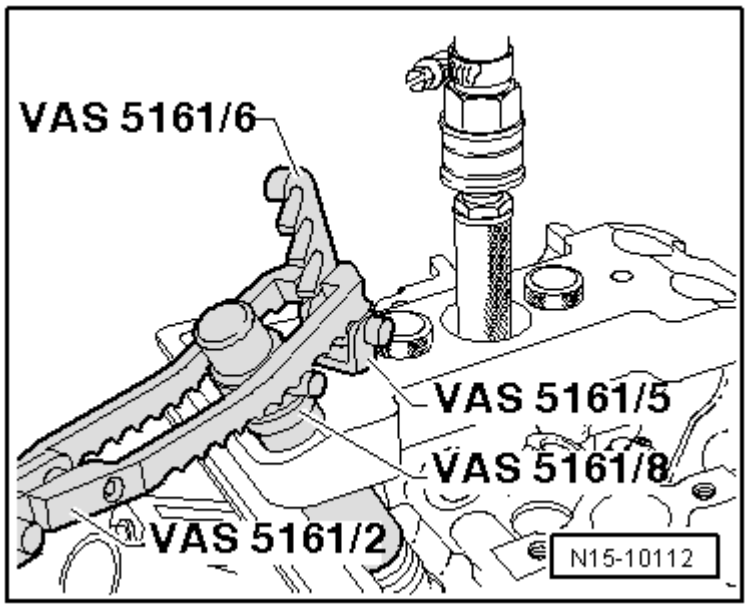

Fig. 56: Identifying Cylinder Head Gasket
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Replacement part No. = arrow 1
- Control code = arrow 2 (ignore this!)
- Holes = arrow 3

NOTE:

- **If varying values occur when measuring the projection, use the gasket for the largest value.**

Piston and cylinder dimensions

Honing dimension		Piston diameter	Cylinder bore diameter
Basic dimension	mm	80.96	81.01

15 ENGINE - CYLINDER HEAD, VALVETRAIN

CYLINDER HEAD

Cylinder head

NOTE:

- **When using an exchanged cylinder head with the 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 the cylinder head is replaced, all coolant must also be replaced.**

Cylinder head, assembly overview --> **Cylinder head, assembly overview** .

Compression, checking--> **Compression pressures, checking** .

Cylinder head, assembly overview

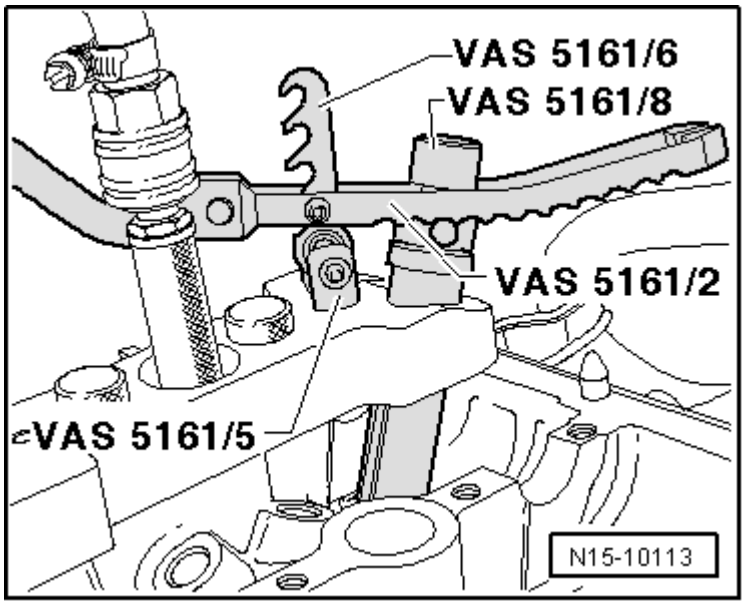

Fig. 57: Cylinder Head, Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Toothed belt cover - upper part

2 - Toothed belt

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

3 - 10 Nm

4 - 25 Nm

5 - 100 Nm

6 - Camshaft sprocket

7 - Hub

- With sensor wheel
- Use counter-holder T10051 to loosen and tighten

- to remove, use puller T10052
- Removing and installing --> **Camshaft, removing and installing**

8 - Rear toothed belt cover

9 - Grommet

- Replace if damaged

10 - Camshaft Position (CMP) sensor -G40-

- For camshaft position

11 - Cylinder head bolt

- Replace
- Observe sequence for loosening and tightening --> **Cylinder head, removing and installing**

12 - Cylinder head cover

- Before installing, clean contact surface of cylinder head with clean shop rag

13 - To turbocharger

14 - Pressure regulator valve

- For crankcase ventilation

15 - Cap

- Replace seal if damaged

16 - Sealing sleeve

- Replace if damaged

17 - 10 Nm

- First, fasten all bolts hand-tight

18 - Seal for cylinder head cover

- Only replace together with cylinder head cover
- Before installing, seal contact surfaces with *sealant AMV 174 004 01* .

19 - 20 Nm

20 - Lifting eye

21 - Pump-Injector unit

- Removing and installing --> **Pump-Injector unit, removing and installing**

22 - Central harness connector

- For Pump-Injector unit

23 - From brake booster

24 - Tandem pump

- For fuel and vacuum supply
- Checking --> **Tandem pump, checking**
- Removing and installing --> **Tandem pump, removing and installing**

25 - Supply hose

- White or with white markings
- Ensure seated tightly
- Secure with spring-type clips

26 - Return hose

- Blue or with blue marking
- Ensure seated tightly
- Secure with spring-type clips

27 - Seal

- Replace

28 - Bolt

29 - Bracket

- For fuel filter

30 - Cylinder head

- Removing and installing --> **Cylinder head, removing and installing**
- After replacing replace entire amount of coolant

31 - Cylinder head gasket

- Replace
- Observe identification **Cylinder head gasket identification**
- After replacing replace entire amount of coolant

32 - Ceramic glow plug

- 15 Nm
- Absolutely observe all assembly guidelines and notes --> **Glow plug system, checking**

33 - Tensioning roller

34 - 20 Nm plus an additional $^{1}/_{8}$ turn (45°)

Checking cylinder head for distortion

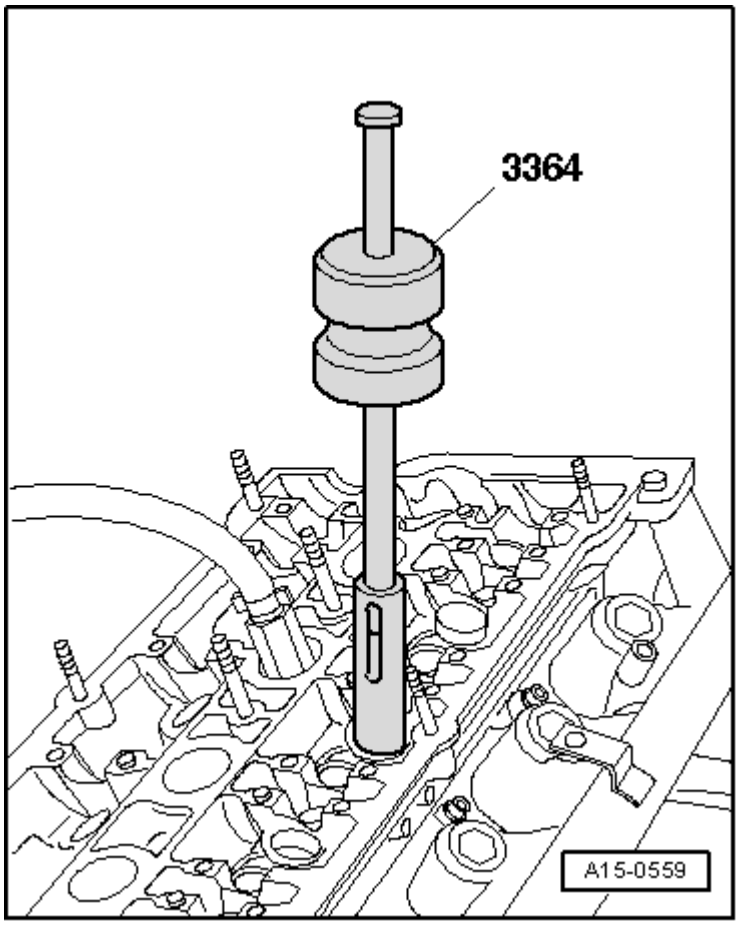

Fig. 58: Checking Cylinder Head For Distortion
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Straight edge
- Feeler gauge

Max. permissible distortion: 0.1 mm

NOTE:

- **Remanufacturing of diesel cylinder heads is not permitted.**

Cylinder head gasket identification

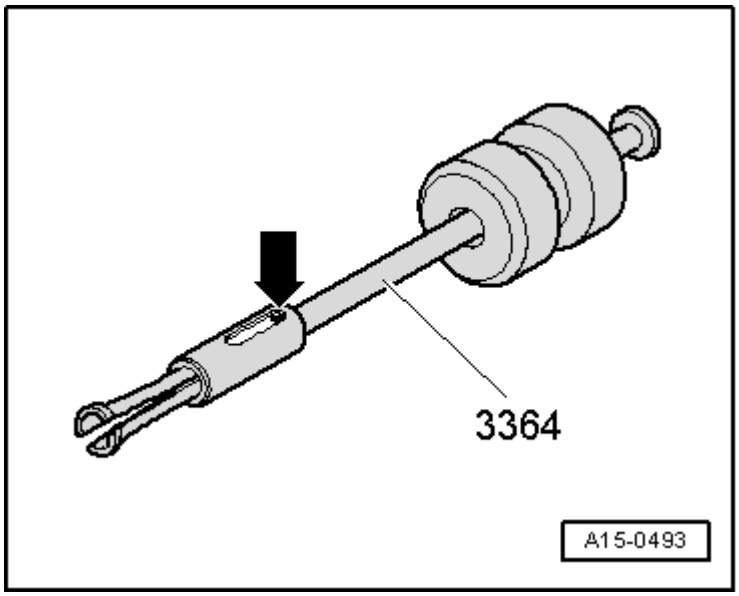

Fig. 59: Identifying Cylinder Head Gasket
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Cylinder head gasket identification

- Replacement part No. = arrow 1
- Control code = arrow 2 (ignore this!)
- Holes = arrow 3

NOTE:

- **Depending on piston projection, varying cylinder head gasket thicknesses can be installed. When replacing a head gasket, install a gasket with the same identification.**
- **When installing new pistons or working with a partial motor, check the piston position at TDC. --> Piston position at TDC, checking**

Toothed belt, removing, installing and tensioning

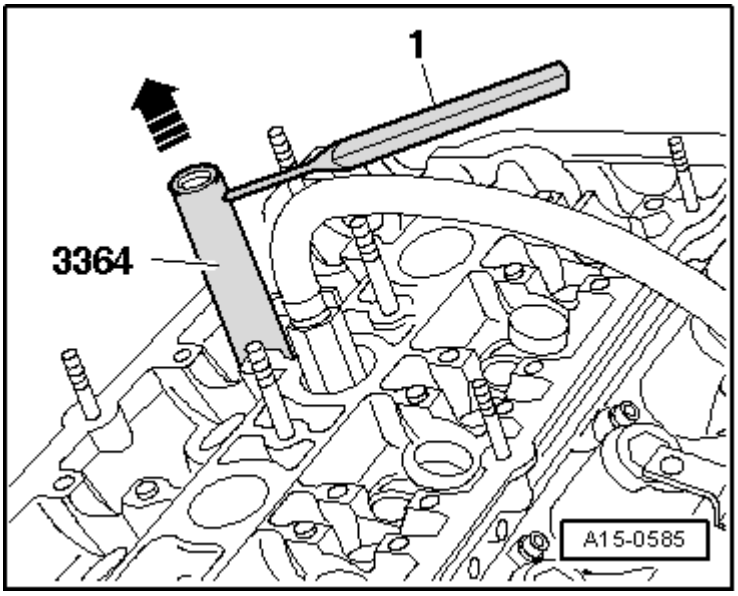

Fig. 60: Identifying Special Tools - Toothed Belt, Removing, Installing And Tensioning
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Rig pin 3359
- Pin wrench 3387
- Crankshaft stop T10050
- Pin T10115
- Torque wrench (5 to 50 Nm) V.A.G 1331
- Torque wrench (40 to 200 Nm) V.A.G 1332

Removing

NOTE:

- **Adjustments to the toothed belt may generally only be performed when the engine is cold.**

- Bring lock carrier into service position: --> **50 BODY, FRONT**
- Remove ribbed belt --> **Ribbed belt, removing and installing** .
- Remove upper toothed belt guard.
- Remove fan wheel from viscous fan clutch.
- Unscrew ribbed belt relay lever from bracket.
- Remove center toothed belt guard.
- Remove harmonic balancer/belt pulley.
- Remove lower toothed belt guard.
- Turn crankshaft to set cylinder 1 at TDC.

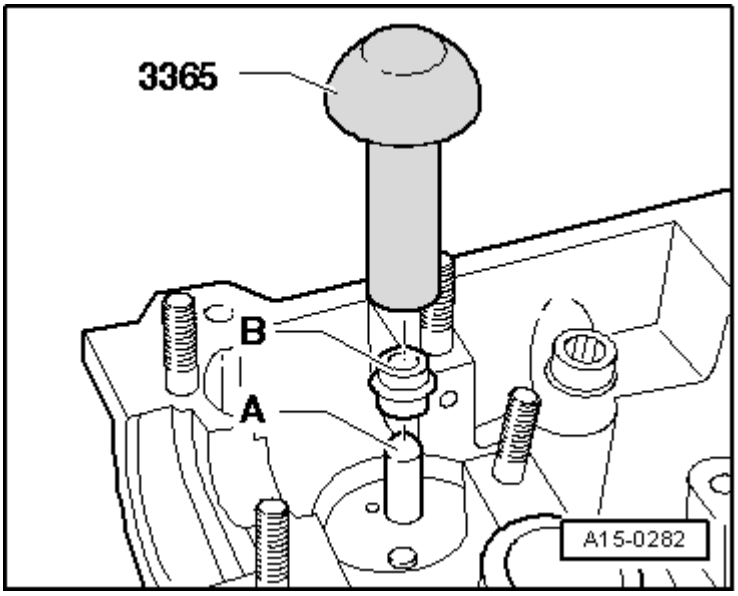

Fig. 61: Identifying Locking Pin 3359 And Crankshaft Stop T10050
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE:

- **Turn the crankshaft so far that the marking on the toothed belt crankshaft sprocket is positioned on top and the arrow on the rear toothed belt guard is positioned across from the tabs of the sensor wheel on the hub - arrows -.**

- Lock hub with rig pin 3359. To do this, push rig pin through left-sided empty slot in bore of cylinder head.
- Also, lock toothed belt crankshaft sprocket with crankshaft stop T10050. Push crankshaft stop from front side of toothed belt sprocket into teeth.

NOTE:

- **Markings on toothed belt crankshaft sprocket and the crankshaft stop must be aligned. The tab of the crankshaft stop must engage in the bore of the sealing flange.**

- Mark direction of rotation of toothed belt.
- Loosen nut of tensioning roller.

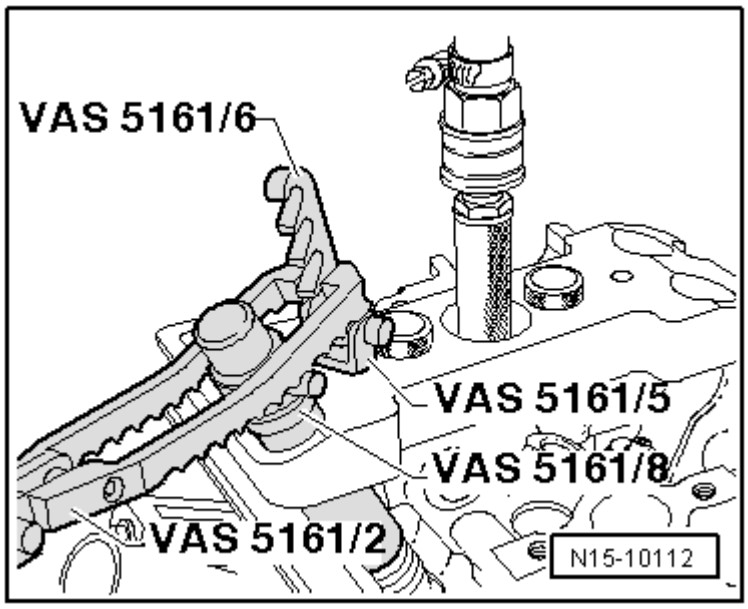

Fig. 62: Identifying Camshaft Pulley Securing Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen bolts - **1** - of camshaft sprockets, until camshaft sprocket can be turned in slots.

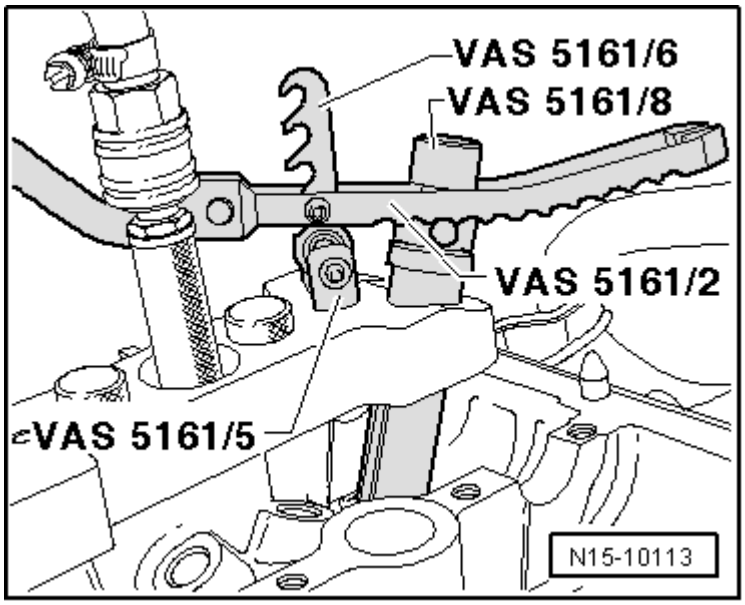

Fig. 63: Identifying Pin Wrench 3387 And Locking Pin T10115
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Turn pin wrench 3387 counter-clockwise (against direction of arrow) until toothed belt tensioning roller can be locked with pin T10115.
- Turn pin wrench in direction of arrow on roller until stop and then tighten nut by hand.
- First, take toothed belt from coolant pump and then from remaining sprockets.

Installing

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

- **Route all the various lines (e.g. for fuel, hydraulics, EVAP system, coolant, refrigerant, brake fluid and vacuum lines and hoses) and electrical wiring so that the original positions are restored.**
- **Ensure sufficient clearance to all moving or hot components.**

Requirements

- Hub locked with rig pin 3359.
- Crankshaft locked with crankshaft stop T10050.
- Tensioning roller secured with pin T10115 and seated on right stop.

NOTE:

- **Adjustments to toothed belt may generally only be performed when the engine is cold, because the indicator position of the tensioning element changes depending on engine temperature.**

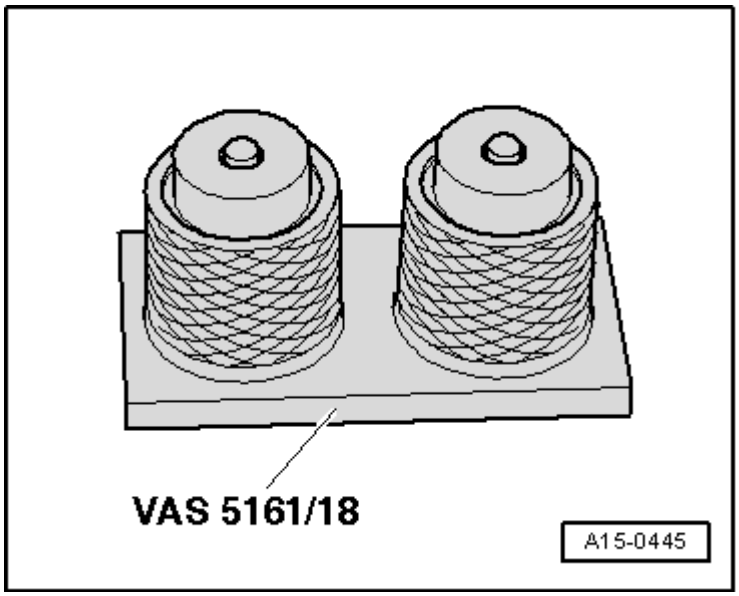

Fig. 64: Turning Camshaft Pulley
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Turn camshaft sprocket counter-clockwise in its slots direction of - **arrow** - onto stop.
- Lay toothed belt on crankshaft sprocket, tensioning roller and camshaft sprocket.
- Lastly, lay toothed belt onto toothed belt coolant pump sprocket.

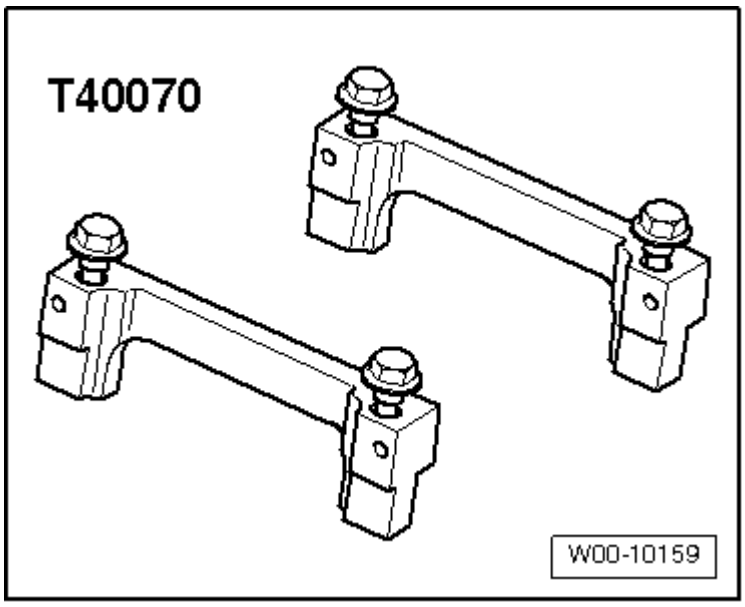

Fig. 65: Identifying Tensioning Roller Is Properly Positioned
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE:

- **Make sure the tensioning roller is properly positioned at the rear toothed belt guard - arrow -.**

- Loosen nut of tensioning roller.
- Tension tensioning roller by turning nut against direction of arrow and removing pin.

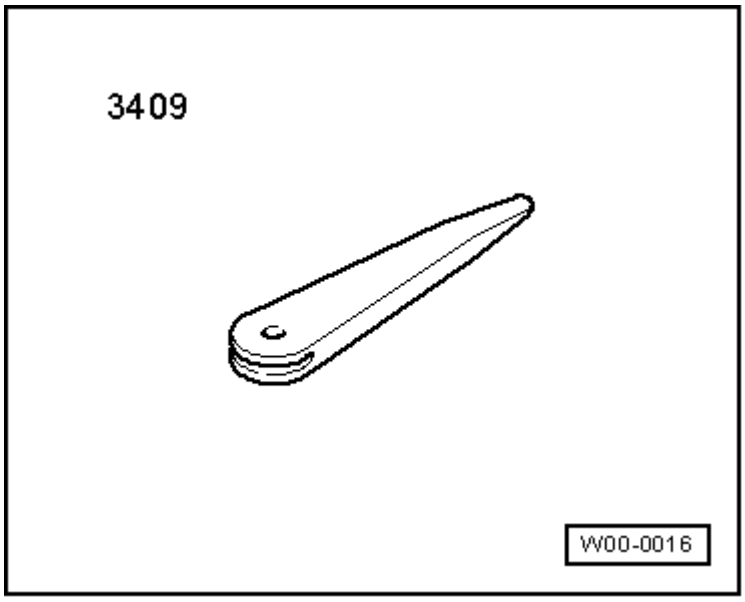

Fig. 66: Identifying Pin Wrench 3387
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Carefully turn tensioning roller with pin wrench 3387 in direction of arrow, until indicator is located

centrally in gap of base plate - **arrow** -.

- Hold tensioning roller in this position and tighten tensioning roller nut: Tightening torque 20 Nm plus an additional 45° ($^{1}/_{8}$ turn)
- Tighten camshaft sprocket bolts to 25 Nm.
- Remove the rig pin 3359 and the crankshaft stop T10050.
- Turn crankshaft over twice in engine running direction and then set cyl. 1 to TDC again.

NOTE:

- **The tab of the crankshaft stop must engage in the sealing flange when turning engine over.**
- **If the crankshaft was turned past TDC for cylinder 1 and if the crankshaft stop could not engage the sealing flange, turn the crankshaft back 1/4 revolution in order to turn the crankshaft in the engine running direction again to TDC for cylinder 1. It is not reliable to correct this by turning the engine against the running direction to set the crankshaft stop.**

- After crankshaft stop has been set, check that hub can be locked with rig pin 3359.

If the hub cannot be locked:

- Pull crankshaft stop tab out of bore in sealing flange and turn crankshaft until hub can be locked with rig pin.

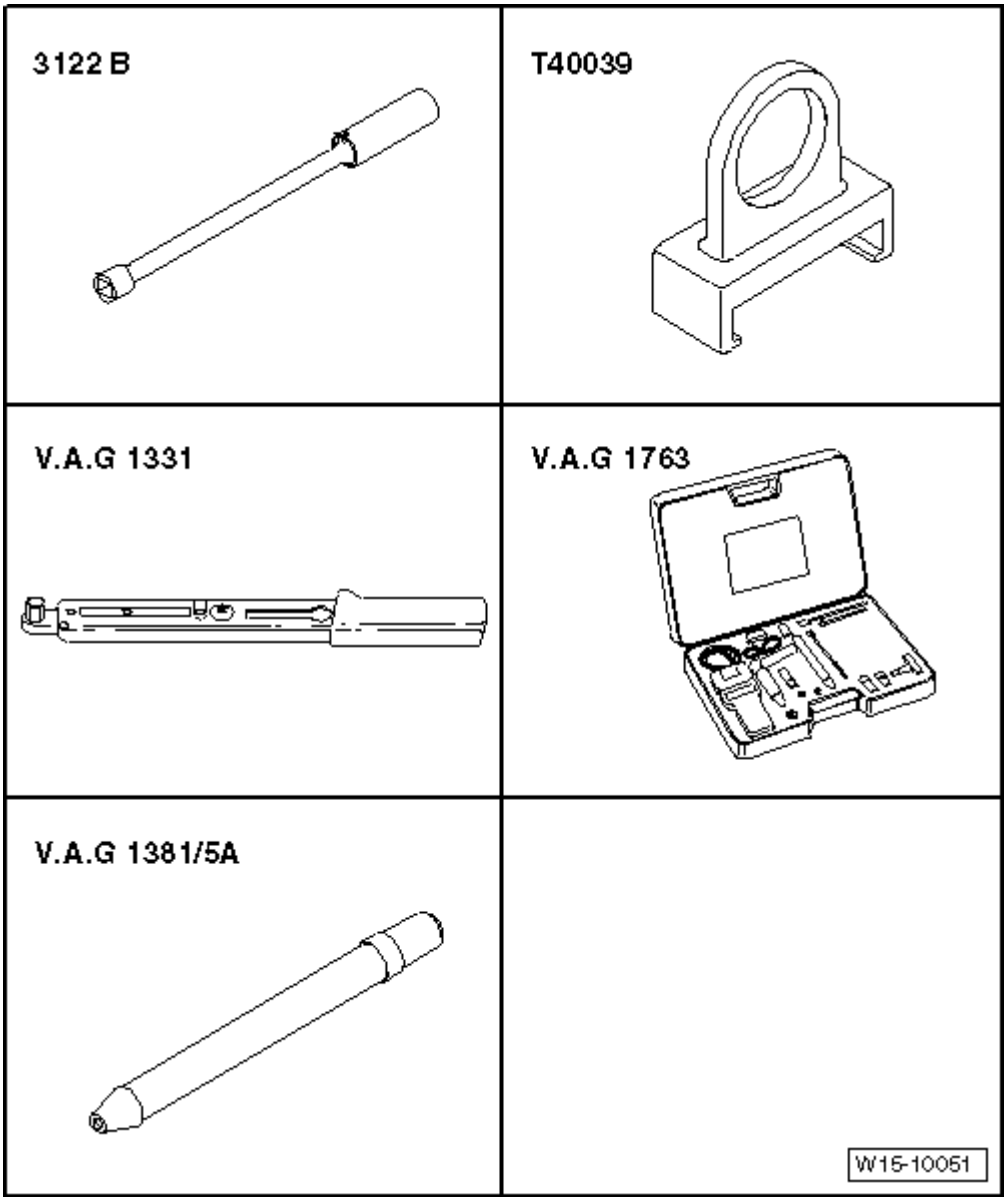

Fig. 67: Identifying Camshaft Pulley Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen camshaft sprocket bolts - **1** -.

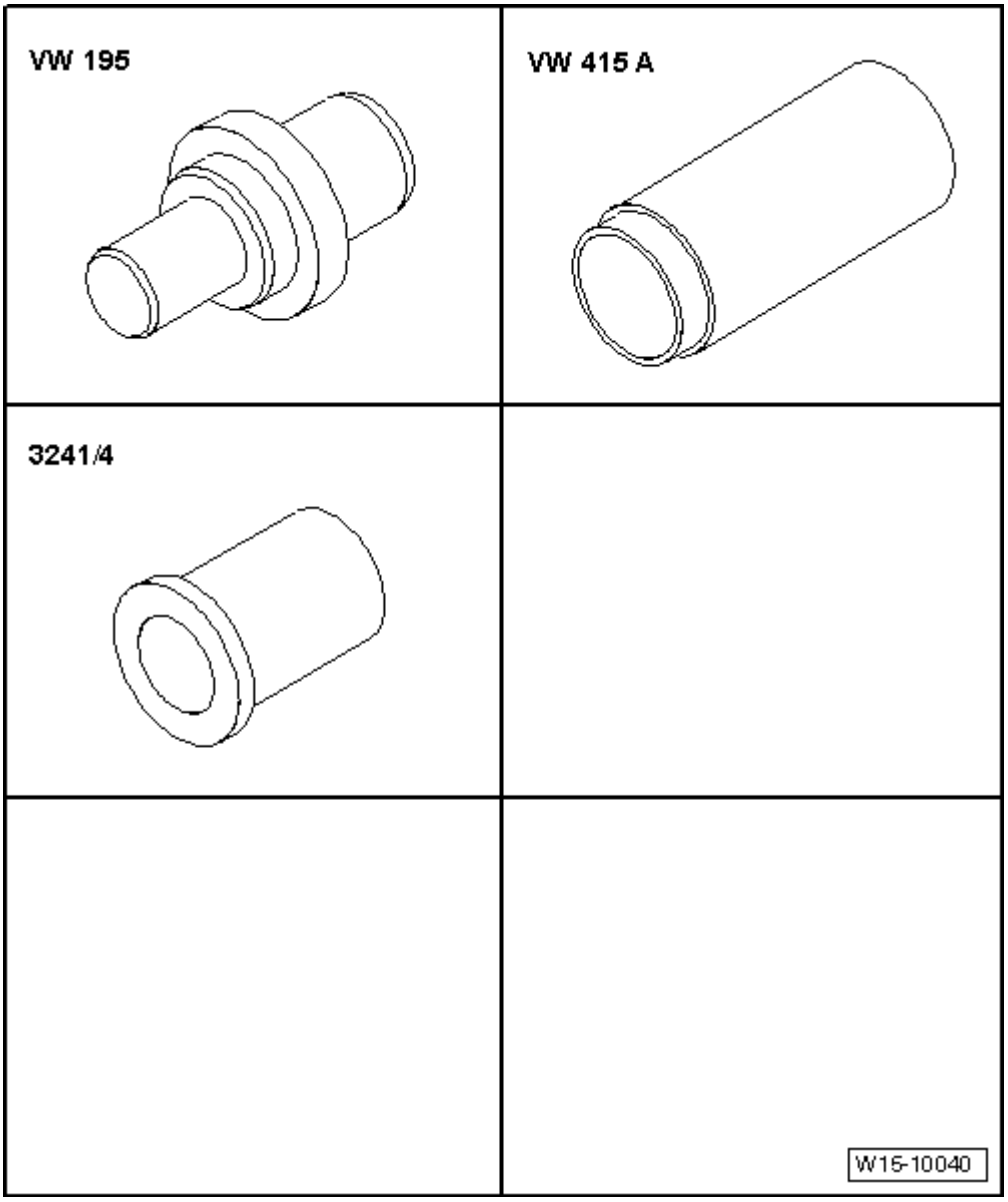

Fig. 68: Identifying Crankshaft Stop T10050
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Turn crankshaft against engine running direction until crankshaft stop tab is positioned shortly before sealing flange bore - **arrow** -.
- Turn crankshaft in engine running direction until crankshaft stop tab engages sealing flange.
- Tighten camshaft sprocket bolts to 25 Nm.
- Remove rig pin 3359 and the crankshaft stop T10050.

- Turn crankshaft twice in engine running direction until crankshaft is at TDC for cylinder 1 again.

NOTE:

- **The tab of the crankshaft stop must engage in the sealing flange when turning engine over.**

- **If the crankshaft was turned past TDC for cylinder 1 and if the crankshaft stop could not engage the sealing flange, turn the crankshaft back 1/4 revolution in order to turn the crankshaft in the engine running direction again to TDC for cylinder 1. It is not reliable to correct this by turning the engine against the running direction to set the crankshaft stop.**

- Check again.
- Install lower toothed belt guard and harmonic balancer/belt pulley.
- Install center toothed belt guard.
- Fasten ribbed belt relay lever to bracket.

- Install ribbed belt --> **Ribbed belt, removing and installing** .
- Install fan wheel to viscous fan clutch.
- Install lock carrier: --> **50 BODY, FRONT**

Cylinder head, removing and installing

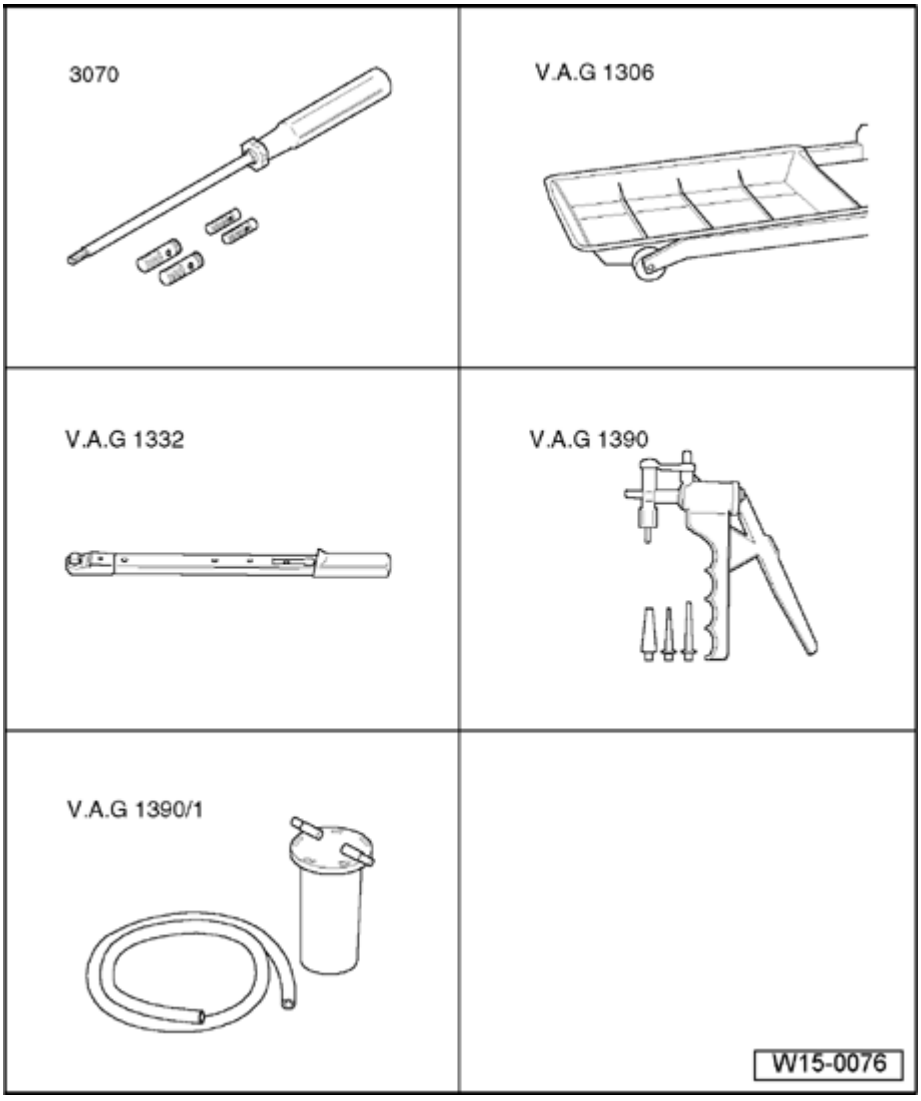

Fig. 69: Identifying Special Tools - Cylinder Head, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Guide pins handle 3070
- Drip tray V.A.G 1306
- Torque wrench (40 to 200 Nm) V.A.G 1332
- Hand vacuum pump V.A.G 1390
- Hand vacuum pump reservoir V.A.G 1390/1

Removing

NOTE:

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

head.

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

- **Route all the various lines (e.g. for fuel, hydraulics, EVAP system, coolant, refrigerant, brake fluid and vacuum lines and hoses) and electrical wiring so that the original positions are restored.**
- **Ensure sufficient clearance to all moving or hot components.**

NOTE:

- **Before the toothed belt is removed from the camshaft sprocket, lock the toothed belt tensioner --> Toothed belt, removing, installing and tensioning ; Toothed belt, removing, installing and tensioning.**

- Disconnect battery Ground (GND) strap with ignition switched off.
- Remove engine cover.
- Remove connecting pipe between charge air cooler and Motor for intake flap -V157-.
- Pull off fuel supply hose (with white marking) and return hose (with blue marking) from fuel lines (clipped onto bulkhead) and catch any spilled fuel with a shop rag.

Remove sound insulation pan: --> **50 BODY, FRONT**

- Drain coolant --> **Cooling system, draining and filling** .
- Before removing cylinder head, extract fuel using hand vacuum pump V.A.G 1390 and the hand vacuum pump reservoir V.A.G 1390/1 at tandem pump --> **Tandem pump, removing and installing** , Tandem pump, removing and installing.
- Pull off/disconnect all electrical wires from cylinder head and set aside.
- Separate all connections, coolant lines and vacuum hoses from cylinder head.
- Remove catalytic converter from turbocharger --> **Catalytic converter and front exhaust pipe for engine code BHW, assembly overview** .
- Remove hub for camshaft sprocket --> **Camshaft, removing and installing** , Camshaft, removing.
- Follow sequence for loosening cylinder head bolts and remove cylinder head.

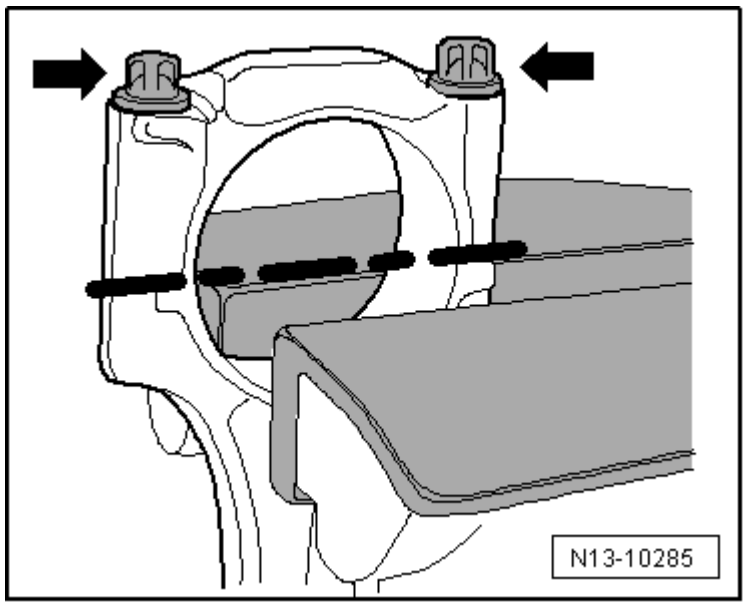

Fig. 70: Identifying Cylinder Head Bolts Loosening Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE:

- **The cylinder head must be carefully guided to prevent damages.**

Installing

NOTE:

- **Always replace cylinder head bolts.**
- **Carefully remove residual sealant from cylinder head and cylinder block. Make sure that no long scrapes or scratches result. When using sandpaper, the grit may not be less than 100.**
- **Thoroughly remove lubrication gel and sanding residue.**
- **Only unpack new cylinder head gasket immediately prior to installation.**
- **Handle gasket carefully. Damages to the silicone layer and in areas of recesses may result in leaks.**

- Before installing cylinder head, position crankshaft to TDC marking.
- Turn crankshaft against engine running direction until all pistons are approx. at same distance below TDC.
- Set cylinder head gasket in place.

NOTE:

- **Observe cylinder head gasket identification Cylinder head gasket identification .**

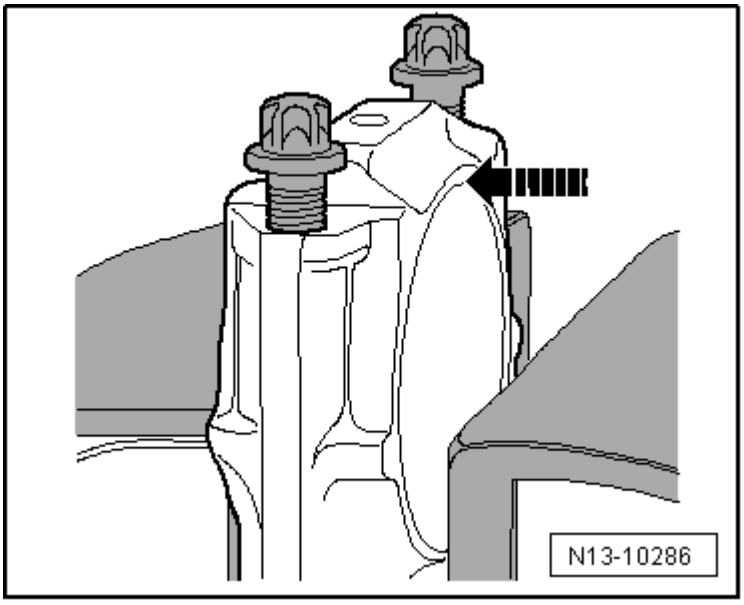

Fig. 71: Identifying Installed Guide Pins
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- To center, screw guide pins from 3070 into outer bores on intake side.
- Install cylinder head, insert remaining 8 cylinder head bolts and hand tighten.
- Remove guide pins using guide pin handle from 3070, and then install remaining cylinder head bolts.

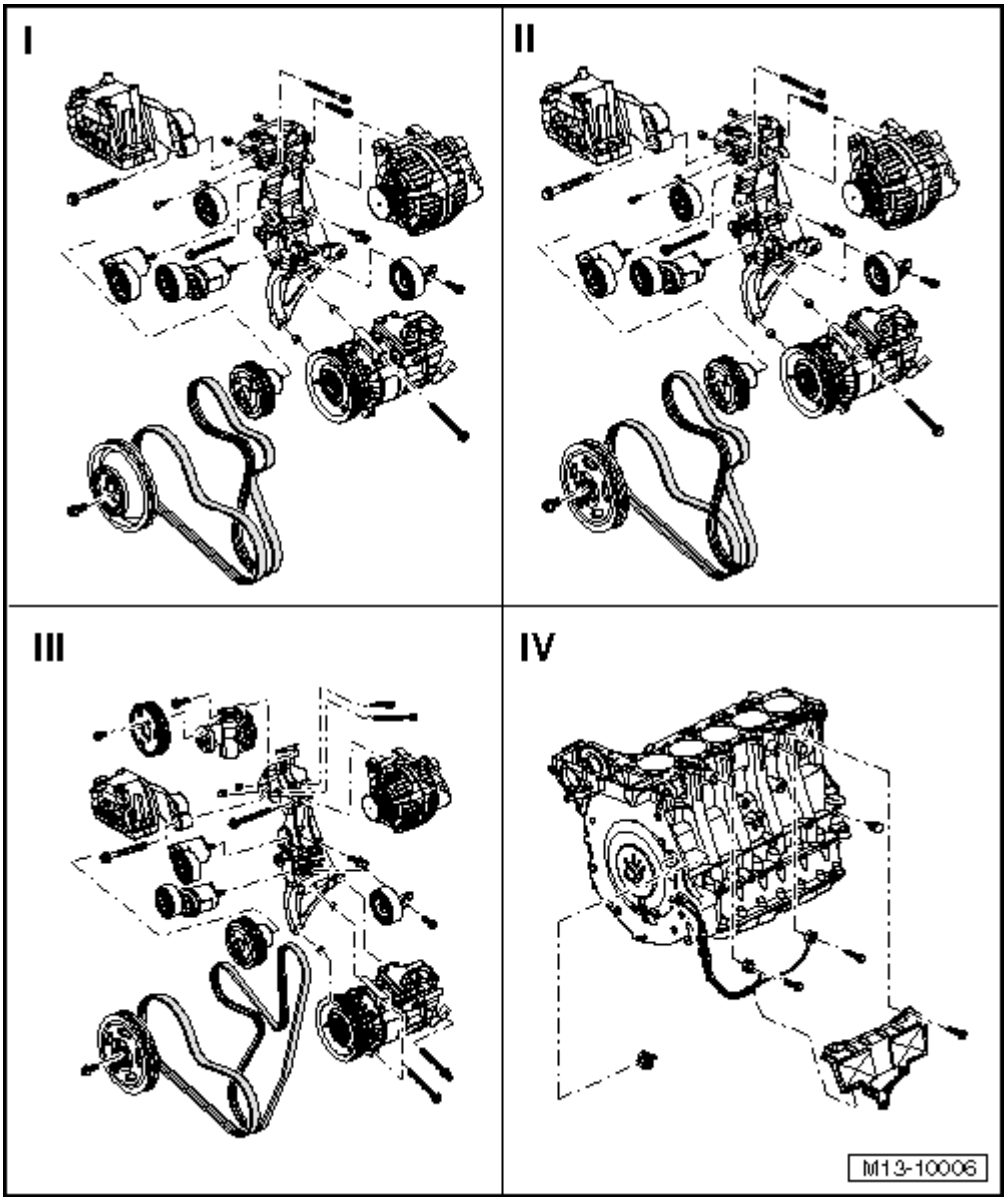

Fig. 72: Identifying Cylinder Head Bolt Tightening Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Fasten cylinder head in four steps in sequence shown as follows:

Step I = 40 Nm

Step II = 60 Nm

Step III = $^{1}/_{4}$ turn (90°)

Step IV = $^{1}/_{4}$ turn (90°)

NOTE:

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

Further installation is performed in reverse order. Note the following:

- After fastening cylinder head turn camshaft sprocket so that lobes for cylinder 1 point upward equally. Before installing toothed belt, set crankshaft to TDC by turning in engine running direction --> **Toothed belt, removing, installing and tensioning**
- Install hub for camshaft sprocket --> **Camshaft, removing and installing**
- Fill with coolant --> **Cooling system, draining and filling** .
- Test drive vehicle and check all Diagnostic Trouble Code (DTC) memories --> **Engine control module DTC memory, checking and erasing** .

Compression pressures, checking

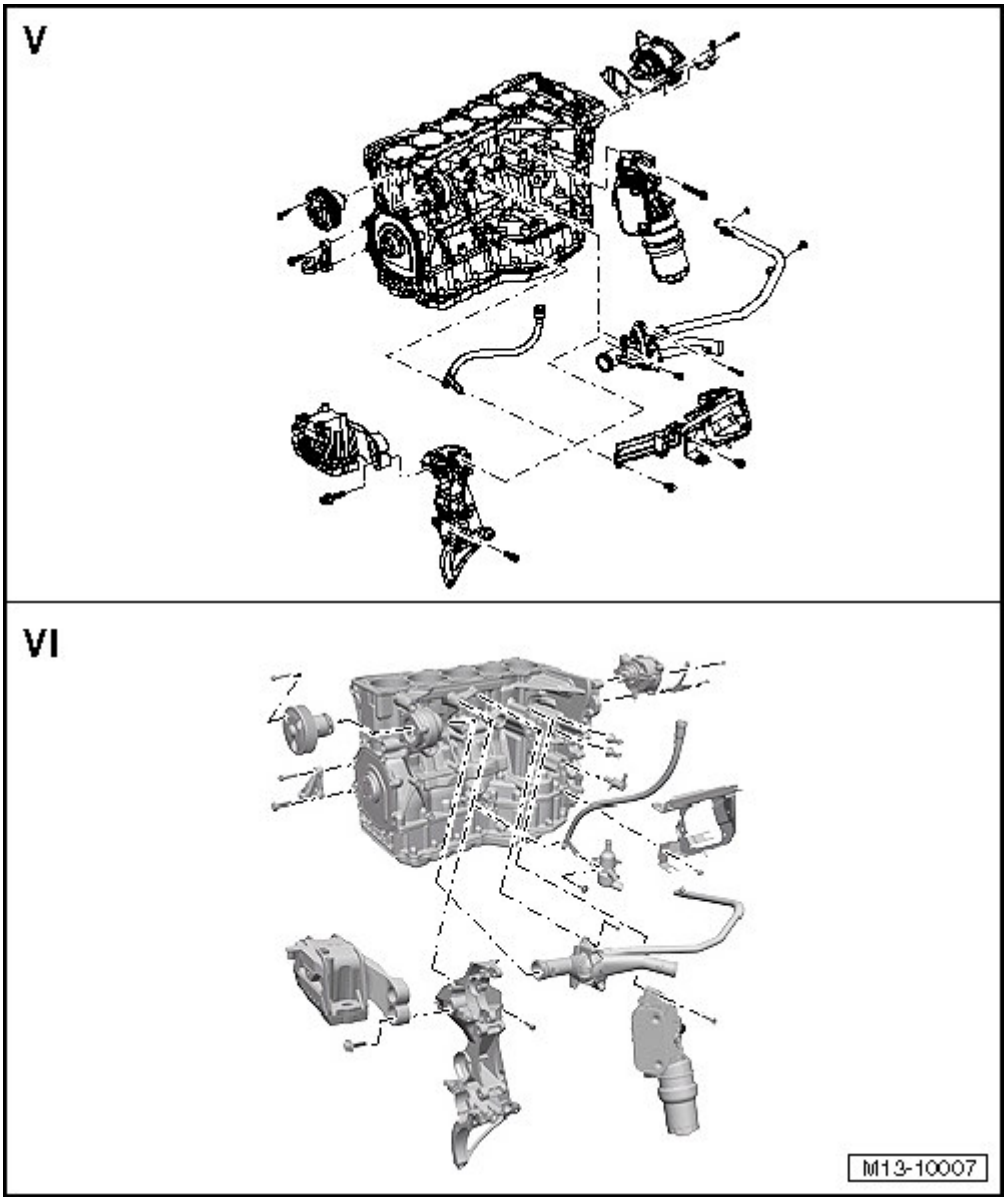

Fig. 73: Identifying Special Tools - Compression Pressure, Checking
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Hinged socket 3220
- Torque wrench (5 to 50 Nm) V.A.G 1331
- Adapter V.A.G 1381/12
- Compression tester V.A.G 1763

Conditions

- Engine oil temperature min. 30°C

Work sequence

- Disconnect central connector for Pump-Injector unit.
- Remove all ceramic glow plugs with hinged socket 3220.

NOTE:

- **Always observe the notes for removal and installation of ceramic glow plugs --> Glow plug system, checking .**

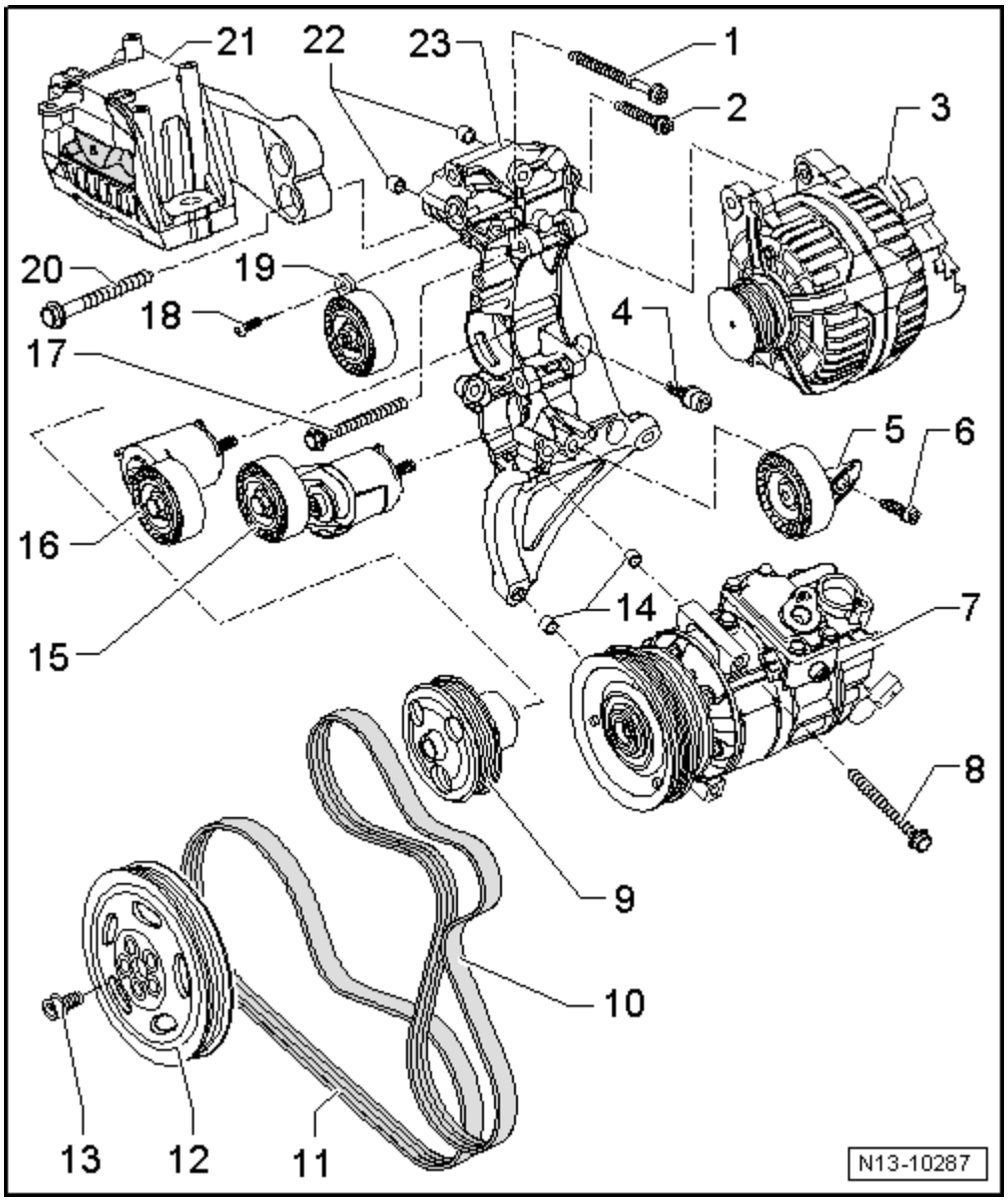

Fig. 74: Check Compression Pressure Using Compression Tester V.A.G 1763 And Adapter V.A.G 1381/12
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install adapter V.A.G 1381/12 in place of ceramic glow plugs.

- Check compression pressure using compression tester V.A.G 1763.

NOTE:

- **Using the compression tester --> Operating instructions.**

- Operate starter until tester shows no further pressure increase.

Compression pressure

New: 25 to 31 bar pressure

Wear limit: 19 bar pressure

Permissible difference between all cylinders: 5 bar

NOTE:

- **Always observe the notes for removal and installation of ceramic glow plugs --> Glow plug system, checking .**

- Install ceramic glow plugs with hinged socket 3220.

NOTE:

- **By disconnecting the central connection for the Pump-Injector unit, DTCs will be stored. Read the DTC memory and erase it, if necessary.**

VALVE GEAR, SERVICING

Valve gear, servicing

NOTE:

- **Cylinder heads with light cracking between the valve seats may continue to be used, as long as the cracks do not exceed a width of 0.5 mm.**

Valve gear, assembly overview --> **Valve gear, assembly overview** .

Valve gear, assembly overview

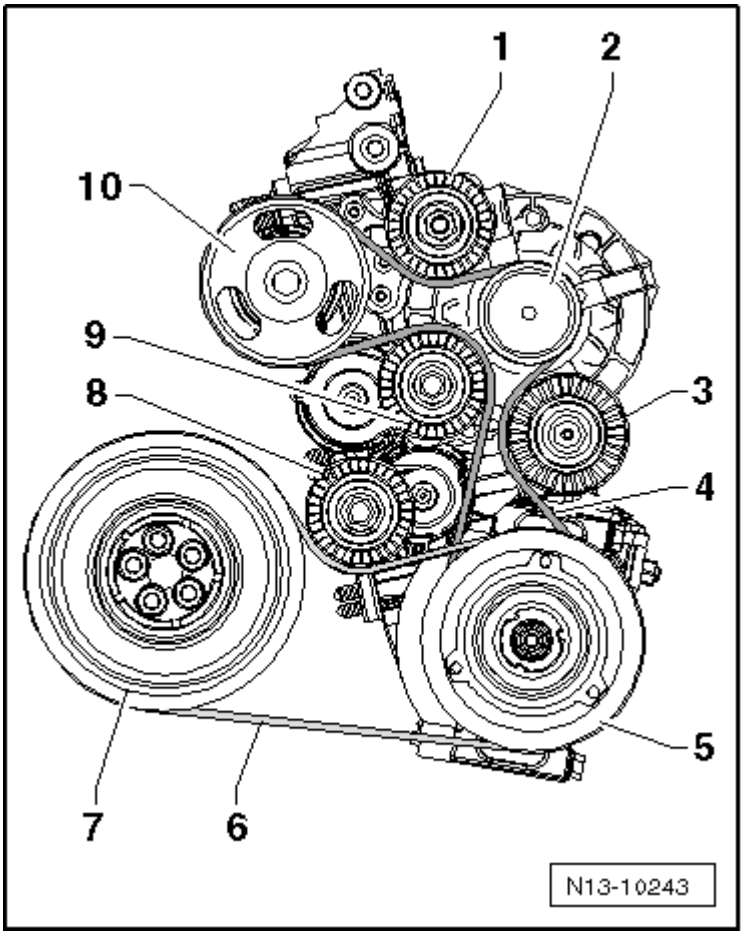

Fig. 75: Valve Gear, Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 20 Nm plus an additional $^{1}/_{4}$ turn (90°)

- Replace
- Observe sequence for loosening and tightening --> **Camshaft, removing and installing**

2 - Rocker lever shaft

- Do not interchange

3 - Cylinder head bolt

- Replace
- Observe sequence for loosening and tightening --> **Cylinder head, removing and installing**

4 - Washer

- For cylinder head bolts

- Install before bearing caps are installed into cylinder head

5 - Valve lifter

- Do not interchange
- With hydraulic valve clearance compensation
- Place on running surface when setting down
- Before installing, check axial play of camshafts **Checking camshaft axial play**

- Lubricate contact surfaces
- Before removing, remove bearing caps from camshaft

6 - Valve keepers

7 - Valve spring plate

8 - Outer valve spring

- Removing and installing:

with cylinder head removed, using valve spring compressor 2037

with cylinder head installed --> **Valve stem seals, replacing**

9 - Inner valve spring

- Removing and installing:

with cylinder head removed, using valve spring compressor 2037

with cylinder head installed --> **Valve stem seals, replacing**

10 - Valve stem seal

- Replace --> **Valve stem seals, replacing**

11 - Valve guide

- Checking --> **Valve guides, checking**

12 - Pump-Injector unit

- Removing and installing --> **Pump-Injector unit, removing and installing**

13 - Cylinder head

- Read note --> **Valve gear, servicing**

14 - Oil seal

- Do not additionally oil or grease sealing lip of sealing ring
- Before installing, remove oil remains from camshaft journal with a clean cloth
- To install, tape over groove on stem of camshaft with commercially available adhesive strip (e.g. cellophane tape)
- Removing and installing --> **Camshaft seal, removing and installing**

15 - Valves

- Valve dimensions **Valve dimensions**
- Checking valve guide --> **Valve guides, checking**

16 - Bearing shell

- Do not interchange used bearings (mark)
- Make sure retaining tabs are correctly positioned in bearing caps and cylinder head

17 - Camshaft

- Checking axial play **Checking camshaft axial play**
- Removing and installing --> **Camshaft, removing and installing**
- Checking radial clearance with Plastigage, Wear limit: 0.11 mm
- Run-out: max. 0.01 mm

18 - Bearing cap

- Installation sequence --> **Camshaft, removing and installing**
- When installing, seal separating surfaces of bearing caps 1 and 5 with AMV 174 004 01 **Sealing separating surfaces of bearing caps 1 and 5 with sealant AMV 174 004 01**

19 - 8 Nm plus an additional $^{1}/_{4}$ turn (90°)

- Replace

Checking camshaft axial play

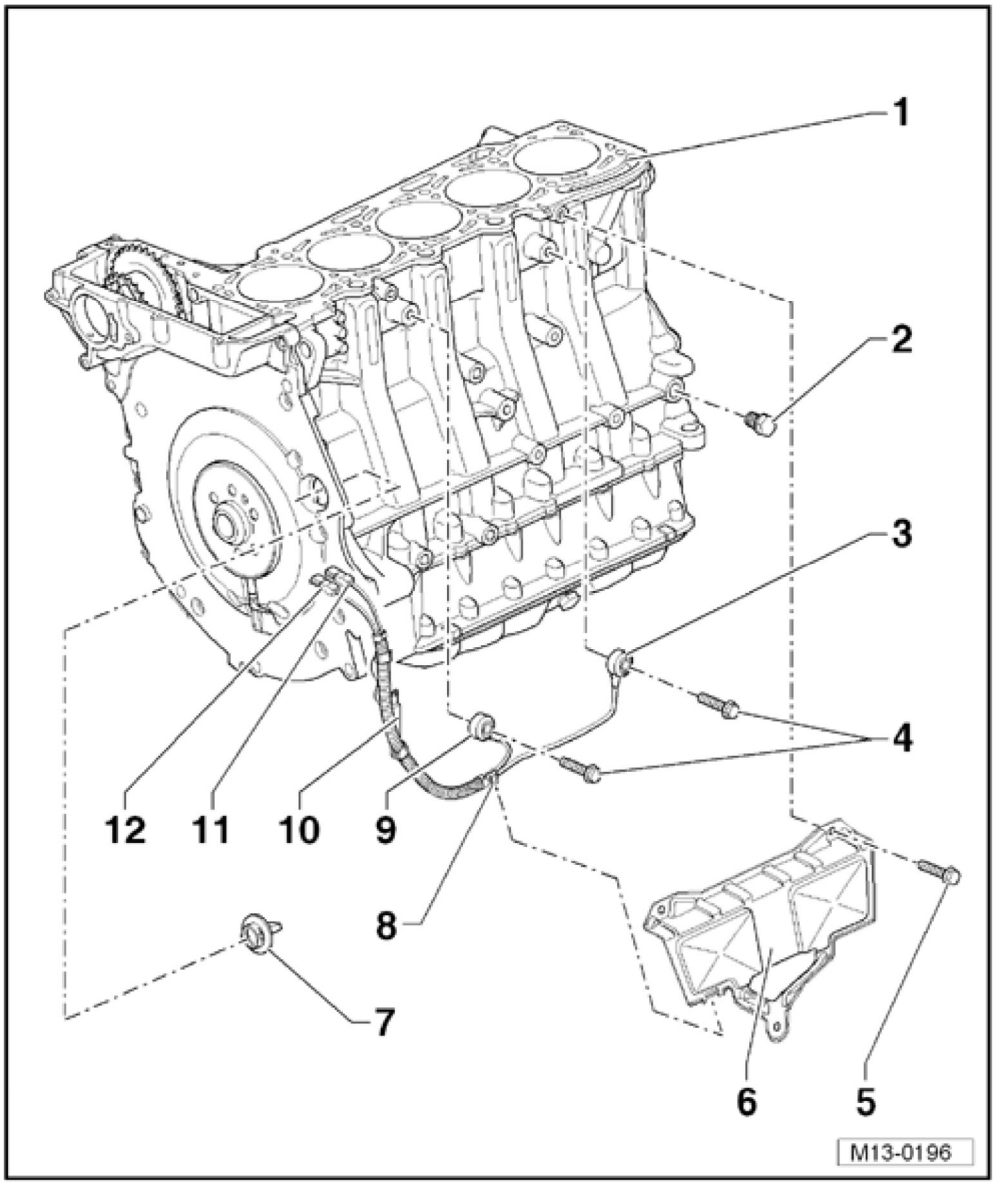

Fig. 76: Identifying Camshaft Clearance
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

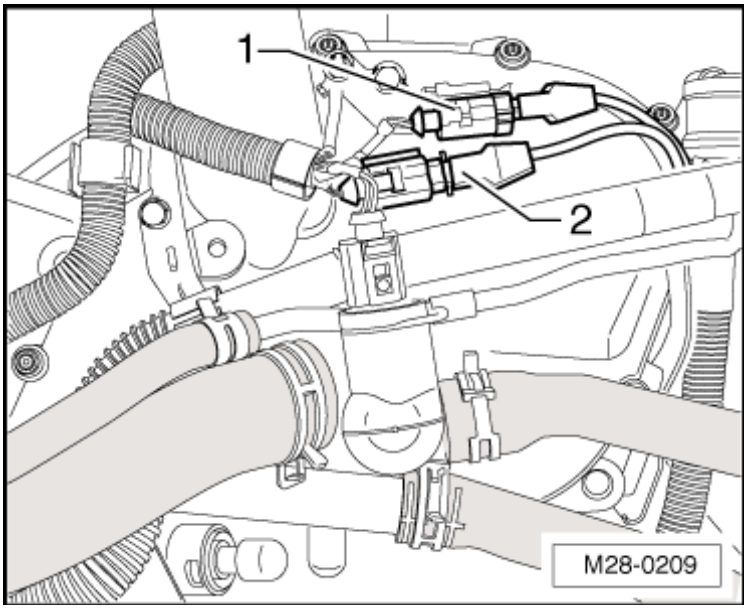

Fig. 77: Dial Gauge Holder VW 387
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Dial gauge holder VW 387
- Dial gauge

Measure with valve lifters removed and with first, third and last bearing cap installed.

Wear limit: max. 0.15 mm

Sealing separating surfaces of bearing caps 1 and 5 with sealant AMV 174 004 01

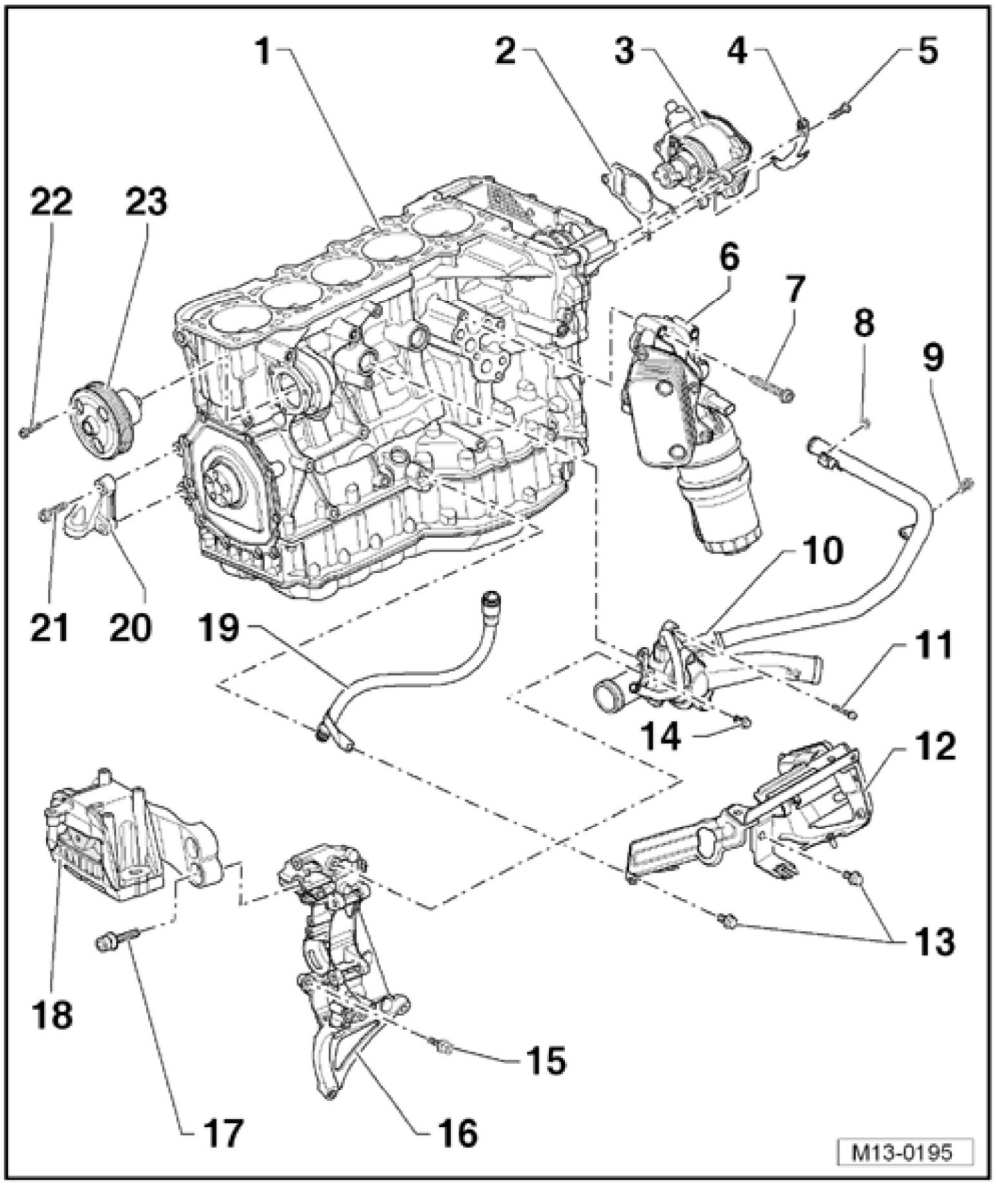

Fig. 78: Identifying Sealant
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Apply *sealant AMV 174 004 01* thinly and evenly onto surfaces - **1** -.

NOTE:

- **Make sure that no sealant enters the grooves - arrows -.**

Valve dimensions

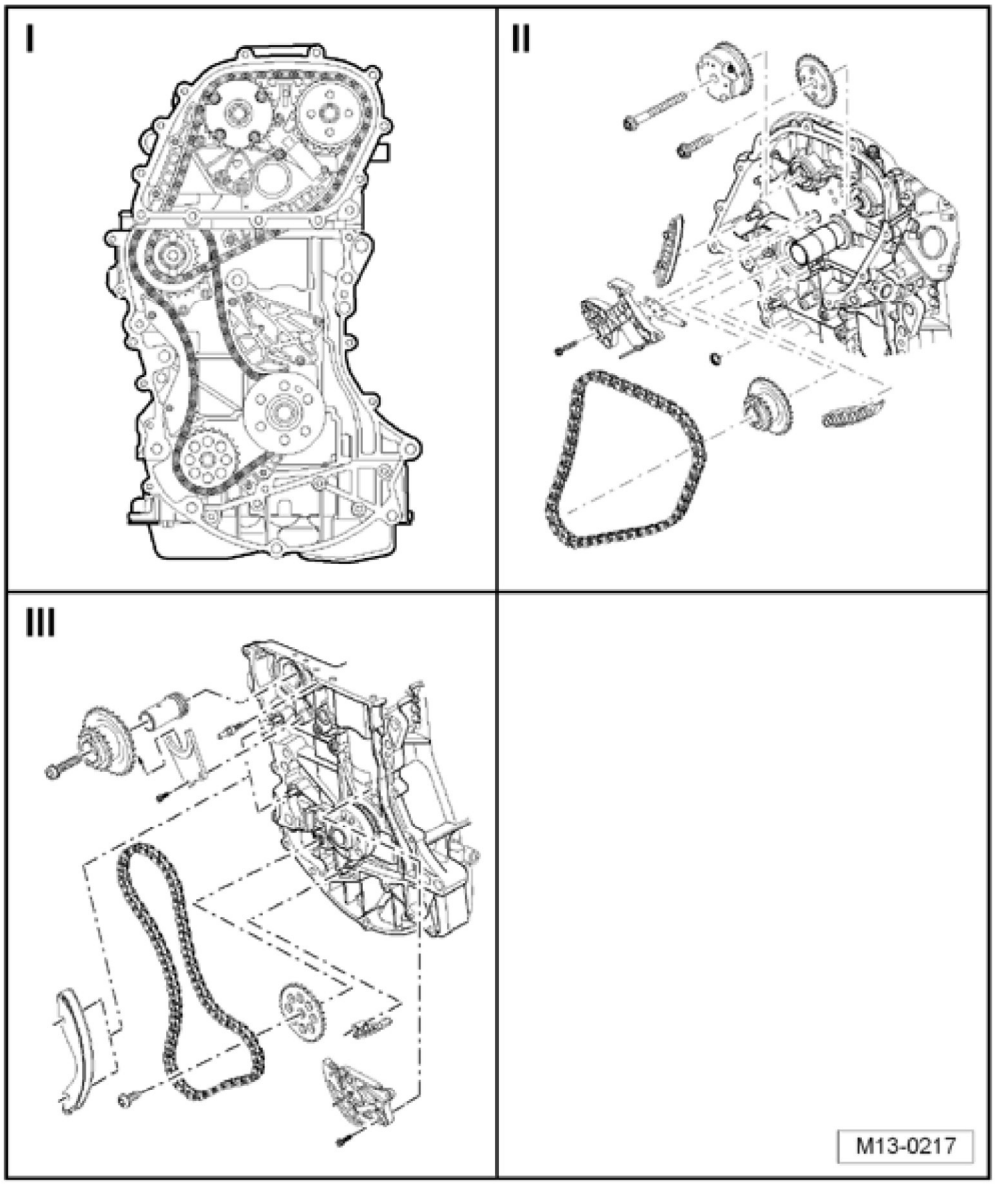

Fig. 79: Identifying Valve Dimensions
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE:

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

Dimension		Intake valve	Exhaust valve
diameter a	mm	35.95	31.45
diameter b	mm	6.980	6.956
c	mm	89.95	89.95
a	Angle°	45	45

Valve guides, checking

Special tools, testers and auxiliary items required

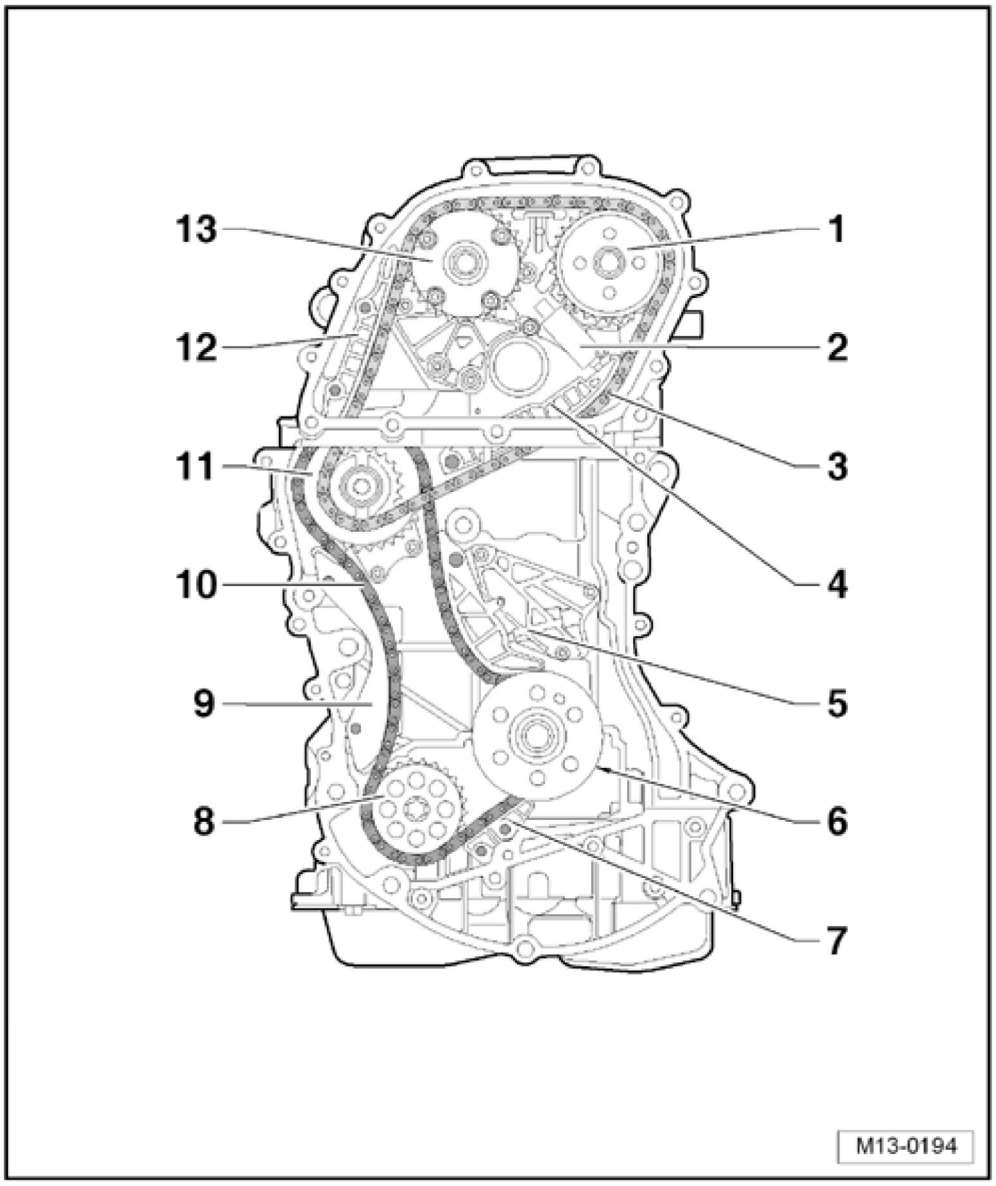

Fig. 80: Dial Gauge Holder VW 387
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Dial gauge holder VW 387
- Dial gauge

Work sequence

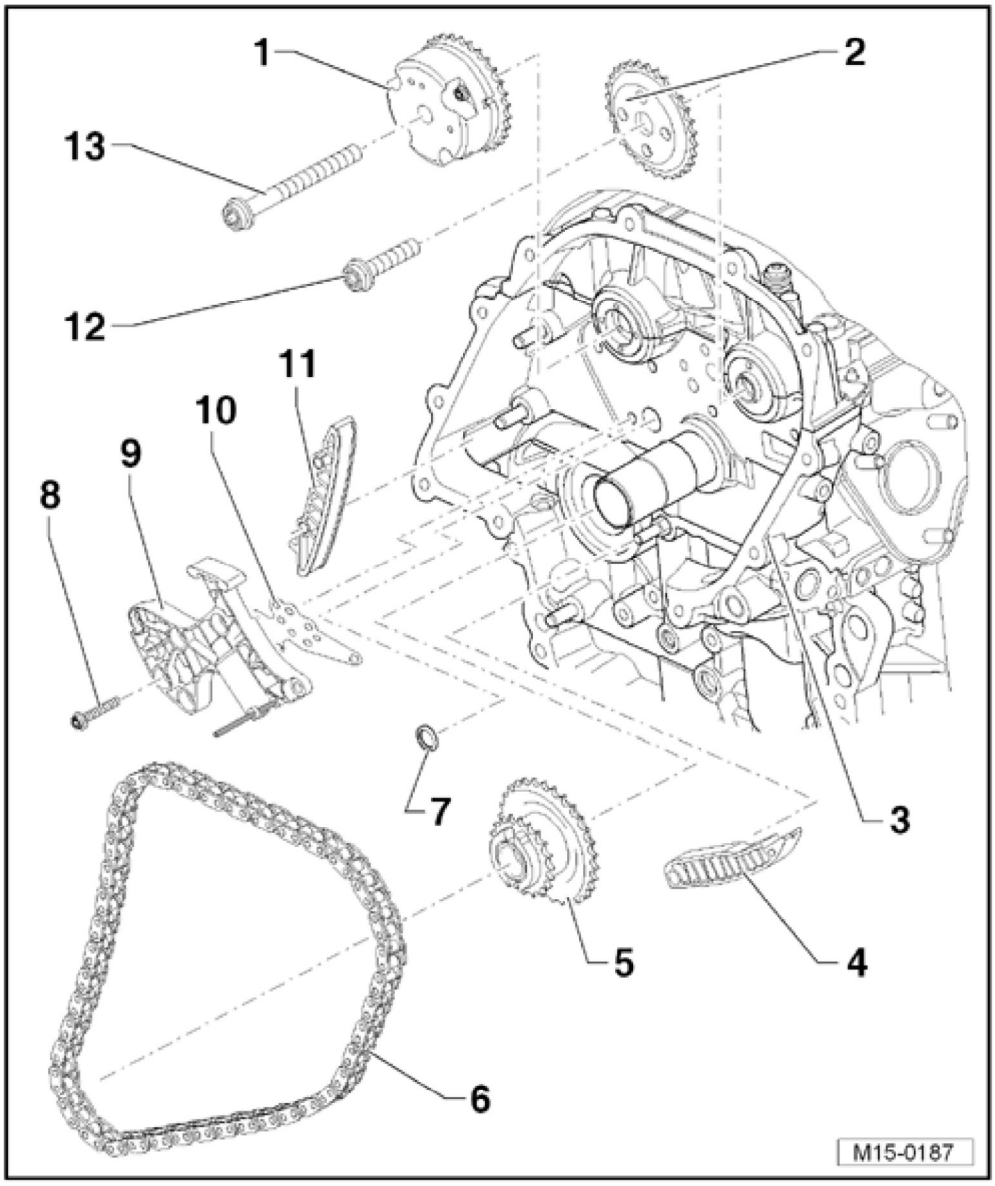

Fig. 81: Determining Valve Rock (Wear limit)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert new valve into guide. Valve stem tip must seal with guide. Due to slight difference in stem dimensions, ensure that only an intake valve is used in an intake guide and an exhaust valve in an exhaust guide.
- Determine valve rock.

Wear limit: max. 1.3 mm

- If valve rock exceeds wear limit, replace cylinder head.

Valve stem seals, replacing

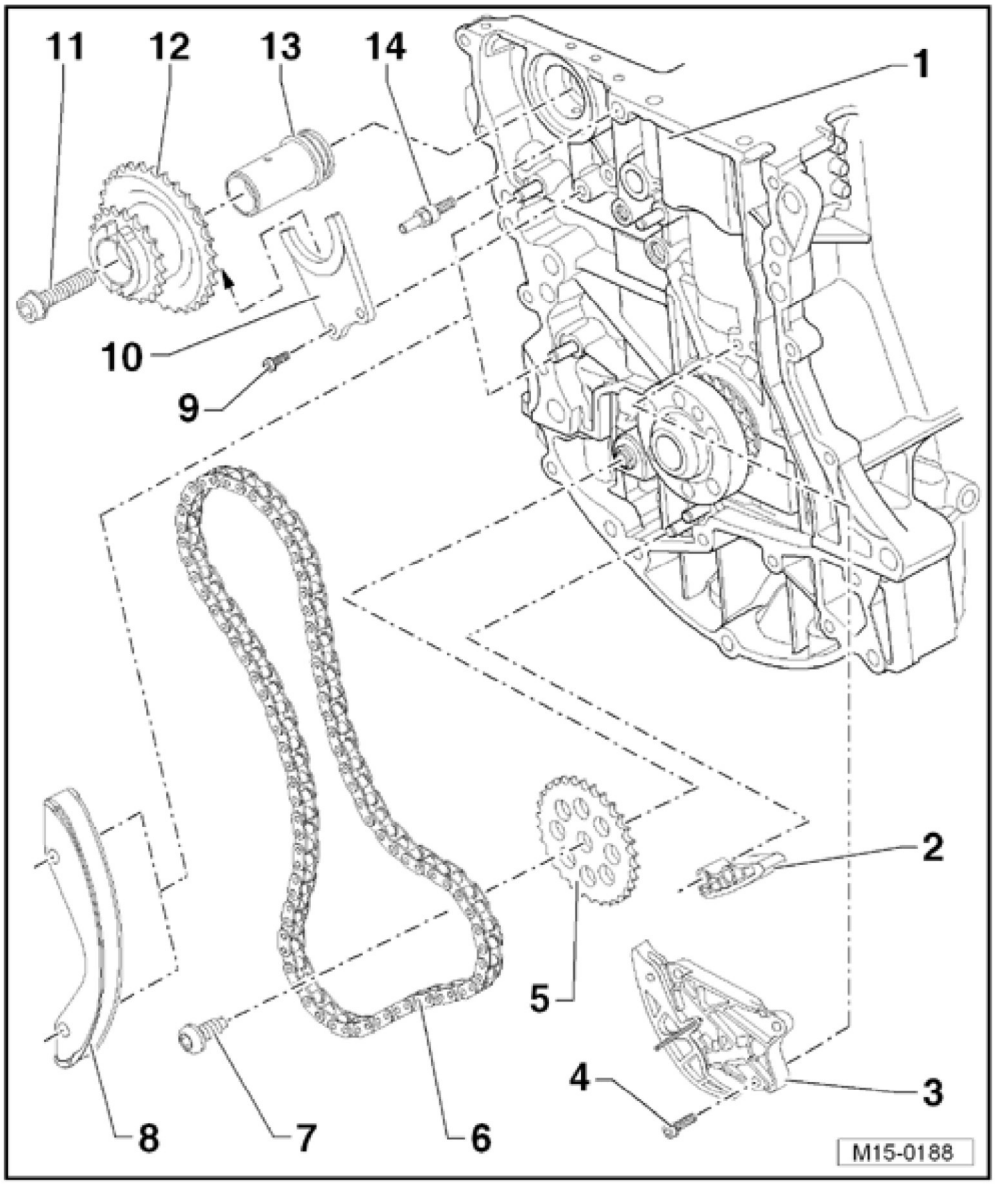

Fig. 82: Identifying Special Tools - Valve Stem Seals, Replacing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Adjustable rod 2036
- Removal tool 3047 A
- Valve stem seal driver 3129
- Valve lever VW 541/1 A
- Thrust piece for VW 541 / 1A and 2037 VW 541/5

Removing

(with cylinder head installed)

- Remove camshaft --> **Camshaft, removing and installing** .
- Remove valve lifters and place on running surface when setting down. Be careful not to interchange valve lifters.
- Move piston of respective cylinder to top dead center (TDC).

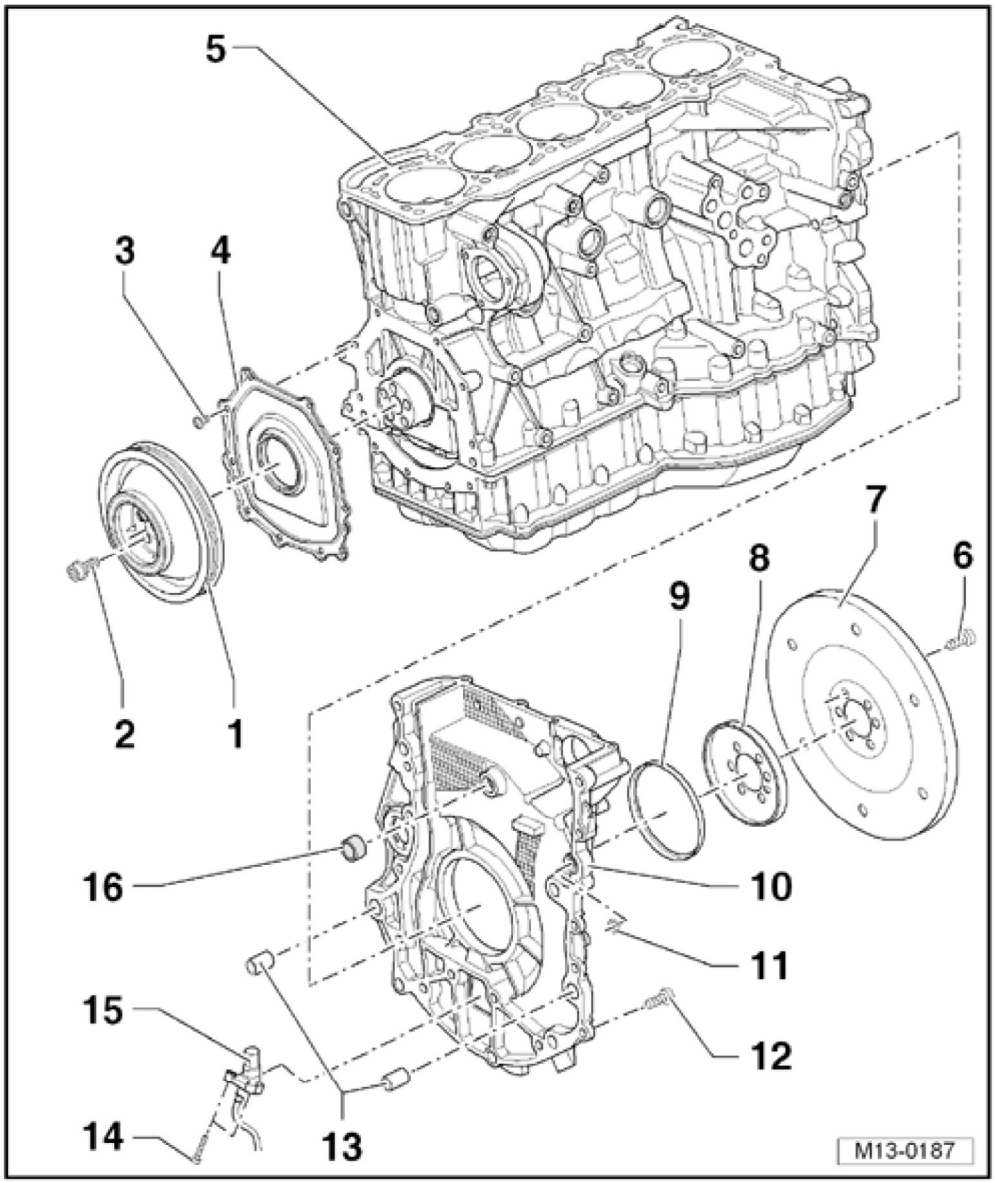

Fig. 83: Identifying Valve Springs Using Valve Lever VW 541/1A And Press Tool VW 541/5
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert adjustable rod 2036 and adjust mounting to stud height.
- Remove valve springs with valve lever VW 541/1 A and thrust piece for VW 541 / 1A and 2037 VW 541/5.

NOTE:

- **The valves are supported by resting on the piston face.**

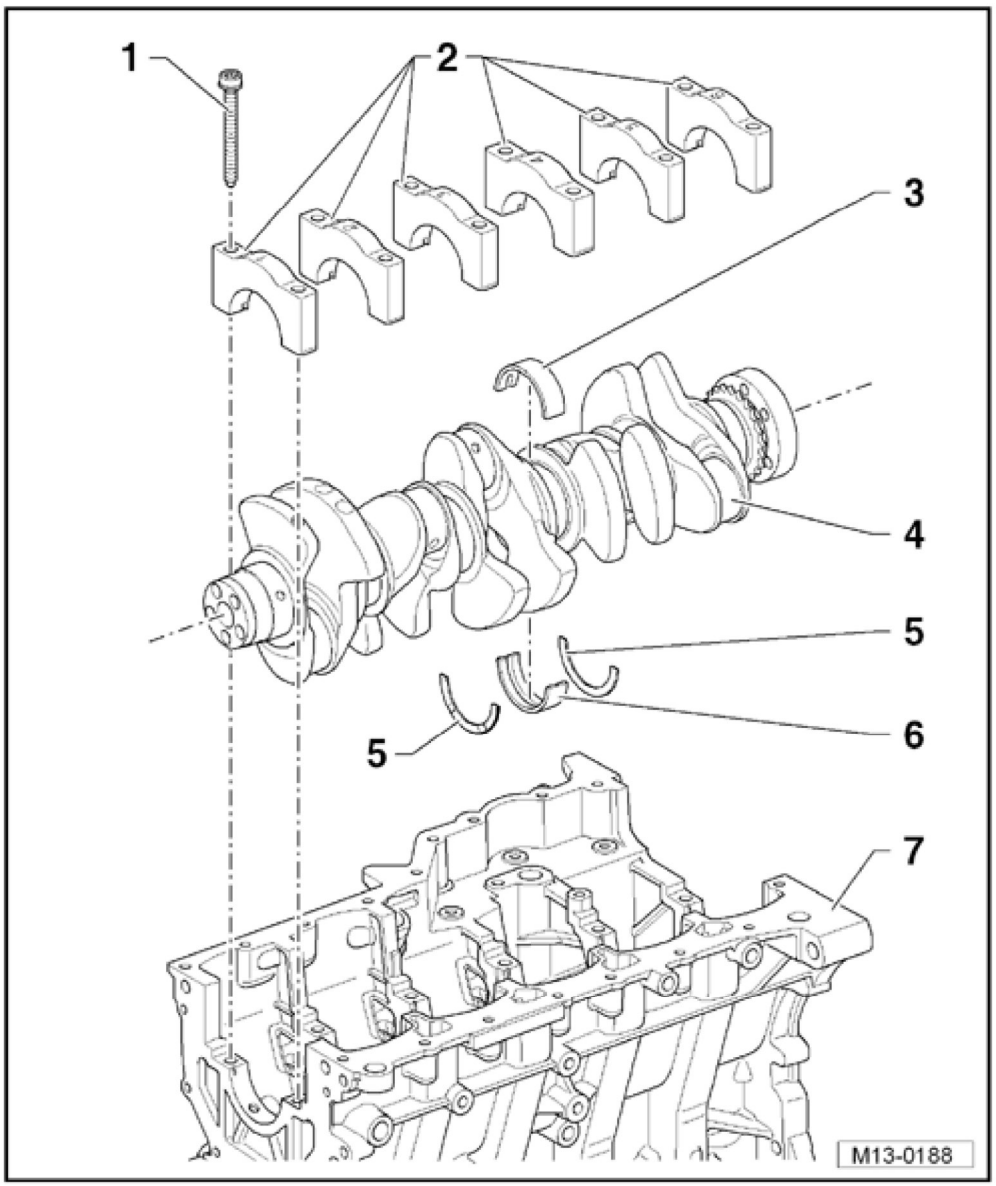

Fig. 84: Identifying Special Tool - 3047 A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull off valve stem seals with valve stem seal removal tool 3047 A.

Installing

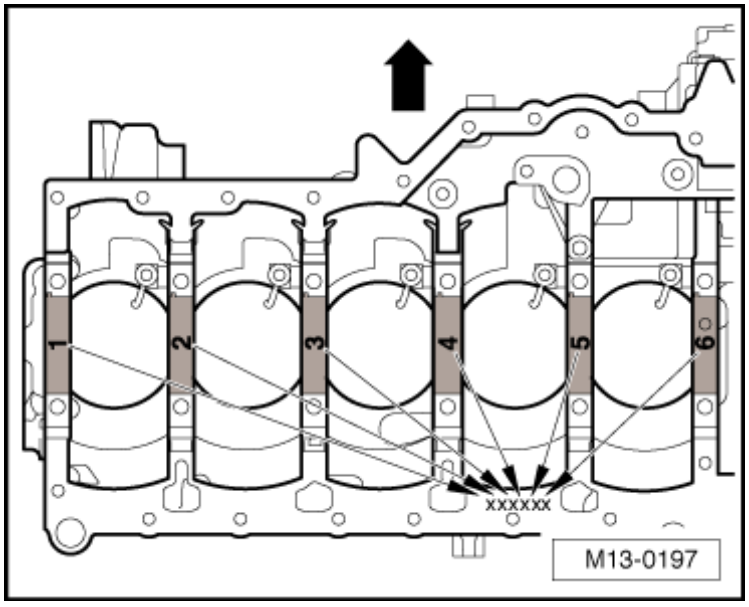

Fig. 85: Identifying Special Tool - 3129
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Attach plastic sleeves provided - **A** - to respective valve stem. This will help avoid damage to new valve stem seal - **B** -.
- Insert new valve stem seal into valve stem seal driver 3129.
- Grease lip of valve stem seal and carefully slide onto valve guide.

Camshaft, removing and installing

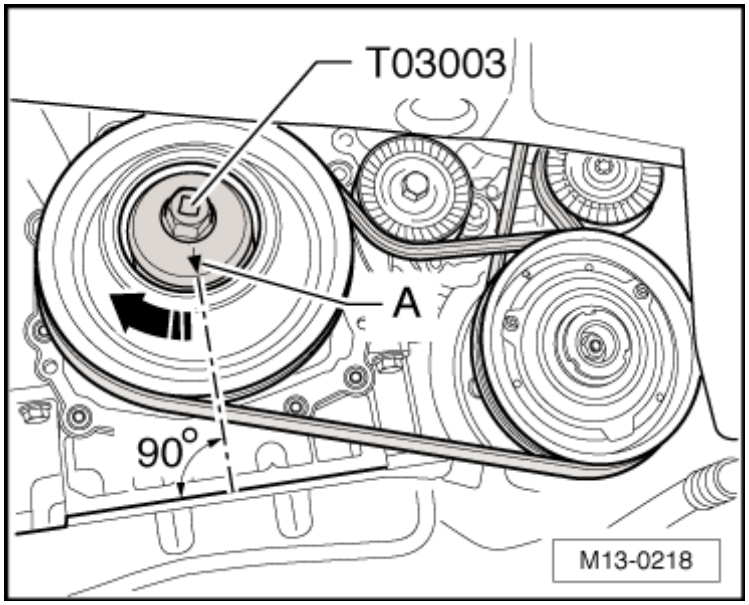

Fig. 86: Special Tools - Camshaft, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Counter-holder tool T10051
- Puller T10052
- Torque wrench (5 to 50 Nm) V.A.G 1331
- Torque wrench (40 to 200 Nm) V.A.G 1332
- *Sealant AMV 174 004 01*

Removing

- Bring lock carrier into service position: --> **50 BODY, FRONT**
- Remove ribbed belt --> **Ribbed belt, removing and installing** .
- Remove toothed belt--> **Toothed belt, removing, installing and tensioning** .

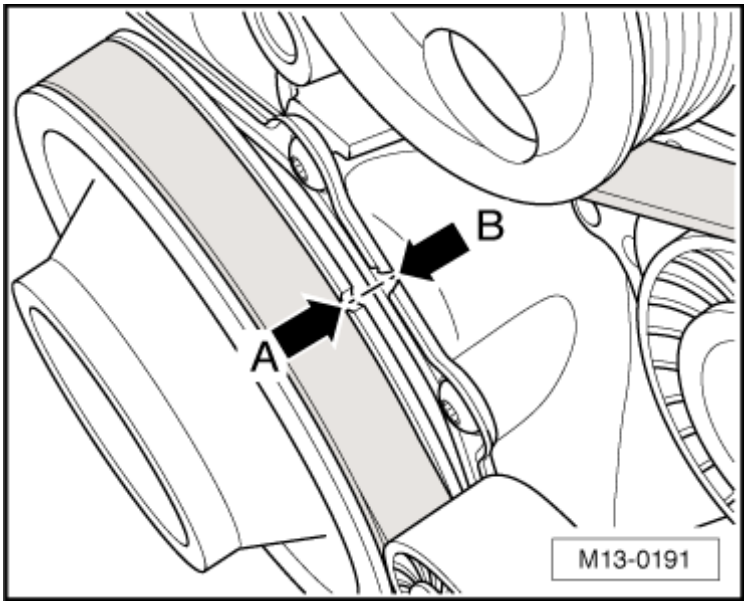

Fig. 87: Identifying Camshaft Pulley Securing Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **1** - for camshaft sprocket.
- Pull off camshaft sprocket from hub.

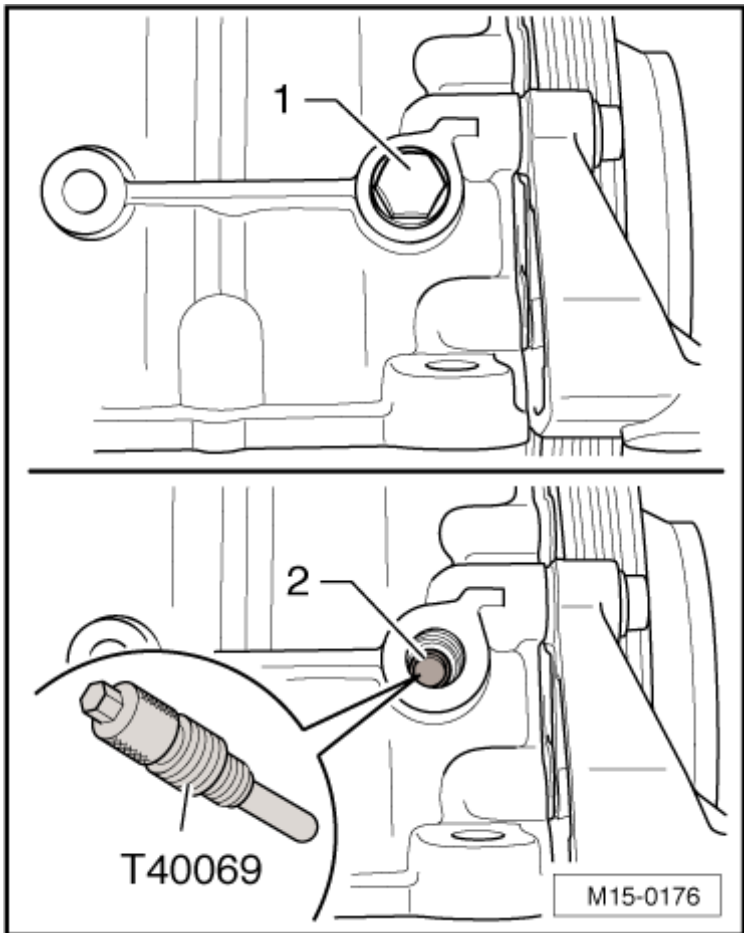

Fig. 88: Identifying Counterhold T10051 & Hub Securing Bolt
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen bolt - **1** - for hub using counter-holder T10051.
- Unscrew bolt for hub by approx. 2 turns.

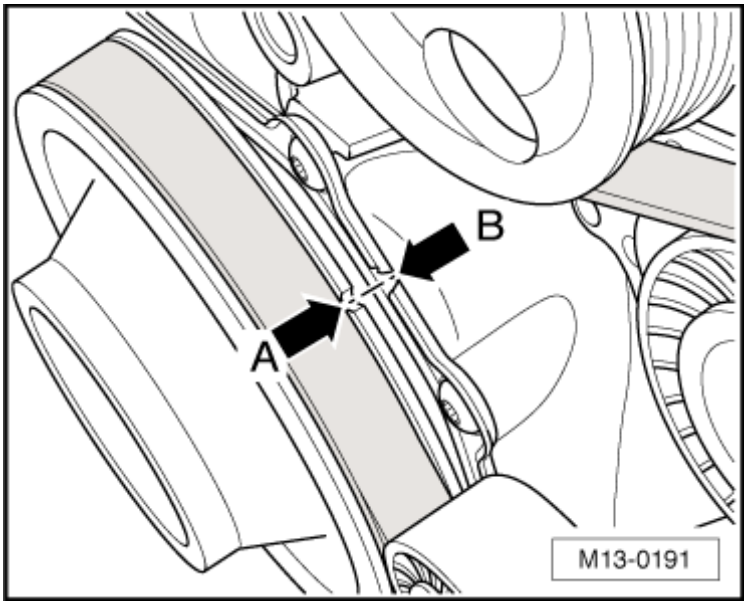

Fig. 89: Identifying Puller T10052
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Set puller T10052 in place and screw in bolt for hub - **1** -.
- Steadily fasten central bolt - **2** - to place hub under tension until hub is loosened from cone of camshaft.

NOTE:

- **Hold puller with a wrench.**

- Remove hub from cone of camshaft.
- Remove cylinder head cover.

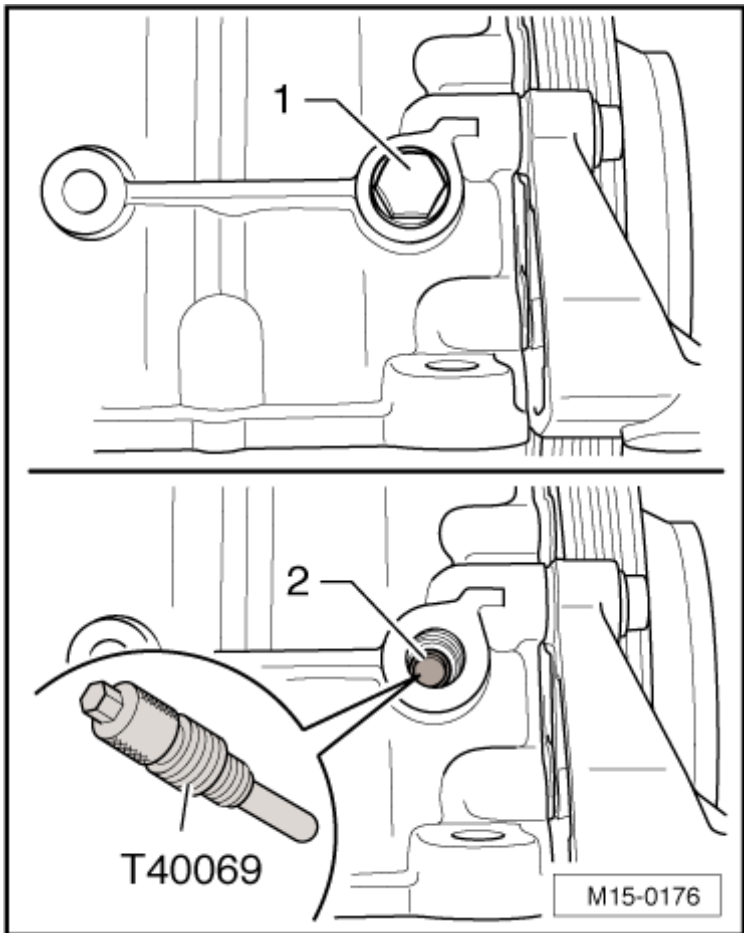

Fig. 90: Marked Rocker Arm Shafts For Reassembly
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Mark rocker lever shafts with water-proof marker, to prevent mixing them and thereby having to perform base setting for Pump-Injector unit - **arrows** -.
- Remove rocker lever shafts.

NOTE:

- **First loosen both outer bolts and then the inner bolts.**

- Remove tandem pump --> **Tandem pump, removing and installing** .

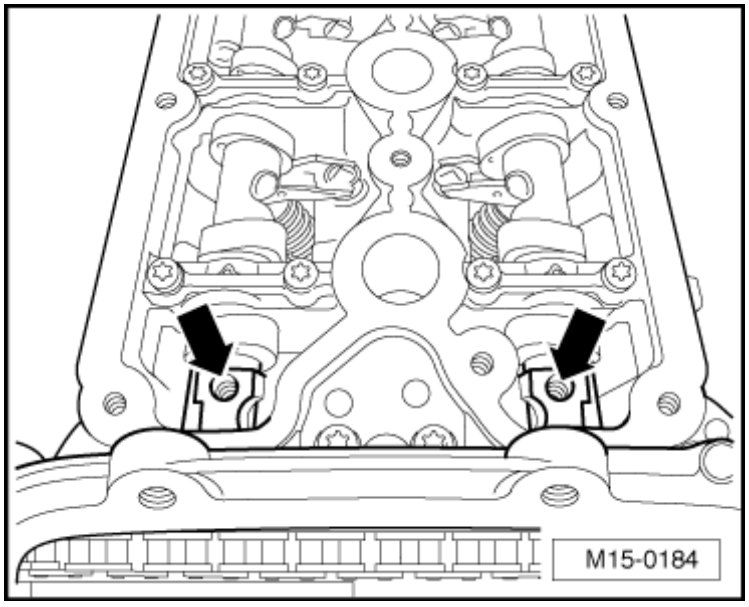

Fig. 91: Identifying Bearing Caps
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- First remove bearing caps 5, 1 and 3. Then loosen bearing caps 2 and 4, alternating in a diagonal sequence.
- Remove camshaft.

Installing

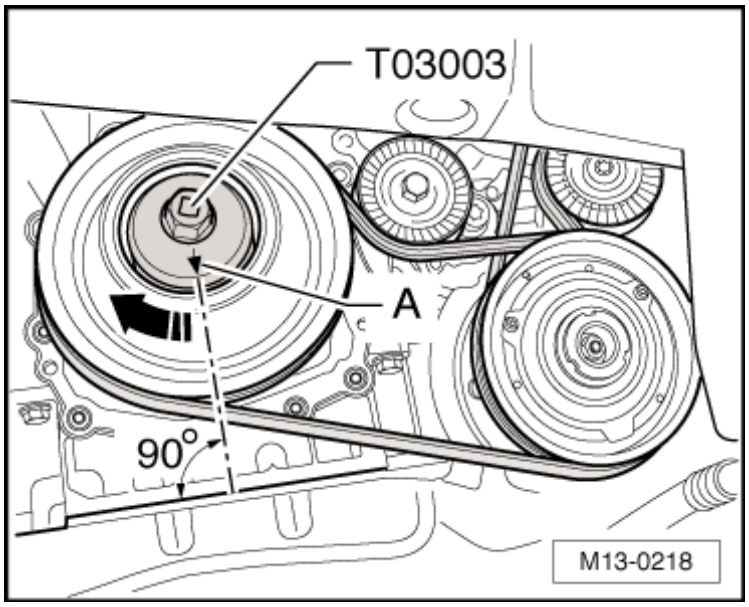

Fig. 92: Cam Lobes For Cylinder 1 Pointing Upward
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE:

- **When installing the camshaft, the cam lobes for cylinder 1 - arrows - must**

point upward.

- **Do not interchange used bearings (mark)**
- **When installing the camshaft, verify that the retaining tabs of the bearing shells are correctly seated in the bearing caps and cylinder head.**
- **Before the bearing caps are installed, make sure the washers for the cylinder head bolts are set in place in the cylinder head.**

- Oil running surfaces of bearing shells.
- Install bearing caps 2 and 4 with new bolts.
- Fasten bearing caps 2 and 4, alternating in a diagonal sequence to 8 Nm plus an additional $^{1}/_{4}$ turn (90°).
- Install bearing caps 5, 1 and 3 with new bolts.

NOTE:

- **Seal separating surfaces of bearing caps 1 and 5 with *sealant AMV 174 004 01* .**
- **Bearing cap 5 must seat flush with the outer edge of the cylinder head, otherwise leaks at the tandem pump may result.**

- Fasten bearing caps 5, 1 and 3 to 8 Nm plus an additional $^{1}/_{4}$ turn (90°).
- Install camshaft seal --> **Camshaft seal, removing and installing** .

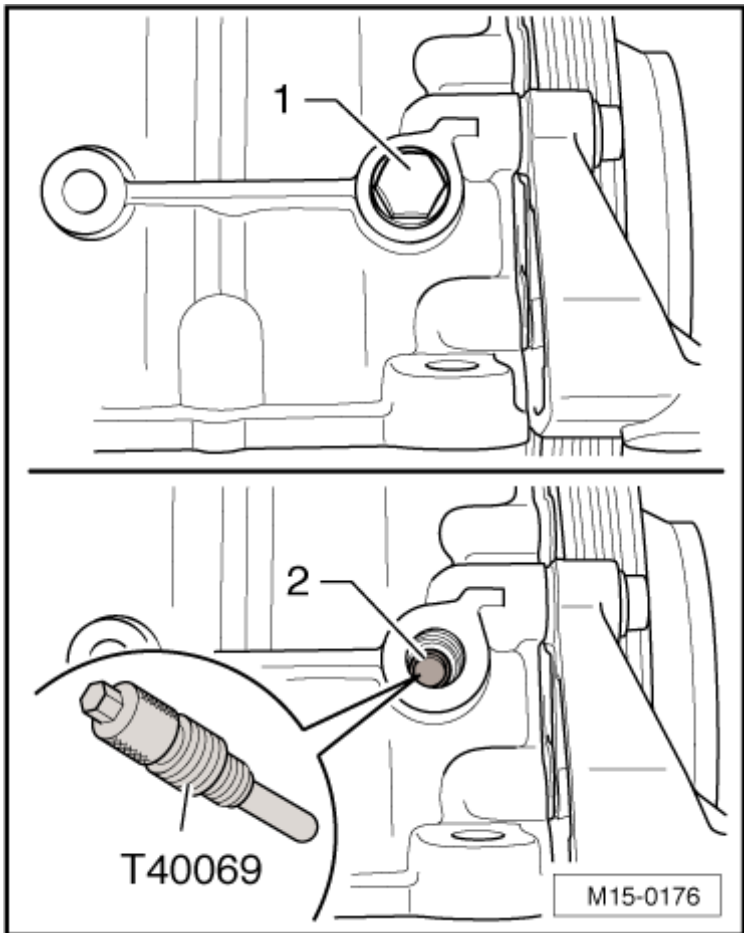

Fig. 93: Marked Rocker Arm Shafts For Reassembly
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install rocker lever shafts and first, fasten new inner bolts - **2** - and then new outer bolts - **1** - , evenly in a diagonal sequence to 20 Nm plus an additional $^{1}/_{4}$ turn (90°).
- Place hub onto camshaft.

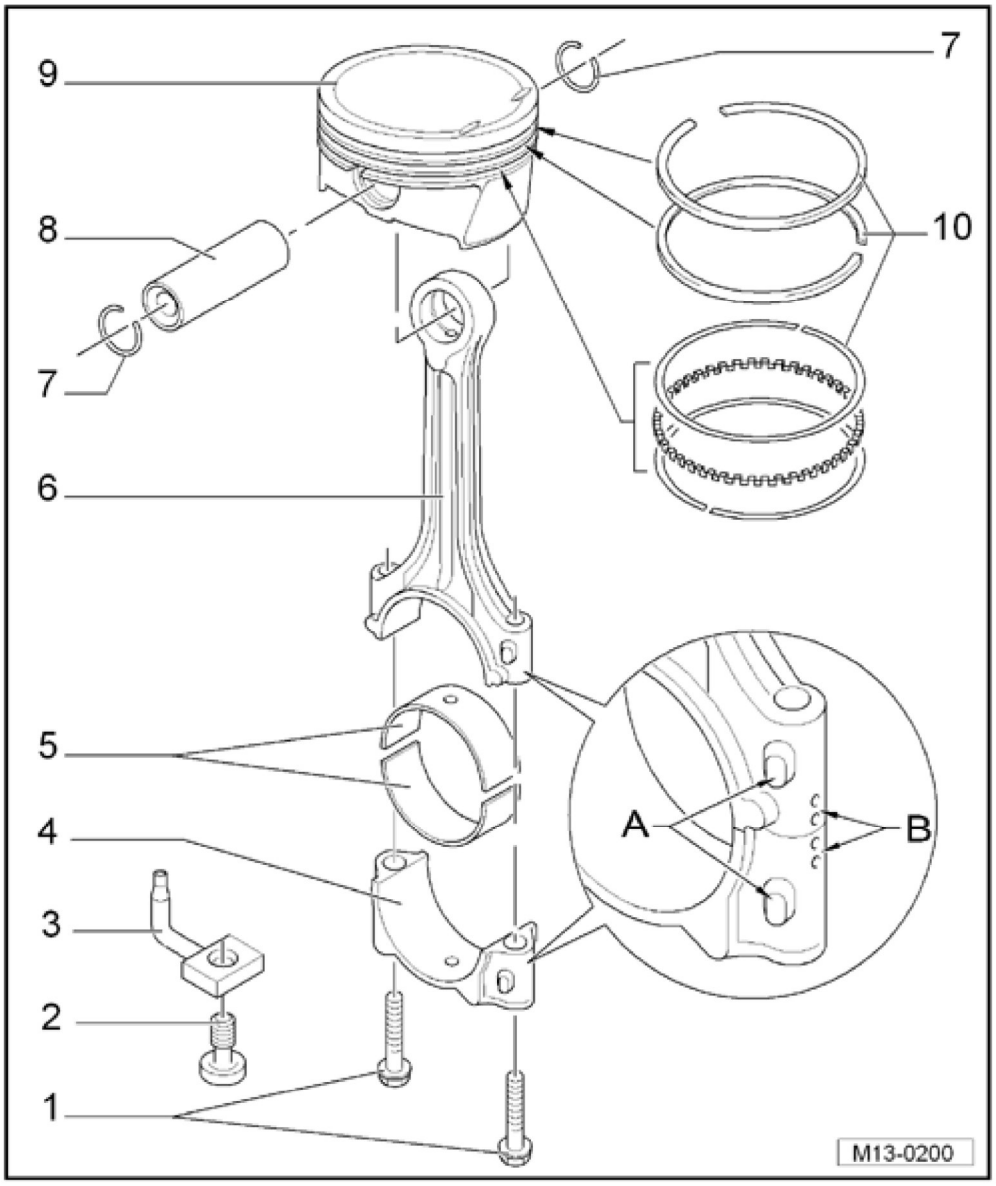

Fig. 94: Identifying Counterhold T10051 & Hub Securing Bolt
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Fasten bolt - **1** - for hub using counter-holder T10051. Tightening torque: 100 Nm.
- Push camshaft sprocket onto hub.

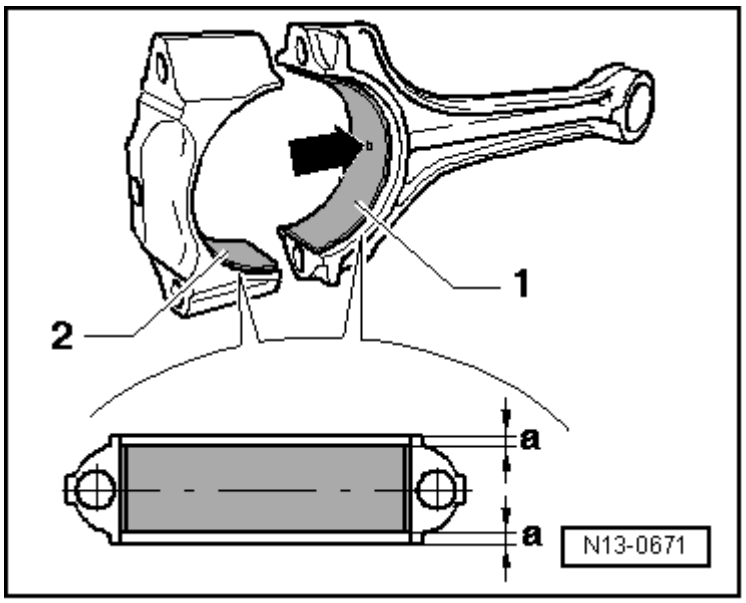

Fig. 95: Identifying Camshaft Pulley Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE:

- **The toothed segment - arrow - of the camshaft sprocket must face upward.**

- Align camshaft sprocket to central location in slots.
- Install bolts - **1** - into camshaft sprocket by hand tight enough to eliminate play.
- Lock hub with rig pin 3359.
- Install and tension toothed belt --> **Toothed belt, removing, installing and tensioning** .

- Install tandem pump --> **Tandem pump, removing and installing** .

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 seal, removing and installing

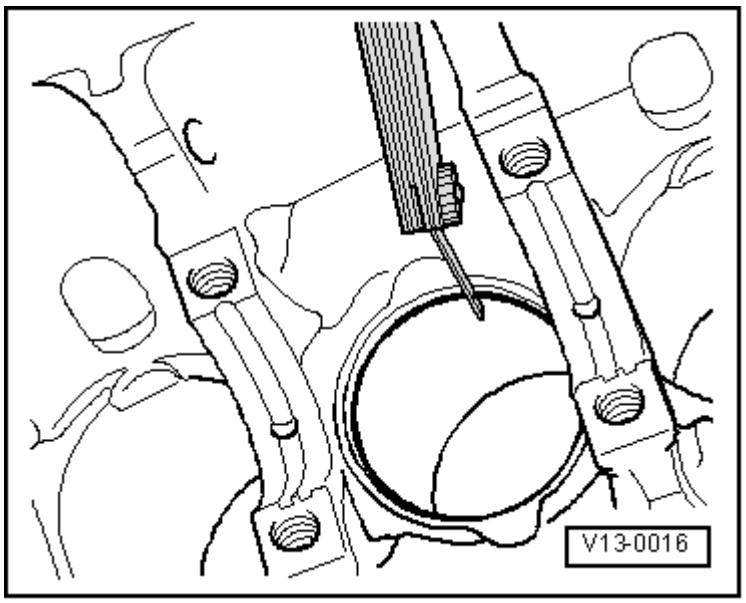

Fig. 96: Identifying Special Tools - Camshaft Seal, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Pulling fixture 10-203
- Seal remover 3240
- Torque wrench (5 to 50 Nm) V.A.G 1331
- Torque wrench (40 to 200 Nm) V.A.G 1332
- Bolt M12 x 1.5 x 65

Removing

- Bring lock carrier into service position: --> **50 BODY, FRONT**
- Remove ribbed belt --> **Ribbed belt, removing and installing** .
- Remove toothed belt --> **Toothed belt, removing, installing and tensioning** .
- Remove camshaft sprocket and hub --> **Camshaft, removing and installing** , Camshaft, removing and installing.

- Turn inner portion of seal remover 3240 two revolutions (approx. 3 mm) out from outer portion and lock it with knurled bolt.

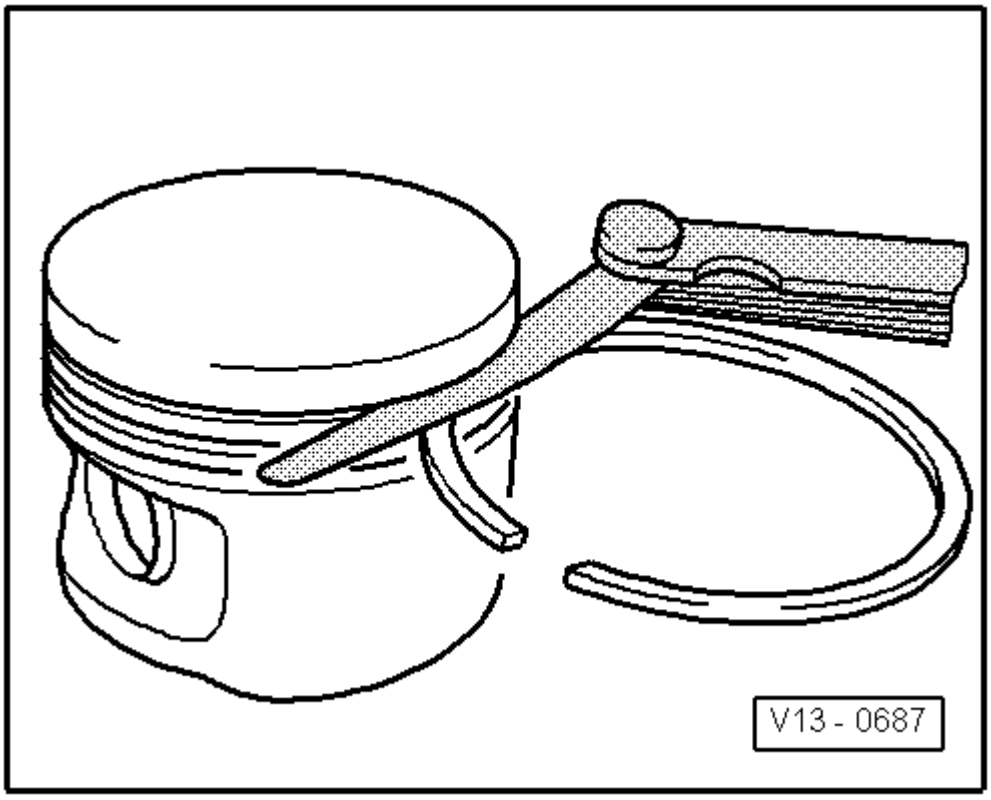

Fig. 97: Identifying Special Tool - 3240
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Lubricate threaded head of seal remover 3240, place against seal, and with strong force screw into seal as far as possible.
- Loosen knurled bolt and turn inner part against camshaft until seal is removed.

Installing

- Before installing, remove oil remains from camshaft journal with a clean cloth.
- Tape groove in cone of camshaft (e.g. with cellophane tape).
- Carefully set seal onto camshaft.

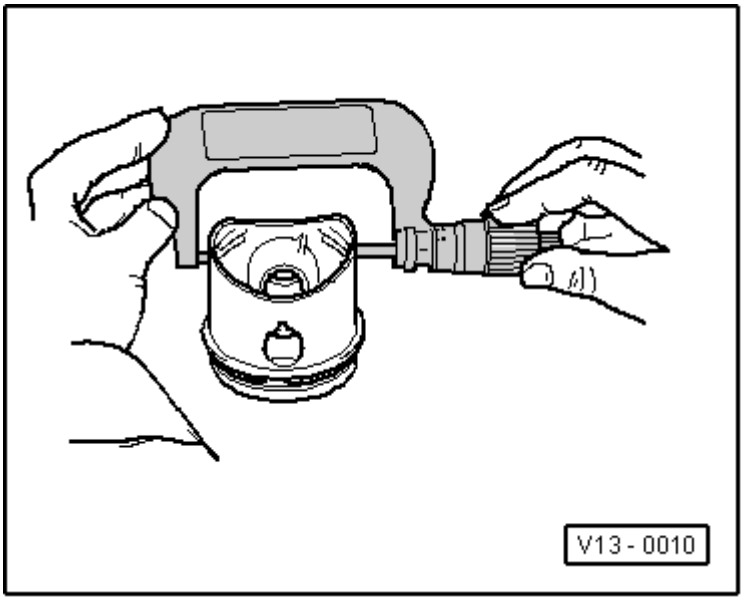

Fig. 98: Installing Camshaft Oil Seal
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press seal in up to stop using thrust piece of oil seal driver 10-203 and bolt M12 x 1.5 x 65.
- Install and tension toothed belt --> **Toothed belt, removing, installing and tensioning** .
- Install ribbed belt --> **Ribbed belt, removing and installing** .
- Install lock carrier: --> **50 BODY, FRONT**

17 LUBRICATION

COMPONENTS OF LUBRICATION SYSTEM

Components of lubrication system

NOTE:

- **The oil level must not be above the max. mark - danger of damage to the catalytic converter!**
- **If large quantities of metal particles or abraded material are detected during engine repairs, it may be an indication of 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 insert**

Engine oil --> **Engine oil** .

Part I: Parts of lubrication system --> **Part I** .

Oil supply line, assembly overview --> **Oil supply line, assembly overview** .

Oil pressure, checking --> **Oil pressure and oil pressure switch, checking** .

Engine oil

Oil filling quantities.

Engine oil specifications.

Markings on oil dipstick.

Oil system capacity

with oil filter 3.8 L

without oil filter 3.3 L

Engine oil specifications

Vehicles without service interval extension:

Only use engine oil in compliance with VW standard 505 01

Markings on oil dipstick

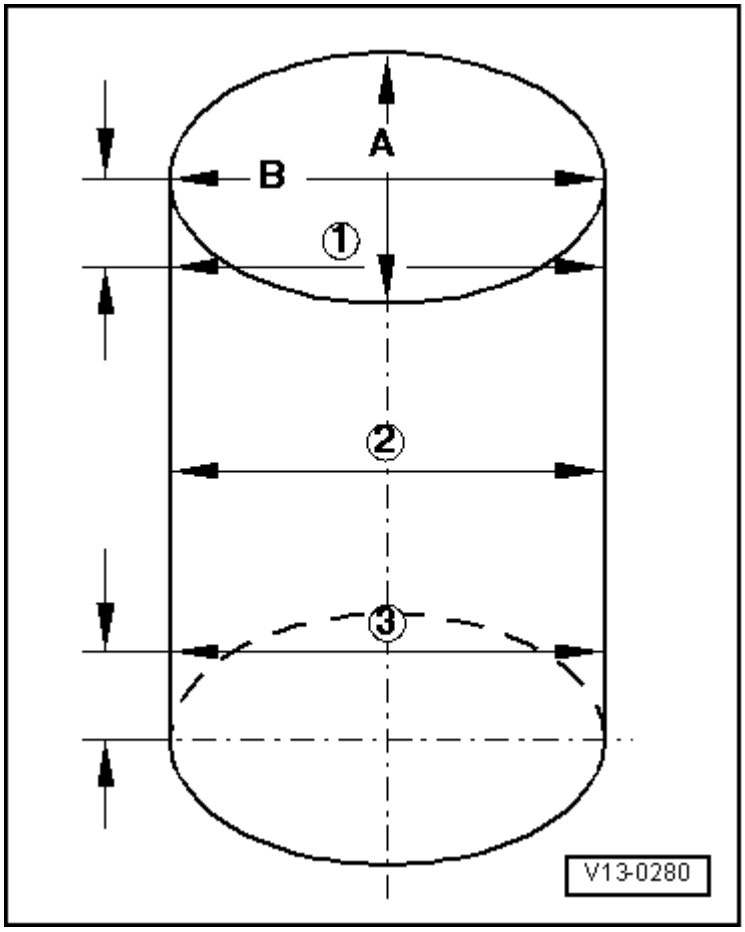

Fig. 99: Identifying Dipstick Markings
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Max. mark

2 - Min. mark

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

b - Oil level within hatched field: Engine oil can be added

c - Area from Min. mark up to hatched field: Add a max. 0.5 liter of engine oil!

Part I

Engine code BHW

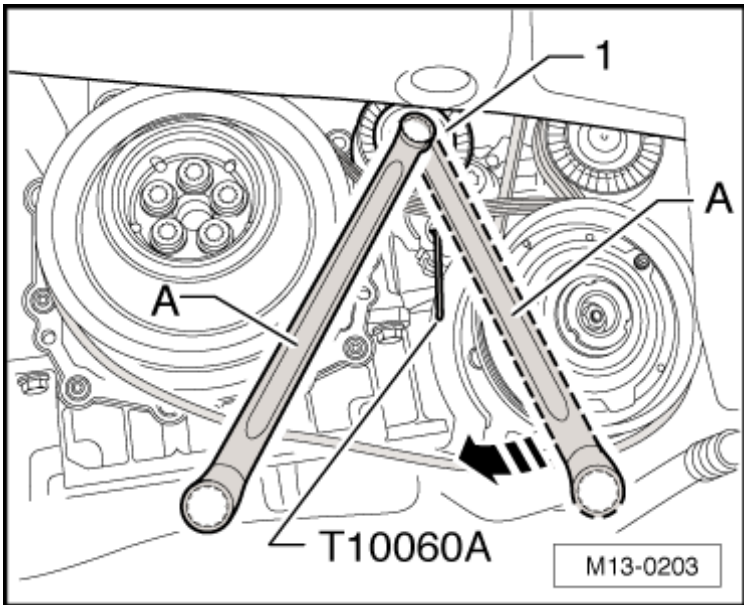

Fig. 100: Engine Code BHW, Components Of Lubrication System (Part 1)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 15 Nm

2 - Sealing flange

- With seal
- Must be located on dowel sleeves
- To remove, remove oil pan --> **Oil pan, removing and installing**
- Removing and installing --> **Sealing flange - belt pulley side, removing and installing**

- Install with *silicone sealant D 176 404 A2*
- Do not additionally oil or grease sealing lip of sealing ring
- Before installing, remove oil remains from crankshaft journal with a clean cloth
- Seal for crankshaft - belt pulley side, replacing --> **Seal for crankshaft - ribbed belt side, replacing**

3 - Chain

- When removing, mark running direction with a water-proof marker

4 - 25 Nm

- Install without sealant

5 - Oil spray jet

- For piston cooling

6 - Oil dipstick

- Tabs of oil dipstick and inlet spout must be positioned one above the other
- Oil level must not be above max. mark!
- Marks

7 - Inlet spout

- Tabs of oil dipstick and inlet spout must be positioned one above the other
- For extracting oil

8 - Guide tube

9 - Assembly sleeves

10 - Balance shaft module

- Removing and installing --> **Balance shaft module, removing and installing**

11 - Bolt

- M8 = 20 Nm plus an additional $^{1}/_{4}$ turn (90°)
- Replace
- M7 = 13 Nm plus an additional $^{1}/_{4}$ turn (90°)
- Replace
- Observe tightening sequence --> **Balance shaft module, removing and installing** , Balance shaft module, removing and installing

12 - Assembly sleeves

13 - O-ring

- Replace

14 - Washer

15 - 10 Nm

16 - Oil pump

- With pressure relief valve, 12 bar
- Before installing, check to be sure both assembly sleeves are present (for centering oil pump/cylinder block)

- Replace if running surfaces and gears are scored
- Removing and installing --> **Oil pump, removing and installing**

17 - 13 Nm plus an additional $^{1}/_{4}$ turn (90°)

- Replace

18 - Oil pan

- Removing and installing --> **Oil pan, removing and installing**
- Clean sealing surface before installing
- Use hex ball socket T10058 to remove and install two rear bolts on transmission

19 - 40 Nm

20 - 15 Nm

21 - Oil seal

- Replace

22 - Oil drain plug, 30 Nm

- If sealing ring is leaking cut open and replace.

23 - 10 Nm

24 - Protective cap

25 - Oil level thermal sensor -G266-

26 - Oil seal

- Replace

27 - Shaft

- For oil pump drive

28 - Circlip

29 - Suction line

- Clean strainer if soiled

30 - 10 Nm

31 - Chain sprocket

32 - 10 Nm plus an additional $^{1}/_{4}$ turn (90°)

- Replace

33 - Cover

34 - 8 Nm

35 - 10 Nm

36 - Chain tensioner

37 - 20 Nm

Part II

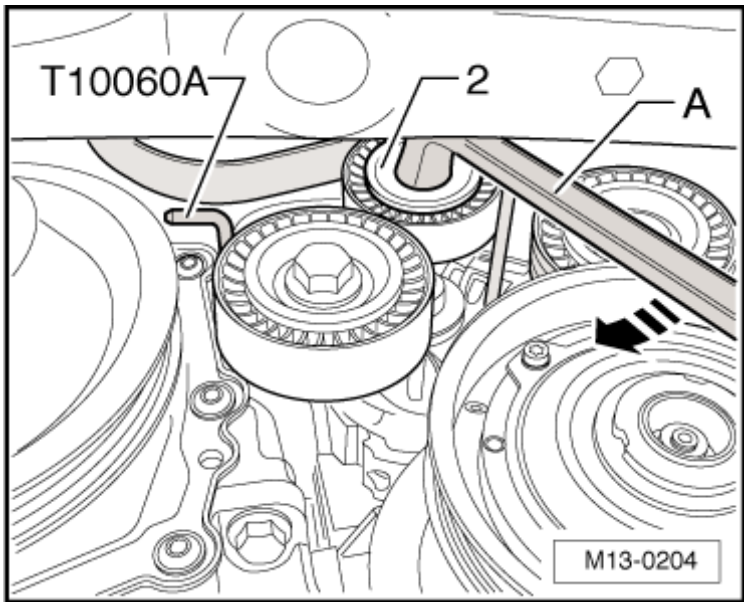

Fig. 101: Engine Code BHW, Components Of Lubrication System (Part 2)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Oil pressure switch -F1-, 20 Nm

- 0.7 bar switch: brown
- If sealing ring is leaking cut open and replace.
- Checking --> **Oil pressure and oil pressure switch, checking**

2 - Seal

- Replace

3 - 15 Nm plus an additional $^{1}/_{4}$ turn (90°)

- Replace
- First, fasten upper left and lower right bolts, and then tighten all four bolts in a diagonal sequence

4 - Oil filter bracket

5 - Oil seal

- Replace

6 - Oil supply line

- To turbocharger
- Removing and installing --> **Oil supply line, assembly overview**

7 - Banjo bolt, 20 Nm

8 - Cap, 25 Nm

- Loosen and tighten with oil filter wrench 3417

9 - O-ring

- Replace

10 - Oil filter element

- Note installed position: oben = top

11 - Oil cooler

- Ensure sufficient clearance to surrounding components
- Read note --> **Components of lubrication system**

12 - Locking bolt, 25 Nm

13 - Seal

- Replace

14 - Seal

- Replace
- Snaps into tabs of oil cooler

15 - Locking bolt, 10 Nm

- If sealing ring is leaking cut open and replace.

16 - Locking bolt

- For pressure relief valve
- Do not loosen

Oil pump, removing and installing

Engine code BHW

Special tools, testers and auxiliary items required

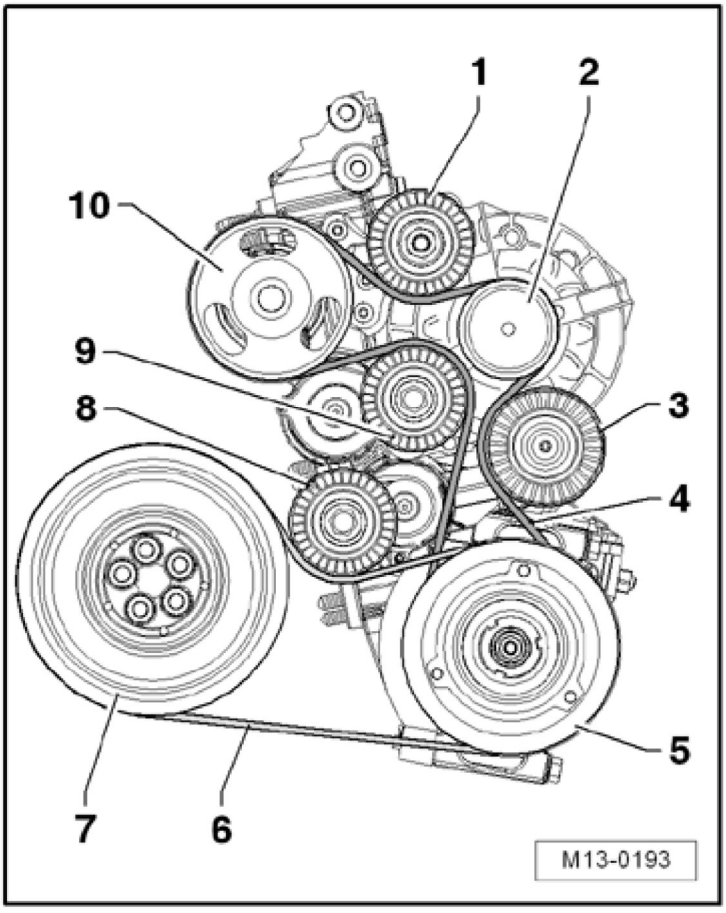

Fig. 102: Torque Wrench V.A.G 1331
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Torque wrench (5 to 50 Nm) V.A.G 1331
- Wrench (diameter 3 mm)

Removing

- Set engine cylinder 1 to TDC --> **Toothed belt, removing, installing and tensioning**
- Remove toothed belt --> **Toothed belt, removing, installing and tensioning** .
- Drain engine oil.
- Remove oil pan --> **Oil pan, removing and installing** .
- Remove sealing flange --> **Sealing flange - belt pulley side, removing and installing** .

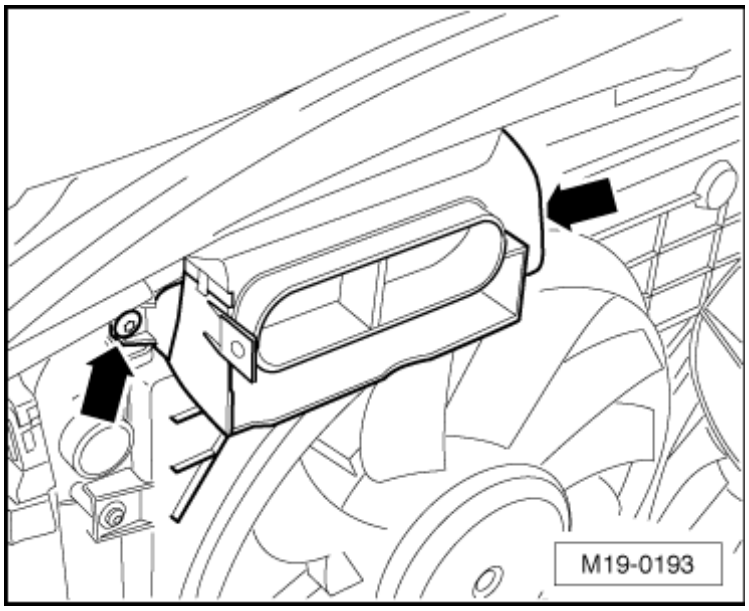

Fig. 103: Identifying Cover And Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

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

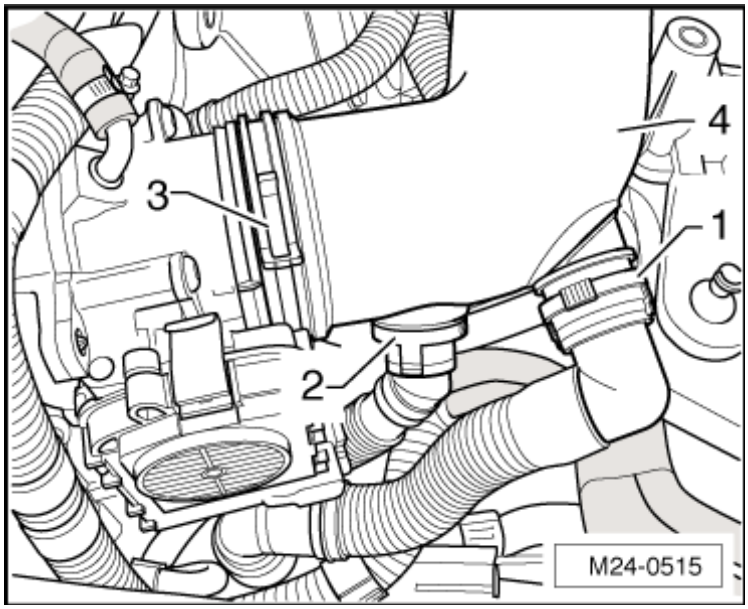

Fig. 104: Removing/Installing Chain Tensioner
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- With a screwdriver, carefully press center of tensioning rail indirection of - **arrow** - and fix chain tensioner in place as shown using a wrench (diameter 3mm) - **1** -.
- Remove bolts - **2** - for chain tensioner.
- Remove bolts - **3** -.
- Remove chain tensioner.

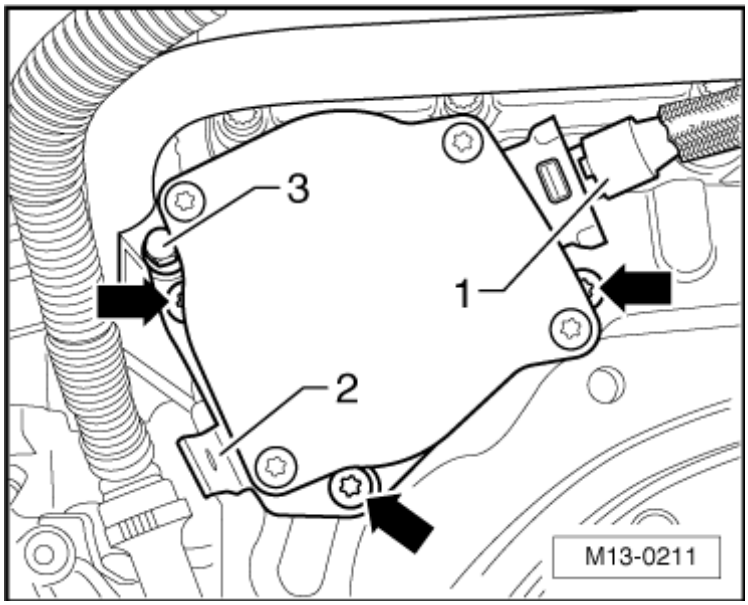

Fig. 105: Identifying Securing Ring
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove securing ring - **1** -.

- Pull out shaft - **2** - from oil pump housing.
- Remove suction line from oil pump.

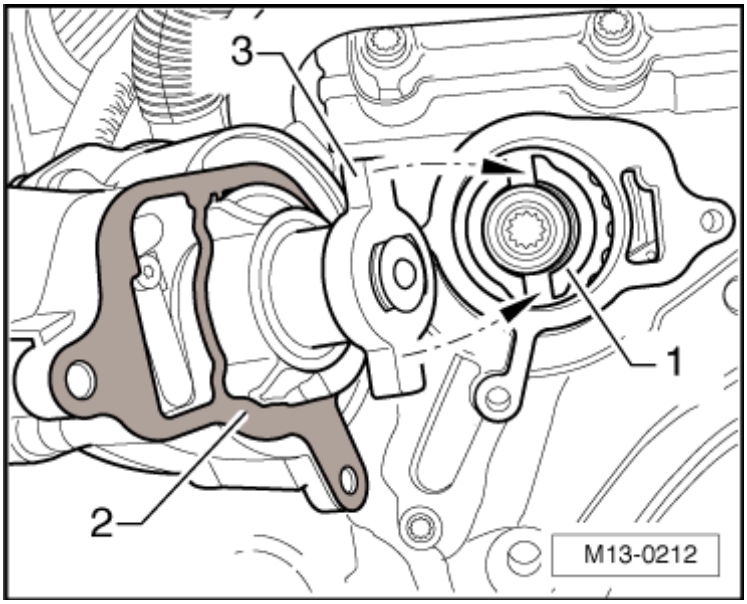

Fig. 106: Removing/Installing Oil Pump
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** - for oil pump and remove oil pump downward.

Installing

NOTE:

- **Before installing, verify that the assembly sleeves are present in the balance shaft module.**

- Install oil pump and fasten bolts - **arrows** - with applicable torque:

M6 = 10 Nm

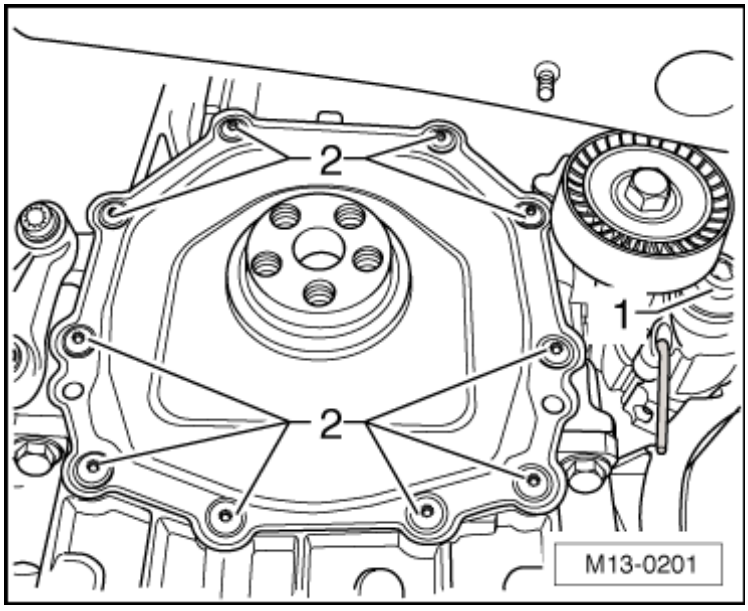

Fig. 107: Removing/Installing Oil Pump
Courtesy of VOLKSWAGEN UNITED STATES, INC.

M7 = 13 Nm plus an additional $^{1}/_{4}$ turn (90°) (replace).

- Install suction line and tighten bolt to 10 Nm.
- Install chain tensioner.

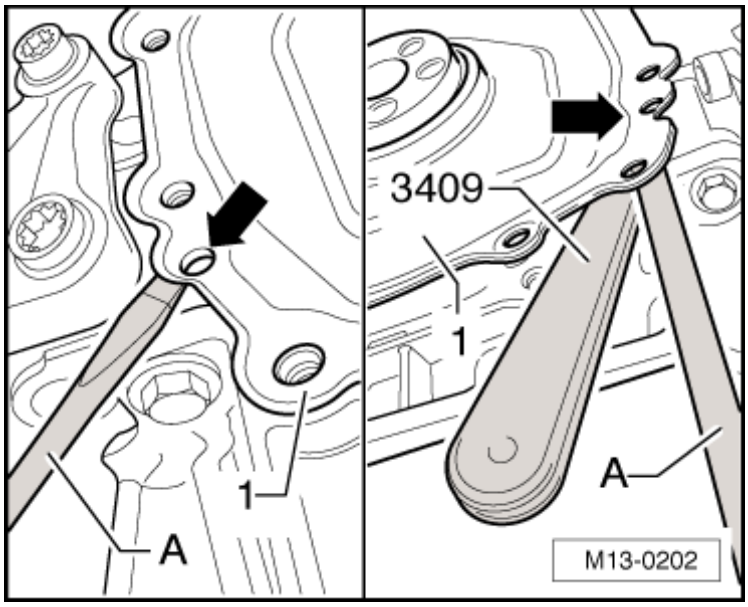

Fig. 108: Removing/Installing Chain Tensioner
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- First, tighten bolt - **3** - to 20 Nm and then bolt - **2** - to 10 Nm.
- Pull out wrench - **1** - out from chain tensioner.

- Install cover and fasten to 8 Nm.
- Install sealing flange --> **Sealing flange - belt pulley side, removing and installing** .

- Install oil pan --> **Oil pan, removing and installing** .
- Install toothed belt --> **Toothed belt, removing, installing and tensioning** .

Balance shaft module, removing and installing

Engine code BHW

Special tools, testers and auxiliary items required

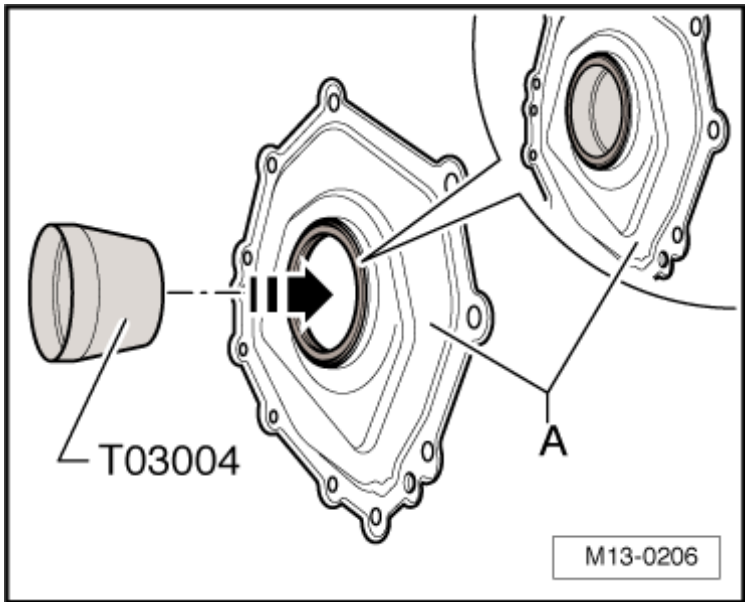

Fig. 109: Torque Wrench V.A.G 1331
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Torque wrench (5 to 50 Nm) V.A.G 1331
- Locking tool T10255
- Wrench (diameter 3mm)

Removing

- Set engine cylinder 1 to TDC --> **Toothed belt, removing, installing and tensioning** , Toothed belt, removing, installing and tensioning
- Remove toothed belt --> **Toothed belt, removing, installing and tensioning** .
- Drain engine oil.
- Remove oil pan --> **Oil pan, removing and installing** .

- Remove sealing flange --> **Sealing flange - belt pulley side, removing and installing** .

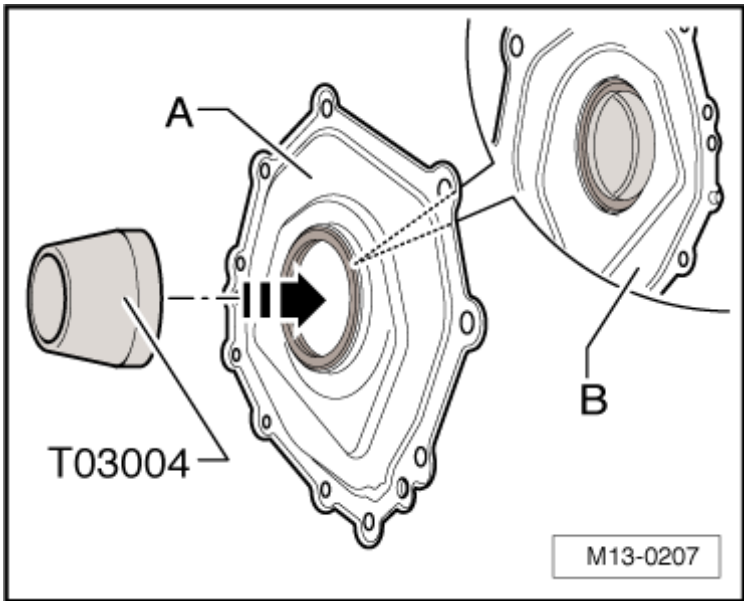

Fig. 110: Securing Balance Shaft Using Locking Tool T10255
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Secure balance shaft using Locking tool T10255.

NOTE:

- **The locking tool T10255 must engage the groove in the balance shaft - 1 -.**

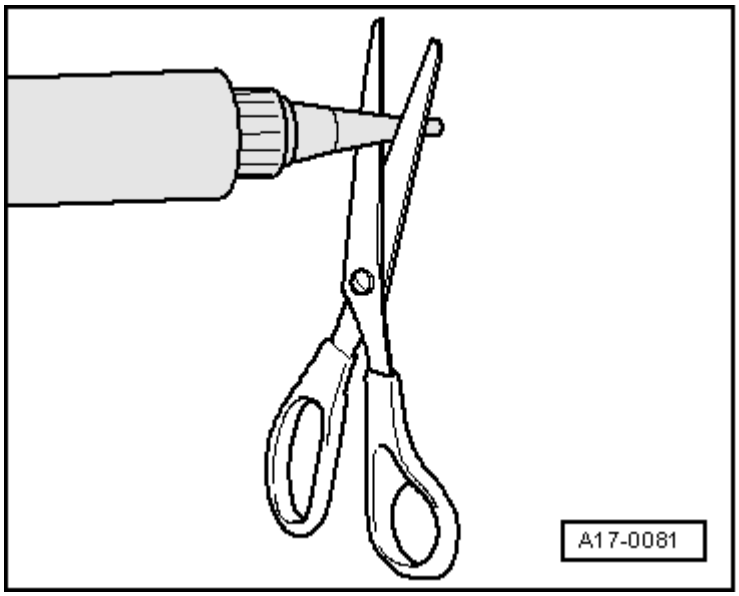

Fig. 111: Identifying Cover And Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

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

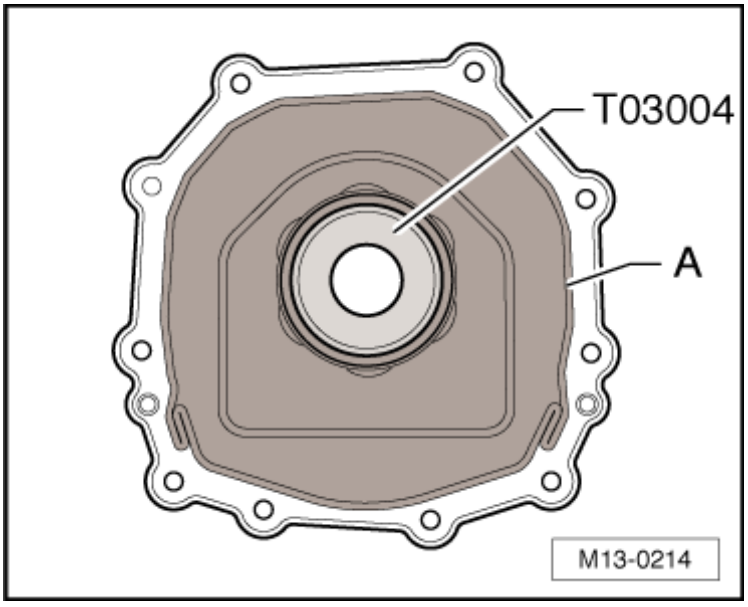

Fig. 112: Removing/Installing Chain Tensioner
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- With a screwdriver, carefully press center of tensioning rail in - **direction of arrow** - and fix chain tensioner in place as shown using a wrench (diameter 3mm) - **1** -.
- Remove bolts - **2** - for chain tensioner.
- Remove bolts - **3** -.
- Remove chain tensioner.

- Mark running direction of chain with a water-proof marker.

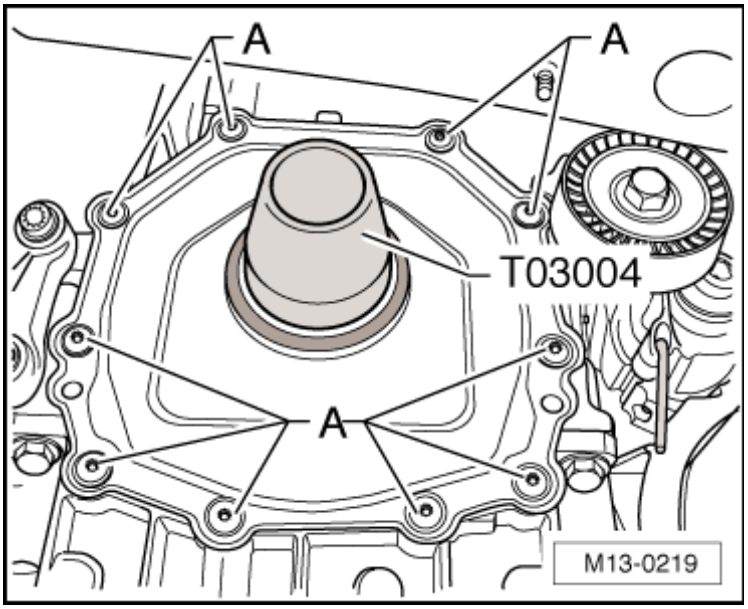

Fig. 113: Removing Balance Shaft Module Chain Sprocket
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen bolts - **arrows** - of chain sprocket and remove chain sprocket together with chain.

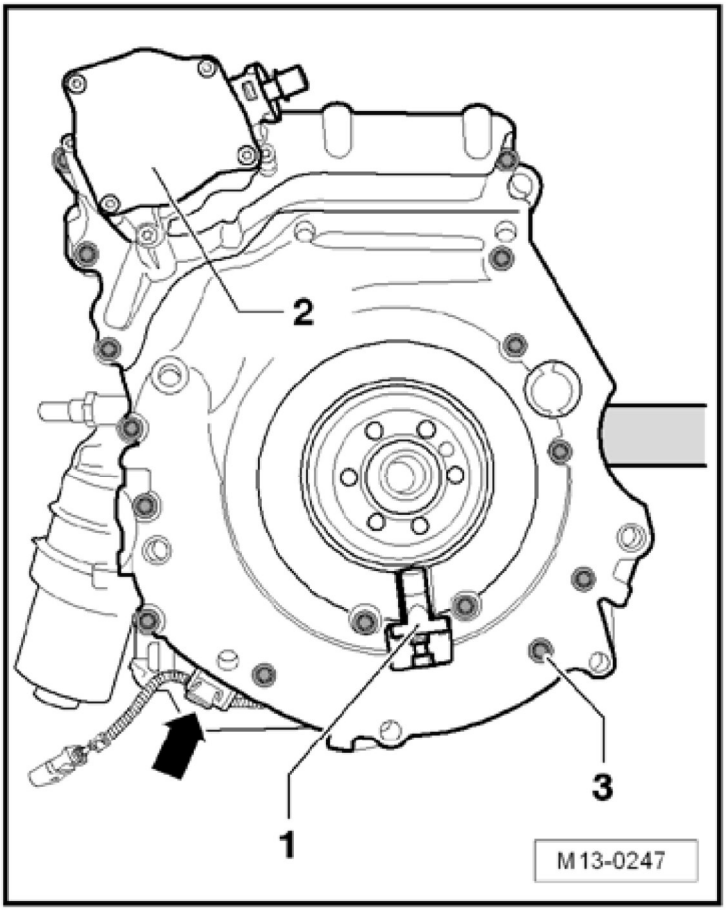

Fig. 114: Removing Balance Shaft Module
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove balance shaft module. When doing this, unscrew bolts - **arrows** - from outside toward inside in a diagonal sequence.

Installing

Conditions

- Engine cylinder 1 is at TDC.
- Balance shaft is secured with locking tool T10255.

NOTE:

- **Before installing, verify that the assembly sleeves are present in the balance shaft module.**

- Install balance shaft module and tighten bolts to 8 Nm.
- Then, fasten bolts in following sequence to applicable torque specification.

M7 = 13 Nm plus an additional $^{1}/_{4}$ turn (90°)

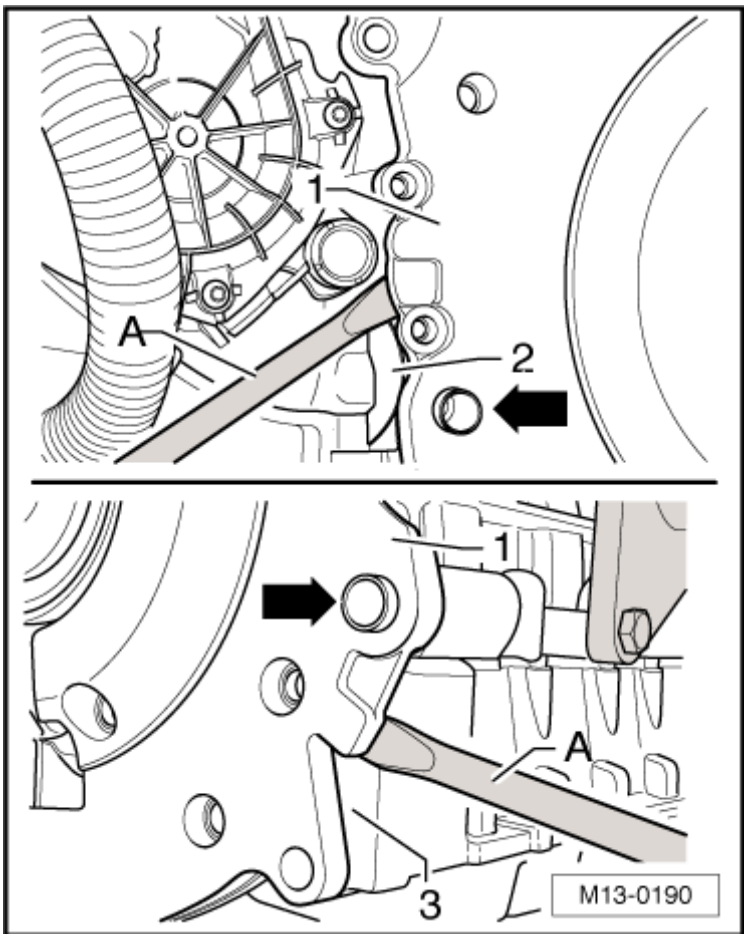

Fig. 115: Tightening Balance Shaft Module In Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

M8 = 20 Nm plus an additional $^{1}/_{4}$ turn (90°)

- Place chain on crankshaft chain sprocket.
- Place chain sprocket into chain.
- Place chain tensioner with chain onto shaft so that bolt holes of shaft are located in middle of slots of chain sprocket.
- Tighten new bolts by hand. Unscrew bolts in mating area by approx. 1 turn.

- Install chain tensioner.

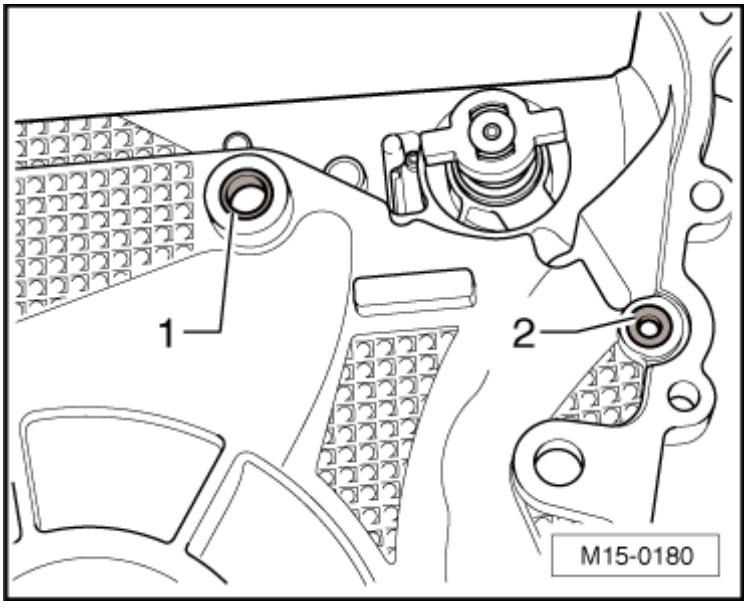

Fig. 116: Removing/Installing Chain Tensioner
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tighten bolt - **3** - to 20 Nm and then bolt - **2** - to 10 Nm.
- Pull out wrench - **1** - from chain tensioner.
- Fasten bolts for chain tensioner. Tightening torque: 10 Nm plus an additional $^{1}/_{4}$ turn (90°)
- Install cover and fasten it to 8 Nm.

- Remove locking tool.
- Install sealing flange --> **Sealing flange - belt pulley side, removing and installing** .
- Install oil pan --> **Oil pan, removing and installing** .
- Toothed belt, installing --> **Toothed belt, removing, installing and tensioning** .

Oil supply line, assembly overview

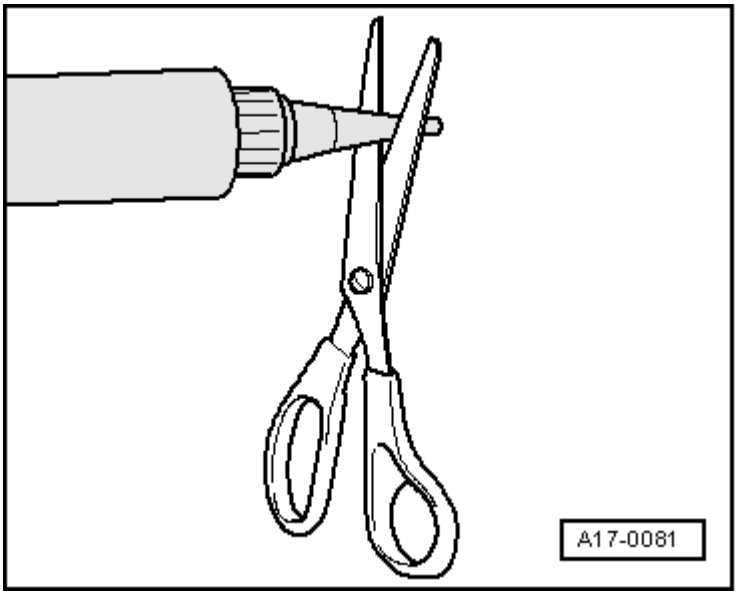

Fig. 117: Oil Supply Line, Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Oil supply line

- To turbocharger
- **Removing**
- **Installing**

2 - Union nut, 22 Nm

- When loosening and tightening, counterhold connection

3 - Oil seal

- Replace

4 - Banjo bolt, 25 Nm

5 - Clamp

6 - 10 Nm

7 - Bracket

8 - 25 Nm

- Replace

9 - 10 Nm

10 - 10 Nm

Removing oil supply line

Special tools, testers and auxiliary items required

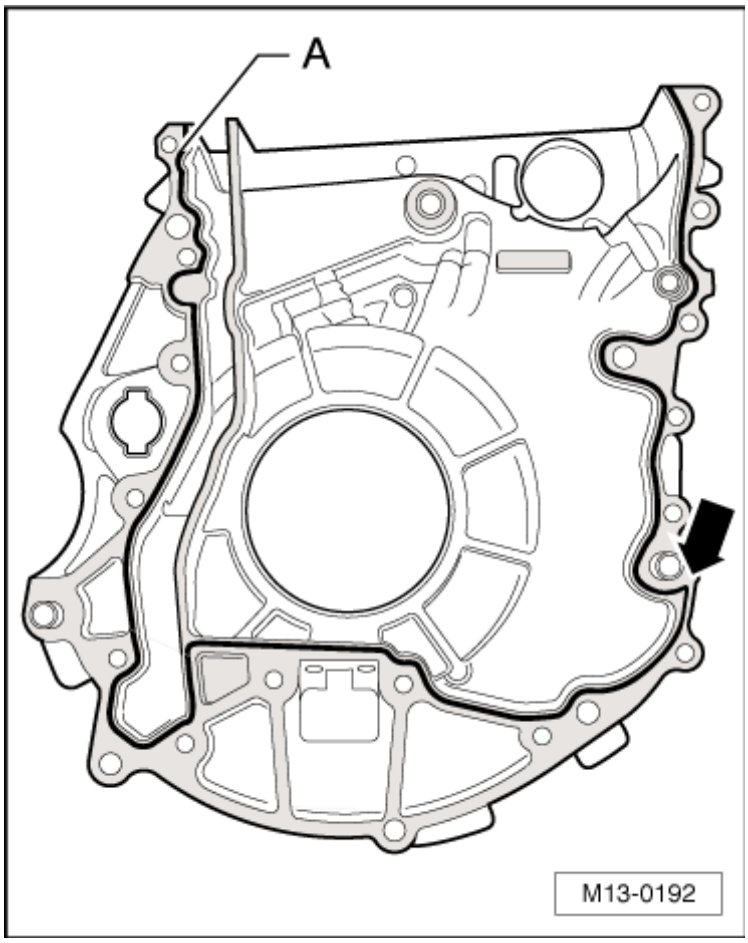

Fig. 118: Torque Wrench V.A.G 1331
Courtesy of VOLKSWAGEN UNITED STATES, INC.

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

- Remove sound insulation pan: --> **50 BODY, FRONT**
- Place drip tray V.A.G 1306 under vehicle.
- Remove air filter housing --> **Air filter, assembly overview**
- Remove union nut - **2** - and banjo bolt - **4** - on oil filter bracket.

- Remove bolt - **6** -.
- Remove union nut - **2** - at turbocharger.
- Remove bolt - **9** - and bracket - **7** -.
- Remove nut - **8** - and take out bracket - **7** -.

- Remove oil supply line - **1** -.

Installing oil supply line

CAUTION: The installation of the oil supply line must be performed exactly as described in the following sequence.

- Loosely attach bracket - **7** - with nut - **8** - to exhaust manifold.
- Install union nut - **2** - and banjo bolt - **4** - hand-tight to oil filter bracket.
- Install union nut - **2** - hand-tight to turbocharger.
- Fasten union nut and banjo bolt to oil filter bracket with 22 Nm.
- Fasten union nut to turbocharger with 22 Nm.
- Position clamps - **5** - on oil supply line and fasten bolts to 10 Nm.
- Tighten nut - **8** - to 25 Nm.

Oil pan, removing and installing

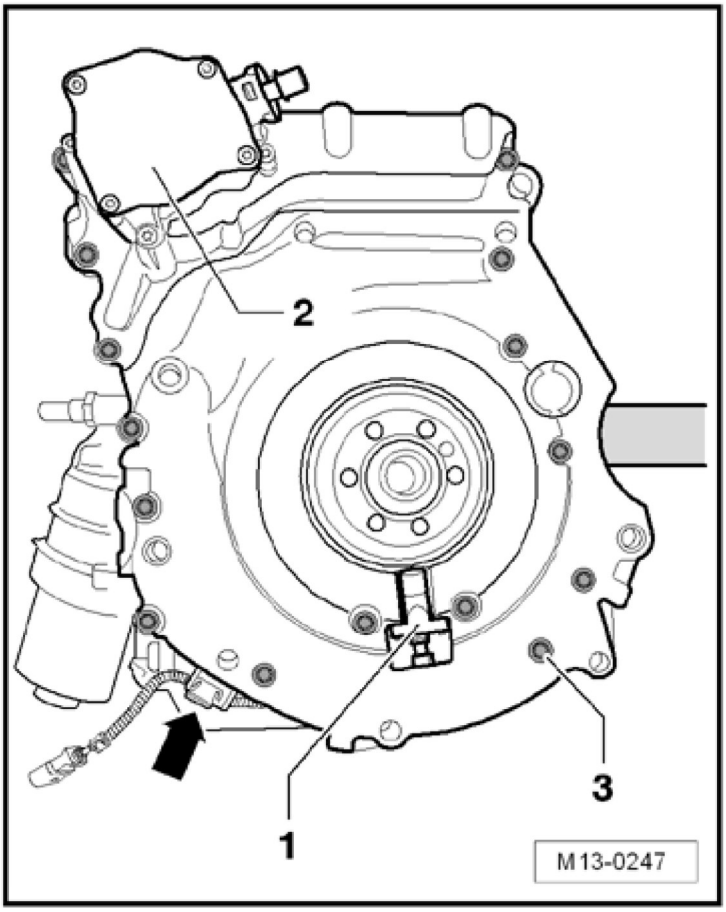

Fig. 119: Identifying Special Tools - Oil Pan, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Engine support bridge 10-222A
- Shop crane V.A.G 1202 A
- Torque wrench (5 to 50 Nm) V.A.G 1331
- Hex ball socket T10058

Not illustrated:

Special tools, testers and auxiliary items required

- Hand drill with plastic brush attachment
- *Silicone sealant D 176 404 A2*
- Flat scraper
- Protective glasses

Removing

- Bring lock carrier into service position: --> **50 BODY, FRONT**
- Drain engine oil.

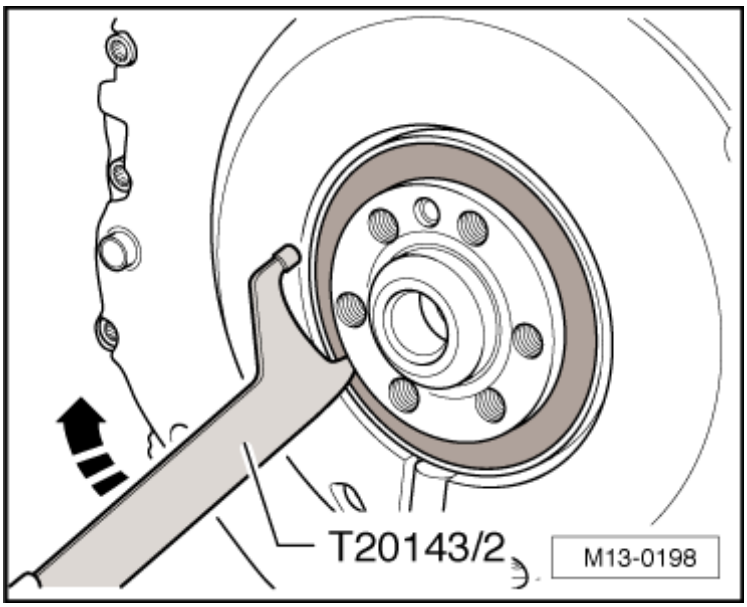

Fig. 120: Starter Wiring Bracket Cable Ties
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Cut through cable ties - **arrows** - , open starter harness retainer and take harness off.

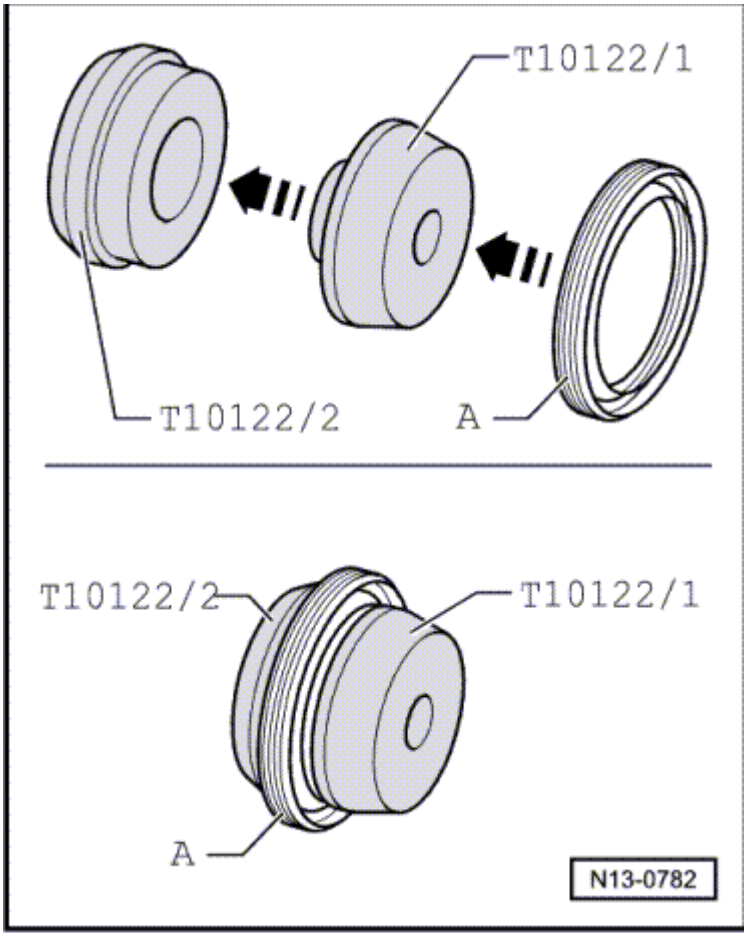

Fig. 121: Identifying Limit Stop
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove limit stop - **1** - - **arrows** -.

Vehicles with automatic transmission

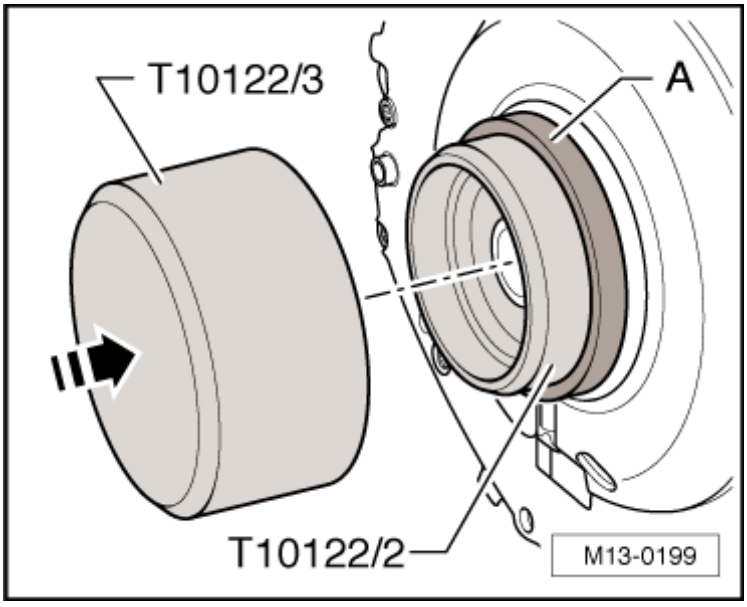

Fig. 122: ATF Line Bracket
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** - from ATF line bracket - **1** - on oil pan.

Continued for all vehicles

- If equipped, disconnect connect connector from Oil Level Thermal Sensor -G266-.

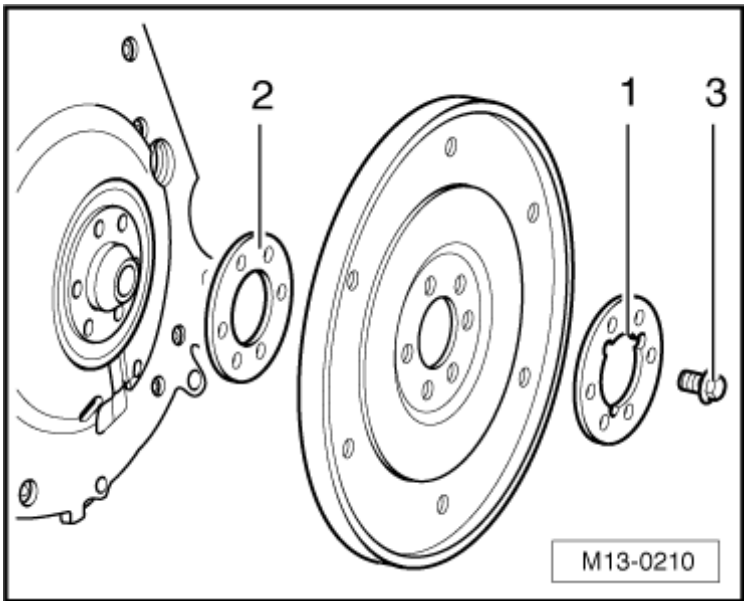

Fig. 123: Threaded Connections And Positioning Sleeves On Lower Engine Mounts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Mark installed position of threaded connections - **1** - and locating sleeves - **2** - on lower left and right engine mounts.

- Remove both lower engine mounts.
- Remove Motor for intake flap -V157-.

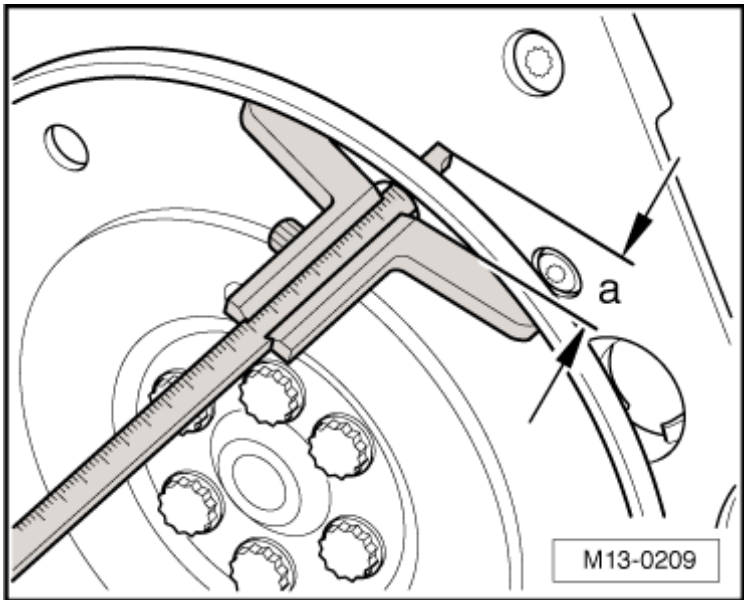

Fig. 124: Engine Support Bridge 10-222A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Set engine support bridge 10-222A in place as shown and connect to engine in installed position.
- Lightly tension engine with spindles of engine support bridge.

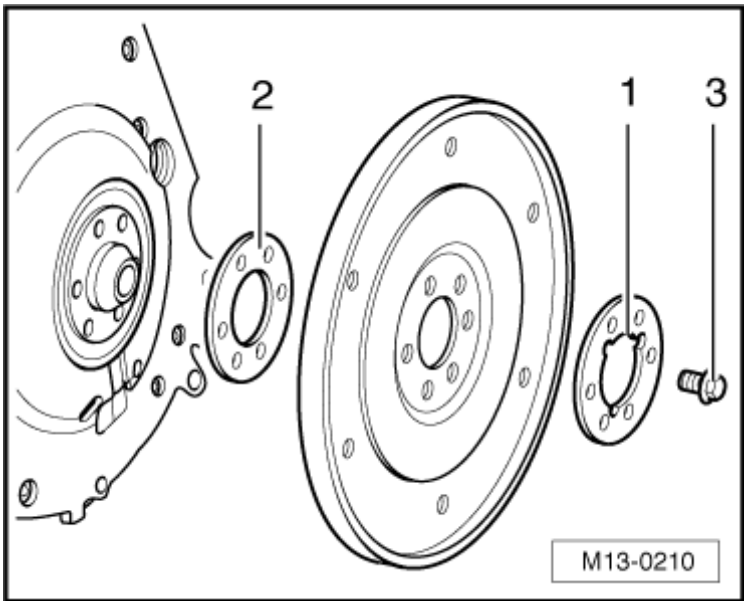

Fig. 125: Subframe Supported Using Workshop Crane V.A.G 1202 A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Support subframe with workshop crane V.A.G 1202 A.

NOTE:

- **To avoid having to perform a wheel alignment, the subframe must only be loosened or lowered at the front end.**

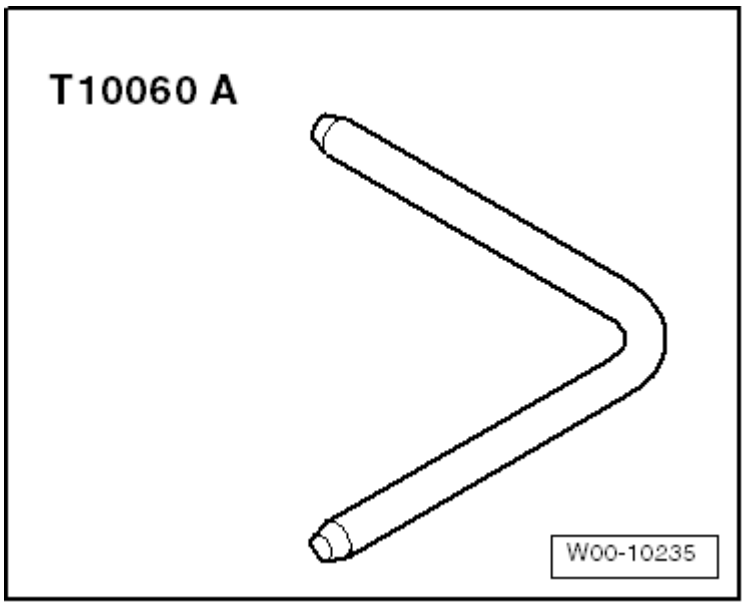

Fig. 126: Front Bolts At Left And Right Sides Of Subframe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove front bolts - **2** - and - **3** - from left and right sides of subframe. Then remove bolts - **4** -.

Vehicles with manual transmission

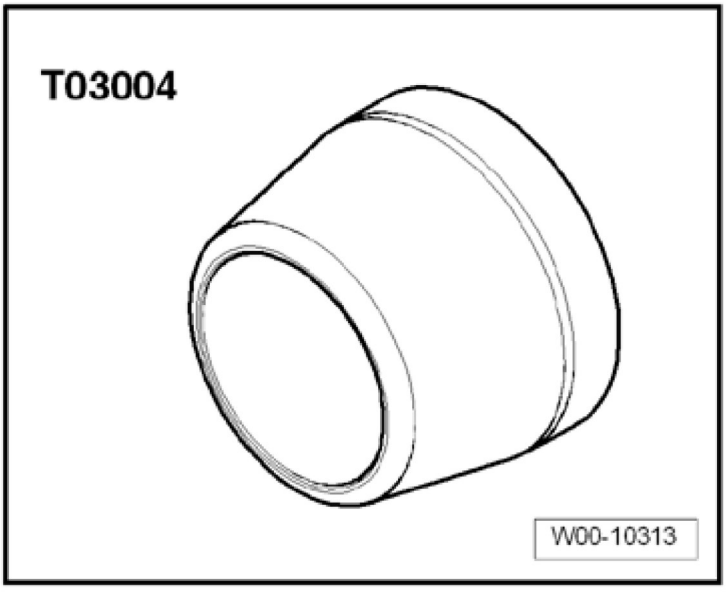

Fig. 127: Left Transmission Mount Nut
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen left transmission mount nut - **arrow** - until it is aligned with lower edge of bolt (approx. 4 turns).

Vehicles with automatic transmission

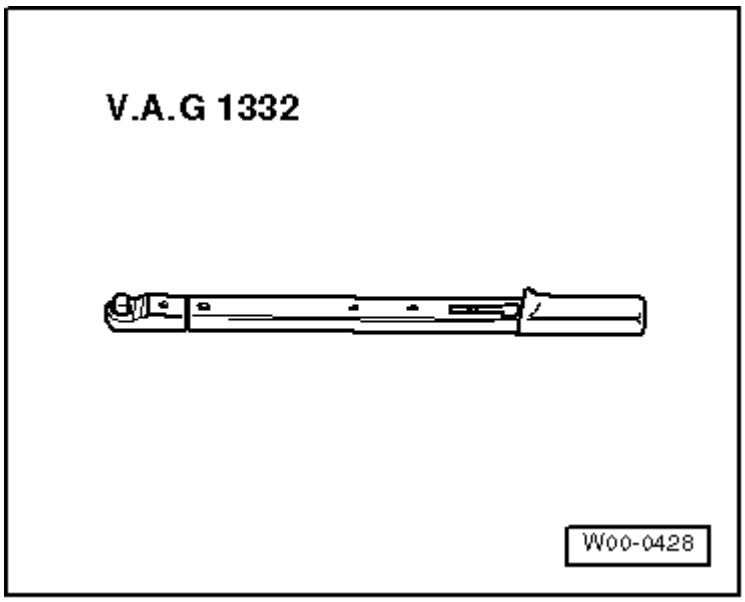

Fig. 128: Identifying Bolt Removal Sequence For Left Transmission Mount
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unscrew rear bolt - **2** - for left transmission mount several turns and remove front bolt - **1** - for left transmission mount.

Continued for all vehicles

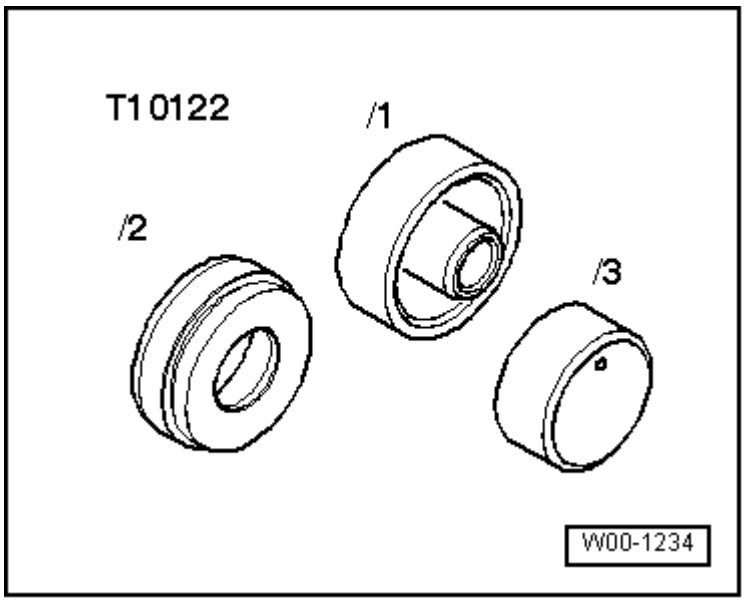

Fig. 129: Right Transmission Mount Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unscrew rear bolt - **2** - for right transmission mount several turns and remove front bolt - **1** - for right transmission mount.

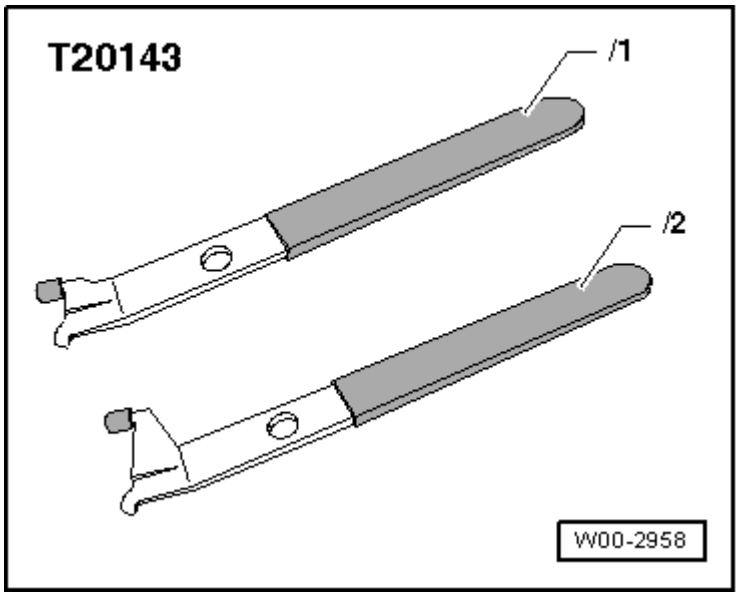

Fig. 130: Subframe Supported Using Workshop Crane V.A.G 1202 A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Slowly lower subframe with workshop crane.
- Roll out workshop crane, and swing stabilizer bar downward.

NOTE:

- **To loosen and tighten both rear oil pan bolts use the hex ball socket T0058.**

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

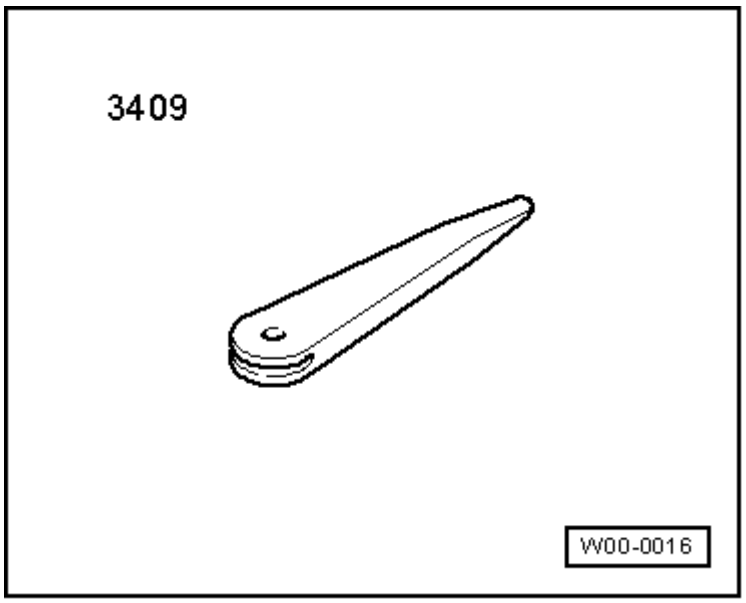

Fig. 131: Removing Sealant Residue From Oil Pan With A Rotating Brush
Courtesy of VOLKSWAGEN UNITED STATES, INC.

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

Installing

NOTE:

- **When installing the oil pan on a removed engine, make sure that the flywheel end of the oil pan is aligned flush with the intermediate plate, therefore the oil pan must extend beyond the cylinder block by 0.8 mm.**
- **When installing the oil pan on an installed engine, the oil pan must be flush with the transmission flange.**
- **Note the expiration date of the sealing compound.**
- **The oil pan must be installed within 5 minutes after application of the silicone sealant.**

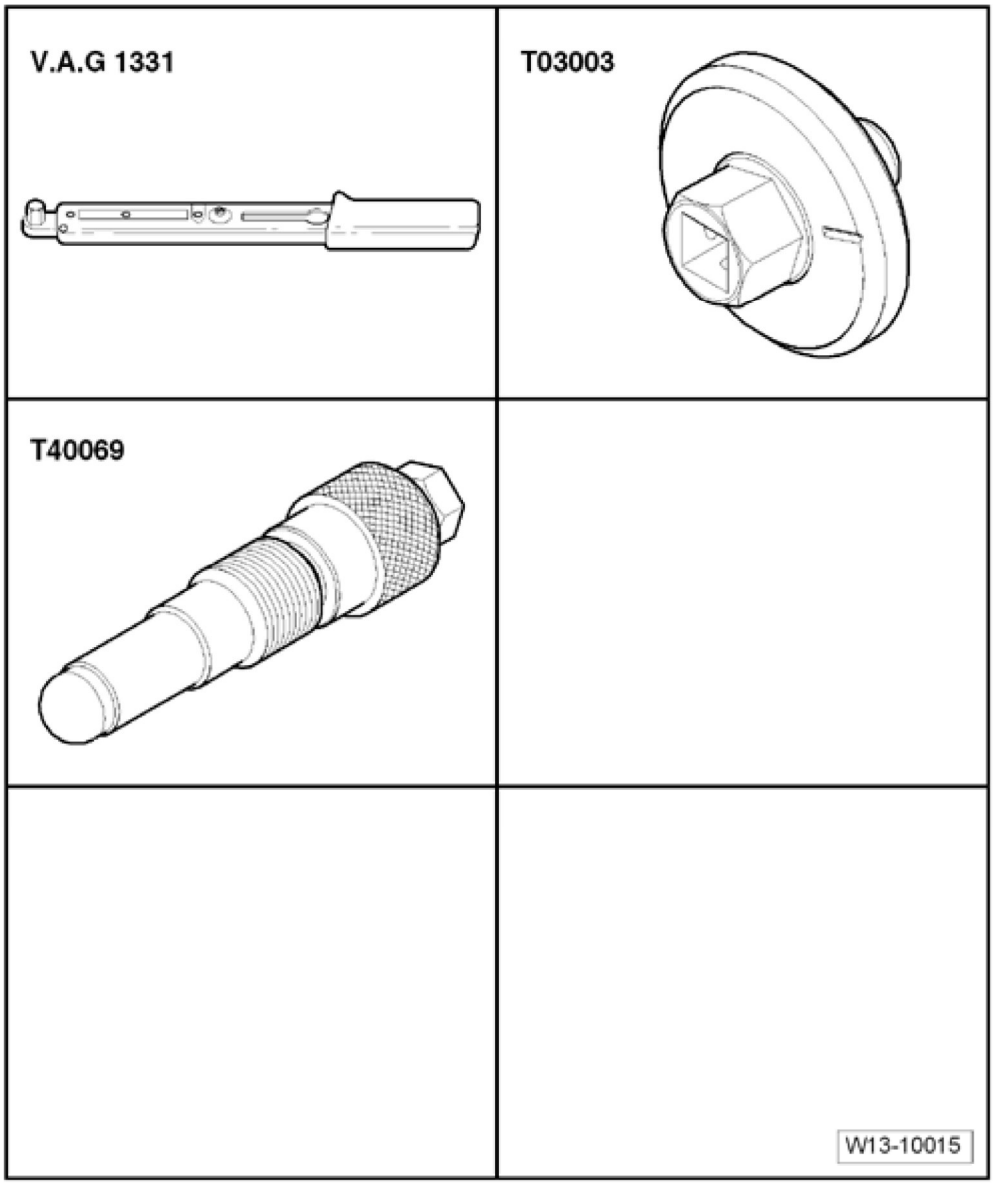

Fig. 132: Applying Sealant To Clean Sealing Surface
Courtesy of VOLKSWAGEN UNITED STATES, INC.

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

- 2...3 mm thick.
- Run around inside of bolt holes - **arrows** -.

NOTE:

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

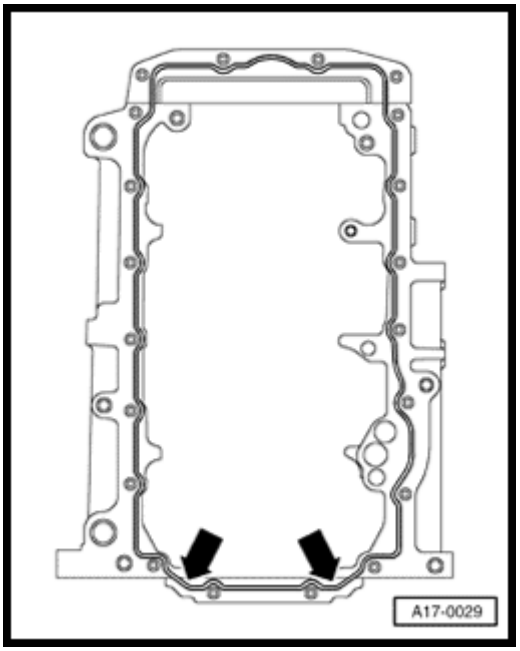

Fig. 133: Identifying Clean Sealing Surfaces To Apply Silicon Sealant
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Apply silicone sealing compound bead as illustrated to clean sealing surface of cylinder block. (The ill. shows the location of the sealant bead on the cylinder block.)
- Before installing oil pan, insert bolts M10 at a right angle into oil pan.
- Install oil pan immediately and tighten all oil pan bolts lightly.
- Lightly fasten oil pan/transmission bolts.

- Tighten oil pan bolts in a diagonal sequence to 15 Nm.
- Tighten M10 bolts for oil pan/cylinder block to 40 Nm.
- Tighten bolts for oil pan/transmission to 45 Nm.

NOTE:

- **After installing oil pan, allow sealant to dry for approx. 30 minutes. Only after this time may the engine be filled with oil.**

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

Oil pressure and oil pressure switch, checking

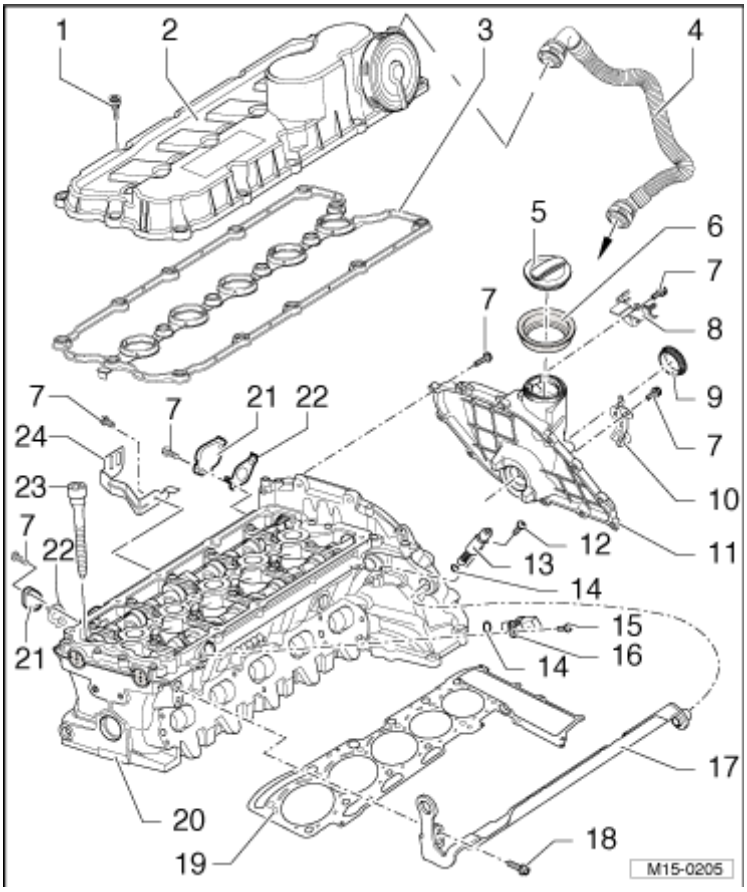

Fig. 134: Identifying Special Tools - Oil Pressure And Oil Pressure Switch, Checking
Courtesy of VOLKSWAGEN UNITED STATES, INC.

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 A

Conditions

- Engine oil level OK, checking.
- Engine oil temperature at least 80°C (coolant fan must have run once).

Work sequence

NOTE:

- **Function test and servicing the optical and acoustic oil pressure indicator: Electrical Wiring Diagrams, Troubleshooting Component Locations, Guided Fault Finding with VAS 5051**

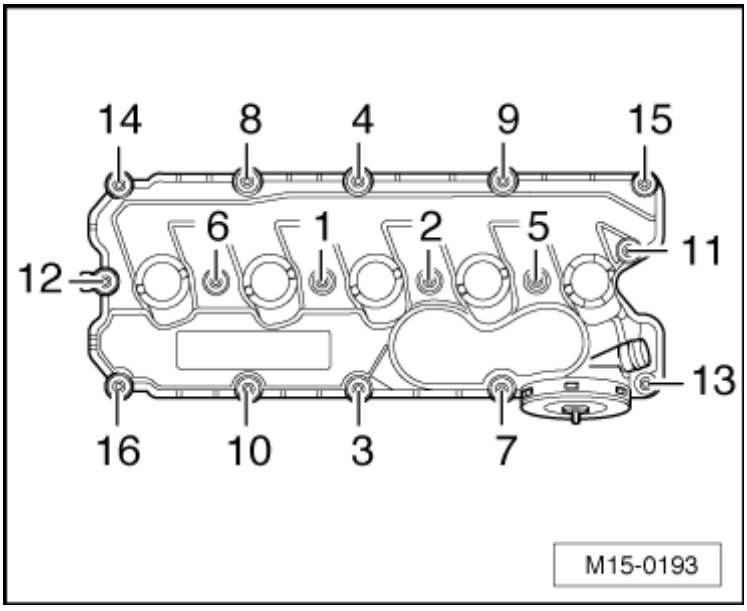

Fig. 135: Identifying Oil Pressure Tester V.A.G 1342
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove Oil pressure switch -F1- and screw into tester.
- Screw test device on in place of oil pressure switch in oil filter bracket.
- Connect brown lead of test device to Ground (-).
- Connect Voltage tester V.A.G 1527 B using adapter cables from Connector test kit V.A.G 1594 A to B+ and oil pressure switch. LED must not light up.
- Start engine and slowly increase engine speed.

LED must light up at 0.55 to 0.85 bar positive pressure.

If LED does not light up at specified pressure:

- Replace oil pressure switch.
- Increase engine speed further. At 2000 RPM and an oil temperature of 80°C, oil pressure must be at least 2.0 bar.

At higher RPMs, the oil pressure must not exceed 7.0 bar. If necessary, replace oil filter bracket.

19 COOLING SYSTEM

COOLING SYSTEM COMPONENTS, REMOVING AND INSTALLING

Cooling system components, removing and installing

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

- **Route all the various lines (e.g. for fuel, hydraulics, EVAP system, coolant, refrigerant, brake fluid and vacuum lines and hoses) and electrical wiring so that the original positions are restored.**
- **Ensure sufficient clearance to all moving or hot components.**

NOTE:

- **When the engine is warm the cooling system is under pressure. If necessary release pressure before beginning repair work.**
- **Hoses are secured with spring-type clips. In cases of repair only use spring-type clips.**

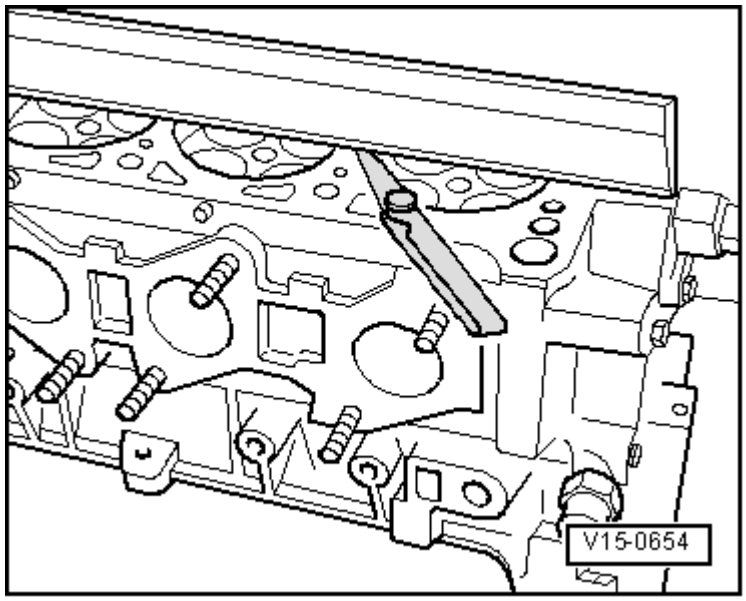

Fig. 136: Spring-Type Clip Pliers VAS 5024A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- **The spring-type clip pliers VAS 5024A are recommended for installing spring-type clips.**
- **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 leak test of cooling system using cooling system tester V.A.G 1274, adapter V.A.G 1274/8 and adapter V.A.G 1274/9.

Cooling system components, body side --> **Cooling system components, body side** .

Cooling system components, engine side --> **Cooling system components, engine side** .

Draining and filling with coolant --> **Cooling system, draining and filling** .

Coolant mixture ratios --> **Cooling system, draining and filling**

Cooling system components, body side

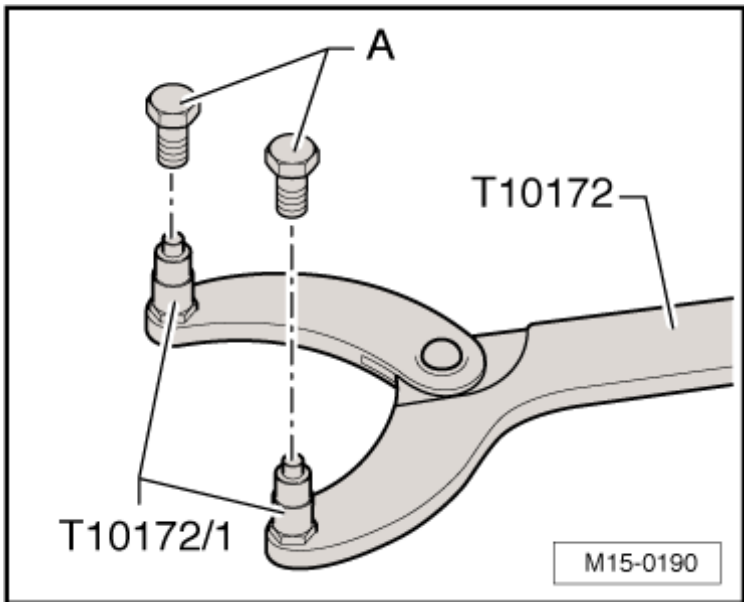

Fig. 137: Cooling System Components, Body Side
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Sealing lip

- For upper radiator

2 - Securing pin

3 - Securing rubber

4 - Upper coolant hose

- Secured to radiator with a retaining clip
- Ensure seated tightly

5 - Rubber washer

6 - Coolant fan -V7-

7 - Bolt

8 - Fan ring

- Is clipped into intake air elbow and secured with bolt

9 - 10 Nm

10 - Cap

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

11 - O-ring

- Replace if damaged

12 - 3 Nm

13 - Reservoir

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

14 - Coolant hose

15 - O-ring

- Check for secure seat
- Replace if damaged

16 - Lower coolant hose

- Secured to radiator and thermostat housing with a retaining clip
- Ensure seated tightly

17 - Retaining clip

- Check for secure seat

18 - O-ring

- Replace if damaged

19 - Coolant Fan Control (FC) thermal switch -F18-

- For electric fan
- Only vehicles with optional equipment
- Switch temperatures: 1. Speed on: 92 to 97°C, off: 84 to 91°C; 2. Speed on: 99 to 105°C, off: 91 to 98°C

20 - Connector

- For Coolant Fan Control (FC) thermal switch

21 - Locking bolt, 10 Nm

22 - Sealing lip

- For bottom of radiator

23 - Drain plug

- Cooling system, draining and filling --> **Cooling system, draining and filling**

Cooling system components, engine side

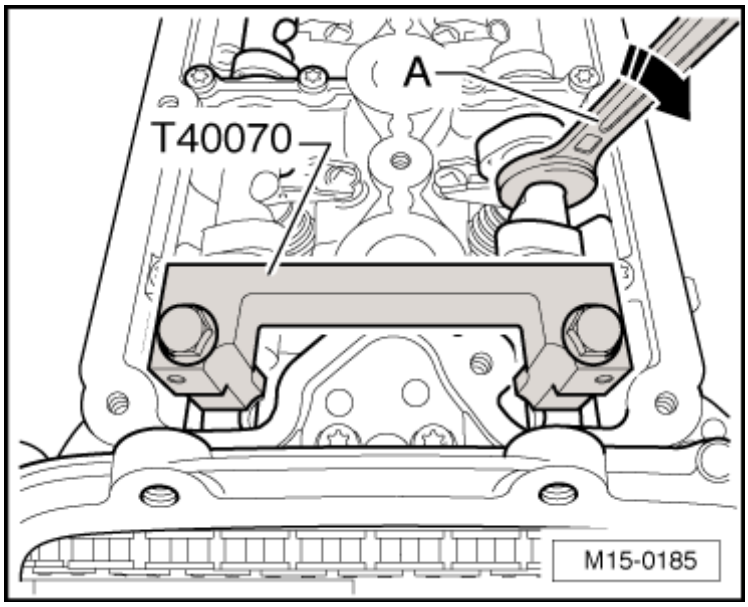

Fig. 138: Cooling System Components, Engine Side
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - To upper radiator

2 - Upper coolant line

3 - Coolant hose

4 - O-ring

- Check for secure seat
- Replace

5 - Coolant hose

6 - Engine Coolant Temperature (ECT) sensor -G62-

- With Engine Coolant Temperature (ECT) sensor -G2-

7 - Retaining clip

- Check for secure seat

8 - O-ring

- Replace

9 - 10 Nm

10 - Connecting piece

- Only vehicles with optional equipment
- With glow plugs for coolant

11 - Coolant hose

- To heat exchanger
- Secured to connections with retaining clip
- Ensure seated tightly

12 - Connecting piece

13 - Coolant hose

- From heat exchanger
- Secured to lower coolant pipe with retaining clip
- Ensure seated tightly

14 - Lower coolant line

15 - 15 Nm

16 - Coolant hose

- Secured to radiator and thermostat housing with a retaining clip
- Ensure seated tightly

17 - Connecting piece

- For thermostat

18 - Coolant thermostat

- Removing and installing --> **Coolant thermostat, removing and installing**
- Observe installed location --> **Coolant thermostat, removing and installing** , Coolant thermostat, removing and installing
- Checking: Heat up thermostat in water
- Opening begins: approx. 85°C
- Ends: approx. 105°C
- Opening lift: min. 7 mm

19 - 40 Nm

20 - Oil cooler

21 - Fan wheel

- For viscous fan clutch
- Viscous fan clutch, removing and installing --> **Viscous fan clutch, removing and installing**

22 - 15 Nm

23 - Coolant pump

- Check for ease of movement
- Note installation position
- Removing and installing --> **Coolant pump, removing and installing**

24 - 25 Nm

Cooling system, draining and filling

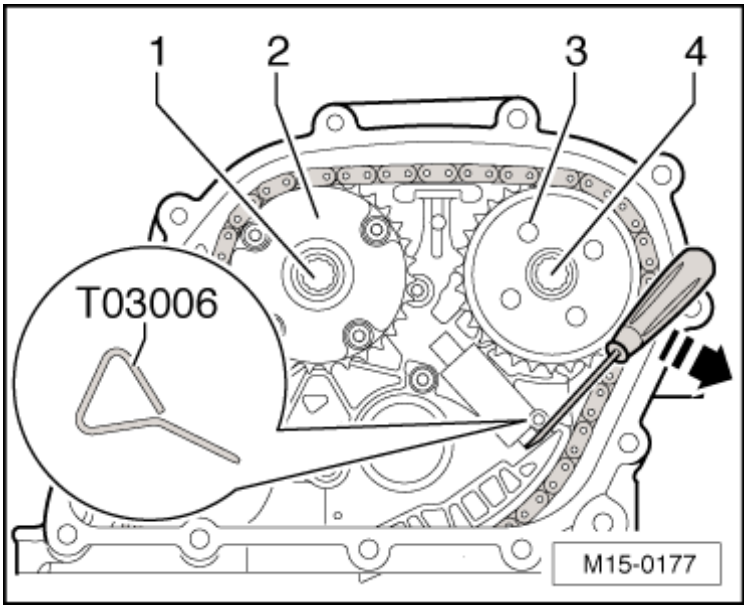

Fig. 139: Identifying Special Tools - Cooling System, Servicing, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Refractometer T10007
- Drip tray V.A.G 1306
- Spring-type clip pliers VAS 5024A
- Cooling system charge unit VAS 6096
- Adapter V.A.G 1274/8
- Torque wrench (5 to 50 Nm) V.A.G 1331

Special tools, testers and auxiliary items required

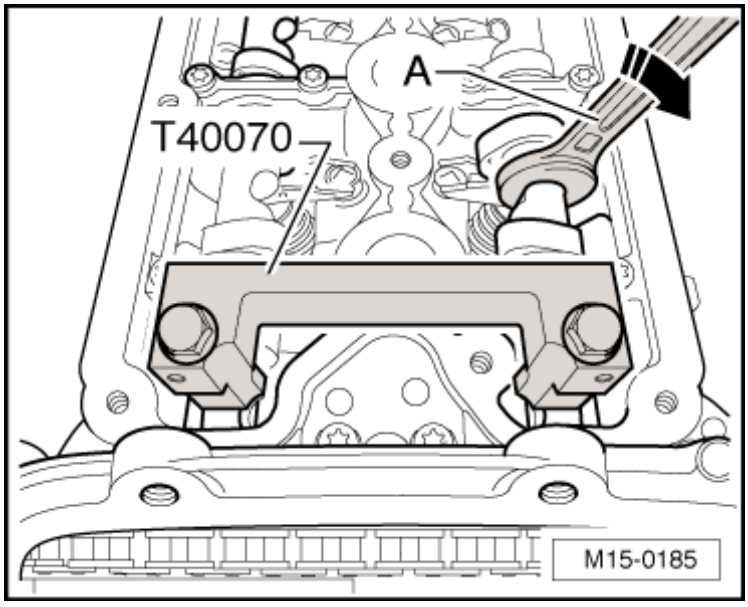

Fig. 140: Adapter V.A.G 1274/10
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Adapter V.A.G 1274/10

Draining

CAUTION: When opening the expansion tank, hot steam may be released. Cover the cap with a rag and open very carefully.

- Open cap on coolant expansion tank.
- Remove sound insulation pan: --> **50 BODY, FRONT**

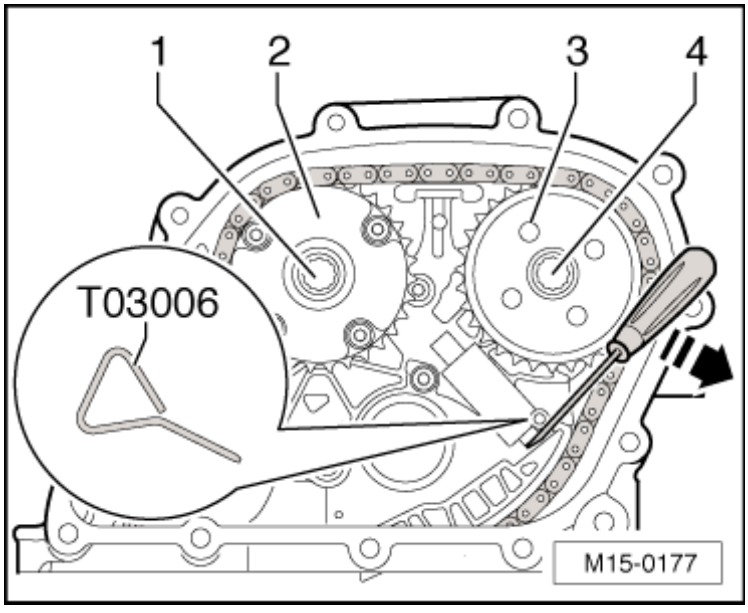

Fig. 141: Lower Coolant Hose At Radiator Retaining Clip
Courtesy of VOLKSWAGEN UNITED STATES, INC.

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

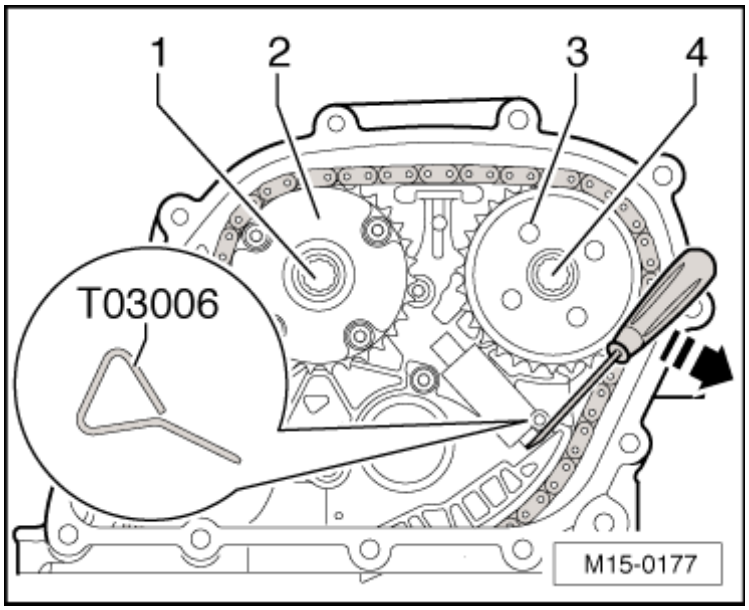

Fig. 142: Identifying Coolant Hoses At Oil Cooler
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- In addition, drain coolant from engine by disconnecting coolant hoses at oil cooler - **arrows** -.

NOTE:

- **Observe disposal regulations for coolant!**

Filling

NOTE:

- **Only use coolant additive G 12 according to TL "VW 774 F". Distinguishing color: violet**
- **G 12 violet according to TL "VW 774 F" may be mixed with previous coolant additive G 12 red!**
- **"G 12" and coolant additives marked in accordance with TL "VW 774 F" prevent frost and corrosion damage, scaling and also raise the boiling point of the coolant. For this reason the system must be filled all year round with frost and corrosion protection additives.**
- **Because of its high boiling point, the coolant improves engine reliability under heavy loads, particularly in countries with tropical climates.**
- **Protection against frost must be assured to about -25°C (in arctic climatic countries to about -35°C).**
- **The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. The 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.**
- **Use only clean drinking water for mixing.**
- **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	Water* See note
-25°C-35°C	40%50%	3.0 L3.5 L	4.0 L3.5 L

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

- Install lower coolant hose and secure.
- Connect coolant hoses on oil cooler.

With cooling system charge unit VAS 6096:

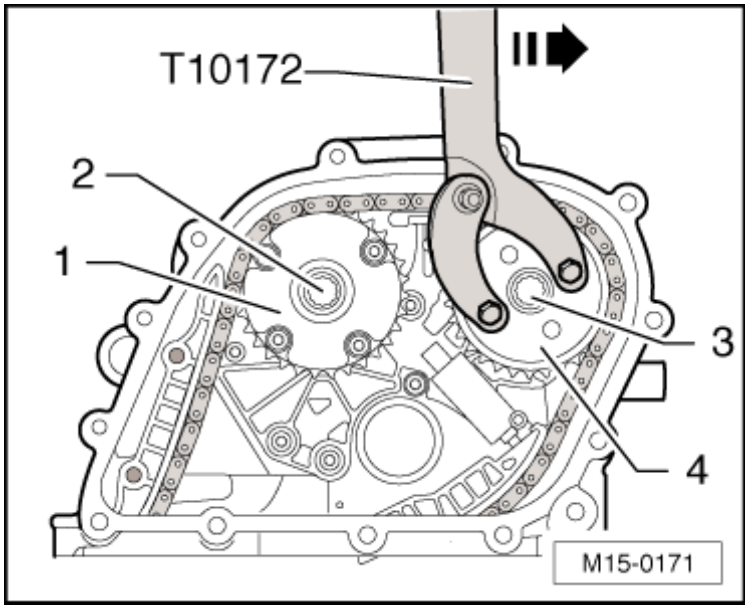

Fig. 143: Identifying Adapter V.A.G 1274/8 On Expansion Tank
Courtesy of VOLKSWAGEN UNITED STATES, INC.

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

Without cooling system charge unit VAS 6096:

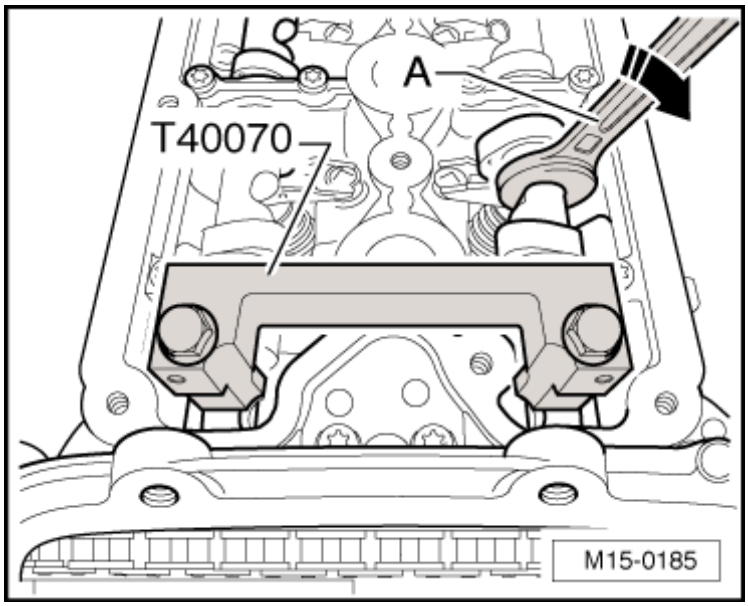

Fig. 144: Adapter V.A.G 1274/8 and V.A.G 1274/10 Installed Onto Expansion Tank
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Screw adapter V.A.G 1274/8 on expansion tank and extend it using adapter for V.A.G 1274 tester V.A.G 1274/10.

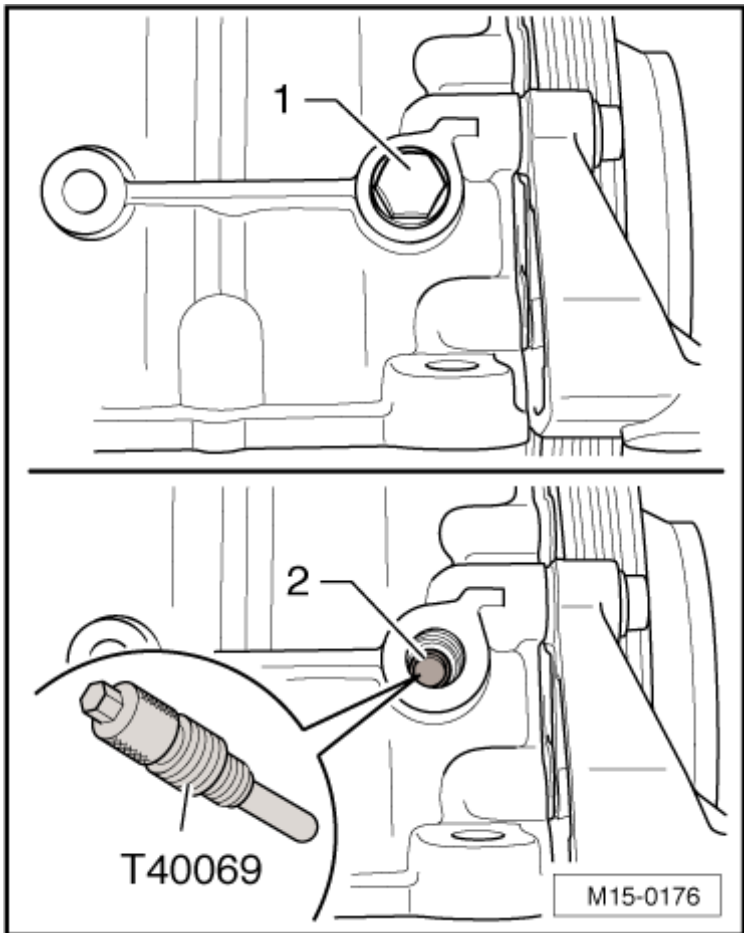

Fig. 145: Locating Bleed Hole In Coolant Hose
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen coolant hose on heater core and pull back hose sufficiently so that bleed hole in coolant hose - **arrow** - is no longer covered by connecting piece.
- Fill with coolant until it escapes from coolant hose bleeder hole.
- Push coolant hose on connection and secure it.

With and without cooling system charge unit VAS 6096:

- Close expansion tank.
- Turn off heater controls.
- Start engine and maintain an engine speed of about 2000 rpm for approx. 3 minutes.
- Allow engine to run at idle speed until lower hose on radiator becomes hot.

CAUTION: When opening the expansion tank, hot steam may be released. Cover the cap with a rag and open very carefully.

- Check coolant level and top off if necessary. With engine at operating temperature, coolant level must be

at max. marking. With engine cold, coolant level must be between min. and max. marking.

Radiator, removing and installing

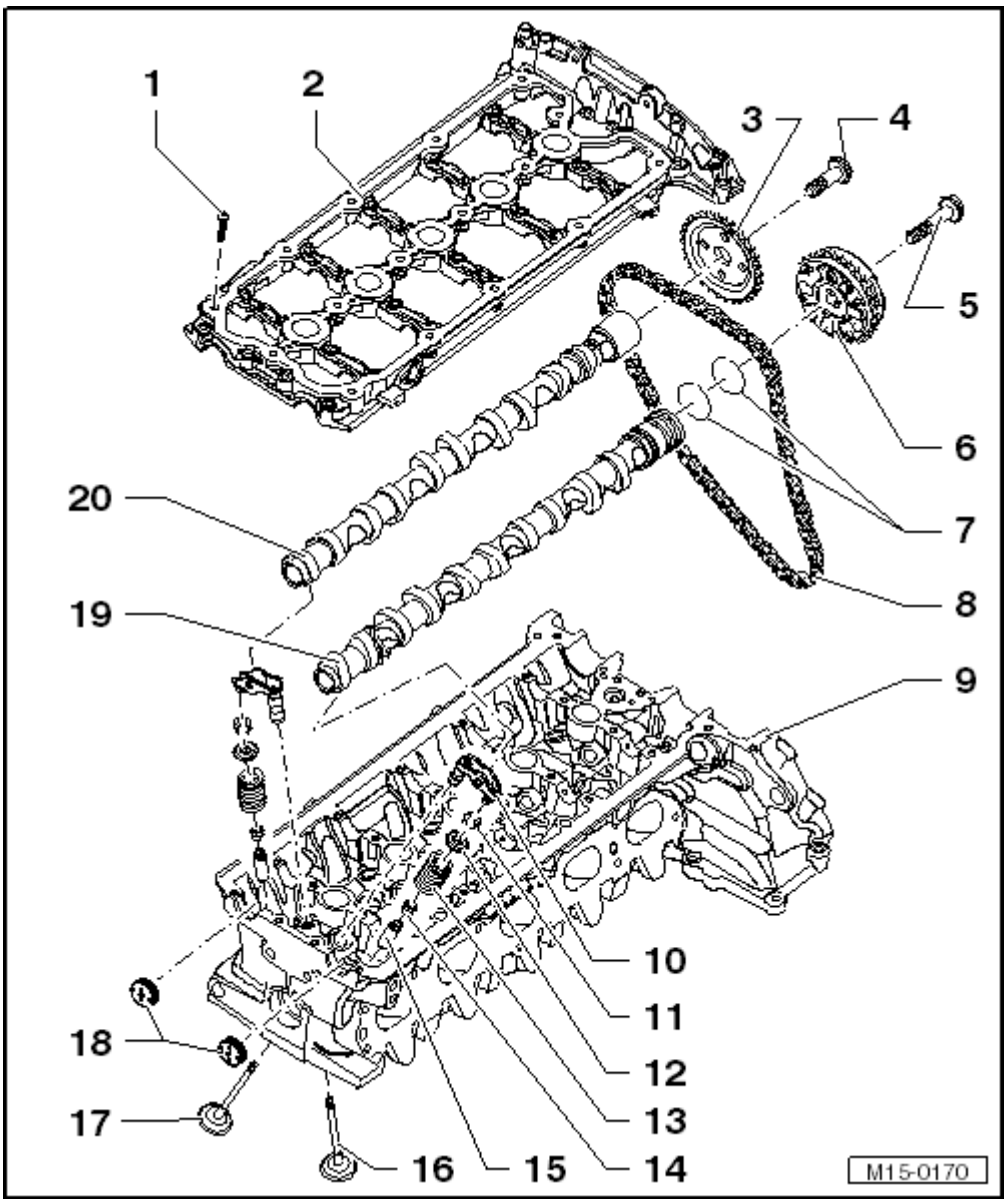

Fig. 146: Identifying Special Tools - Cooling System, Servicing, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Refractometer T10007
- Drip tray V.A.G 1306
- Pliers for spring type clips VAS 5024 A
- Cooling system charge unit VAS 6096

- Adapter V.A.G 1274/8
- Torque wrench (5 to 50 Nm) V.A.G 1331

Special tools, testers and auxiliary items required

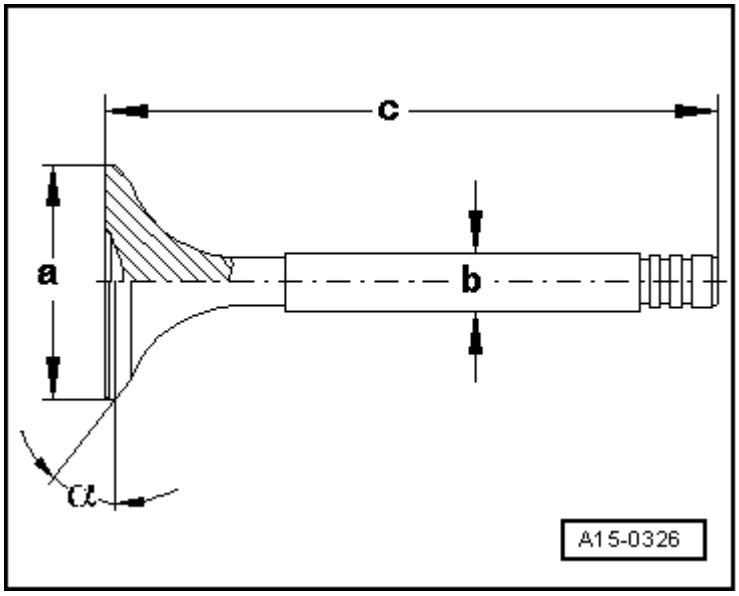

Fig. 147: Adapter V.A.G 1274/10
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Adapter V.A.G 1274/10

Removing

- Drain coolant --> **Cooling system, draining and filling** .
- Remove front bumper: --> **63 BUMPER**
- Pull off coolant hoses from radiator.

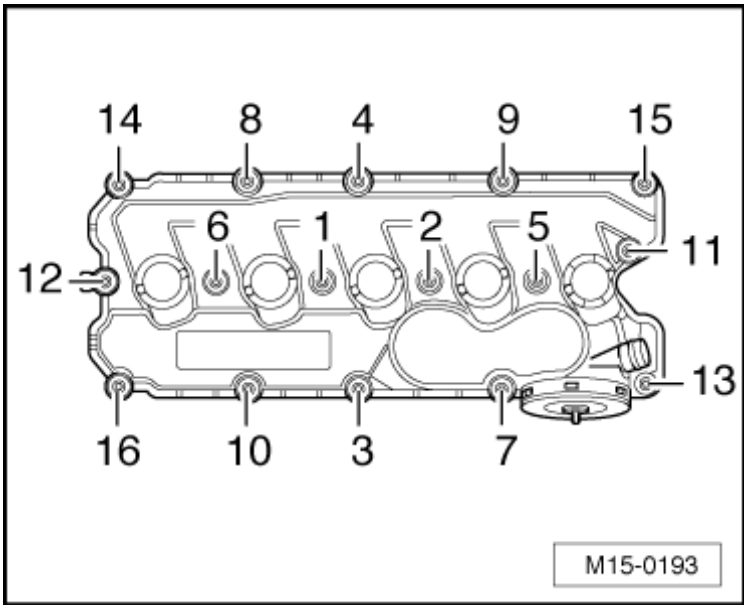

Fig. 148: Identifying Cooling Coil For Power Steering Fluid
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unbolt cooling coil for power steering fluid (arrows) and let hang free; Do not open hydraulic fluid circuit.
- Remove upper radiator securing clips and remove radiator toward front.

Vehicles with air conditioning

- Observe additional information and removal work.

Installing

Installation is performed in the reverse order of removal, noting the following:

- Fill with coolant --> **Cooling system, draining and filling** .
- Check electrical connections and routing: --> **97 - WIRING**
- Install front bumper --> **63 BUMPER**

Additional information and assembly work on vehicles with air conditioning

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

NOTE:

- **Do not bend or stretch lines or hoses as condenser and/or refrigerant lines/hoses may be damaged.**

- Remove retaining clamp(s) from refrigerant lines.

- Unscrew condenser from radiator and pull forward as far as possible.
- Secure condenser to body so that refrigerant lines/hoses are not stressed.
- Pull radiator out between condenser and lock carrier.

Coolant pump, removing and installing

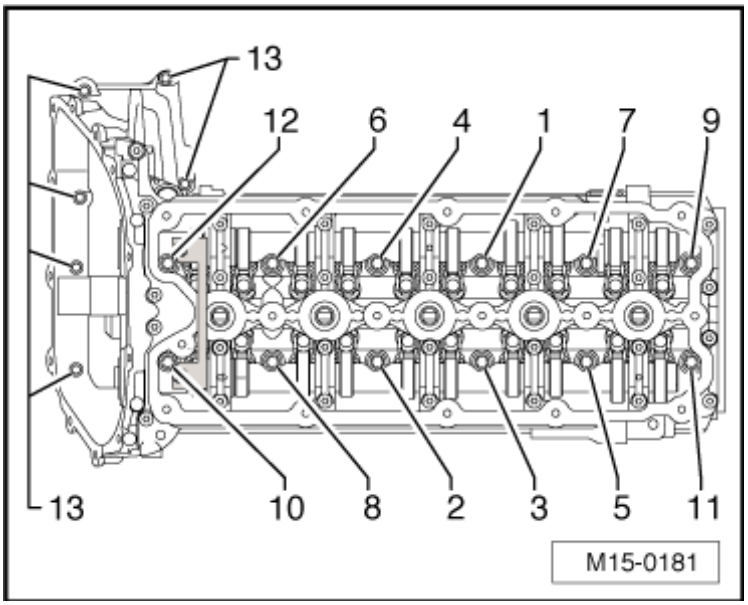

Fig. 149: Identifying Special Tools - Cooling System, Servicing, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Refractometer T10007
- Drip tray V.A.G 1306
- Pliers for spring type clips VAS 5024 A
- Cooling system charge unit VAS 6096
- Adapter V.A.G 1274/8
- Torque wrench (5 to 50 Nm) V.A.G 1331

Special tools, testers and auxiliary items required

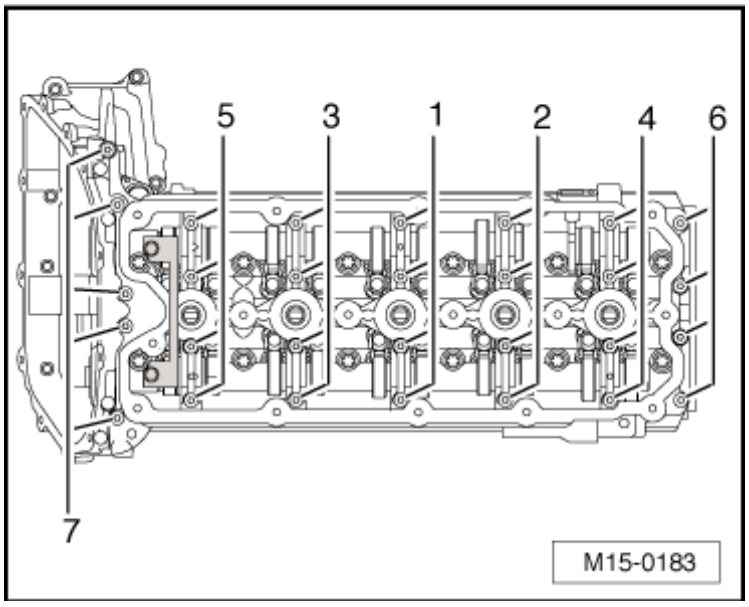

Fig. 150: Adapter V.A.G 1274/10
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Adapter V.A.G 1274/10

Removing

NOTE:

- **Always replace gaskets and seals.**

- Bring lock carrier into service position. --> **50 BODY, FRONT**
- Drain coolant --> **Cooling system, draining and filling** .
- Remove ribbed belt --> **Ribbed belt, removing and installing**
- Remove toothed belt --> **Toothed belt, removing, installing and tensioning** .

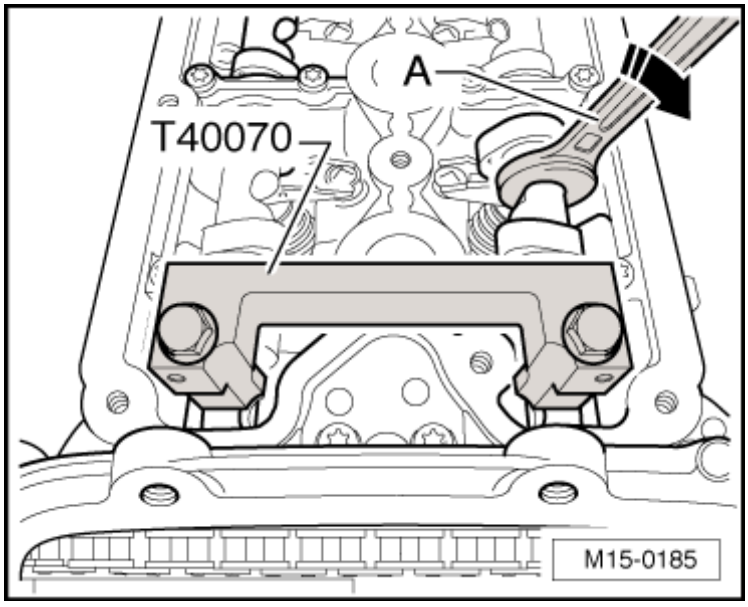

Fig. 151: View Of Coolant Pump And Securing Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **1** - of coolant pump - **2** - and carefully take out coolant pump.

Installing

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

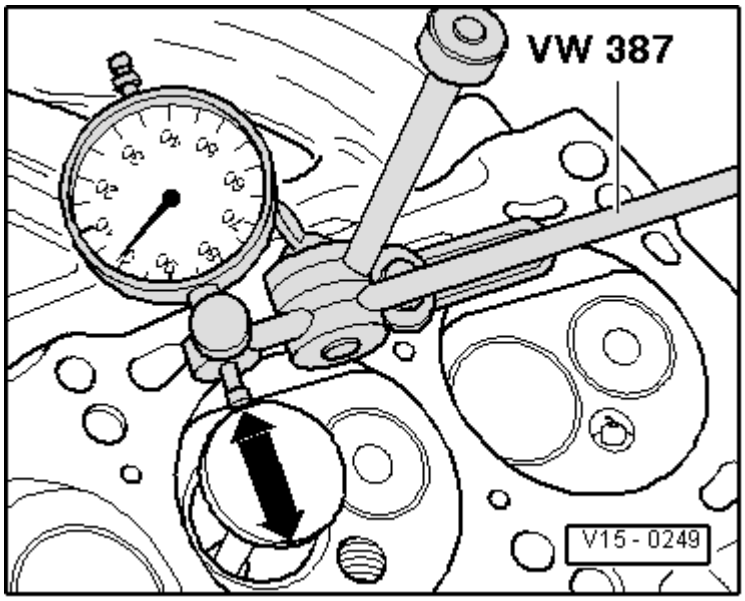

Fig. 152: View Of Coolant Pump And Securing Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Soak new O-ring - **3** - with coolant and install.
- Place coolant pump - **2** - into cylinder block and fasten bolts - **1** - to 15 Nm.

NOTE:

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

- Install toothed belt --> **Toothed belt, removing, installing and tensioning** .
- Install ribbed belt --> **Ribbed belt, removing and installing** .
- Refill with coolant --> **Cooling system, draining and filling** .

Coolant thermostat, removing and installing

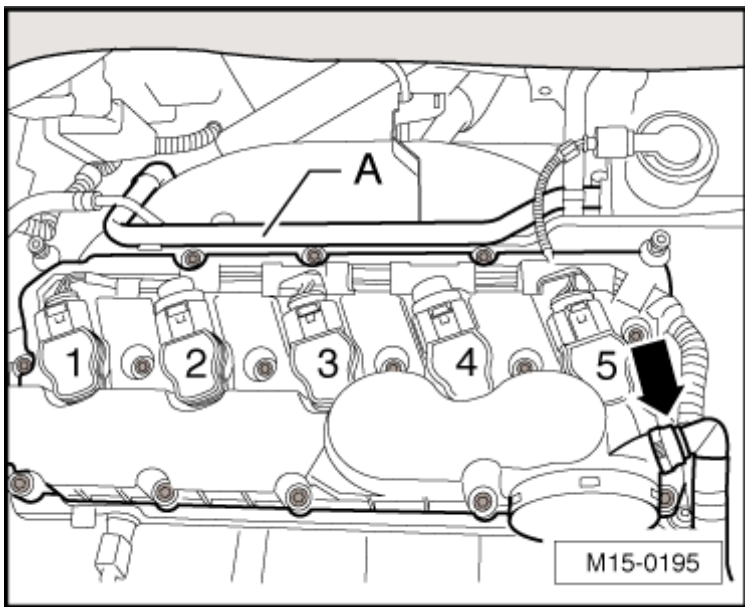

Fig. 153: Identifying Special Tools - Cooling System, Servicing, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Refractometer T10007
- Drip tray V.A.G 1306
- Pliers for spring type clips VAS 5024 A
- Cooling system charge unit VAS 6096
- Adapter V.A.G 1274/8
- Torque wrench (5 to 50 Nm) V.A.G 1331

Special tools, testers and auxiliary items required

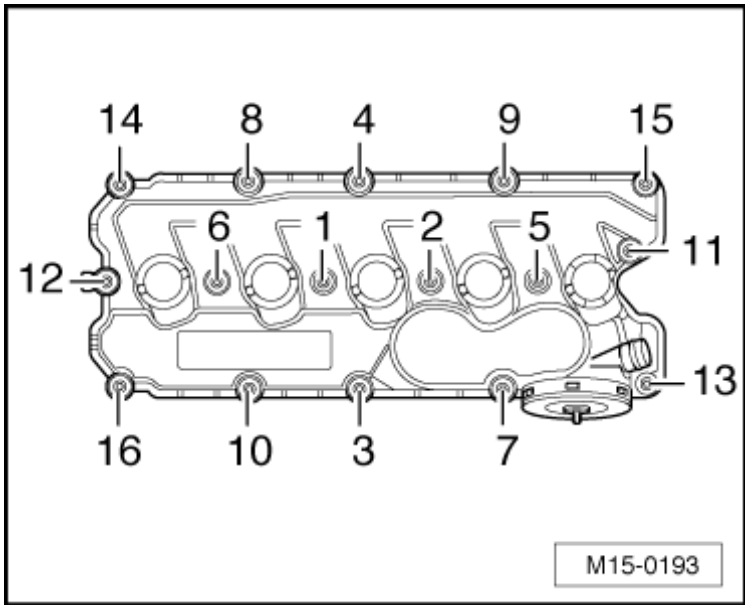

Fig. 154: Adapter V.A.G 1274/10
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Adapter V.A.G 1274/10

Removing

NOTE:

- **Always replace gaskets and seals.**

- Drain coolant --> **Cooling system, draining and filling** .
- Disconnect coolant hose from housing.

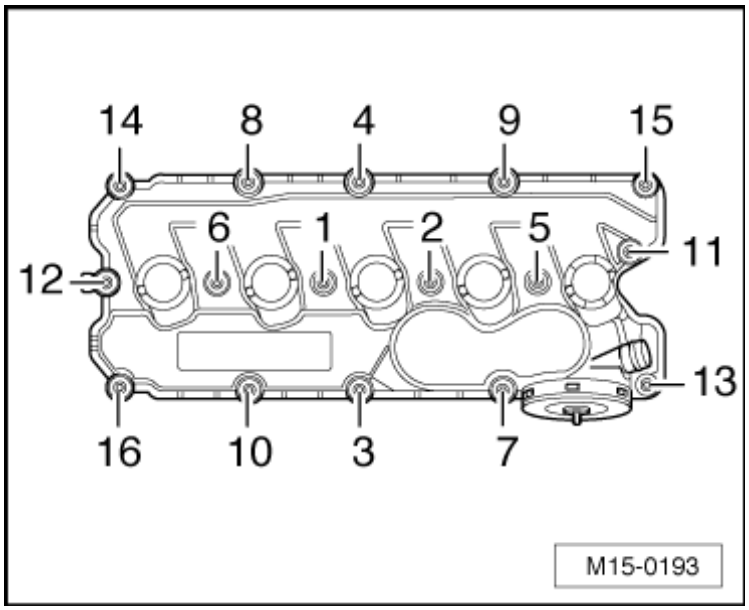

Fig. 155: Identifying Thermostat Housing

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unscrew bolts - **1** - from housing - **2** - and remove with coolant thermostat - **4** -.
- Turn coolant thermostat - **4** - $^{1}/_{4}$ turn (90°) left and remove it from housing - **2** -.

Installing

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

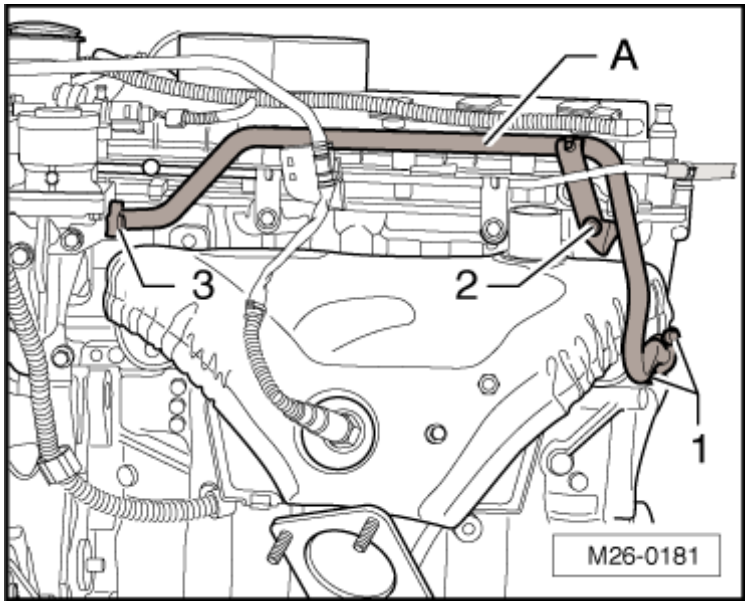

Fig. 156: Identifying Thermostat Housing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Moisten new O-ring - **3** - with coolant and install.
- Insert coolant thermostat - **4** - into housing - **2** - and turn right $^{1}/_{4}$ turn (90°).

NOTE:

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

- Insert housing - **2** - with thermostat - **4** - into engine block.
- Tighten bolts - **1** - : Torque specification 15 Nm
- Fill with coolant --> **Cooling system, draining and filling** .

Viscous fan clutch, removing and installing

Special tools, testers and auxiliary items required

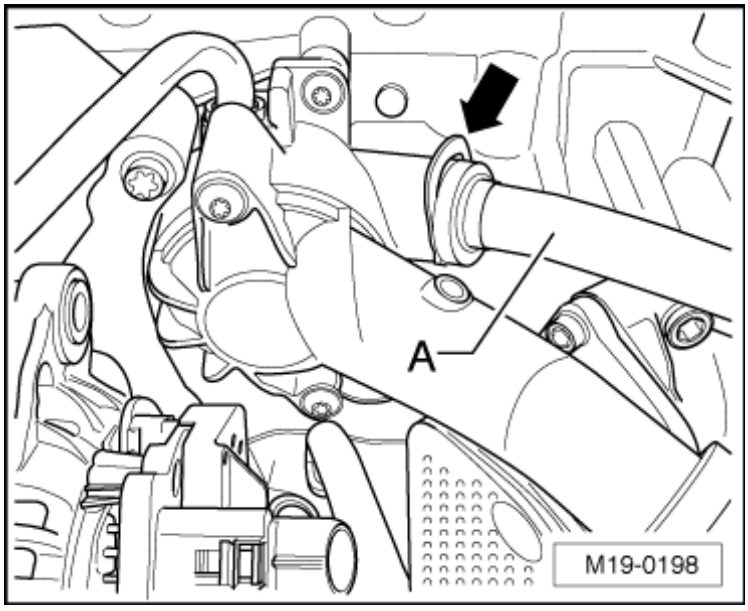

Fig. 157: Pin Wrench 3212
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pin wrench 3212

Special tools, testers and auxiliary items required

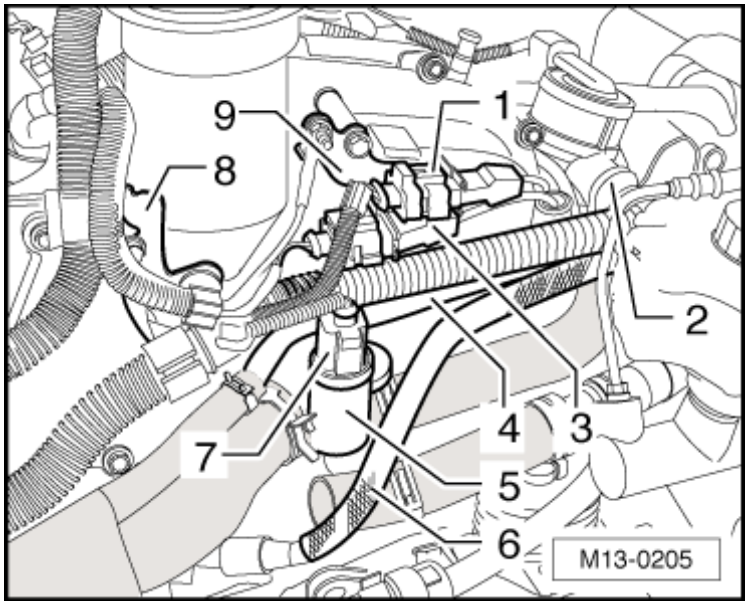

Fig. 158: Torque Wrench V.A.G 1331
Courtesy of VOLKSWAGEN UNITED STATES, INC.

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

Removing

- Bring lock carrier into service position. --> **50 BODY, FRONT**
- Remove ribbed belt --> **Ribbed belt, removing and installing** .
- Remove fan wheel from viscous fan clutch.

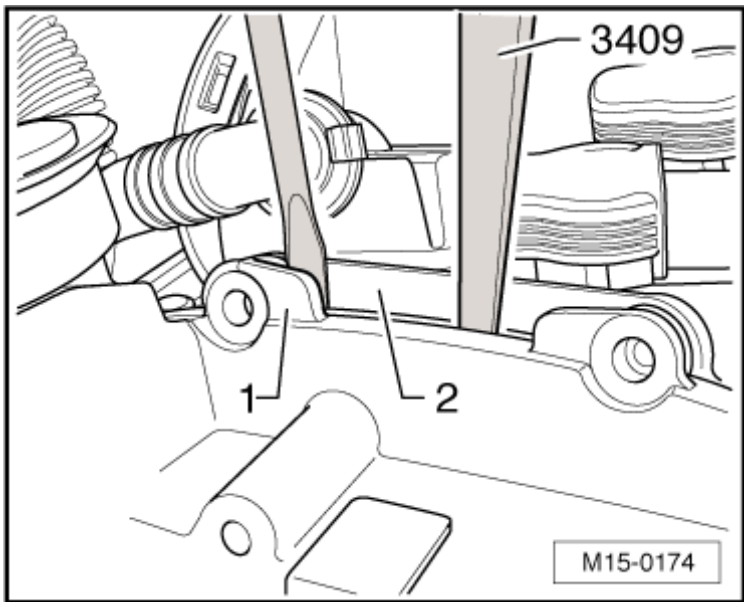

Fig. 159: Removing Belt Pulley From Viscous Fan Clutch
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Counterhold belt pulley for viscous fan clutch with pin wrench 3212 and unscrew from bracket with 8 mm hex socket wrench.
- Remove belt pulley from viscous fan clutch.

Installing

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

- Tighten belt pulley to viscous fan clutch to 30 Nm.
- Tighten viscous fan clutch to bracket to 45 Nm.
- Tighten fan wheel to viscous fan clutch to 10 Nm.
- Install ribbed belt --> **Ribbed belt, removing and installing** .

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.**

- **Spring-type clip pliers VAS 5024 or hose clip pliers V.A.G 1921 are recommended for installing spring-type clips.**

Observe safety precautions --> **Safety precautions when working on fuel supply system** .

Observe rules for cleanliness --> **Rules for cleanliness** .

Fuel tank, assembly overview --> **Fuel tank, assembly overview** .

Fuel filter, assembly overview --> **Fuel filter, assembly overview** .

Fuel cooler, removing and installing --> **Fuel cooler, removing and installing** .

Tandem pump, checking --> **Tandem pump, checking** .

Tandem pump, removing and installing --> **Tandem pump, removing and installing** .

Accelerator pedal mechanism, assembly overview --> **Accelerator pedal mechanism, assembly overview** .

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 all the various lines (e.g. for fuel, hydraulics, EVAP system, coolant, refrigerant, brake fluid and vacuum lines and hoses) and electrical wiring so that the original positions are restored.**
- **Ensure sufficient clearance to all moving or hot components.**

CAUTION:

- **The fuel or fuel lines in the fuel system can become very hot (danger of scalding)!**
- **In addition, the fuel system is under pressure! Before opening the system, place rags around the connection area and release pressure by carefully loosening the connection!**
- **Wear protective goggles and protective gloves when working on the fuel system!**

Always observe the following when removing and installing the sender for fuel gauge or the Fuel Pump (FP) from full or partially filled fuel tanks:

- 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!

Rules for cleanliness

When working on the fuel supply/injection system, pay careful attention to the following "6 rules":

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

Fuel tank, assembly overview

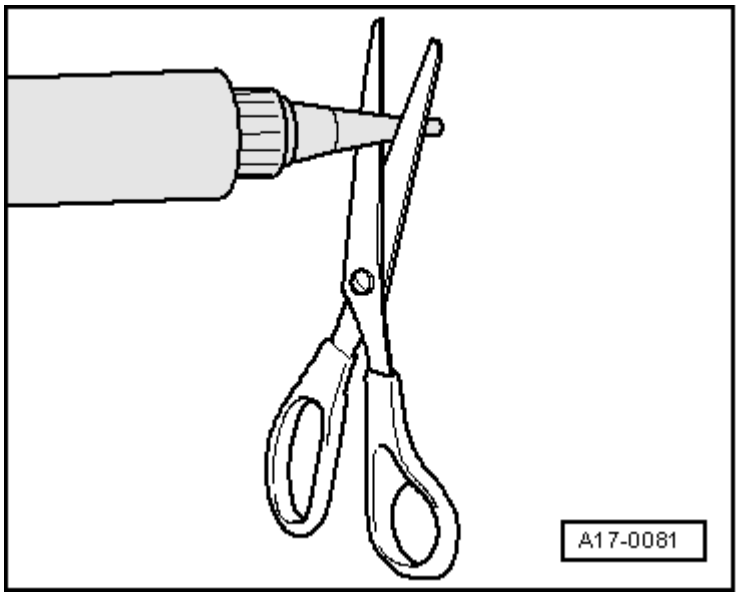

Fig. 160: Fuel Tank, Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Cap

2 - Oil seal

- Replace if damaged

3 - Bolt

4 - Gravity/expansion valve

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

5 - Angle piece

6 - O-ring

- Replace if damaged

7 - Breather valve

- To remove valve unclip sideways out of support
- Checking **Checking breather valve**

8 - Ground connection

- Ensure seated tightly

9 - Supply line

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

10 - Return line

- Clipped in at fuel tank
- Ensure seated tightly
- Blue or with blue marking

11 - Sender for fuel gauge -G-

- Clipped onto baffle housing in fuel tank
- Removing and installing --> **Sender for fuel gauge, removing and installing**

12 - Oil seal

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

13 - Union nut, 80 Nm

- Use ring nut wrench 3217 for removal and installation

14 - Connector

- Black, 4-pin

15 - Flange

- Note installed position on fuel tank **Installed location of the fuel gauge sender**

16 - Fuel delivery unit

- Removing and installing --> **Fuel delivery unit, removing and installing**
- Check fuel pump --> **Fuel pump, checking**
- Clean strainer if soiled

17 - Outer part of baffle housing

- With suction jet pump
- Component of fuel tank

18 - Vent line

- Ensure seated tightly

19 - 25 Nm

20 - Fuel tank

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

21 - Securing strap

- Observe varying lengths

22 - Bracket

- For securing straps

23 - 25 Nm

24 - Tank flap unit

- With rubber cup

Installed location of the fuel gauge sender

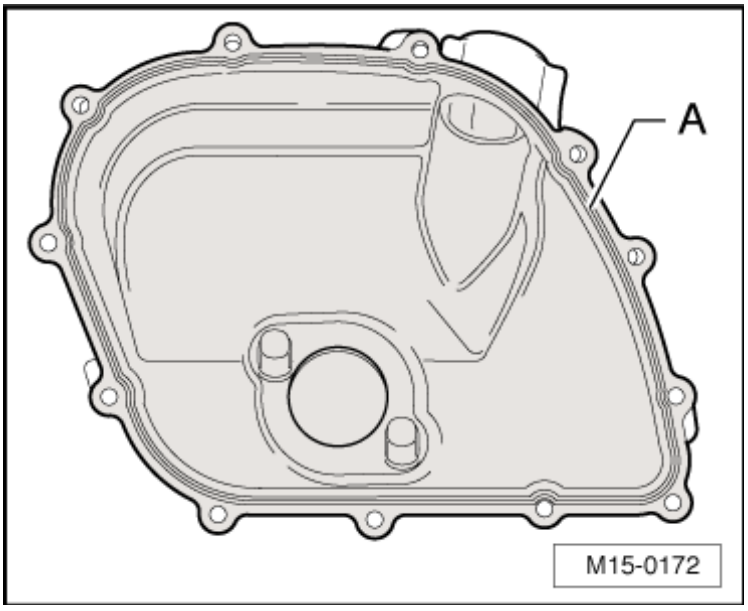

Fig. 161: Identifying Installed Location Of The Fuel Gauge Sender, Fuel Lines And Harness Connector
Courtesy of VOLKSWAGEN UNITED STATES, INC.

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

NOTE:

- **After installing the fuel gauge sender, verify that the fuel supply and return lines at the fuel tank are still clipped in.**

Checking breather valve

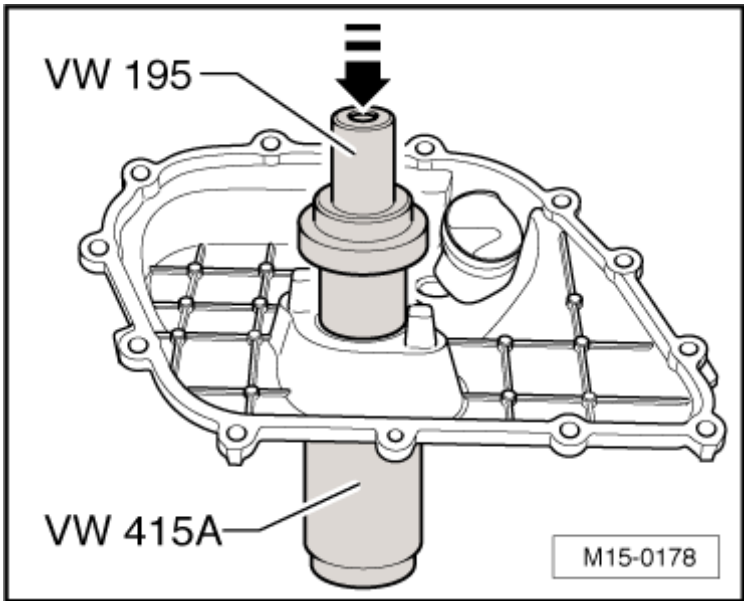

Fig. 162: Checking Bleeder Valve
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Lever in rest position: Closed

Lever pushed in direction of arrow: Open

NOTE:

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

Fuel filter, assembly overview

NOTE:

- **When installing, make sure that the fuel filter is not installed with the water drain plug sitting on the oil filter bracket. This could loosen and begin leaking.**
- **Install the fuel filter so that accessibility to the water drain plug is ensured.**

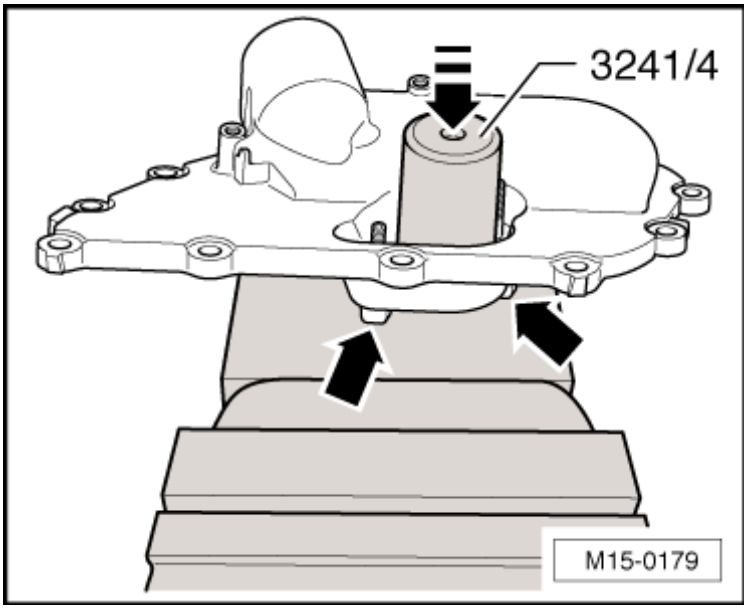

Fig. 163: Fuel Filter, Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Return line

- To fuel cooler --> **Fuel cooler, removing and installing**
- Blue or with blue marking
- Ensure seated tightly

2 - Supply line

- From fuel tank --> **Fuel tank, assembly overview**
- White or with white markings
- Ensure seated tightly

3 - Retaining clip

4 - Regulator valve

- Installed location: direction of arrow to fuel tank
- When changing filter, remove retaining clip and take off regulator valve with fuel lines attached.
- When under + 15° C: flow-through to filter is open
- When over +31° C: flow-through to filter is closed

5 - O-ring

- Replace

6 - Return line

- Ensure seated tightly
- Blue or with blue marking

7 - Fuel line

8 - Fuel temperature sensor -G81-

9 - Supply line

- Ensure seated tightly
- White or with white markings

10 - Fuel filter

- Before installing, fill with diesel fuel
- Direction of flow is marked with arrows
- Do not interchange connections
- Replace if damaged

11 - Seal

- Replace if damaged

12 - Water drain plug

- To vent, remove retaining clip for regulator valve and take off regulator valve with fuel lines attached
- Loosen and allow approx. 100 cm^3 of fluid to drain

Fuel cooler, removing and installing

Special tools, testers and auxiliary items required

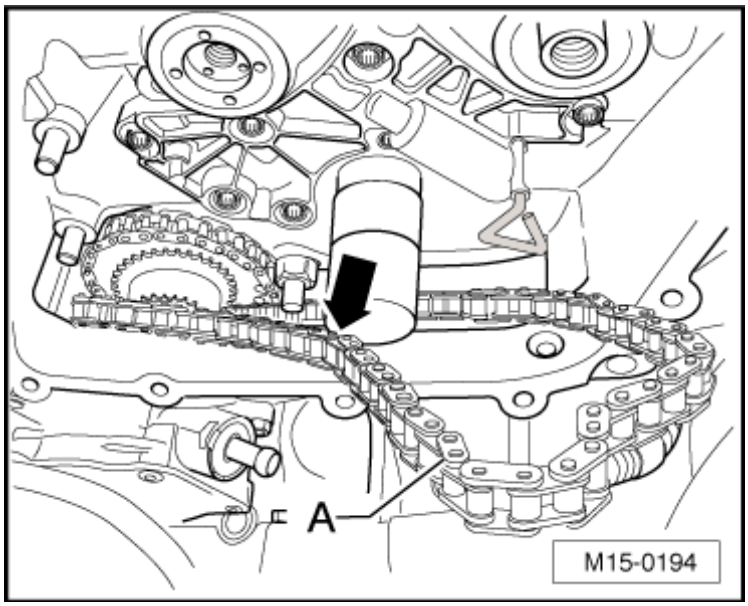

Fig. 164: Torque Wrench V.A.G 1331
Courtesy of VOLKSWAGEN UNITED STATES, INC.

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

Removing

Observe rules for cleanliness --> **Rules for cleanliness** .

NOTE:

- **The fuel cooler is located in the return line to the fuel tank. It is attached to the underbody of the vehicle.**

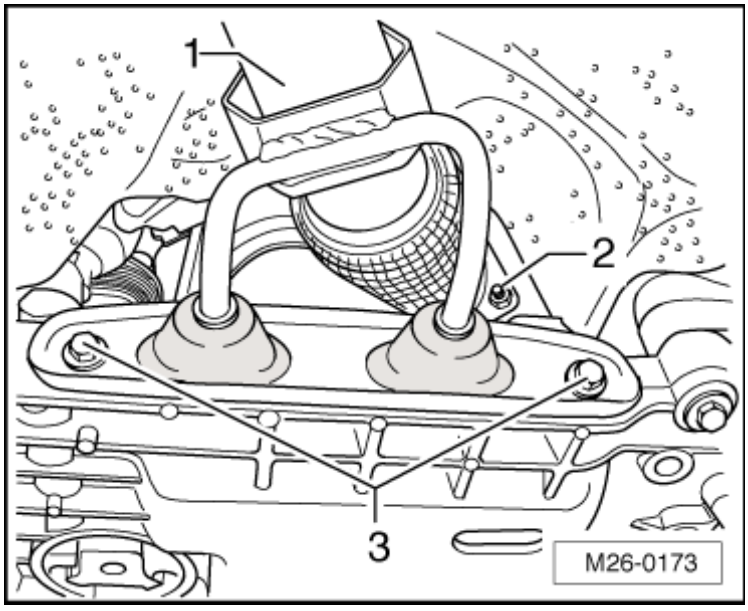

Fig. 165: Fuel Line Cover And Clips
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove retaining clip - **C** - and bolt - **B** - and take off cover - **A** -.
- Separate fuel lines at fuel cooler.

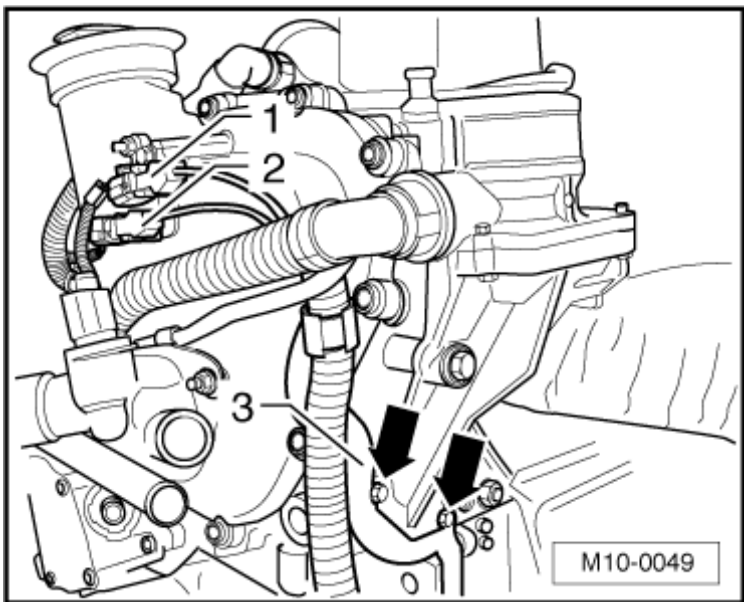

Fig. 166: Fuel Cooler
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove nuts - **arrows** -.

Installing

Installation is performed in reverse order. When doing this note the following:

- Tightening torque of nuts for fuel cooler: 15 Nm

Fuel tank, emptying

Special tools, testers and auxiliary items required

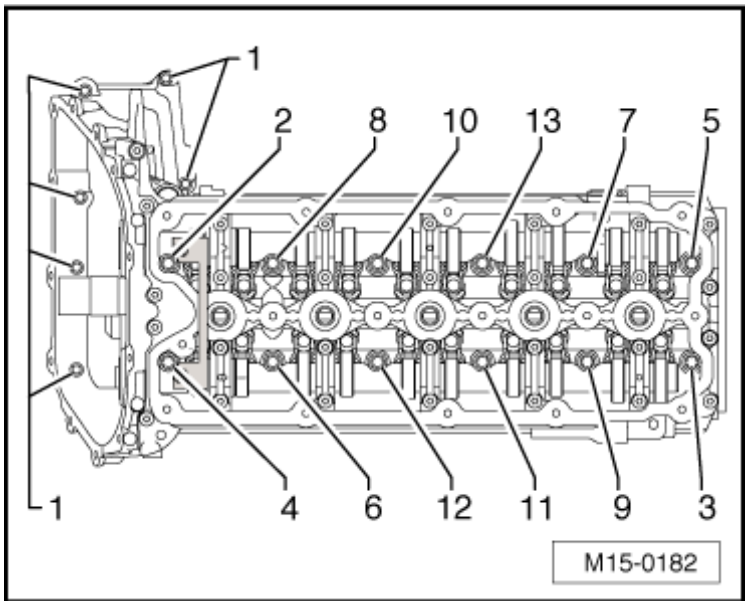

Fig. 167: Fuel Siphoning Unit VAS 5190
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Fuel siphoning unit VAS 5190

Work sequence

- Observe safety precautions before performing repair work. --> **Safety precautions when working on fuel supply system**
- Open fuel tank flap.

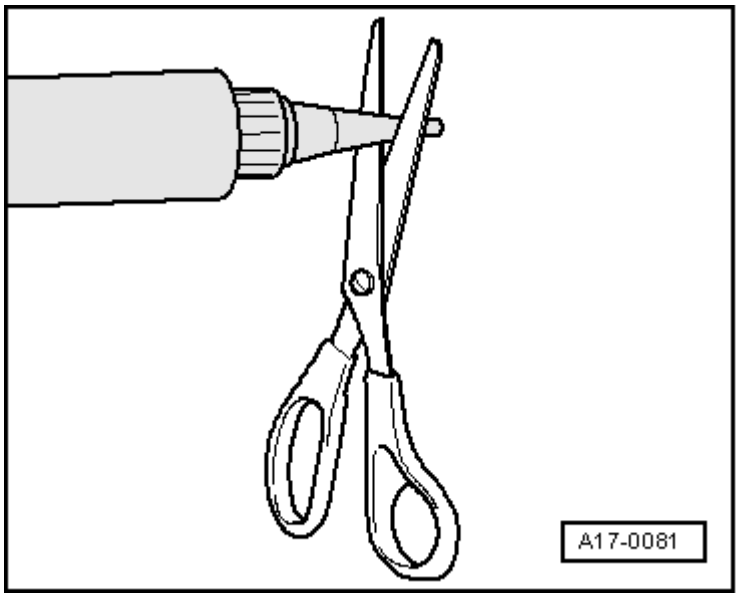

Fig. 168: Fuel Siphoning Unit VAS 5190 Suction Hose In Fuel Filler Neck
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Push suction hose - **arrow** - of fuel extractor VAS 5190 into fuel filler neck and extract fuel.

NOTE:

- **When no more fuel can be extracted, the tank is emptied only enough for the sender flanges to be opened without danger. The tank may be removed while containing the remaining fuel.**

Fuel tank, removing and installing

Special tools, testers and auxiliary items required

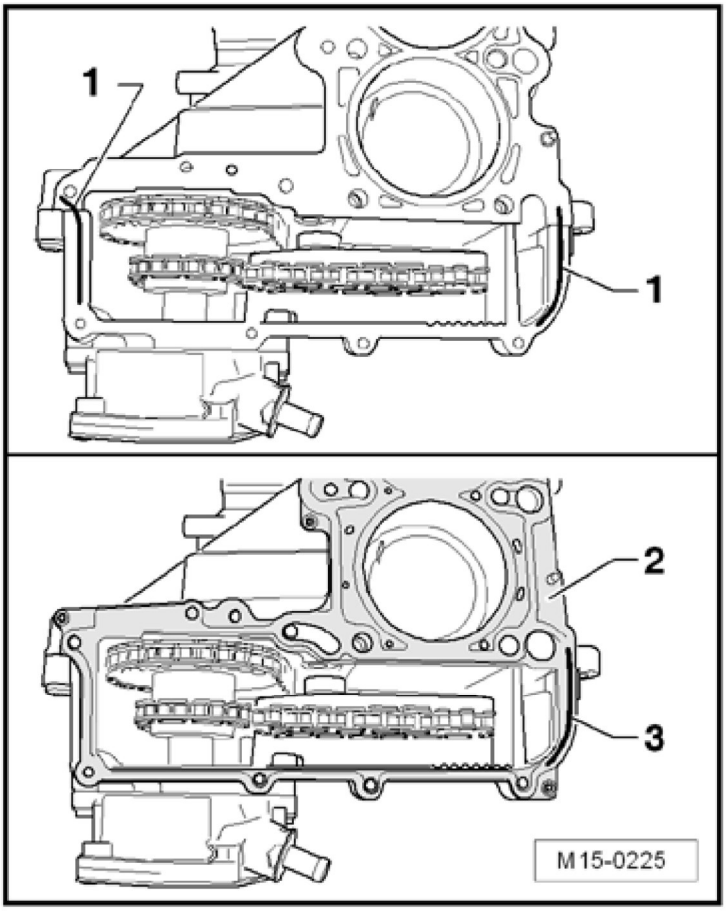

Fig. 169: Engine/Transmission Jack VAG 1383 A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

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

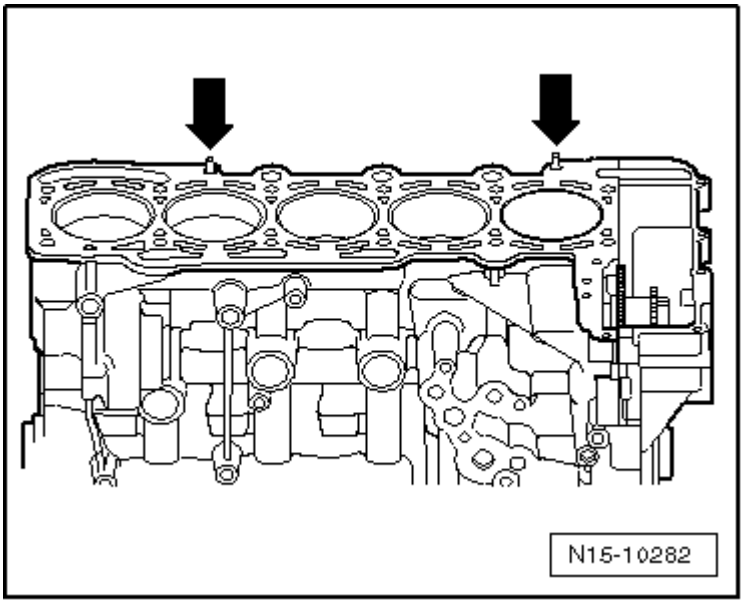

Fig. 170: Torque Wrench V.A.G 1331
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Torque wrench (5 to 50 Nm) V.A.G 1331
- Plug tool for additive tank T10249 (engine code BGW only)

Removing

NOTE:

- **The fuel tank must not be more than 1/4 full.**
- **Empty fuel tank using fuel siphoning unit VAS 5190 --> Fuel tank, emptying .**
- **Observe safety precautions before performing repair work --> Safety precautions when working on fuel supply system .**

- Check whether a coded radio is installed. If necessary, obtain anti-theft coding.
- Disconnect battery Ground (GND) strap with ignition switched off.
- Remove wheelhousing liner, right rear: --> **66 EXTERIOR EQUIPMENT**
- Unscrew securing bolts and remove tank flap unit with rubber cup.

- Remove securing bolt on filler neck.

CAUTION: During all repair procedures be aware of the following:

- **Route all the various lines (e.g. fuel lines, as well as electrical wiring) so that the original positions are restored.**
- **Ensure sufficient clearance to all moving or hot components.**
- **Always perform repair procedures on open systems in rooms with adequate ventilation only!**

- Remove tensioning strap while supporting fuel tank with engine/transmission jack V.A.G 1383/A.

CAUTION:

- **The fuel or fuel lines in fuel system can become very hot (danger of scalding)!**
- **In addition, the fuel system is under pressure. Before opening the system, place rags around the connection area and release pressure by carefully loosening the connection.**
- **Wear protective goggles and protective gloves when working on the fuel system!**

- Lower engine/transmission jack V.A.G 1383/A only so far until supply and return lines and connector on fuel level sensor can be disconnected.

NOTE:

- **Press in securing ring to disengage the fuel lines.**

- Unclip supply and return lines at fuel tank and separate connector for fuel level sensor.
- Lower fuel tank.

Installing

Installation is performed in reverse order. When doing this note the following:

- Route the vent hoses kink-free.
- Route the fuel hoses kink-free.
- Secure fuel lines with clamps.
- Do not interchange supply and return hose (return hose blue or blue markings, supply hose black).
- Clip in the supply and return lines at fuel tank.

Fuel pump, checking

Special tools, testers and auxiliary items required

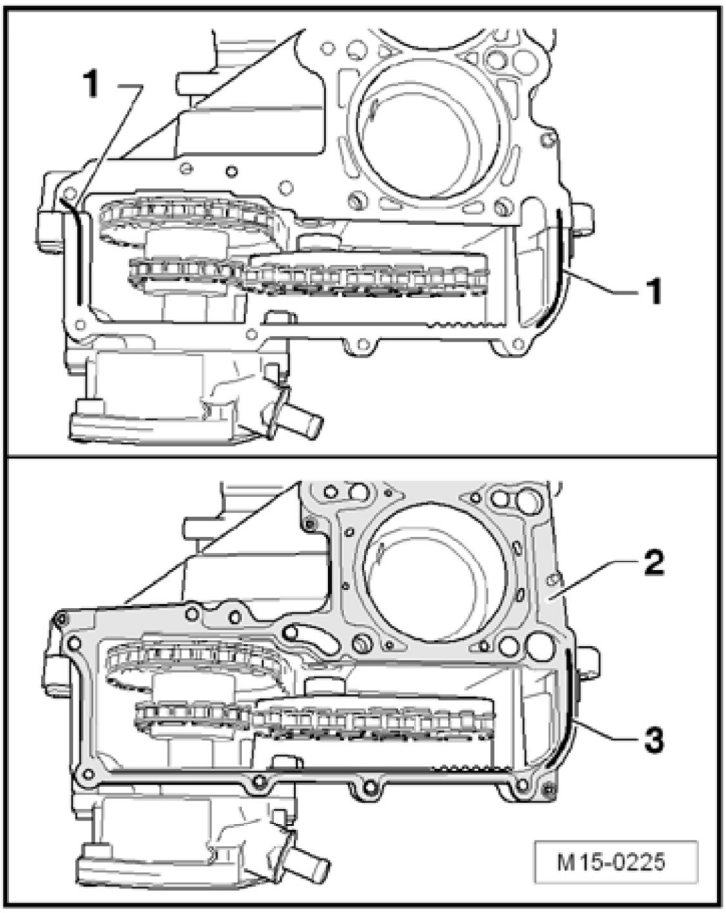

Fig. 171: Multimeter V.A.G 1715
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Hand multimeter V.A.G 1526 B or multimeter V.A.G 1715

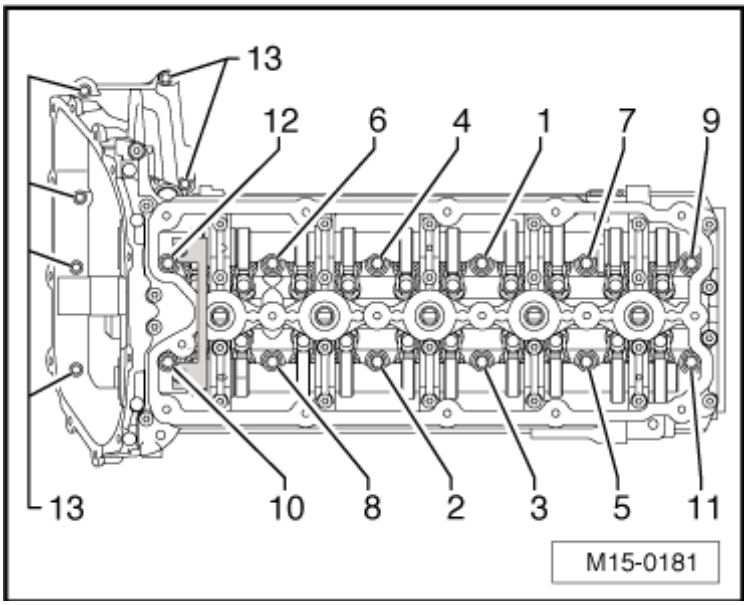

Fig. 172: Voltage Tester V.A.G 1527 B
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Voltage tester V.A.G 1527 B
- Connector test set V.A.G 1594 C

Conditions

- The fuses must be OK.
- Battery voltage must be at least 11.5 Volts.
- All electrical consumers such as lights and rear window defroster must be switched off.

Checking function and voltage supply

- Switch ignition on. Fuel pump must run for approx. 1 second.
- Switch ignition off.

If fuel pump does not activate:

- Remove luggage compartment floor cover.

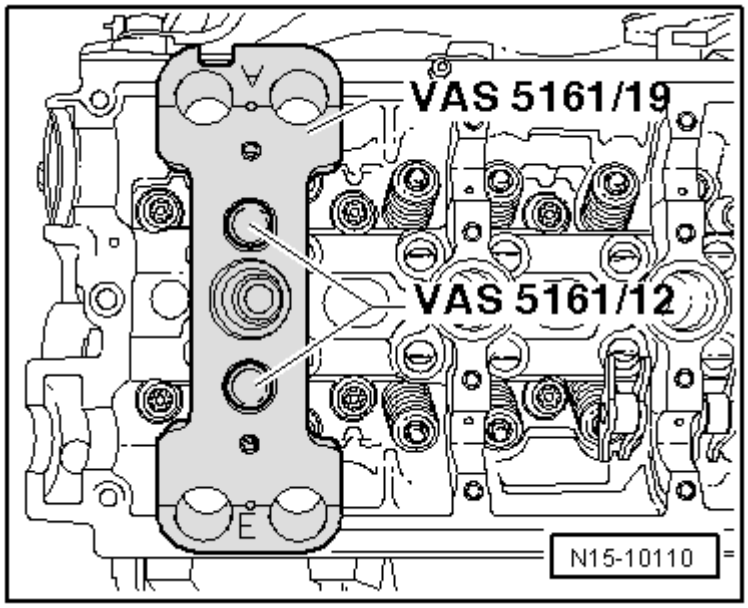

Fig. 173: Checking Voltage Supply To Fuel Pump
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect voltage tester V.A.G 1527 B with adapter cables from test adapter kit V.A.G 1594 C to outer contacts of connector.
- Switch ignition on again, LED must illuminate for approx. 1 second.
- Switch ignition off.

If LED does not illuminate:

- Check actuation of fuel pump relay and check wiring for open circuits and short circuits: Vehicle diagnosis, testing information system VAS 5051

LED lights up (voltage supply OK):

- Remove fuel delivery unit --> **Fuel delivery unit, removing and installing** .
- Check if electrical wiring between flange and fuel pump is connected and has continuity.

If no open circuits are found:

- Replace fuel delivery unit --> **Fuel delivery unit, removing and installing** .

Checking current draw of Fuel Pump (FP)

- Pull connector off of flange of fuel delivery unit.

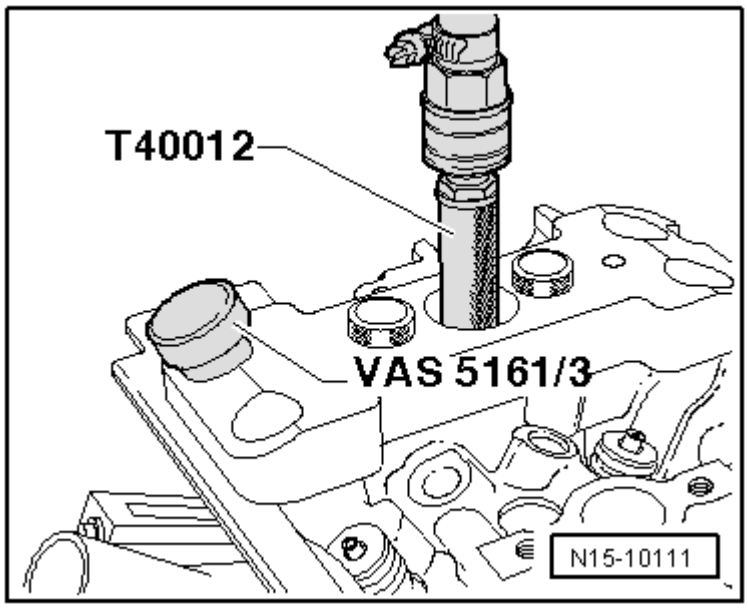

Fig. 174: Checking Current Draw Of Fuel Pump (FP)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Set multimeter to measuring range 20 A and connect it inline between contacts - **1** - of connector and fuel pump using adapter cables from connector test set V.A.G 1594 C.

NOTE:

- **Also, the current clamp of the multimeter V.A.G 1715 can be attached to an adapter cable between the contacts - 1 - of the connector and the fuel pump.**

- Connect contacts - **4** - of connector and fuel pump with an adapter cable from connector test set V.A.G 1594 C.

- Start engine and run at idle speed.
- Measure current draw of fuel pump: Specification: 3.5 to 4.5 Amps.

If the measured value lies outside the specified value:

- Replace fuel delivery unit --> **Fuel delivery unit, removing and installing** .

Fuel delivery unit, removing and installing

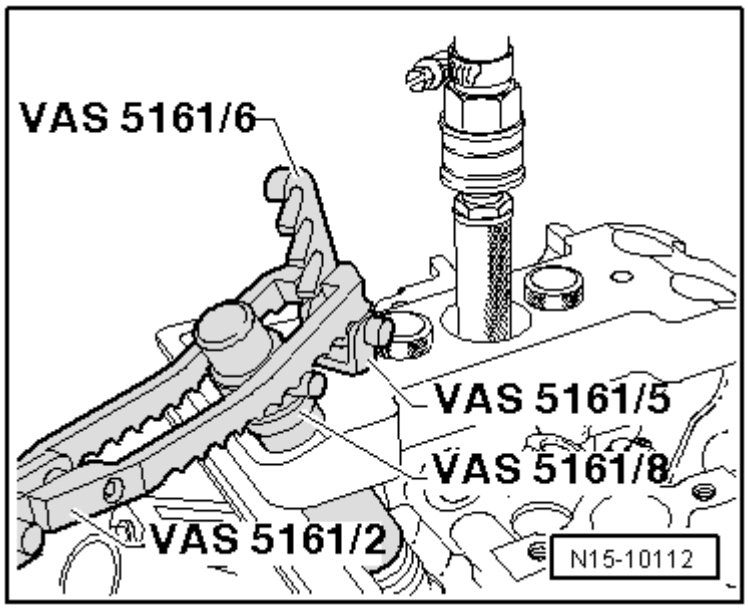

Fig. 175: Identifying Special Tools - Fuel Delivery Unit, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Ring nut wrench 3217
- Fuel pump wrench 3307
- Torque wrench (40 to 200 Nm) V.A.G 1332

Removing

NOTE:

- **The fuel tank must not be more than 1/4 full.**
- **Empty fuel tank if necessary --> Fuel tank, emptying .**
- **Observe safety precautions before performing repair work --> Safety precautions when working on fuel supply system .**

- Check whether a coded radio is installed. If necessary, obtain anti-theft coding.
- Disconnect battery Ground (GND) strap with ignition switched off.
- Remove luggage compartment floor cover.

- Pull supply line - **1** - and return line - **2** - , as well as 4-pin connector - **3** - off of flange.

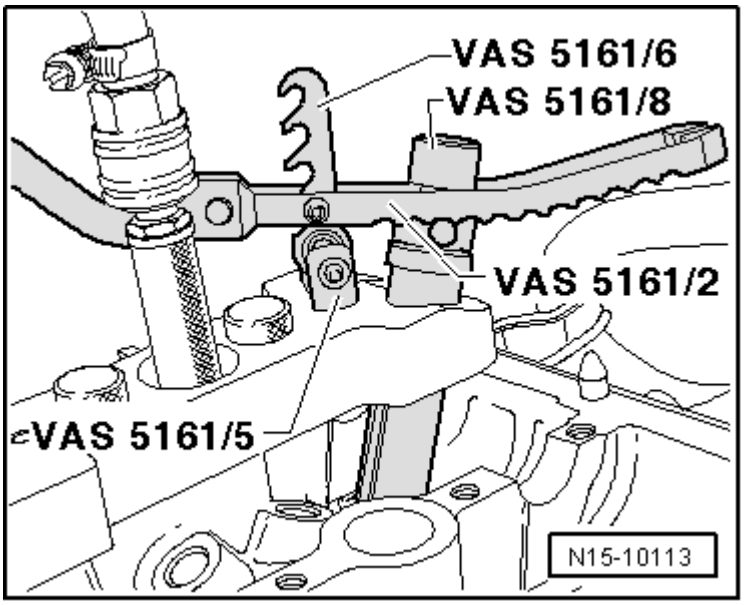

Fig. 176: Identifying Installed Location Of The Fuel Gauge Sender, Fuel Lines And Harness Connector
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Separate connector - **4** -.

CAUTION: Fuel supply lines are under pressure! Before removing from hose connection wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

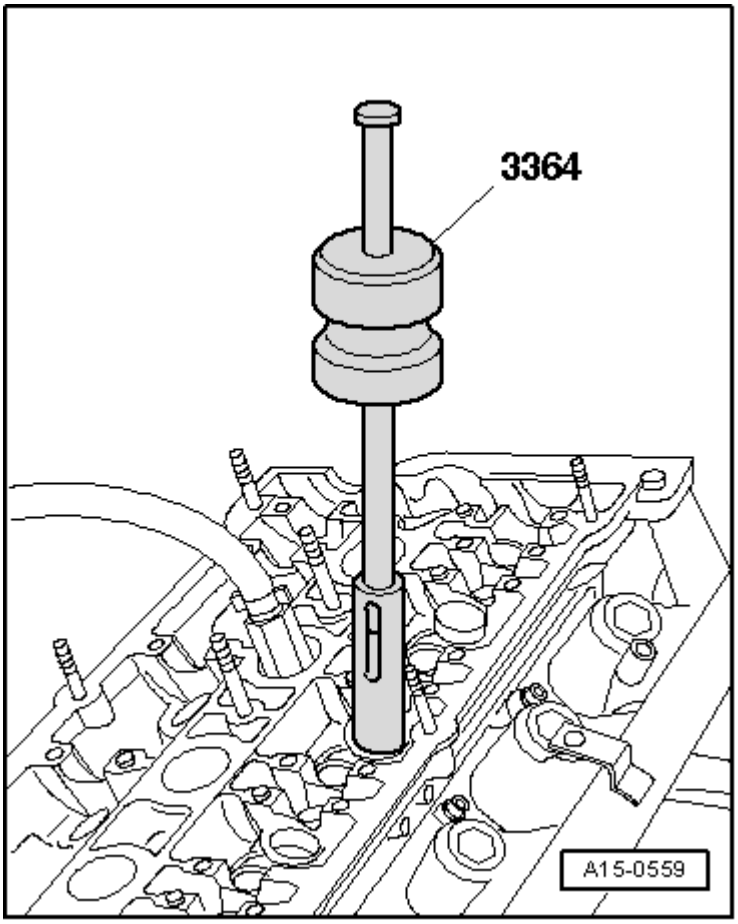

Fig. 177: Removing/Installing Union Nut With Union Nut Tool 3217
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Use Ring nut spanner 3217 to remove union nut.
- Pull flange and seal out of opening in fuel tank.

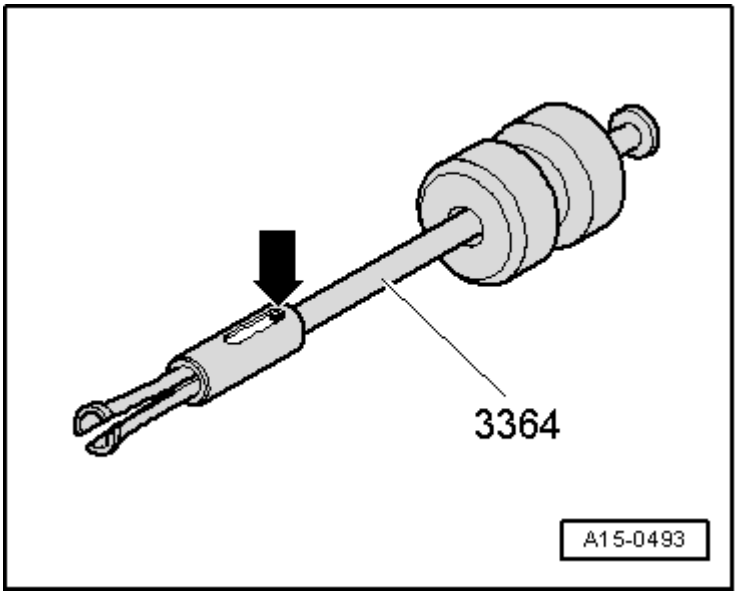

Fig. 178: Remove Fuel Return Line And Connector For Fuel Gauge Sender
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull off fuel return line - **2** - and connector for fuel gauge sender on underside of flange - **1** -.

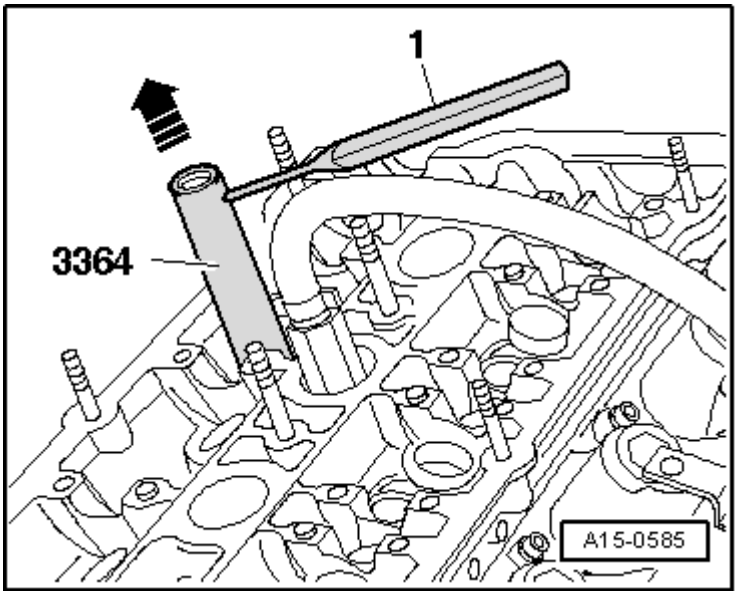

Fig. 179: Pulling Off Connection Piece Of Return Hose At Inner Part Of Baffle Housing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull off connection piece of return hose at inner part of baffle housing in direction of arrow.

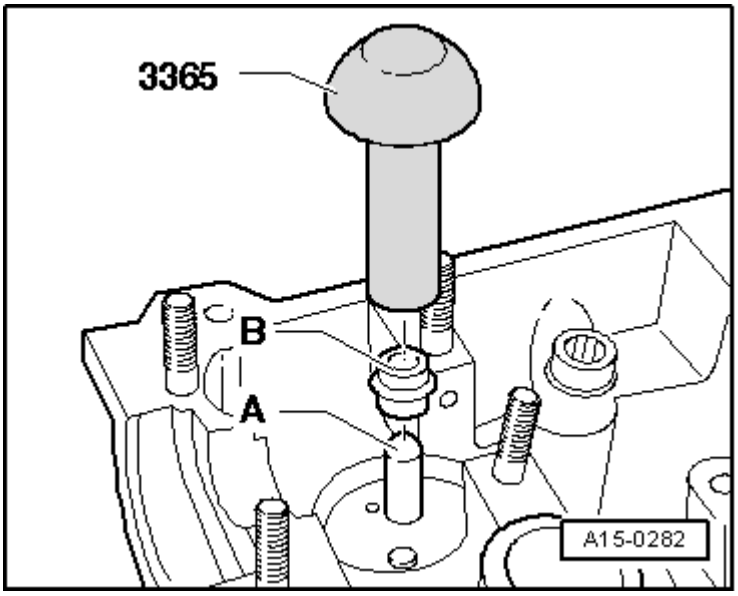

Fig. 180: Removing Sender For Fuel Gauge -G-
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- While pressing retaining tab, pull out Sender for fuel gauge -G- from baffle housing in fuel tank - **arrows** -.

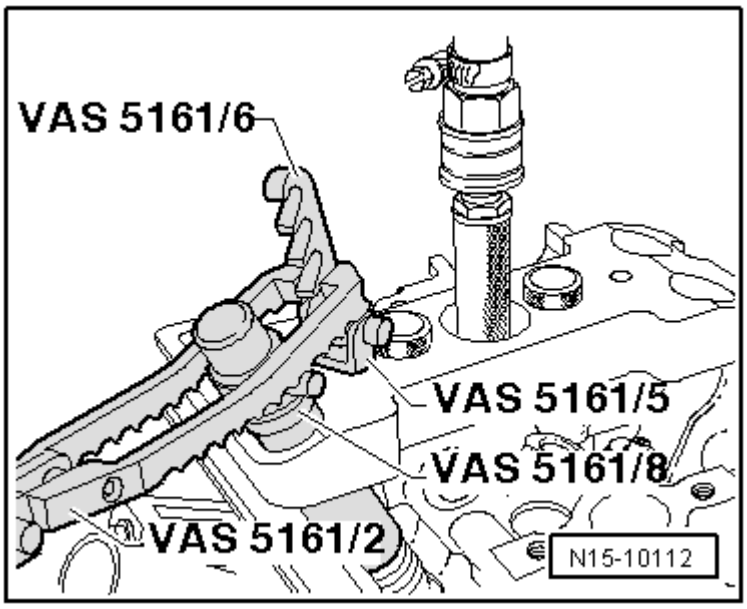

Fig. 181: Press Release Buttons And Separate Fuel Hose At Y-Fitting
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press release buttons - **arrows** - and separate fuel hose at Y-fitting.

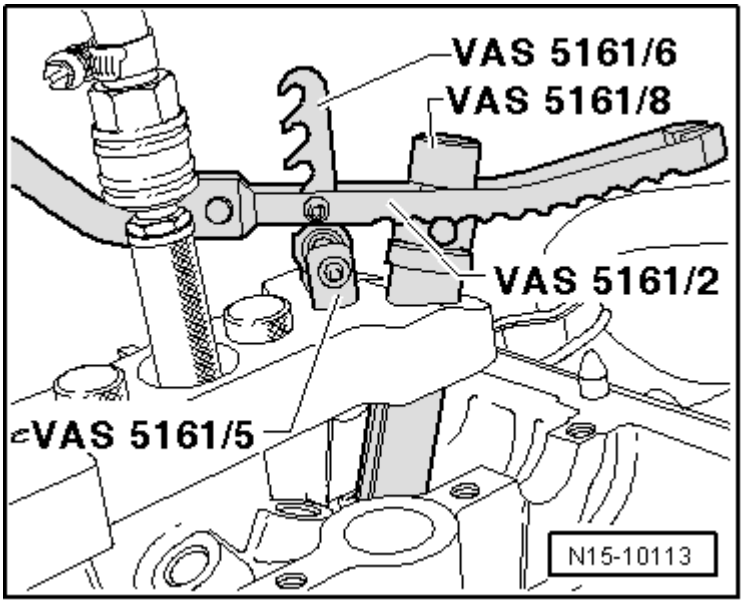

Fig. 182: Removing And Installing In Tank Fuel Pump (FP)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Turn fuel delivery unit approx. 15° counter-clockwise onto stop using Fuel pump wrench 3307 and remove with flange.

NOTE:

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

Installing

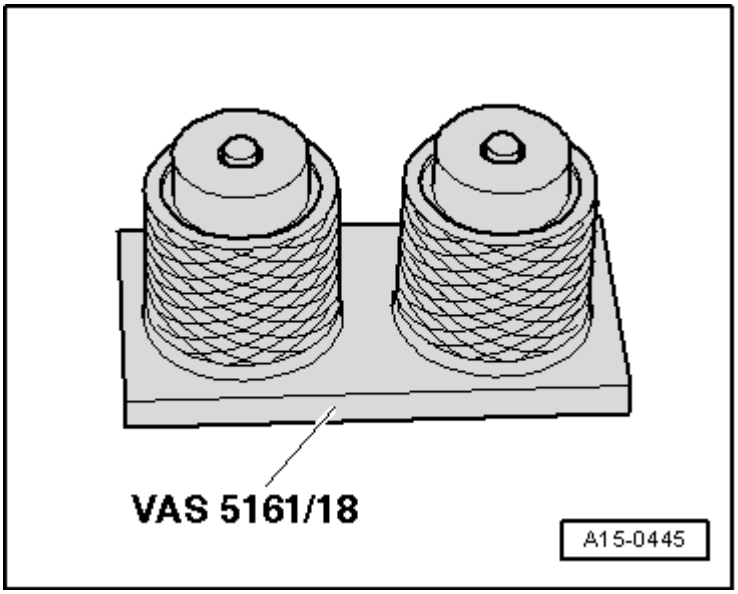

Fig. 183: Inserting Fuel Pump Into Baffle Housing In Fuel Tank
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert fuel pump into baffle housing in fuel tank so that notch - **1** - at fuel pump aligns with marking - **2** - at baffle housing.

NOTE:

- **Baffle housing is shown without fuel tank for the sake of illustration.**

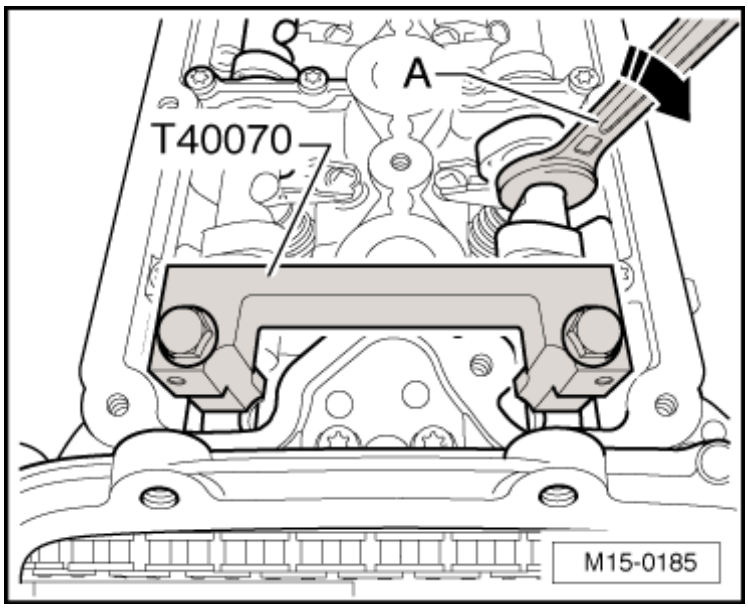

Fig. 184: Removing And Installing In Tank Fuel Pump (FP)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Turn fuel delivery unit approx. 15° clockwise onto stop using fuel pump wrench 3307.

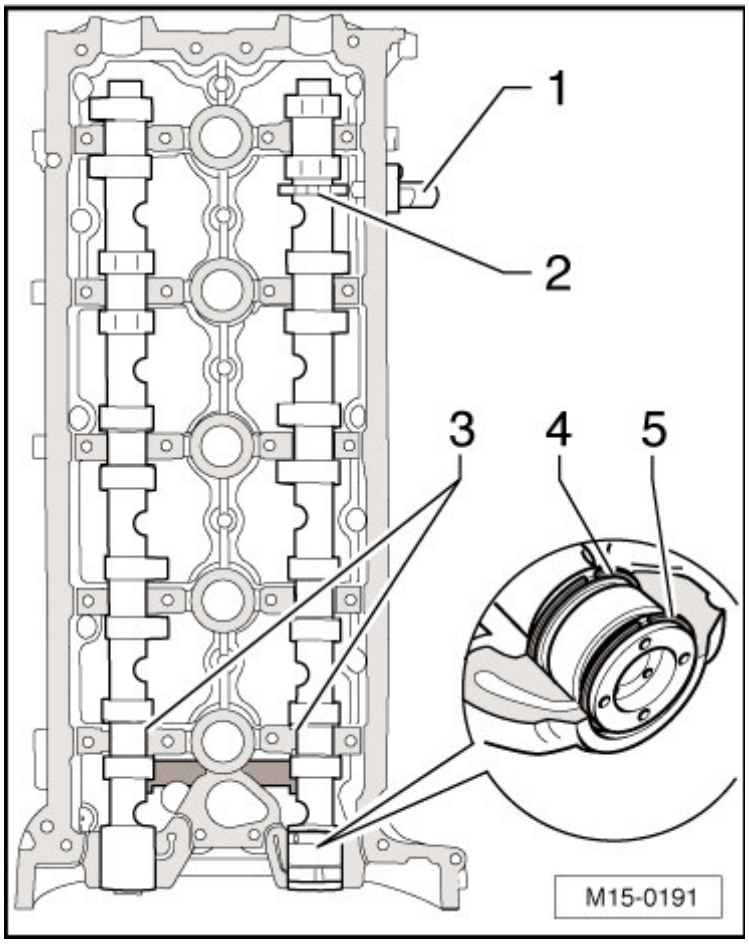

Fig. 185: Inserting Fuel Pump Into Baffle Housing In Fuel Tank
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Notch - **1** - aligns with marking - **3** - (bayonet connection).

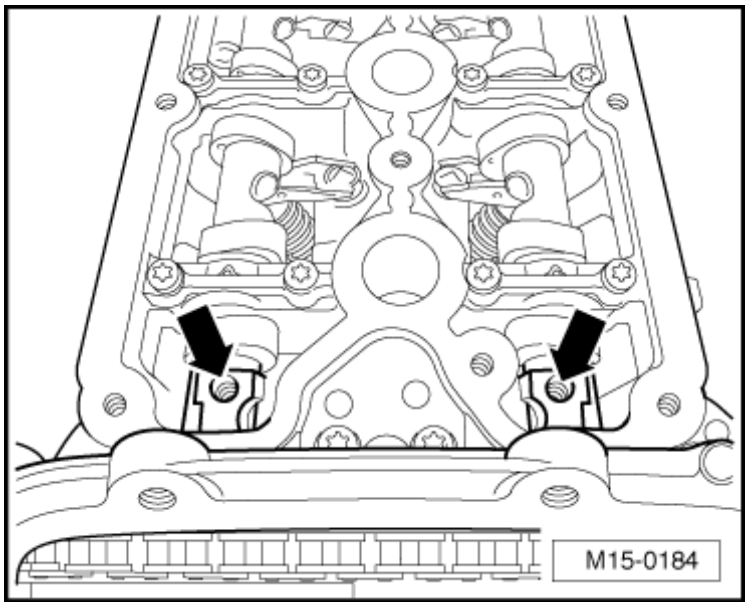

Fig. 186: Pushing Fuel Hose And Y-Fitting Together Until Retaining Tabs Engage
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Push fuel hose onto Y-fitting and push together until retaining tabs - **arrows** - engage.
- Place Y-fitting with fuel hoses into fuel tank toward right rear.

NOTE:

- **Make sure that the fuel hose from the baffle housing to the Y-fitting is hooked into the retainer at the outer part of the baffle housing.**

- Clip in fuel return line at inner part of baffle housing.
- Insert fuel gauge sender in guide at baffle housing and press down until it engages.
- Reconnect fuel gauge sender connector and fuel return line to flange.

NOTE:

- **Insert dry seal of fuel pump into opening of fuel tank.**
- **Only coat seal with fuel when installing Fuel Pump (FP).**

- With flange in installation position, turn clockwise and insert into fuel tank.

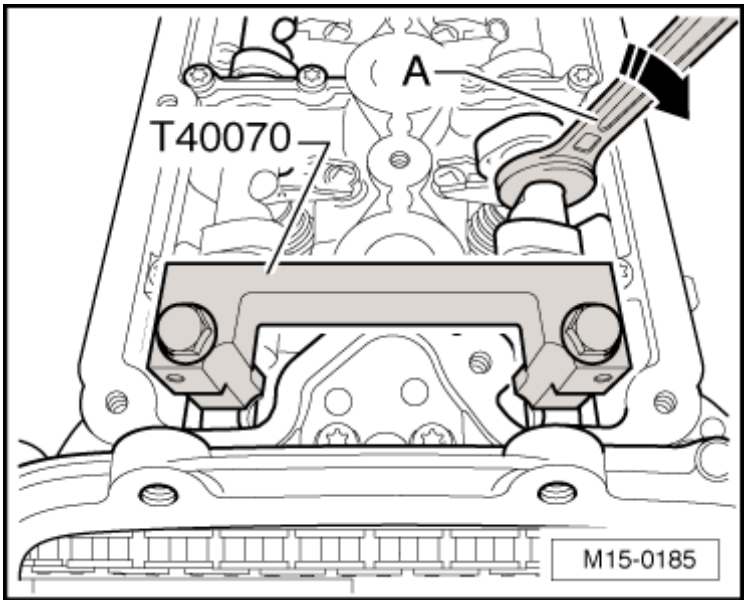

Fig. 187: Identifying Installed Location Of The Fuel Gauge Sender, Fuel Lines And Harness Connector
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Check that marking on flange aligns with marking on fuel tank - **arrow** -.
- Tighten union nut. Tightening torque: 80 Nm

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

NOTE:

- **Do not switch supply and return hoses (return line -blue- or with blue**

markings).

- **Ensure fuel hoses are seated securely.**

Sender for fuel gauge, removing and installing

Removing

NOTE:

- **The fuel tank must not be more than 1/4 full.**
- **Empty fuel tank if necessary --> Fuel tank, emptying .**
- **Observe safety precautions before performing repair work --> Safety precautions when working on fuel supply system .**

- Remove flange --> **Fuel delivery unit, removing and installing**

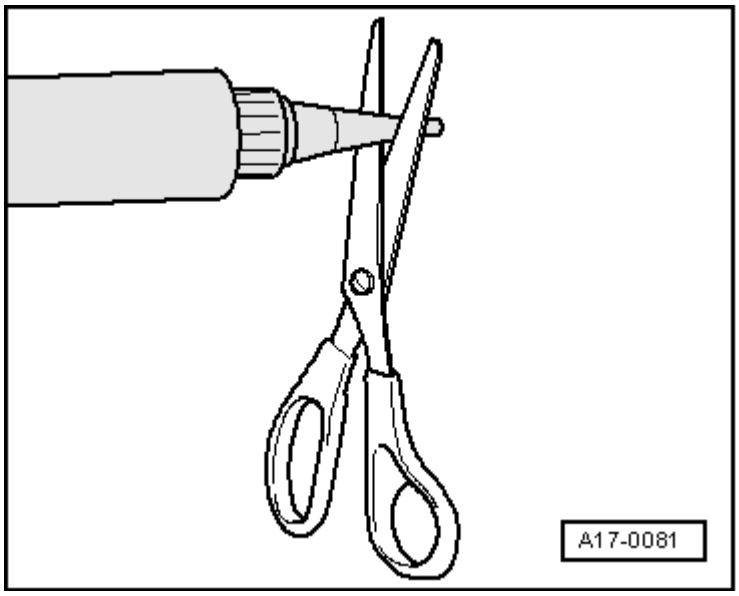

Fig. 188: Removing Sender For Fuel Gauge -G-
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- While pressing retaining tab, pull out Sender for fuel gauge -G- from baffle housing in fuel tank - **arrows** -.

Installing

- Insert Sender for fuel gauge -G- in guide on baffle housing and press down until it engages.
- Install flange of fuel delivery unit --> **Fuel delivery unit, removing and installing**

Accelerator pedal mechanism, assembly overview

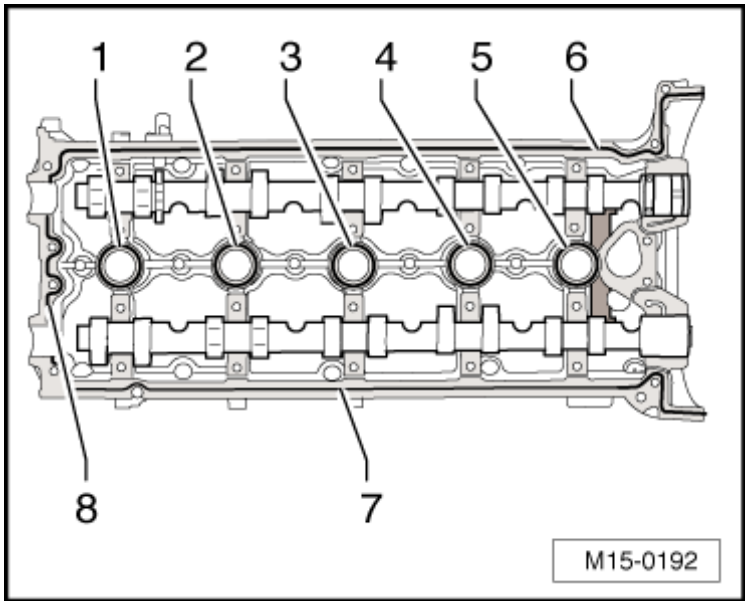

Fig. 189: Electronic Engine Power Control (EPC), Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Bracket

2 - Connector

- Black, 6-pin

3 - 10 Nm

4 - Throttle position (TP) sensor -G79-

- Not adjustable
- Throttle position sensor transmits driver control to engine control module
- To remove, remove footwell cover

5 - Bracket

- For footwell cover
- Clipped to throttle position sensor

Tandem pump, checking

Special tools, testers and auxiliary items required

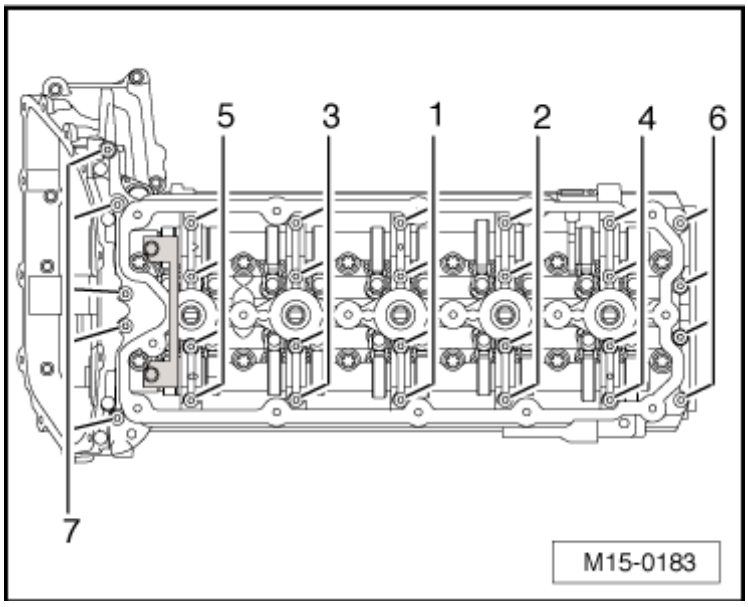

Fig. 190: Special Tool - Pressure Tester VAS 5187
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pressure gauge VAS 5187

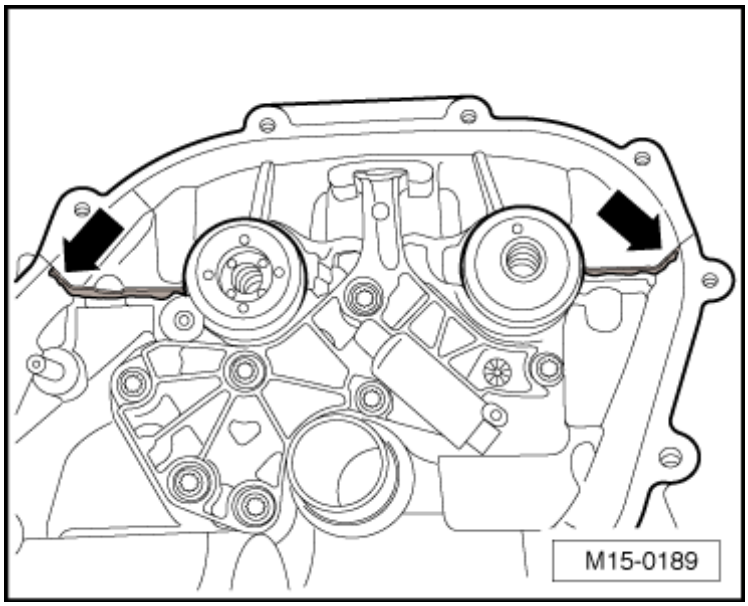

Fig. 191: Torque Wrench V.A.G 1331
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Torque wrench (5 to 50 Nm) V.A.G 1331
- Vehicle diagnostic, testing, and information system VAS 5051
- Diagnostic cable VAS 5051/6A

Conditions

- Coolant temperature must be at least 85°C.
- Pump-Injector units O.K.
- Fuel filter and fuel lines must not be plugged.
- Fuel level sensor must be OK.

Work sequence

- Loosen charge air tube and set aside.

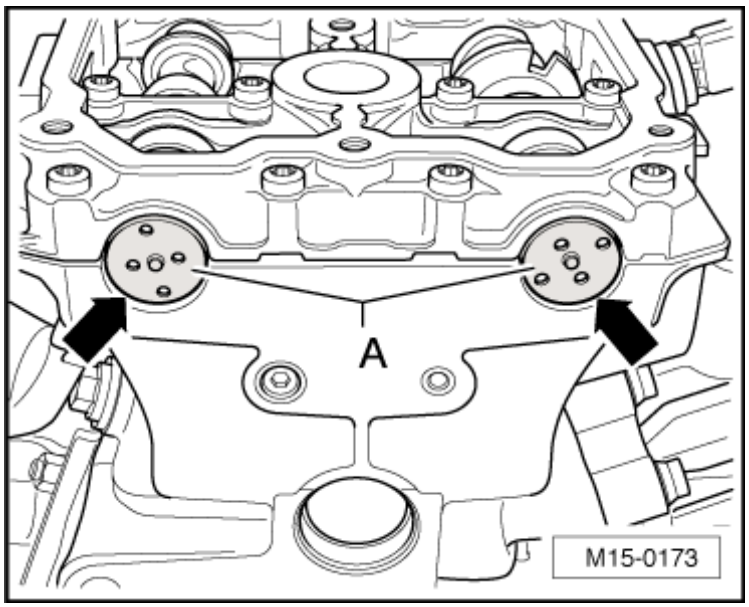

Fig. 192: Identifying Plug
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove locking bolt - **arrow** -.

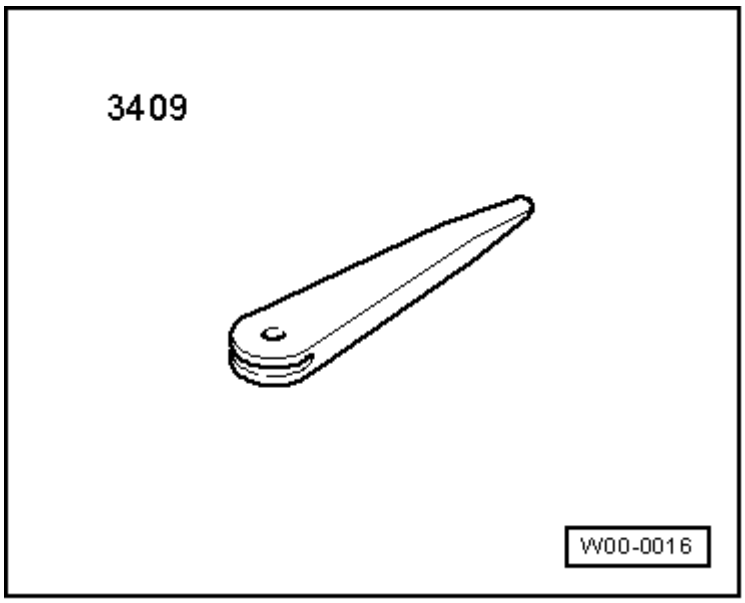

Fig. 193: Installing Pressure Gauge VAS 5187
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install pressure gauge VAS 5187 as shown.
- Secure charge air tube in place again.
- Start engine and run at idle speed.
- Connect vehicle diagnostic, testing, and information system VAS 5051 and select operating mode "Vehicle self-diagnosis".
- Press button "01 - Engine electronics" on display.
- Press diagnostic function"08 - Read measured value block".
- Using number keypad, enter display group "1" and acknowledge entry with Q-key.
- Read idle RPM in display field "1".
- Increase engine speed to 4000 RPM.
- Observe displayed pressure on pressure gauge.

Specification: min. 7.5 bar

- Return engine to idle speed.

If the specification is not obtained:

- Clamp return line closed between fuel filter and tandem pump with a hose clamp.
- Increase engine speed to 4000 RPM.
- Observe displayed pressure on pressure gauge.

Specification: min. 7.5 bar

- Return engine to idle speed.

If the specification is now obtained:

Pressure loss at Pump-Injector unit.

- Replace O-rings of Pump-Injector unit.

If the specification is not obtained:

- Replace tandem pump --> **Tandem pump, removing and installing**

NOTE:

- **After removing the pressure gauge, fasten the locking bolt to 25 Nm. Always replace the seal.**

Tandem pump, removing and installing

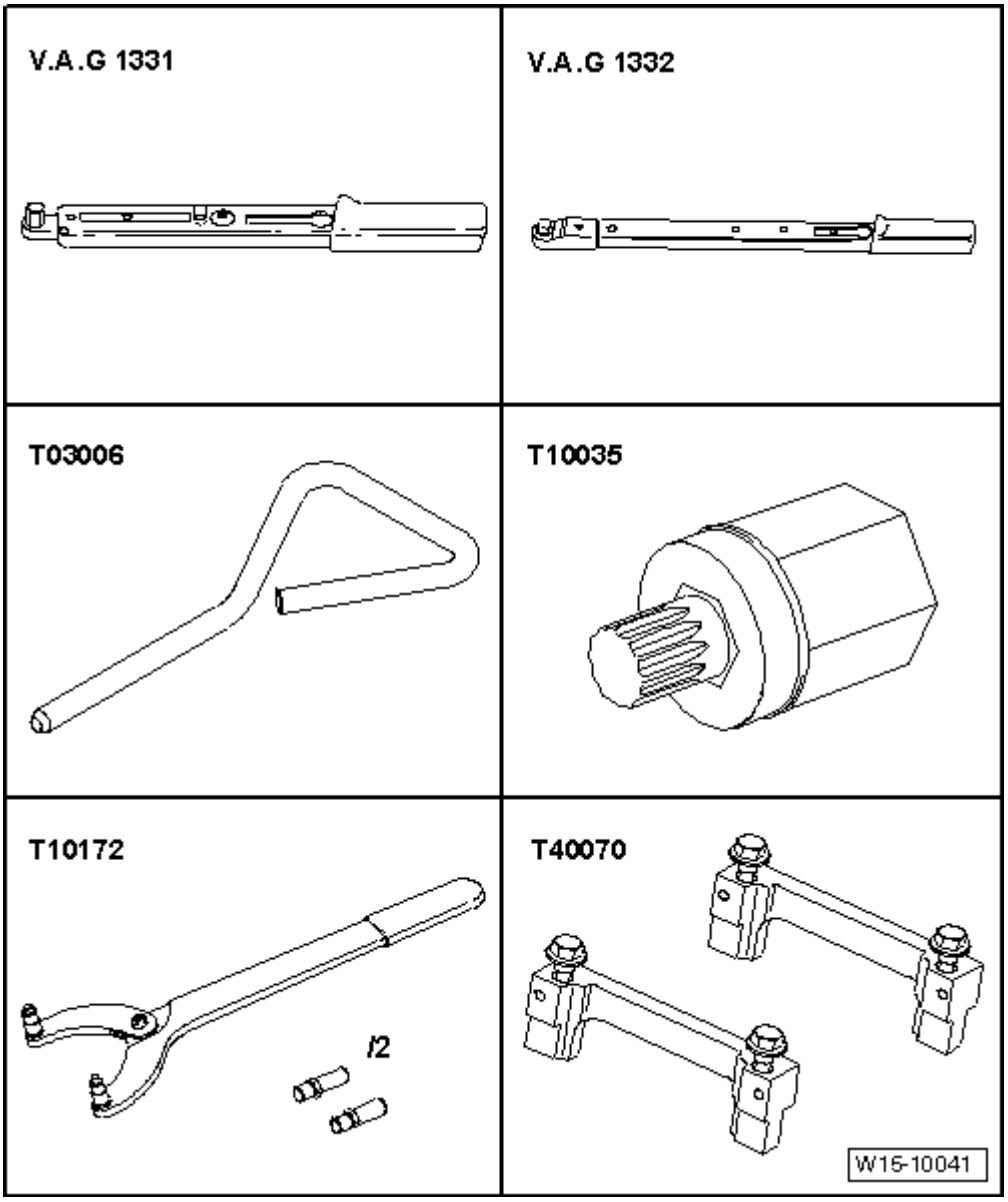

Fig. 194: Identifying Special Tools - Tandem Pump, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Torque wrench (5 to 50 Nm) V.A.G 1331
- Hand vacuum pump V.A.G 1390
- Hand vacuum pump reservoir V.A.G 1390/1
- Pliers for spring type clips VAS 5024

Removing

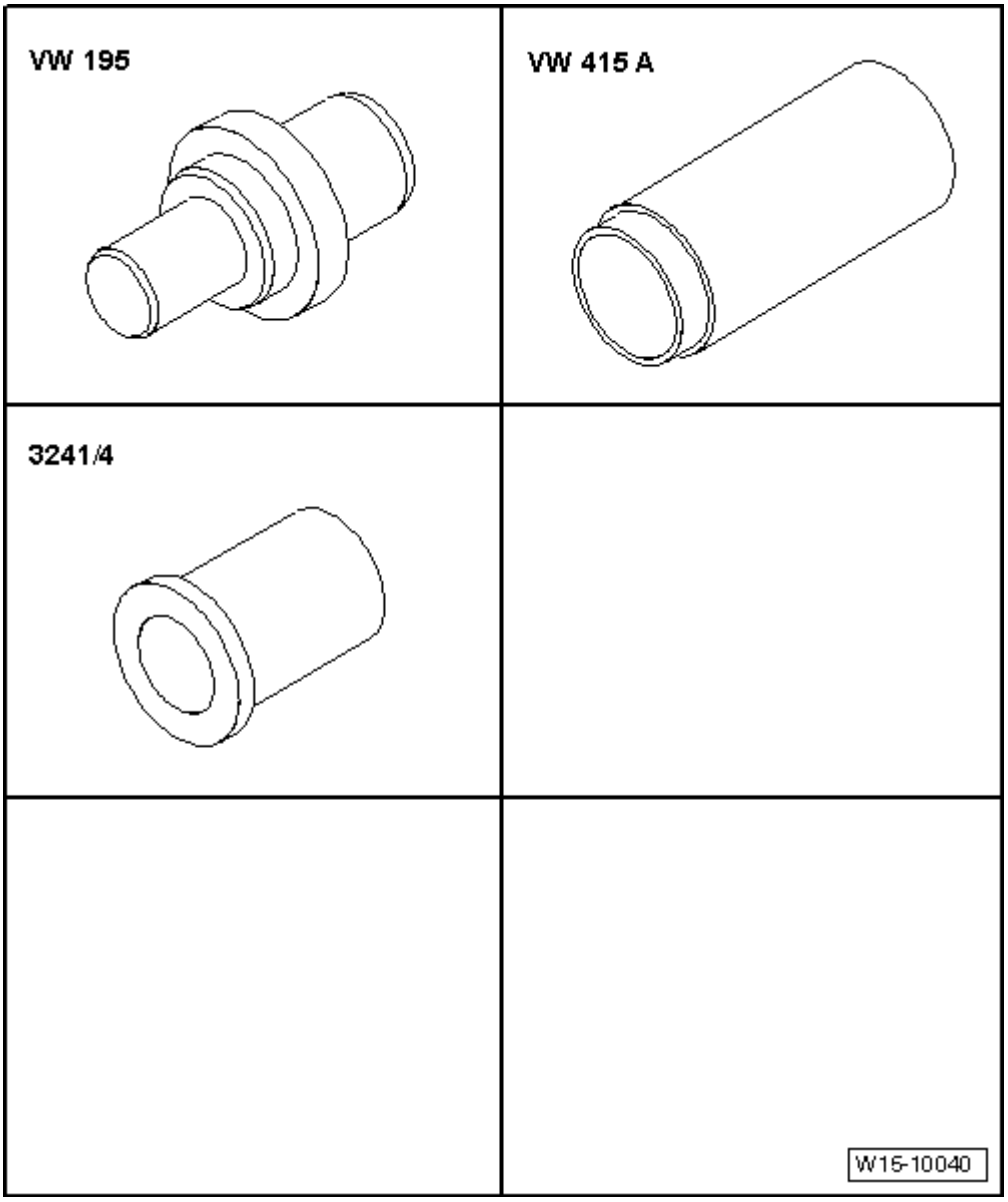

Fig. 195: Identifying Fuel Lines At Fuel Filter
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull off supply hose - **1** - (white marking) and return hose - **2** - (blue marking) from fuel filter.
- Connect hand vacuum pump V.A.G 1390 with hand vacuum pump reservoir V.A.G 1390/1 to return hose.
- Operate hand vacuum pump until no more fuel runs from return hose. Make sure that no fuel is sucked into hand vacuum pump.
- Loosen charge air tube and set aside.

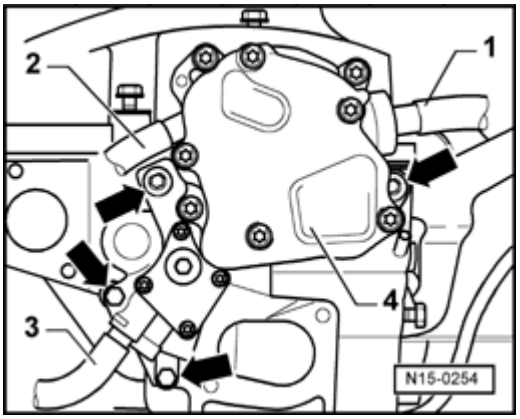

Fig. 196: Identifying Vacuum Hose, Supply Hose, And Return Hose
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull vacuum line - **1** - from brake booster off of tandem pump - **4** -.
- Disconnect central connector for Pump-Injector unit.
- Pull supply hose - **2** - (white marking) off of tandem pump - **4** -.
- Remove bolts - **arrows** -.

- Remove the tandem pump - **4** - from the cylinder head.
- Pull tandem pump - **4** - slightly upward, pull off return hose - **3** - (blue marking) and remove tandem pump - **4** -.

Installing

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

NOTE:

- **Make sure that the tandem pump is properly seated in the camshaft.**
- **Always replace the seals of the tandem pump.**

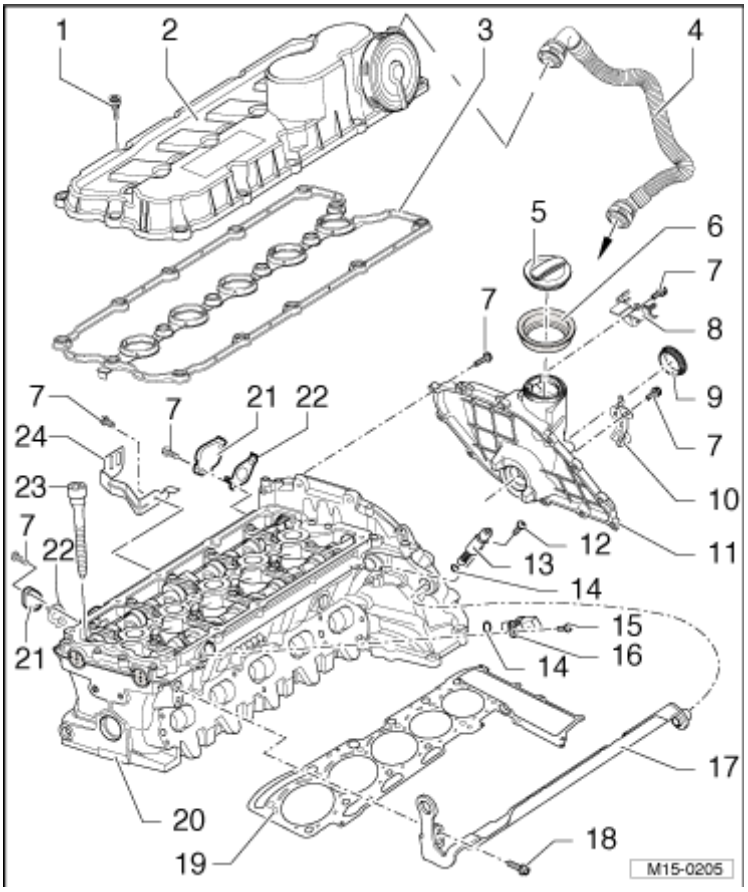

Fig. 197: Identifying Vacuum Hose, Supply Hose, And Return Hose
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect return hose - **3** - (blue marking) to return connection on tandem pump.
- Install tandem pump and tighten upper bolts to 20 Nm.
- Tighten lower bolts to 10 Nm.
- Connect supply hose - **2** - (white marking) to supply connection and vacuum line - **1** - from brake booster to tandem pump - **4** -.

- Connect central connector for Pump-Injector unit.
- Install charge air tube.

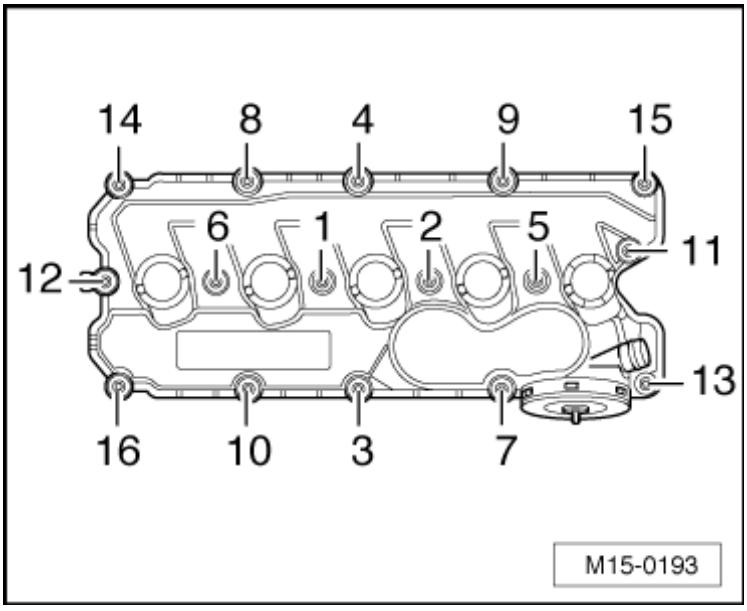

Fig. 198: Identifying Fuel Lines At Fuel Filter
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect supply hose - **1** - (white marking) to fuel filter.
- Connect hand vacuum pump V.A.G 1390 with hand vacuum pump reservoir V.A.G 1390/1 to return hose - **2** - (blue marking) of fuel filter.
- Operate hand vacuum pump, until fuel runs from return hose. Make sure that no fuel is sucked into hand vacuum pump.
- Connect return hose - **2** - (blue marking) to fuel filter.

21 TURBOCHARGER, G-CHARGER

CHARGE AIR SYSTEM WITH TURBOCHARGER

Charge air system with turbocharger

Observe safety precautions --> **Safety precautions** .

Observe rules for cleanliness --> **Rules for cleanliness** .

Observe notes for hose connections with connection couplings --> **Hose connections with couplings** .

Turbocharger, assembly overview --> **Turbocharger, assembly overview** .

Charge air cooler, assembly overview --> **Charge air cooler, assembly overview** .

Safety precautions

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

attention to the following due to clearance issues:

- **Route all the various lines (e.g. for fuel, hydraulics, EVAP system, coolant, refrigerant, brake fluid and vacuum lines and hoses) and electrical wiring so that the original positions are restored.**
- **Ensure sufficient clearance to all moving or hot components.**

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 passenger seat and the vehicle is involved in an accident, there is a possibility that the person sitting in this seat may receive serious injuries when the airbag is triggered.

Rules for cleanliness

When working on turbocharger, carefully observe the following 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.).
- Supplied transport and protective packaging and sealing caps should only be removed immediately before installing.
- During repair, clean oil from connections and hose ends.
- When the system is open: Avoid working with compressed air if possible. Do not move vehicle unless absolutely necessary.

Hose connections with couplings

NOTE:

- **If necessary, use lubricant (water without additive) to assist assembly. Do not use lubricants containing oil.**
- **Various hose connections of the charge air system are secured by spring-type hose clamps or couplings. With couplings, the following points must be observed:**

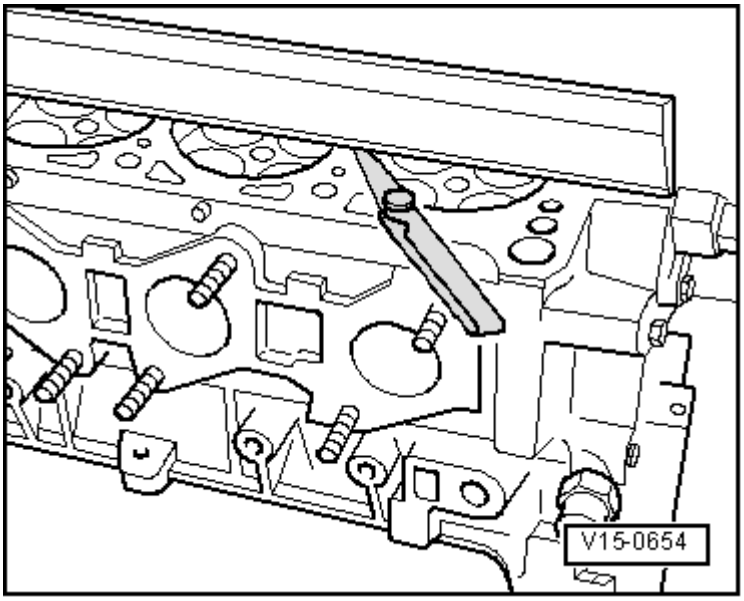

Fig. 199: Identifying Hose/Tube Retaining Tabs
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Release coupling by pulling securing clip - **arrow** -. Separate hose/tube without assistance from tools.
- When installing, make sure that retaining tabs - **A** - are securely engaged.

Turbocharger, assembly overview

Observe safety precautions --> **Safety precautions** .

Observe rules for cleanliness --> **Rules for cleanliness** .

NOTE:

- **Various hose connections of the charge air system are secured by spring-type hose clamps or couplings.**
- **If necessary, use lubricant (water without additive) to assist assembly. Do not use lubricants containing oil.**
- **Charge air system must be properly sealed.**
- **Fill the oil supply line of the turbocharger with engine oil before fastening it to the connection fitting.**
- **After installing, allow the turbo to run at idle for approx. 1 minute and do not increase RPMs. Thereby, proper lubrication of the turbocharger is ensured.**
- **Replace self-locking nuts.**

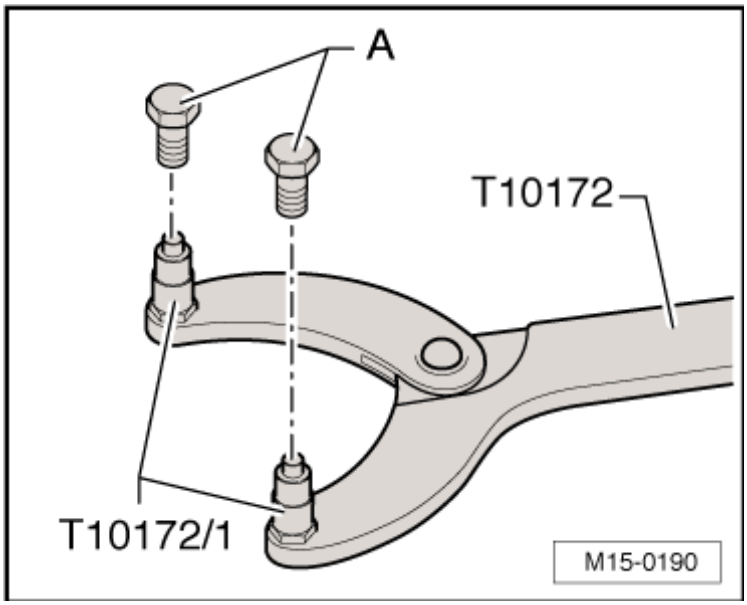

Fig. 200: Turbocharger Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Turbocharger intake temperature sensor -G507-

- Tightening torque: 45 Nm

2 - Exhaust manifold

3 - 25 Nm

- Replace
- Coat threads of studs with *G 000 500* .

4 - Intake manifold

- With Motor for intake flap -V157-

5 - From charge air cooler

6 - Seal

- Replace

7 - 25 Nm

8 - Seal

- Replace
- Note installed position

9 - Bracket

10 - Washer

11 - Heat shield

12 - Vacuum diaphragm

- For boost pressure regulation
- Component of turbocharger cannot be replaced separately

13 - Turbocharger

14 - From crankcase ventilation

15 - From air filter

16 - Seal

- Replace

17 - 15 Nm

18 - Oil seal

- Replace

19 - Connecting piece, 40 Nm

20 - Oil return line, 25 Nm

- To cylinder block

21 - Bracket

22 - To charge air cooler

23 - Seal

- Replace

24 - Front exhaust pipe

25 - Vacuum hose

- To Wastegate bypass regulator valve -N75-

26 - Connection, 30 Nm

- Replace
- Coat threads and bolt head contact surface with G 052 112 A3
- Fill oil supply line with oil before fastening it to connection fitting

27 - 10 Nm

28 - Oil supply line

- From oil filter bracket
- Fill oil supply line with oil before fastening it to connection fitting
- Oil supply line, assembly overview --> **Oil supply line, assembly overview**

29 - Bracket

- Fasten oil supply line before installation

30 - Nut

Charge air cooler, assembly overview

NOTE:

- **Charge air system must be properly sealed.**
- **Various hose connections of the charge air system are secured by spring-type hose clamps or couplings.**
- **If necessary, use lubricant (water without additive) to assist assembly. Do not use lubricants containing oil.**
- **With couplings, follow the installation instructions closely --> Hose connections with couplings .**

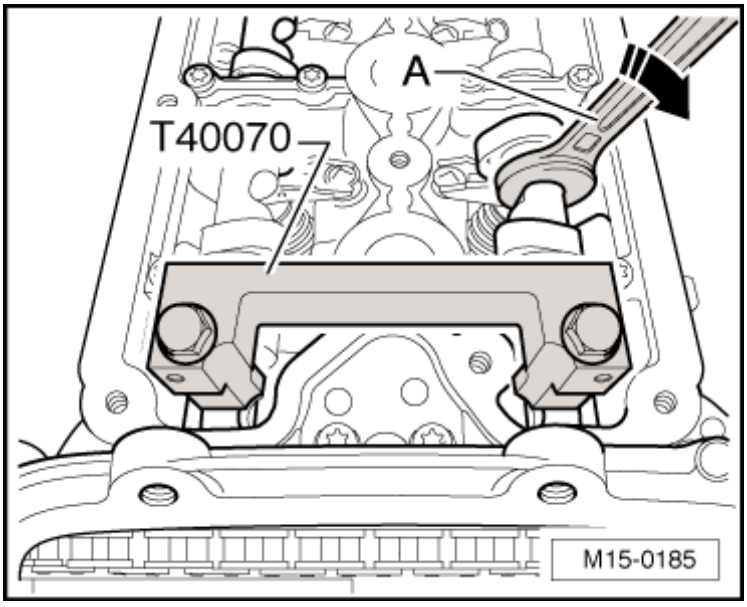

Fig. 201: Charge Air Cooler Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Charge air cooler

2 - Retaining clip

3 - O-ring

- Black
- Replace

4 - Connecting hose

5 - Rubber grommet

6 - Bushing

7 - 10 Nm

8 - O-ring

- Replace if damaged

9 - Manifold Absolute Pressure (MAP) sensor -G71- with Intake Air Temperature (IAT) sensor -G72-

10 - 3 Nm

11 - To Motor for intake flap -V157-

12 - Retaining clip

- Check for secure seat

13 - Connecting hose

14 - Charge air pipe

15 - Connecting hose

16 - O-ring

- Green
- Replace

17 - From turbocharger

18 - Transverse pipe

19 - Connecting hose

23 DIESEL FUEL INJECTION

DIESEL DIRECT FUEL INJECTION SYSTEM, SERVICING

Diesel Direct Fuel Injection System, servicing

The control module for Diesel Direct fuel injection system is equipped with a DTC memory. Before and after repairs or adjustments, the DTC memory must be checked --> **Engine control module DTC memory, checking and erasing** .

Observe the safety precautions --> **Safety precautions** .

Observe the rules for cleanliness --> **Rules for cleanliness** .

Intake manifold with motor for intake flap, assembly overview --> **Intake manifold with motor for intake flap, assembly overview** .

Air filter, assembly overview --> **Air filter, assembly overview** .

Pump-Injector unit, assembly overview --> **Pump-Injector unit, assembly overview** .

Safety precautions

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

- **Route all the various lines (e.g. for fuel, hydraulics, EVAP system, coolant, refrigerant, brake fluid and vacuum lines and hoses) and electrical wiring so that the original positions are restored.**
- **Ensure sufficient clearance to all moving or hot components.**

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 passenger seat and the vehicle is involved in an accident, there is a possibility that the person sitting in this seat may receive serious injuries when the airbag is triggered.

To reduce the risk of personal injury and/or damage to the fuel injection and glow plug system, always observe the following:

- Only disconnect and reconnect wires for glow plug and fuel injection systems, including test leads, when ignition is turned off.
- If engine is to be cranked at starting RPM without starting, e.g. for a compression test, separate the connection for Pump-Injector unit at cylinder head.
- Obtain radio code for radios with anti-theft coding before disconnecting battery.
- Always switch ignition off before disconnecting or connecting battery, as failure to do so may damage the control module for Diesel Direct Fuel Injection System.

Rules for cleanliness

When working on the fuel supply/injection system, pay careful attention to the following "6 rules":

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

Intake manifold with motor for intake flap, assembly overview

When the engine is switched off, the intake manifold flap closes for approx. 3 seconds and then opens again. This reduces the stop jolt.

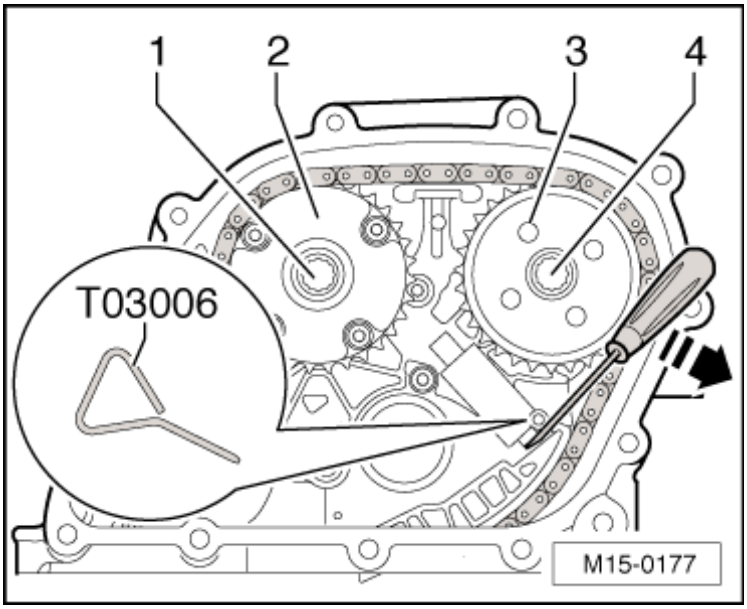

Fig. 202: Intake Manifold Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Motor for intake flap -V157-

2 - Intake manifold

3 - Seal

- Replace

4 - Connecting pipe

- For Exhaust Gas Recirculation (EGR) system

5 - 25 Nm

6 - 10 Nm

7 - Potentiometer for EGR -G212-

- Removing and installing --> **Exhaust Gas Recirculation (EGR), assembly overview**

8 - 25 Nm

9 - Seal

- Replace

10 - Oil seal

- Replace

11 - 10 Nm

Air filter, assembly overview

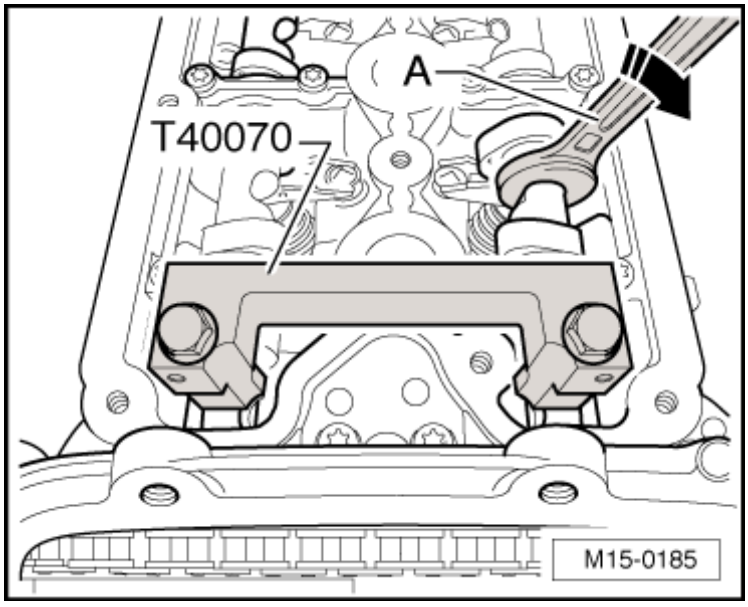

Fig. 203: Air Filter Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Air ducts

- To lock carrier

2 - 3.5 Nm

3 - Mass air flow (MAF) sensor -G70-

4 - Oil seal

5 - Air filter upper part

6 - Vacuum hose

- To Wastegate bypass regulator valve -N75-

7 - Filter element

8 - 2.5 Nm

9 - Heat shield

10 - Connection

11 - 10 Nm

12 - Spacing sleeve

13 - Rubber grommet

14 - Rubber buffer

15 - Air filter lower part

Pump-Injector unit, assembly overview

- Observe rules of cleanliness --> **Rules for cleanliness**
- Always replace sealing rings and O-rings

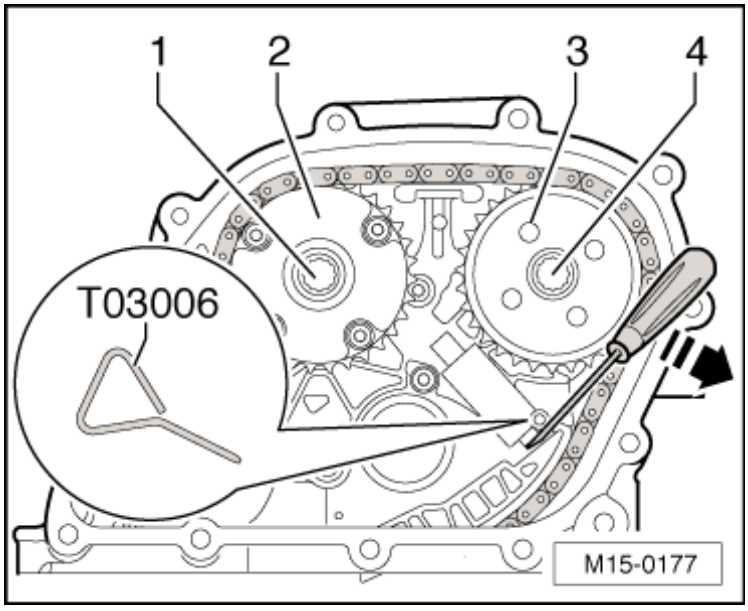

Fig. 204: Pump-Injector Unit Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 20 Nm plus an additional $^{1}/_{4}$ turn (90°)

- Replace

2 - Rocker lever shaft

- With rocker lever
- Removing and installing --> **Pump-Injector unit, removing and installing** , Pump-Injector unit, removing and installing

3 - Lock nut, 30 Nm

4 - Adjustment screw

- Replace

5 - Ball pin

- Replace

6 - Pump-Injector unit

- Removing and installing --> **Pump-Injector unit, removing and installing**

7 - O-ring

- Replacing --> **O-ring for Pump-Injector unit, removing and installing** , O-ring for Pump-Injector unit, removing and installing

8 - O-ring

- Replacing --> **O-ring for Pump-Injector unit, removing and installing** , O-ring for Pump-Injector unit, removing and installing

9 - O-ring

- Replacing --> **O-ring for Pump-Injector unit, removing and installing** , O-ring for Pump-Injector unit, removing and installing

10 - Heat protection seal

- Replace

11 - Circlip

12 - Cylinder head

13 - Tension block

14 - 12 Nm plus an additional $^{3}/_{4}$ turn (270°)

- Replace

O-ring for Pump-Injector unit, removing and installing

Special tools, testers and auxiliary items required

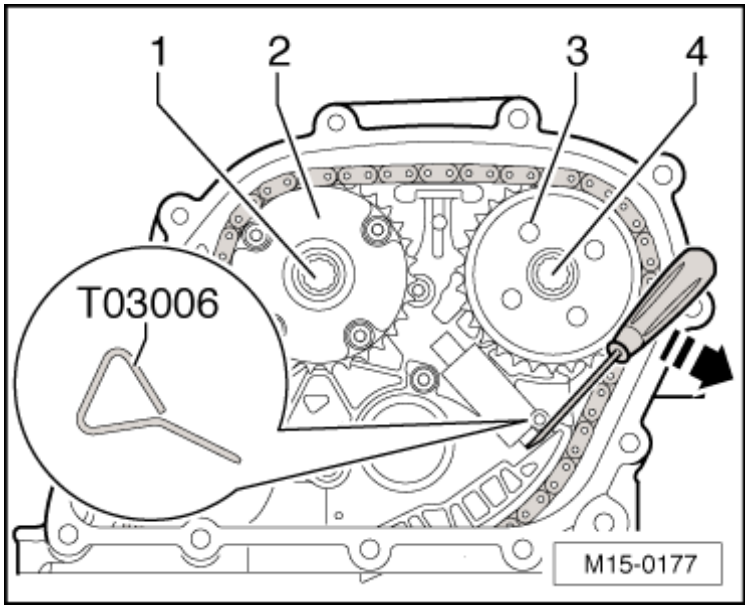

Fig. 205: Special Tool - Assembly Sleeves T10056
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Assembly sleeves T10056

Removing

- Pry old O-rings off extremely carefully from Pump-Injector unit.

NOTE:

- **It is extremely important to ensure that no burrs develop at the O-ring seat.**

Installing

NOTE:

- **Always use the assembly sleeves when installing the O-rings. Not using them may cause the O-rings to be damaged during installation.**
- **There has been a gradual introduction of O-rings without differing color identification. Make sure the O-rings are correctly positioned in the grooves: the ring size decreases toward the nozzle.**
- **Avoid a rolling motion when pushing the O-rings on. The O-rings must not be twisted when seated in the Pump-Injector unit.**

- Pull off heat protection seal together with securing ring.
- Thoroughly clean seating surfaces for O-rings on Pump-Injector unit.

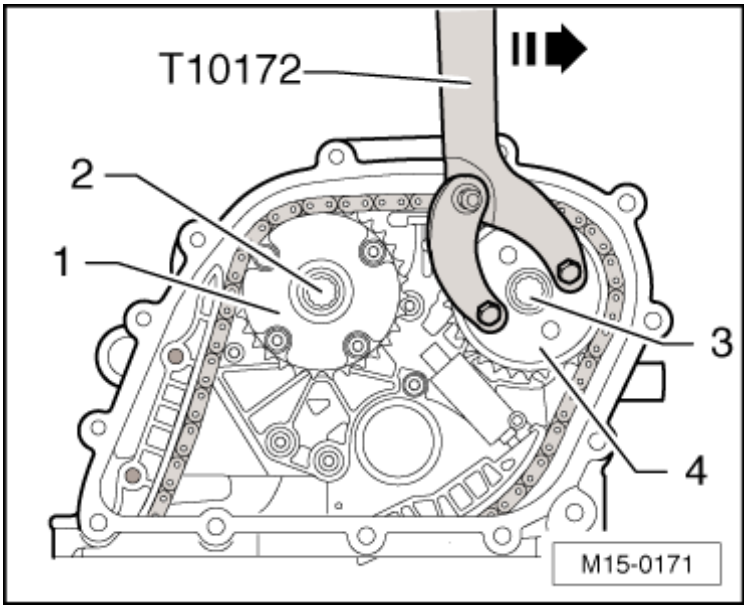

Fig. 206: Installing Thinker O-Ring Onto Pump-Injector Unit
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press assembly sleeve T10056/1 onto Pump-Injector unit up to stop.
- Carefully push upper, thicker O-ring onto assembly sleeve and into seat of Pump-Injector unit.
- Remove assembly sleeve.

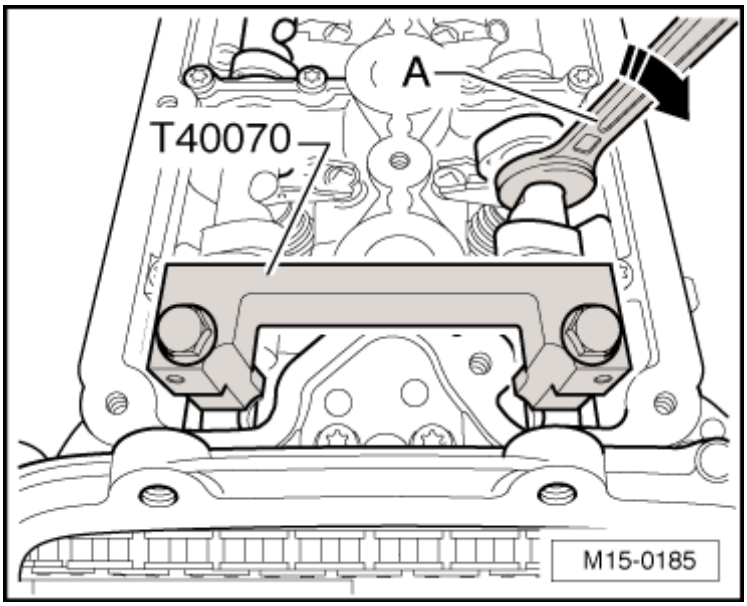

Fig. 207: Installing Thinner O-Ring Onto Pump-Injector Unit
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press assembly sleeve T10056/2 onto Pump-Injector unit up to stop.
- Carefully push middle, thinner O-ring onto assembly sleeve and into seat of Pump-Injector unit.
- Remove assembly sleeve.

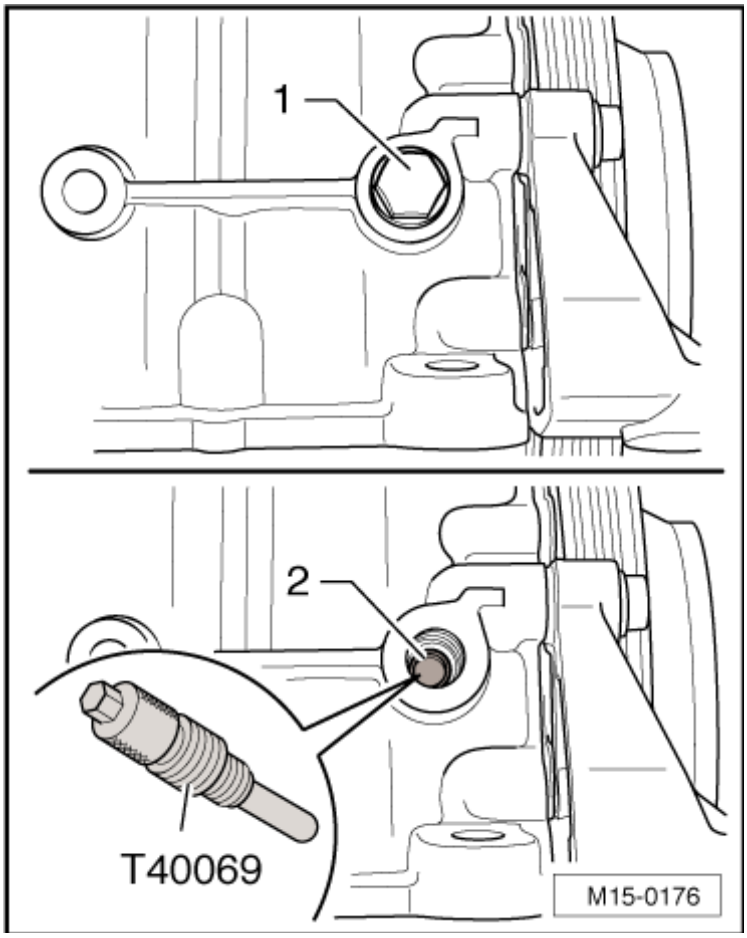

Fig. 208: Installing Lower O-Ring Into Seat Of Pump-Injector Unit
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press assembly sleeve T10056/3 onto Pump-Injector unit up to stop.
- Carefully push lower O-ring onto assembly sleeve and into seat of Pump-Injector unit.
- Remove assembly sleeve.
- Push on a new heat protection seal together with securing ring.

Pump-Injector unit, removing and installing

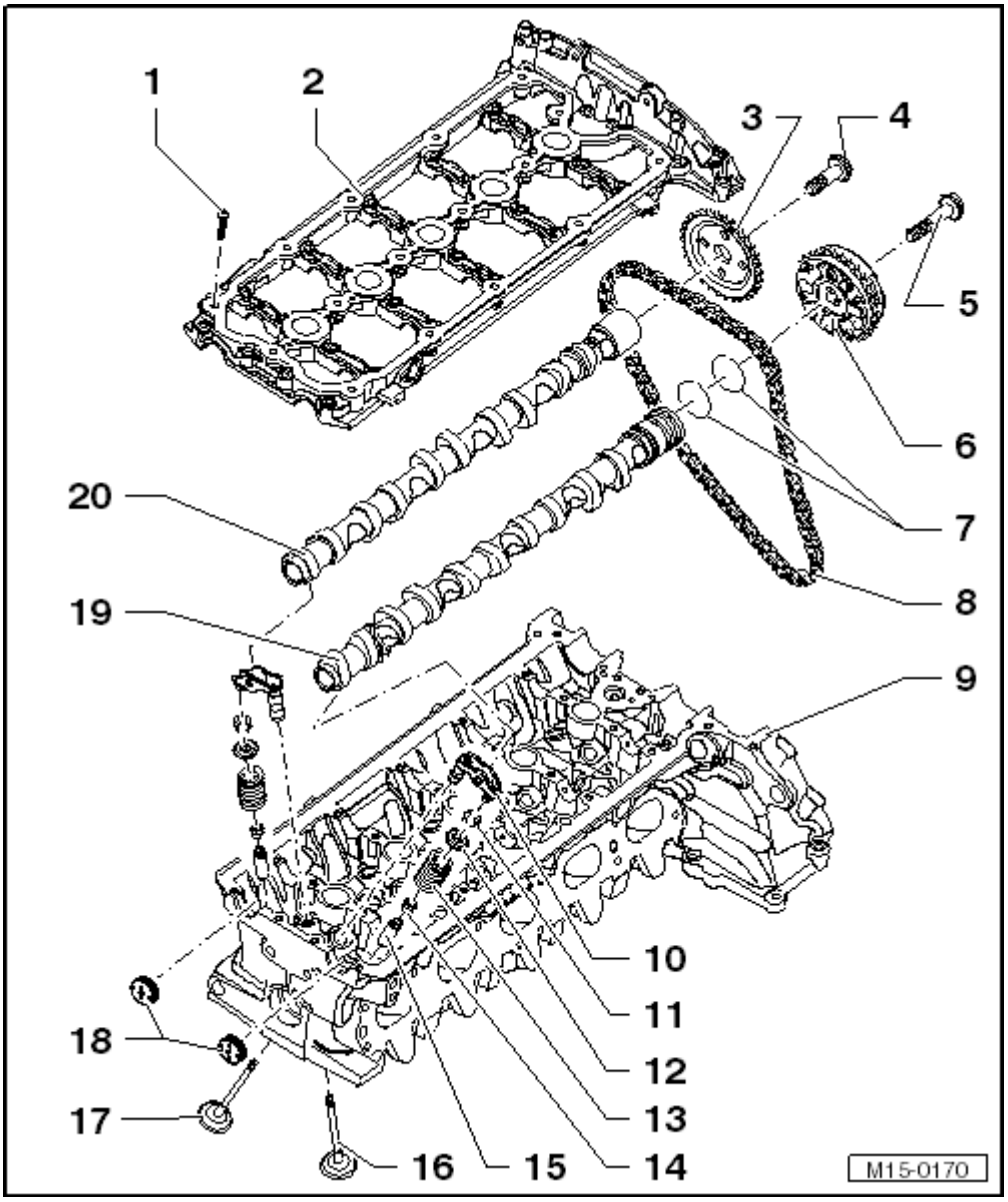

Fig. 209: Identifying Special Tools - Pump-Injector Unit, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Dial gauge holder VW 387
- Hex ball socket 3410
- Hex ball socket T10054
- Removal tool T10055
- Torque wrench (5 to 50 Nm) V.A.G 1331

Removing

- Remove upper toothed belt guard.
- Remove cylinder head cover.
- Turn crankshaft until cam lobe pair for respective Pump-Injector unit point upward equally.

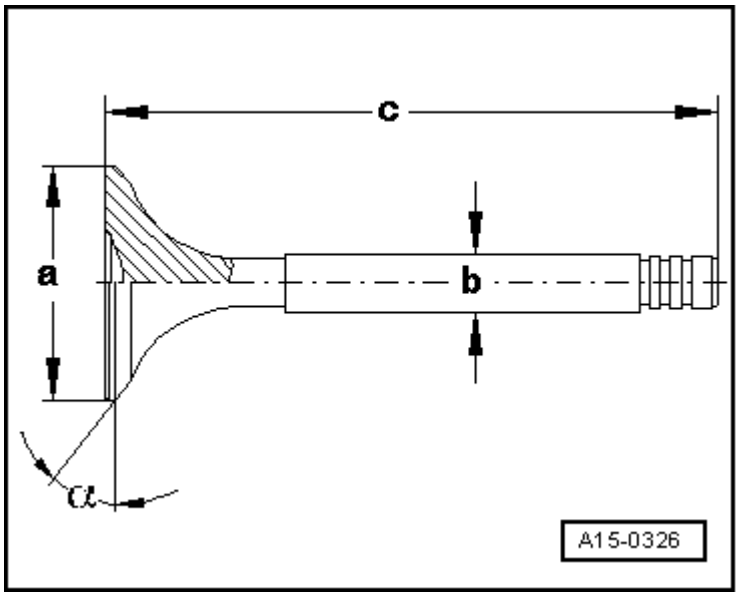

Fig. 210: Identifying Lock Nuts And Securing Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen lock nut of adjustment screw - **1** - and remove adjustment screw.
- Loosen bolts - **2** - for rocker lever shaft from outside toward inside, using socket insert 3410 and remove rocker lever shaft.
- Loosen bolt - **3** - for tension block, using socket insert T10054 and remove tension block.
- Remove connector from Pump-Injector unit. Carefully slide a small screwdriver down center of housing until securing tab is released and connector can be pulled free. To avoid canting, support opposite side of connector with light finger pressure.

NOTE:

- **Observe the cylinder allocation of the Pump-Injector units.**

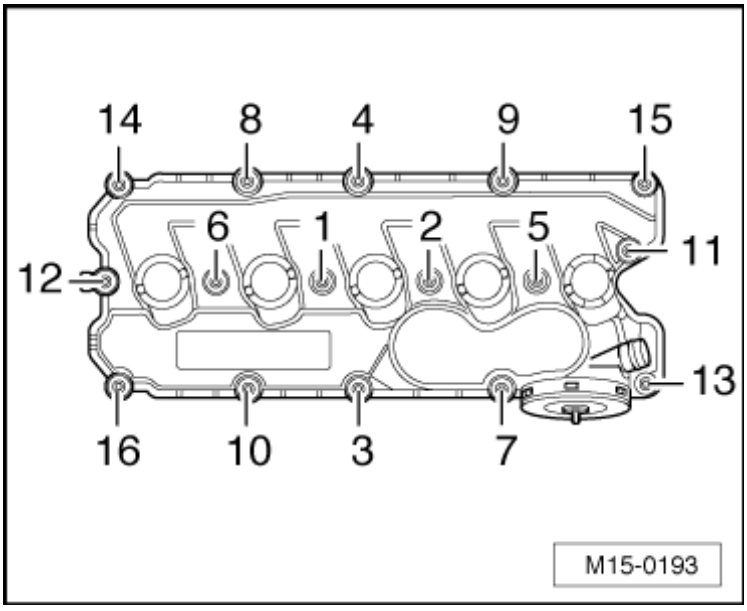

Fig. 211: Removing Pump-Injector Unit Using Insert Extractor - T10055
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Set removal tool T10055 in place of tension block into side slit of Pump-Injector unit.
- Pull Pump-Injector unit upward and out of its seat in cylinder head through careful tapping movements.

Installing

NOTE:

- **For every procedure that requires adjustment of the Pump-Injector unit, the adjustment screw in the rocker lever and the ball pin of the pump-injector unit must be replaced.**
- **New Pump-Injector units come equipped with O-rings and heat protection seal.**

- Replace Pump-Injector O-rings and heat protection seal --> **O-ring for Pump-Injector unit, removing and installing** .
- Before installing Pump-Injector unit, verify that sealing rings, heat protection seal and securing ring are correctly installed in their seats.

NOTE:

- **The seals must not be twisted.**

- Lubricate seals and insert Pump-Injector unit with extreme caution into its seat in cylinder head.
- By applying uniform pressure, push Pump-Injector unit into cylinder head seat up to limit stop.
- Set tension block into side slit of Pump-Injector unit.

NOTE:

- **If the Pump-Injector unit is not positioned at a right angle to the tension block, the bolt can loosen and thereby result in damages to the Pump-Injector unit and cylinder head.**

Align the pump-injector unit as follows:

- Screw new bolt into tension block just far enough so that Pump-Injector unit can still be slightly turned.
- Now, align Pump-Injector unit at a right angle to bearing blocks of camshaft.

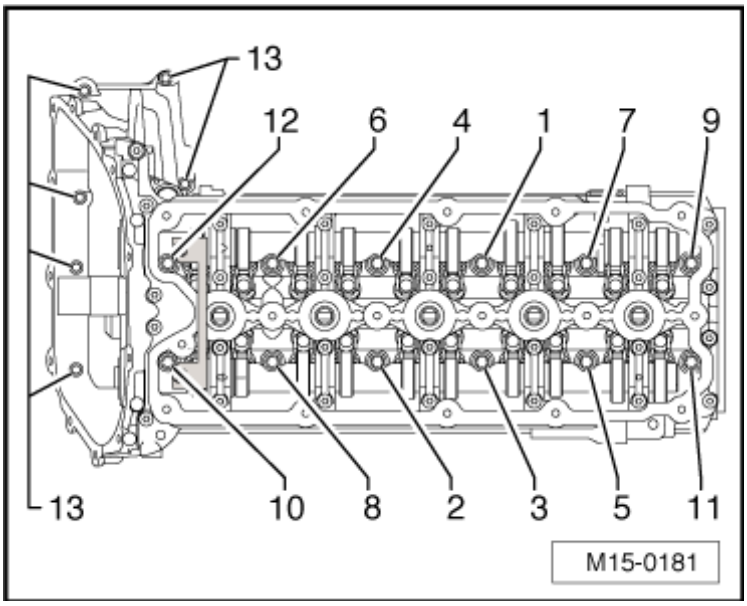

Fig. 212: Identifying Dimension "a"
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Using a caliper gauge (measuring range at least 400 mm), check dimension "a" from outer edge of cylinder head to round surface of pump-injector unit.

Cylinder	Dimension "a"
1	333.0 ± 0.8 mm
2	245.0 ± 0.8 mm
3	153.6 ± 0.8 mm
4	65.6 ± 0.8 mm

- Align Pump-Injector unit, if necessary, and fasten bolt as follows: 12 Nm plus 270° ($^{3}/_{4}$ turn). (Turning further may be performed in several steps.)
- Set rocker lever shaft in place and fasten new bolts as follows:

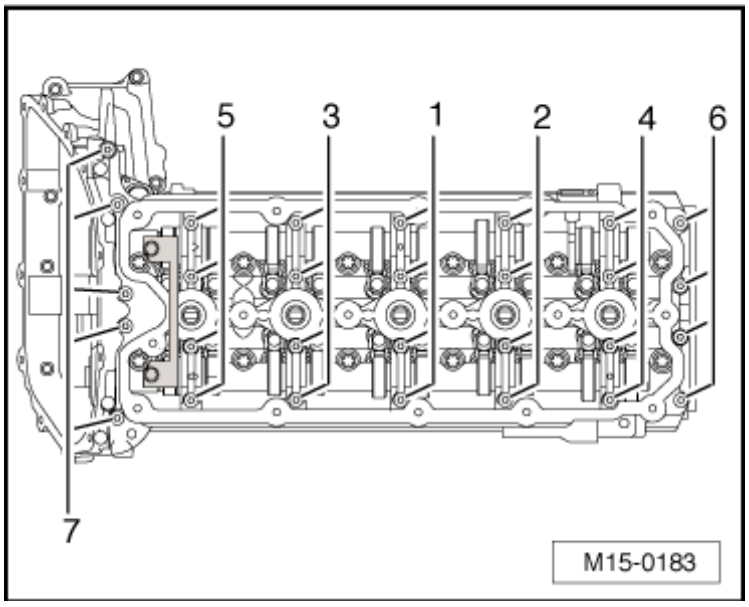

Fig. 213: Marked Rocker Arm Shafts For Reassembly
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- First, fasten inner bolts - **2** - , then outer bolts - **1** - uniformly hand-tight. Then, tighten in same order to 20 Nm plus 90° ($^{1}/_{4}$ turn) uniformly.

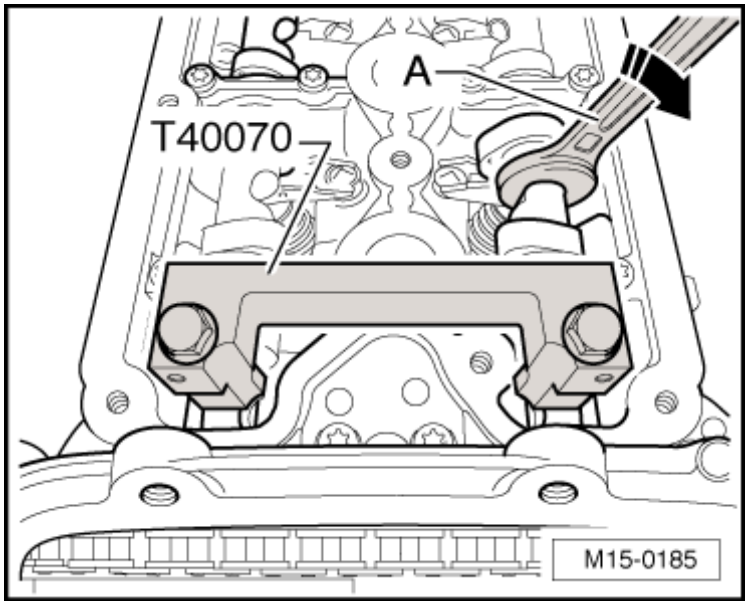

Fig. 214: Setting-Up Dial Gauge Onto Adjustment Bolt Of Pump-Injector Unit
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place a dial gauge as shown onto adjustment screw of Pump-Injector unit.
- Turn crankshaft in engine running direction until roller of rocker lever is positioned on tip of cam lobe. Roller side - **arrow A** - is positioned at highest point, dial gauge - **arrow B** - is positioned at lowest point.
- Remove dial gauge.

- Turn adjustment screw in rocker lever until considerable resistance is felt (Pump-Injector unit is on limit stop).

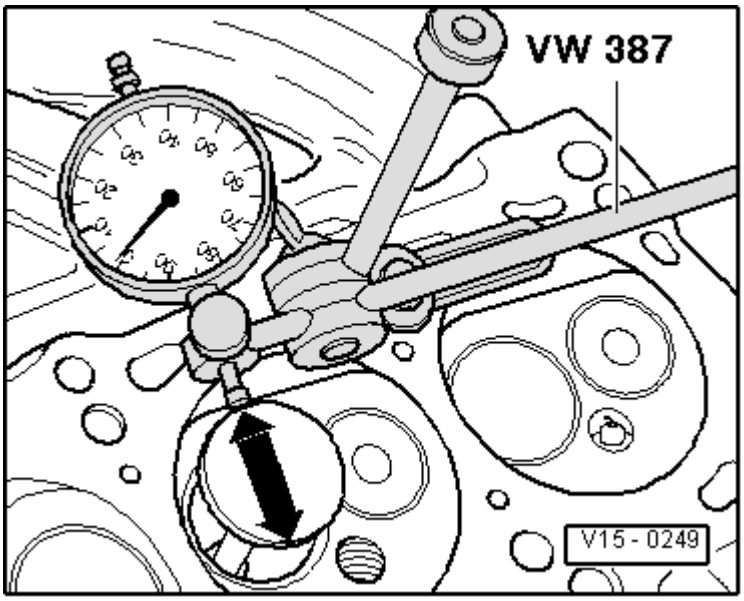

Fig. 215: Adjusting Rocker Arm Adjustment Bolt, 225 Degrees
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Turn adjustment screw 225° back from limit stop.
- Hold adjustment screw in this position and fasten lock nut to 30 Nm.
- Connect connector to Pump-Injector unit.
- Install cylinder head cover.

- Install toothed belt guard.

ENGINE CONTROL MODULE

Engine control module

Diagnostic Trouble Code (DTC) memory of Engine Control Module (ECM), checking and erasing --> **Engine control module DTC memory, checking and erasing** .

Adapting functions and components --> **Adapting functions and components** .

Engine Control Module (ECM), removing and installing --> **Engine Control Module (ECM), removing and installing** .

Engine control module DTC memory, checking and erasing

Special tools, testers and auxiliary items required

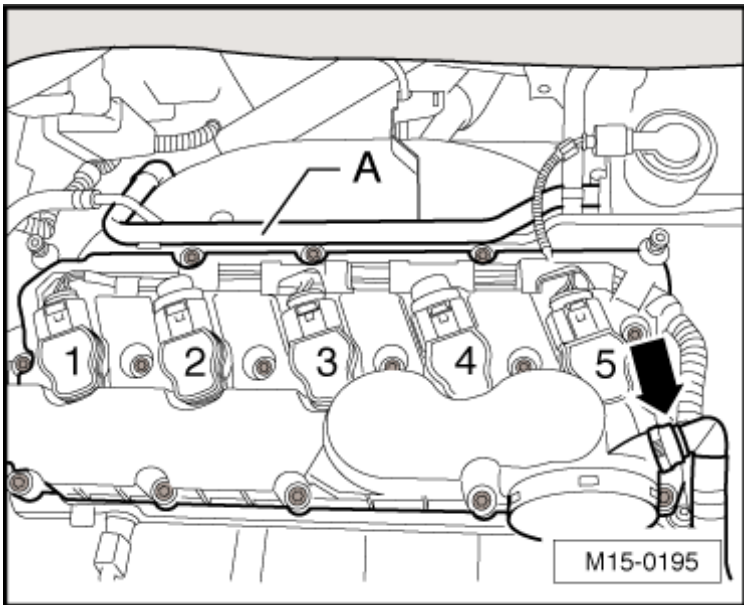

Fig. 216: VAS 5051 Vehicle Diagnosis, Testing and Information System
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Vehicle diagnosis, testing, and information system VAS 5051

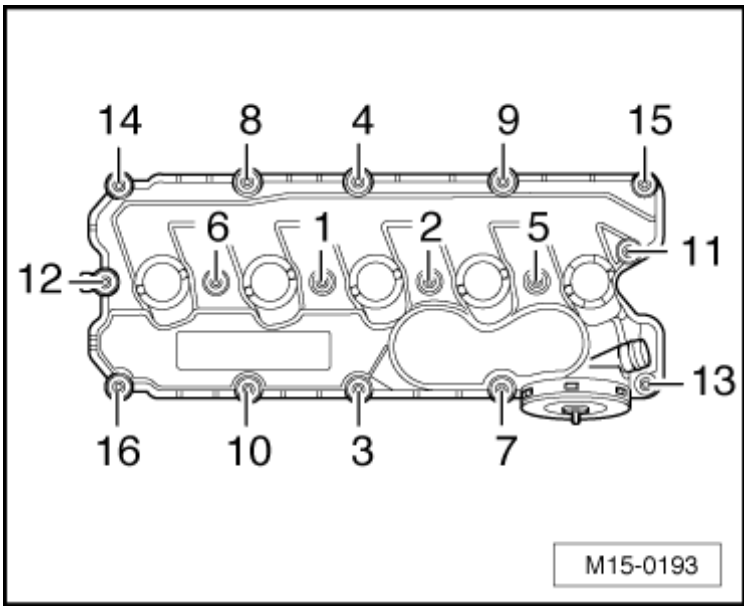

Fig. 217: Diagnostic Cable - VAS 5051/6A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Diagnostic cable VAS 5051/6A

Work sequence

- Connect vehicle diagnosis, testing and information system VAS 5051 as follows:

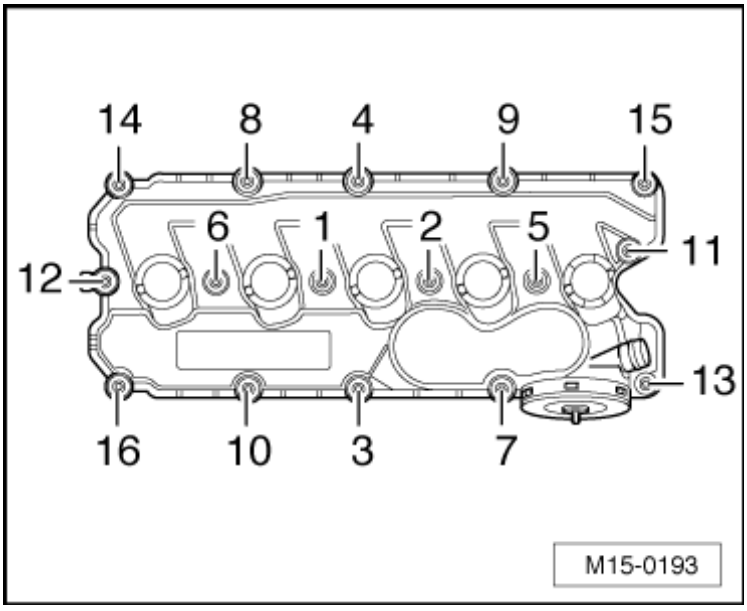

Fig. 218: Locating DLC
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect diagnostic cable VAS 5051/6A connector to Data Link Connector (DLC) - **arrow** -.
- Start engine and run at idle speed.

Only when engine does not start:

- Switch ignition on.

Selecting operating mode

- Press button on display for "Vehicle On Board Diagnostic (OBD)".

Selecting vehicle system

- Press button "01 - Engine electronics" on display.

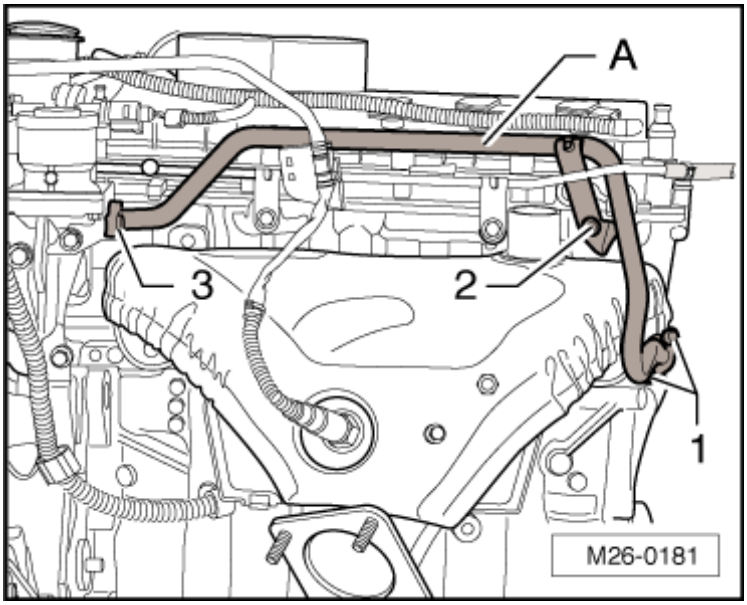

Fig. 219: Locating Control Module Identification With Code Indicated On The Display
Courtesy of VOLKSWAGEN UNITED STATES, INC.

The control module identification with code - **2** - as well as chassis number and immobilizer identification number will be indicated on the display.

NOTE:

- **A print-out is available. Press the Print button if required.**

Selecting diagnosis function

- Press button "02 - Check DTC memory" on display.
- If no malfunction is stored in engine control module, "0 DTC(s) detected" is displayed.

If malfunctions are stored in the engine control module, these are shown one below another on the display

- Press <-- key.
- Press button "05 - Erase DTC memory" on display.
- Press function "06 - End output".

Adapting functions and components

Special tools, testers and auxiliary items required

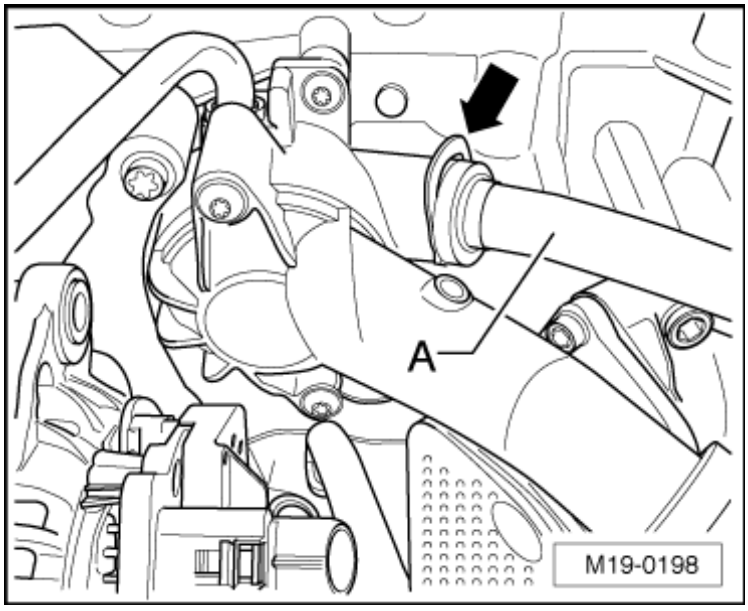

Fig. 220: VAS 5051 Vehicle Diagnosis, Testing and Information System
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Vehicle diagnosis, testing, and information system VAS 5051

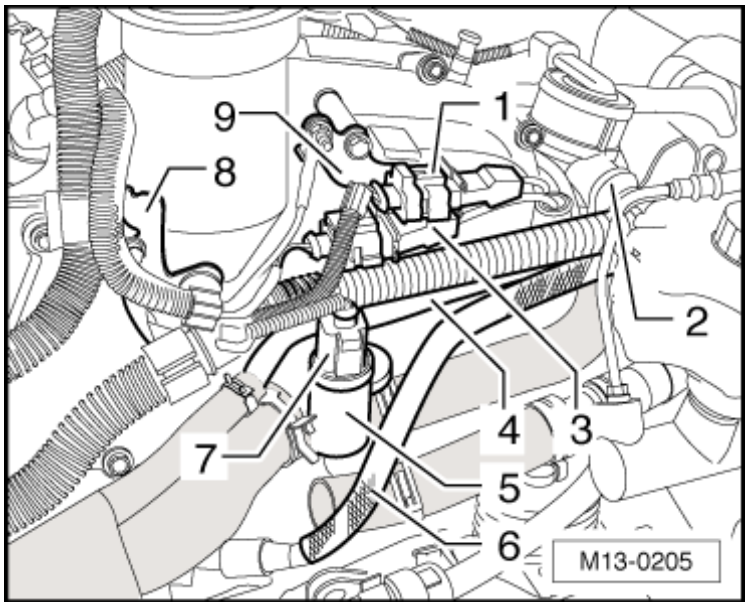

Fig. 221: Diagnostic Cable - VAS 5051/6A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Diagnostic cable VAS 5051/6A

Work sequence

- Connect vehicle diagnosis, testing and information system VAS 5051 as follows:

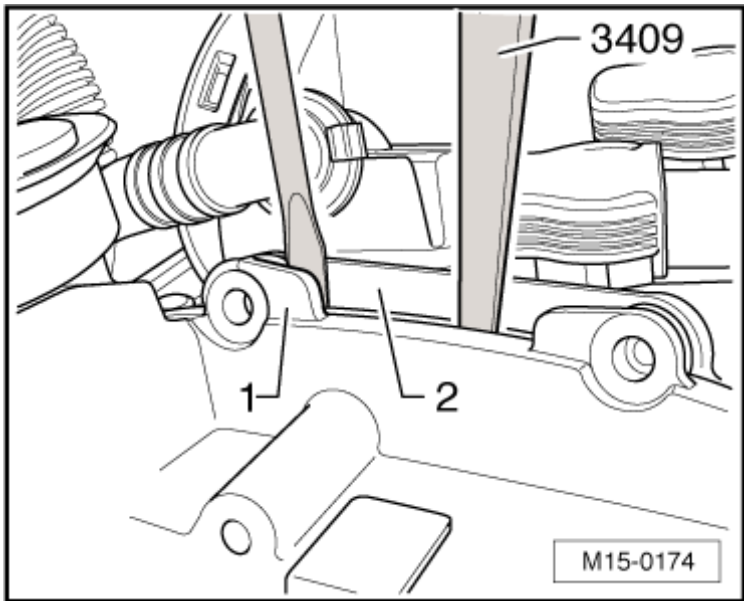

Fig. 222: Locating DLC
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect diagnostic cable VAS 5051/6A connector to Data Link Connector (DLC) - **arrow** -.

On vehicle diagnosis, testing, and information system VAS 5051, select "guided fault finding".

Once all control modules have been checked:

- Press "Go to" button
- Select "Function/component selection"
- Select "Drivetrain"
- Select "Engine code"
- Select "01-Systems capable of On Board Diagnostic (OBD)"
- Select "engine management system"
- Select "Functions"
- Select "Function or component"

Engine Control Module (ECM), removing and installing

- Before removing Engine Control Module (ECM), check control module identification and coding --> **Engine control module DTC memory, checking and erasing** , DTC memory of Engine Control Module (ECM), checking and erasing.

Work sequence

- Switch off ignition.

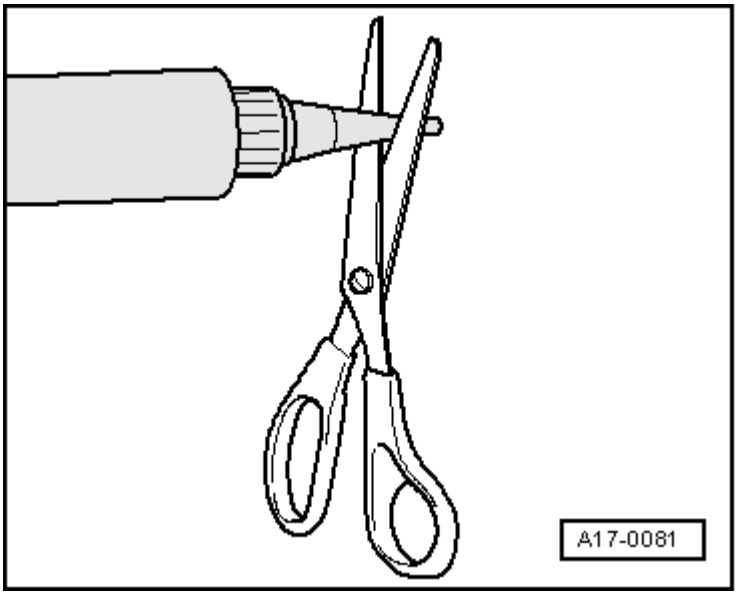

Fig. 223: Identifying Engine Control Module (ECM) Protective Housing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove cover from E-box.

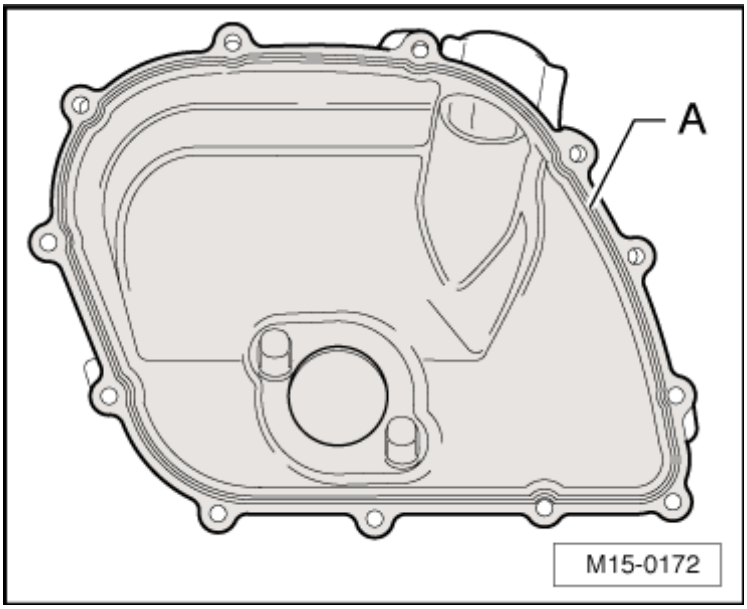

Fig. 224: Removing Engine Control Module
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unclip retaining clip for Engine Control Module (ECM).
- Release connector from engine control module and pull off.
- Remove old control module and install new control module.
- Verify old coding and adapt new control module --> **Adapting functions and components** , Adapting functions and components.

- Read DTC memory of new Engine Control Module (ECM) and, if necessary, erase DTC memory --> **Engine control module DTC memory, checking and erasing** .
- Test drive vehicle.
- Check ECM DTC memory again.

26 EXHAUST SYSTEM, EMISSION CONTROLS

EXHAUST SYSTEM COMPONENTS, REMOVING AND INSTALLING

Exhaust system components, removing and installing

Special tools, testers and auxiliary items required

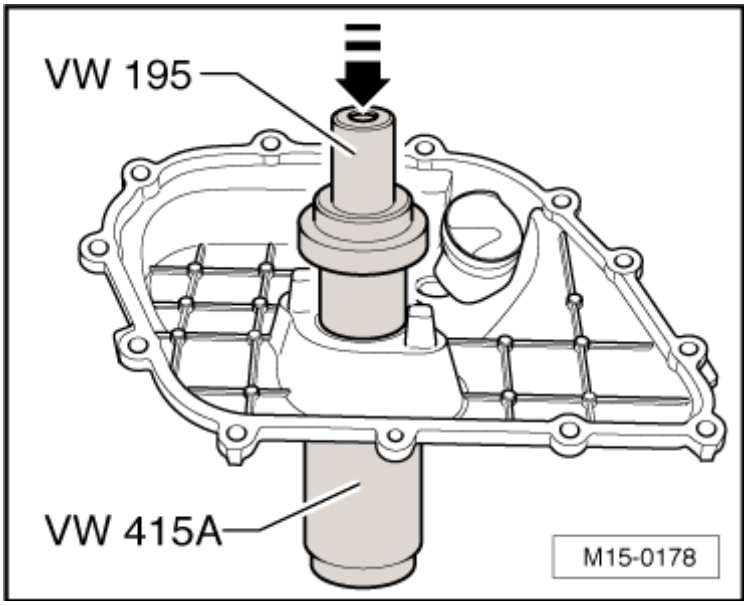

Fig. 225: 3337 Oxygen Sensor Ring Spanner Set
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Ring spanner set 3337

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

- **Route all the various lines (e.g. for fuel, hydraulics, EVAP system, coolant, refrigerant, brake fluid and vacuum lines and hoses) and electrical wiring so that the original positions are restored.**
- **Ensure sufficient clearance to all moving or hot components.**

NOTE:

- **Exhaust manifold, removing and installing --> Turbocharger, assembly overview .**

- **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 the support mounts carry uniform loads.**
- **Replace self-locking nuts.**
- **Do not use sealants containing silicone. Particles of silicone drawn into the engine, will not be burned in the engine and will damage the oxygen sensor.**

Catalytic converter and front exhaust pipe for engine code BHW, assembly overview --> **Catalytic converter and front exhaust pipe for engine code BHW, assembly overview** .

Muffler with mountings, assembly overview --> **Mufflers with mountings, assembly overview** .

Catalytic converter and front exhaust pipe for engine code BHW, assembly overview

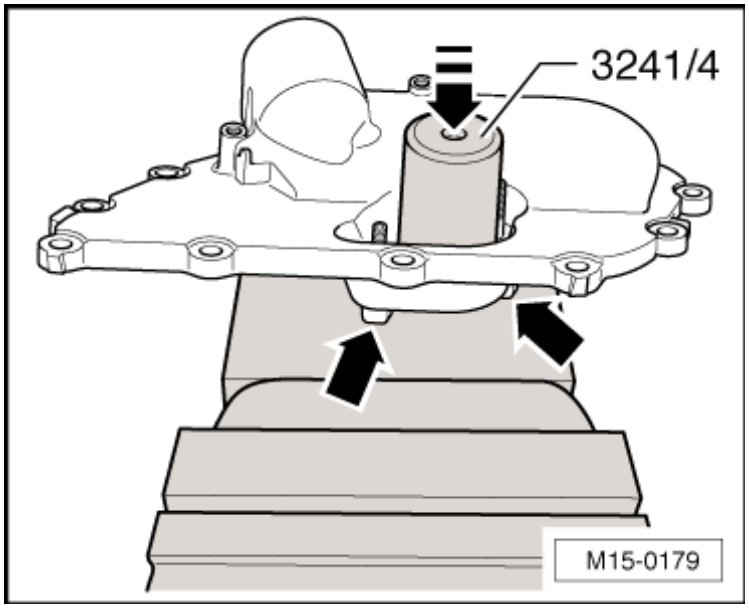

Fig. 226: Front Exhaust Pipe And Catalytic Converter With Attachments, Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Turbocharger

2 - Seal

- Replace

3 - 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

- To remove, remove Motor for intake flap -V157-
- To remove, use ring spanner set 3337

4 - Bolt

5 - 25 Nm

6 - To middle muffler

7 - Front exhaust pipe

8 - Catalytic converter

9 - 25 Nm

- Replace

Mufflers with mountings, assembly overview

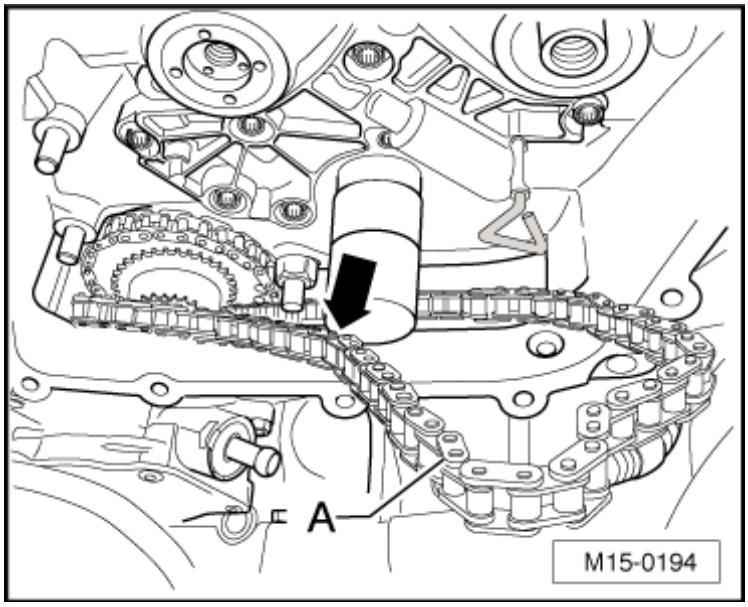

Fig. 227: Mufflers With Mountings, Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 40 Nm

2 - From particle filter

3 - Carriage bolt

4 - Double clamp

5 - 25 Nm

6 - Support mount

- With retaining ring
- Note installed position **Installed location of mountings**
- Replace if damaged

7 - Center muffler

8 - Bracket

9 - Support mount

- Note installed position **Installed location of mountings**
- Replace if damaged

10 - Rear muffler

11 - Repair double clamp

12 - Separating point

- As standard, center and rear mufflers are installed as a single component. In cases of repair, center and rear muffler are supplied individually and with a double clamp for connecting.
- Cut through connecting pipe at right angles at separating point using body repair saw V.A.G 1523 **Separating point between center and rear muffler**

Separating point between center and rear muffler

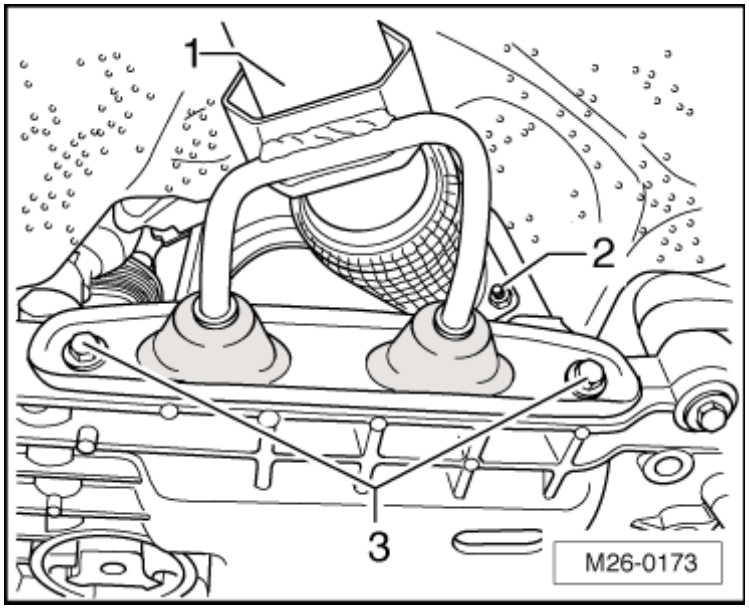

Fig. 228: Separation Point For Center And Rear Mufflers
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- e.g. Body repair saw V.A.G 1523

Work sequence

- Separate connecting pipe between center muffler and rear muffler at location - **arrow** - marked with a groove.

Installed location of mountings

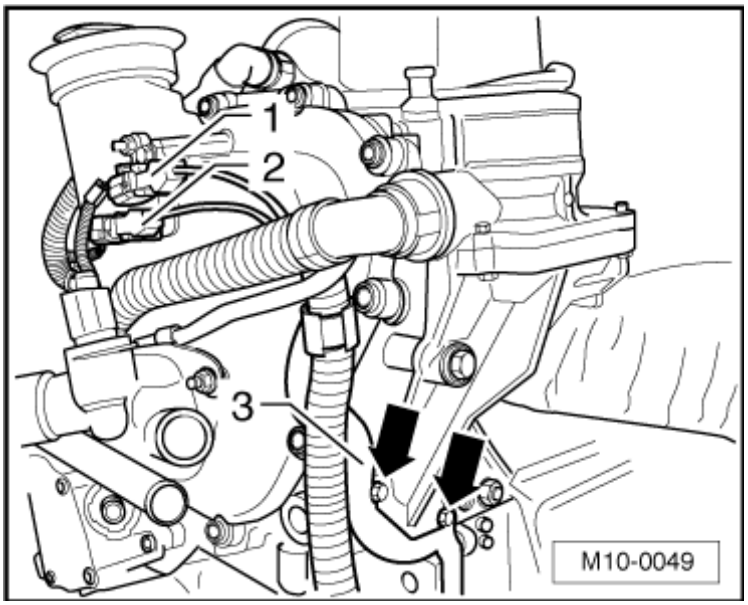

Fig. 229: Installed Location Of Mountings (Exhaust System)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Specified dimension a: 7... 9 mm when exhaust system is cold.

The large - **arrows** - indicate forward direction of travel.

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

Exhaust Gas Recirculation (EGR) system

NOTE:

- **The Exhaust Gas Recirculation (EGR) system is activated by the Diesel Direct Fuel Injection (DFI) Engine Control Module (ECM) -J248- via the Potentiometer for EGR -G212-.**
- **Exhaust Gas Recirculation (EGR), assembly overview --> Exhaust Gas Recirculation (EGR), assembly overview .**

Exhaust Gas Recirculation (EGR), assembly overview

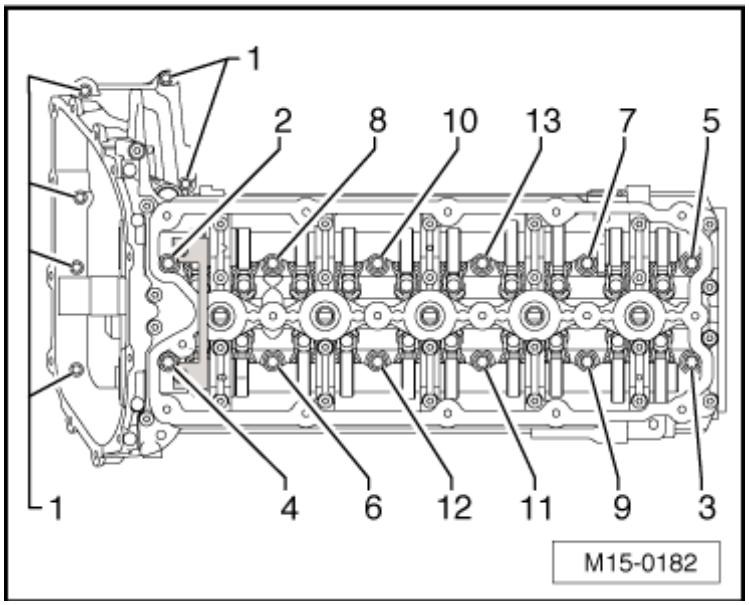

Fig. 230: Exhaust Gas Recirculation (EGR) System Components Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Potentiometer for EGR -G212-

- Before assembly, check contact surface on intake manifold for contamination and clean, if necessary.
- After replacing Potentiometer for EGR -G212- ignition must be turned on and then off again. Then, wait one minute for control module after-run (valve is learning, main relay must click during this time)
- After above replacement procedures, start engine and let run at idle for at least 1 minute.
- Then, check DTC memory of Engine Control Module (ECM); there must be no DTC stored in memory --> **Engine control module DTC memory, checking and erasing**
- If a DTC is stored in memory, erase DTC memory and perform procedure again.

2 - 10 Nm

3 - O-ring

- Replace

4 - Motor for intake flap -V157-

5 - Intake manifold

6 - Seal

- Replace

7 - Connecting pipe

- For Exhaust Gas Recirculation (EGR) system

8 - 25 Nm

9 - Radiator

- For Exhaust Gas Recirculation (EGR) system

10 - 10 Nm

11 - Exhaust manifold

12 - To heat exchanger

13 - From connection fitting

28 IGNITION/GLOW PLUG SYSTEM

GLOW PLUG SYSTEM, CHECKING

Glow plug system, checking

CAUTION: The ceramic glow plugs Visual characteristics of the ceramic glow plugs are very sensitive to impacts and bending. For this reason, any glow plugs that have been dropped (even from a short distance of approx. 2 cm) must not be used under any circumstances, even if there appears to be no external damage. The installation instructions must be followed exactly, otherwise there is a dangerous risk that the plug may break and thereby cause engine damage.

Visual characteristics of the ceramic glow plugs

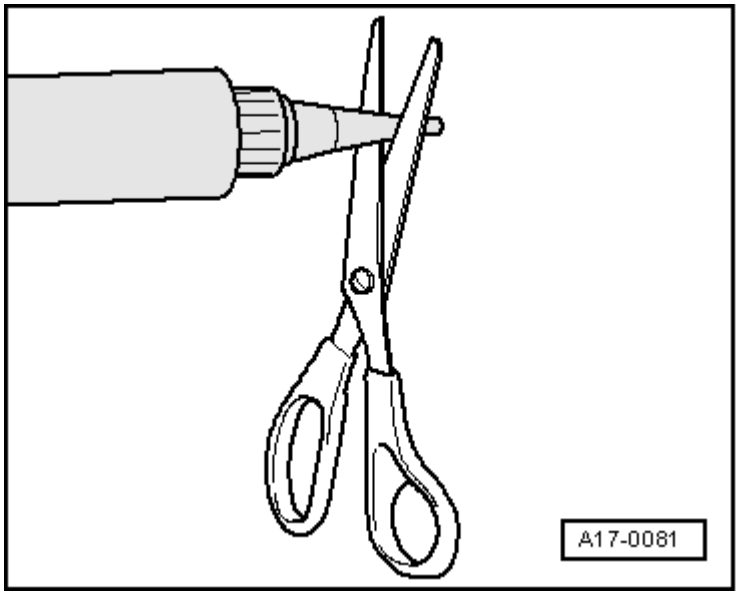

Fig. 231: Identifying Ceramic Sheathed Element Glow Plugs (A) & Metal Glow Plugs (B)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- **A** - = Ceramic glow plug, phased step at the tip (see magnification), white color coding - **arrow** -.

- **B** - = Metal glow plug, green color coding - **arrow** -.

Removing, installing and checking the ceramic glow plugs --> **Ceramic glow plugs, removing, installing and checking** .

Ceramic glow plugs, removing, installing and checking

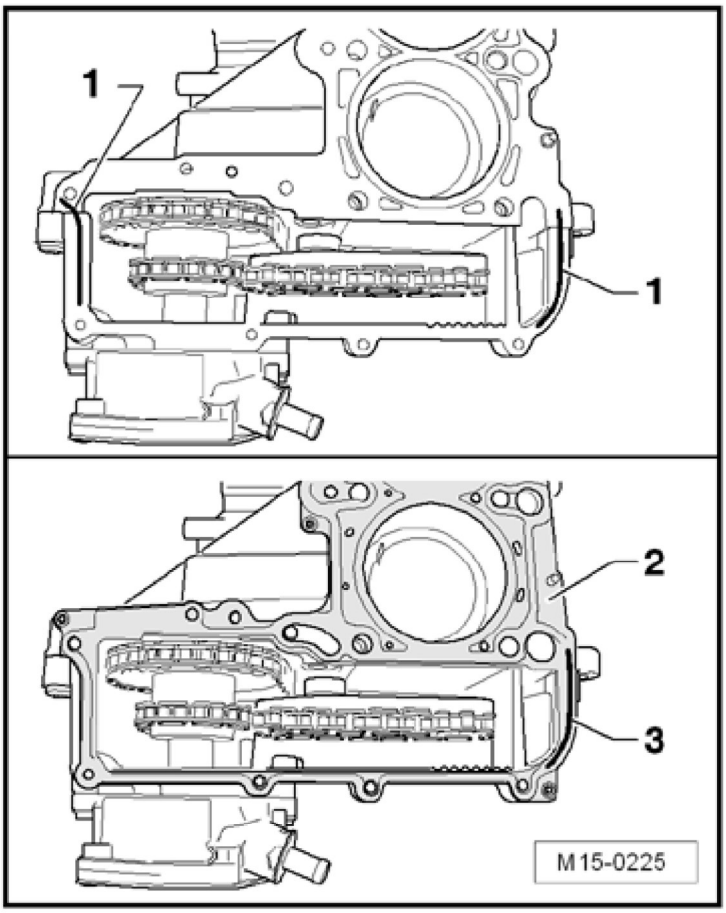

Fig. 232: Identifying Special Tools - Ceramic Glow Plugs, Removing, Installing And Checking
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Hinged socket 3220
- Torque wrench (5 to 50 Nm) V.A.G 1331
- Portable multimeter V.A.G 1526 A
- Test adapter kit V.A.G 1594 C

Conditions

- Engine is cold
- Ignition is switched off

Work sequence

NOTE:

- **When removing and installing, do not deform ceramic glow plugs. Damaged components must be removed.**

- Disconnect connectors from ceramic glow plugs.
- Remove ceramic glow plugs using hinged socket 3220.

Installation is performed in the reverse sequence, when doing this note the following:

- Before installing, cylinder head bore for glow plug and threads must be cleaned completely of sediments.

NOTE:

- **The threads of the cylinder head bore and the ceramic glow plugs are not to be oiled or greased.**

- Thread ceramic glow plug into cylinder head by hand using hinged socket 3220.
- Tighten ceramic glow plugs. Tightening torque: 15 Nm

CAUTION: After installing and before the starting the engine, test the resistance of all ceramic glow plugs with the engine still cold.

- Specification: max. 1 ohms

- If specified value is exceeded, replace faulty ceramic glow plug.

NOTE:

- **If the faulty ceramic glow plug is broken, remove the broken pieces from the engine, otherwise engine damage will occur.**

