ENGINE

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

00 GENERAL, TECHNICAL DATA

TECHNICAL DATA

Engine number

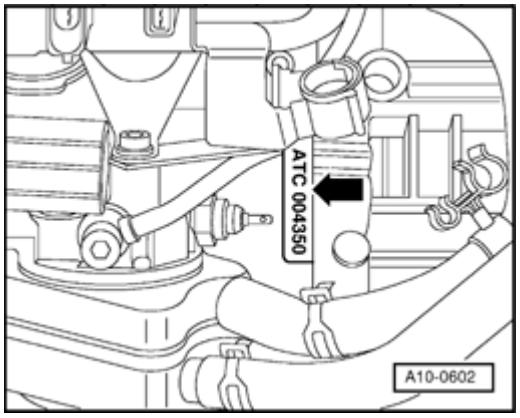

Fig. 1: Locating Engine Number
Courtesy of VOLKSWAGEN UNITED STATES, INC.

The engine number ("Engine code" and "Serial number") can be found at the front at the connection between the engine and transmission.

There is also a sticker on the cylinder head cover showing the engine code and serial number.

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

Engine data

Engine code		**ATC**	**AWP**
Manufactured		from 01.99	from 05.00
Displacement	liters	1.781	1.781
Output	kW at RPM	132 @5500	132 @5500
Torque	Nm at RPM	235 @1950-4700	235 @1950-4700
Bore	mm	81	81
Stroke	mm	86.4	86.4
Compression ratio		9.5:1	9.5:1
RON	min.	95 unleaded	95 unleaded
Injection/ignition system		Motronic	Motronic
Knock control		Yes	Yes
On Board Diagnostic (OBD)		Yes	Yes

Oxygen sensor control	Yes	Yes
Catalytic converter	Yes	Yes

Engine code	**ATC**	**AWP**
Turbocharged	Yes	Yes
Exhaust gas recirculation system	No	No
Secondary air system	Yes	Yes
Camshaft adjustment	Yes	Yes
Valve timing		
At 1 mm valve lift and 0 mm valve clearance		
Inlet opens after TDC	18°	18°
Inlet closes after BDC	28°	28°
Exhaust opens before BDC	28°	28°
Exhaust closes before TDC	8°	8°

10 ENGINE - ASSEMBLY

ENGINE, REMOVING AND INSTALLING

Engine, removing and installing

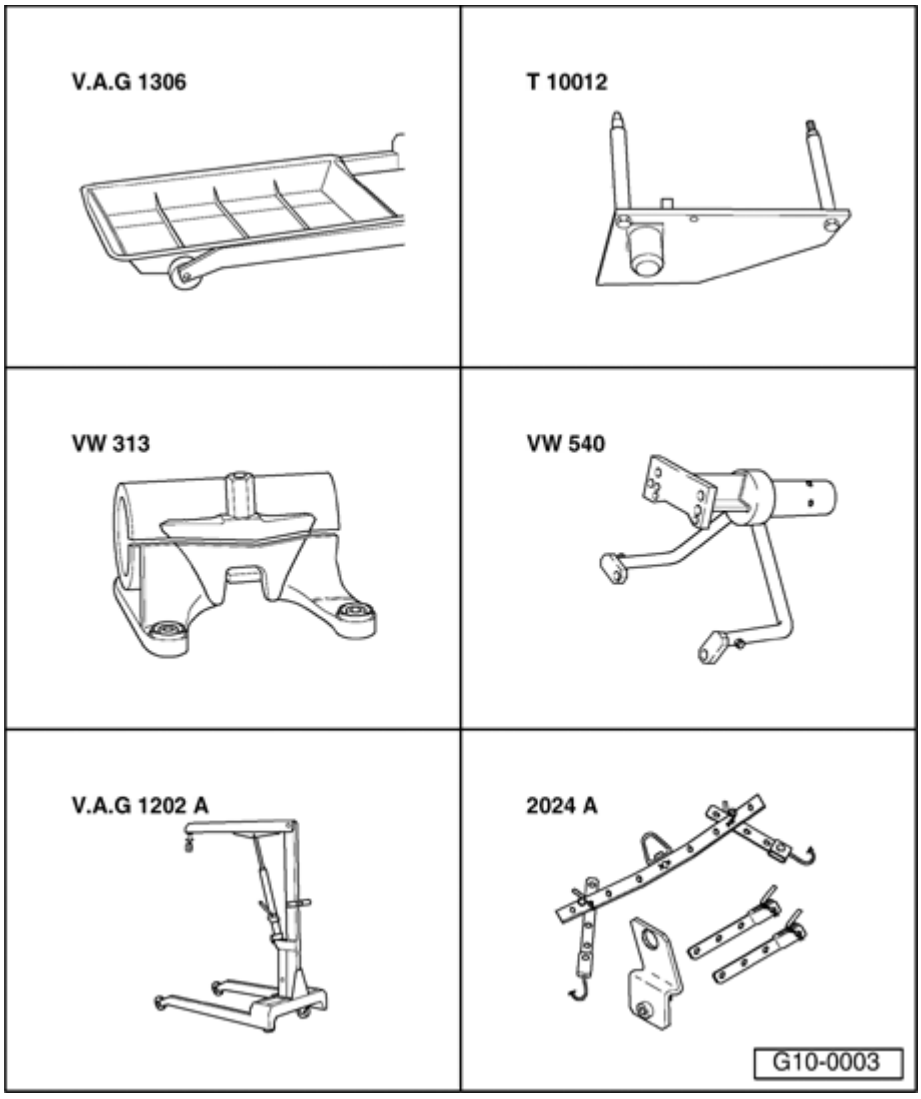

Fig. 2: Identifying Special Tools - Engine, Removing And Installing (1 Of 3)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and repair equipment required

- V.A.G 1306 Drip tray
- T10012 Engine bracket
- VW 313 Support clamp
- VW 540 Engine and transmission support

- 3180 Retainer
- V.A.G 1202 A Workshop crane
- 2024 A Lifting tackle

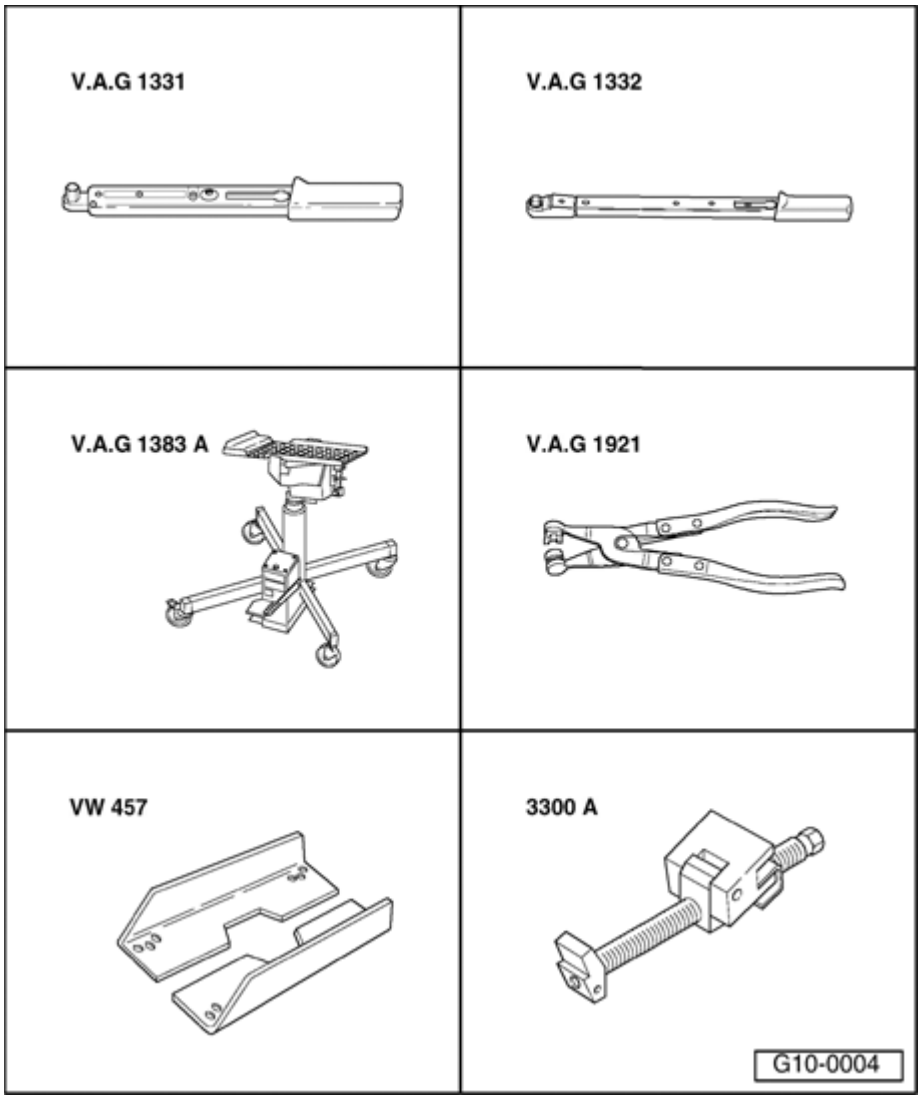

Fig. 3: Identifying Special Tools - Engine, Removing And Installing (2 Of 3)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- V.A.G 1331 Torque wrench (5-50 Nm)
- V.A.G 1332 Torque wrench (40-200 Nm)
- V.A.G 1383 A Engine/transmission jack
- V.A.G 1921 Spring-type clip pliers
- VW 457 Support rails
- 3300 A Engine support device

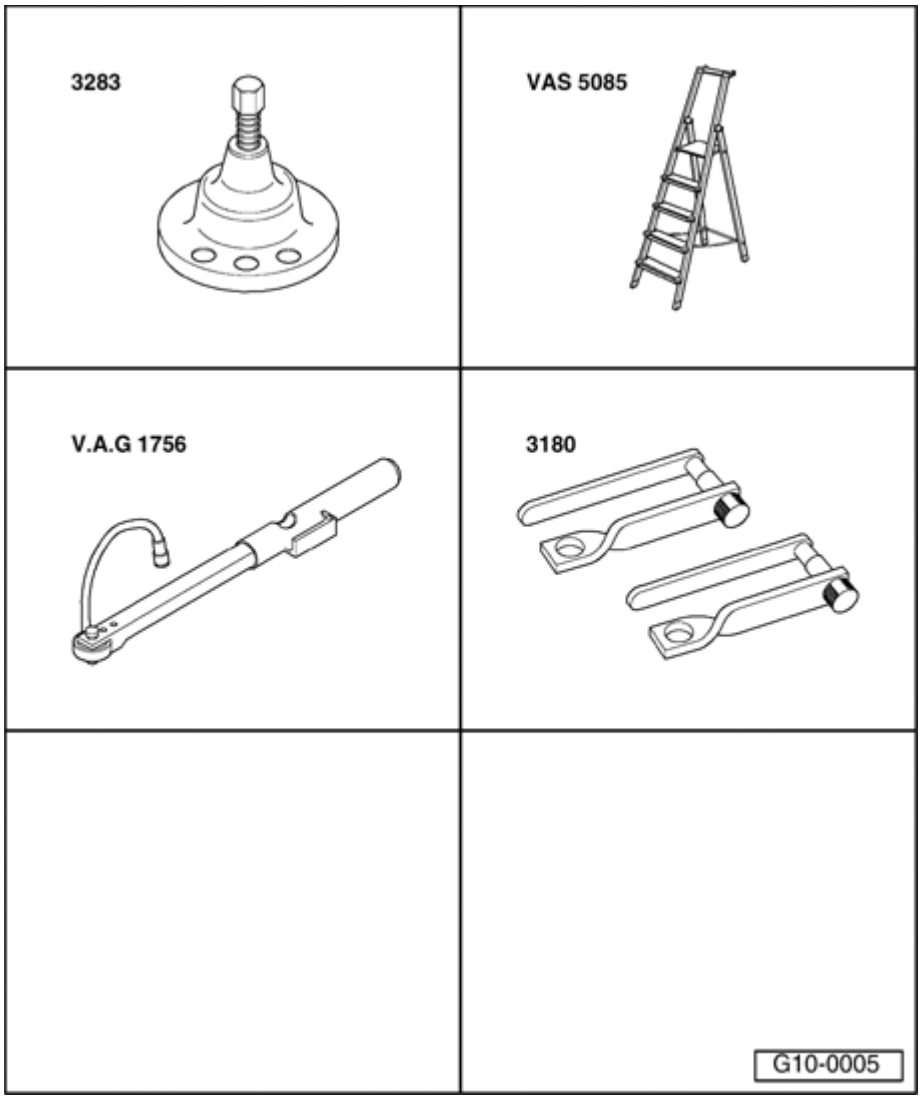

Fig. 4: Identifying Special Tools - Engine, Removing And Installing (3 Of 3)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- 3283 Pressing-out appliance
- VAS 5085 Step ladder
- V.A.G 1756 Angle wrench
- G 000 100 grease (vehicles with manual transmission)

- Bolt M10 X 25/8.8
- Bolt M8 X 25/8.8

Engine, removing

NOTE:

- **The engine is removed from underneath together with the transmission.**
- **All cable ties which are opened or cut open when removing the engine**

must be replaced in the same position when installing the engine.

- **Secure all hose connections with hose clamps of the same type as those installed at the factory.**

- V.A.G 1921 hose clip pliers are recommended when installing spring-type clips.
- Make sure the connectors are correctly assigned; mark if necessary.

- Obtain radio anti-theft code on vehicles with coded radio.
- With the ignition switched off, disconnect the battery Ground strap.

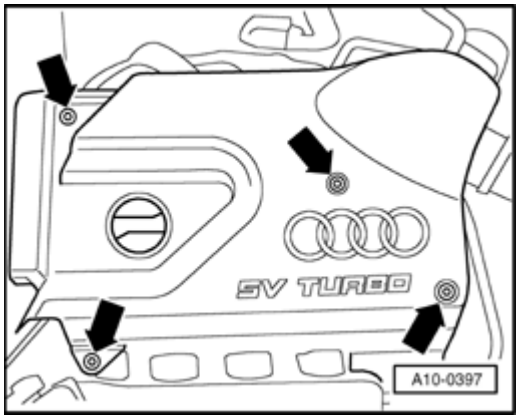

Fig. 5: Removing Engine Cover Panel Above Cylinder Head
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove engine cover from cylinder head cover.

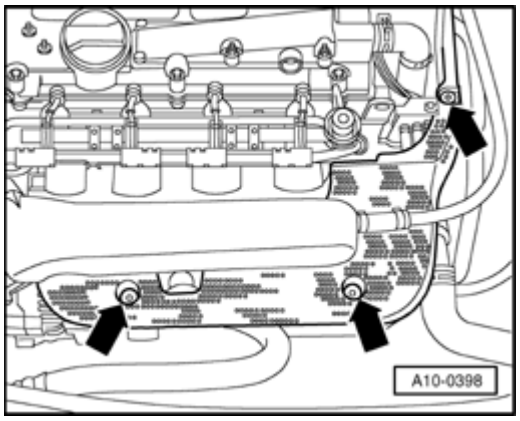

Fig. 6: Removing Cover In Front Of Intake Manifold
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove cover in front of intake manifold.

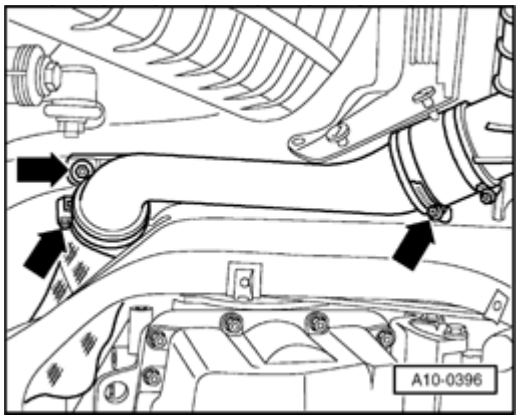

Fig. 7: Disconnecting Air Duct At Bottom Of Right Side Longitudinal Member
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect air duct at bottom of right side longitudinal member (air duct leads to charge air cooler).

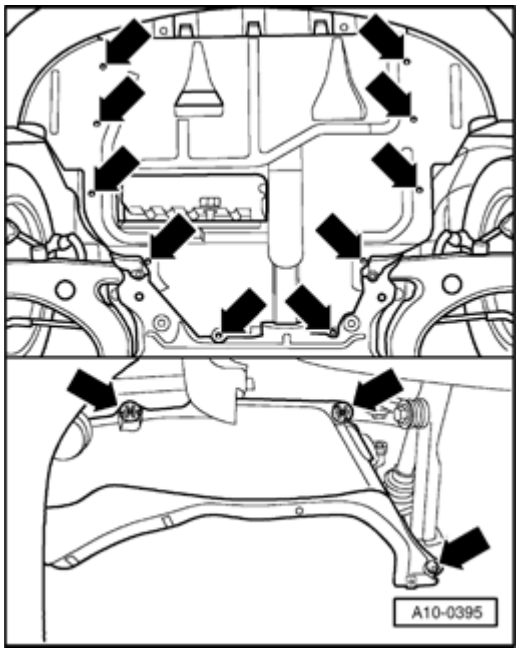

Fig. 8: Removing Noise Insulation Panels (Center, Left And Right)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove sound insulation in the center and on left and right sides (arrows).
- Unbolt heat shield for right side drive axle.

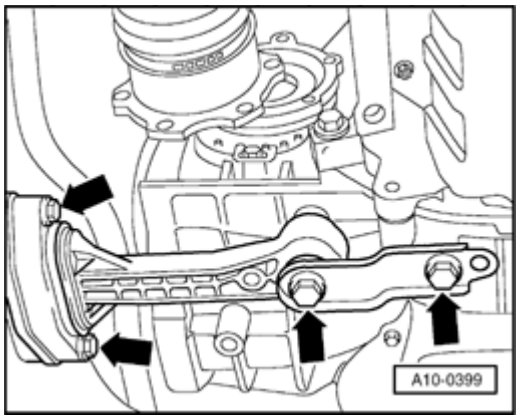

Fig. 9: Unbolting Pendulum Support And Left/Right Side Drive Axles From Transmission Flange
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unbolt pendulum support.
- Unbolt left and right side drive axles from transmission flange.
- Move left side drive axle toward rear of vehicle and secure in place by tying to stabilizer bar.
- Remove front exhaust pipe. Refer to **Front exhaust pipe, removing and installing**.

NOTE: Do not bend the flexible connection on the front exhaust pipe more than necessary (not more than 10°).

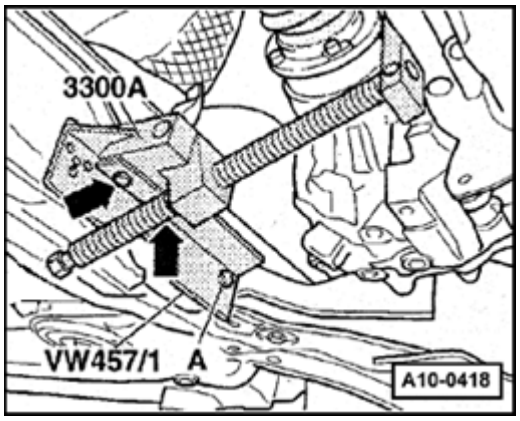

Fig. 10: Securing Support Rails 457/1 To Subframe With Bolt M8 X 25 And Engine Support Device 3300A To Support Rails 457/1
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Secure support rails 457/1 to subframe with bolt M8 x 25 (-B-). Also secure engine support device 3300A (-C-) to support rails 457/1 (arrows).
- Press engine forward.

NOTE: Make sure not to damage the power steering line.

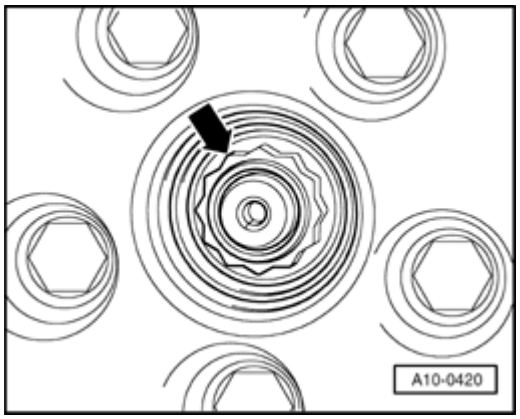

Fig. 11: Loosening Right Side 12-Point Nut For Drive Axle
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen right side 12-point nut for drive axle. When doing this, vehicle must be standing on its wheels.
- Unbolt wheel.

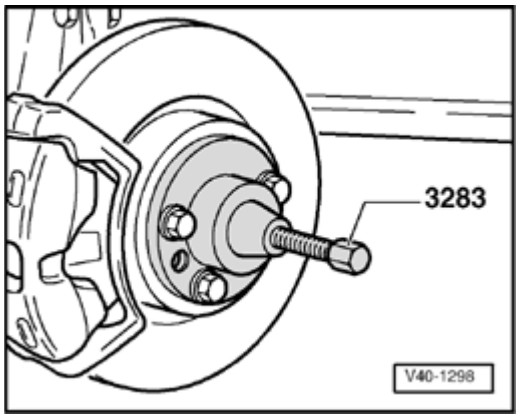

Fig. 12: Pressing Out Drive Shaft Using Special Tool 3283
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press out drive axle using special tool 3283.

NOTE: Make sure there is enough clearance when pressing out the axle shaft.

- Remove drive axle.
- Place drip tray V.A.G 1306 below engine.
- Remove cap from coolant expansion tank.

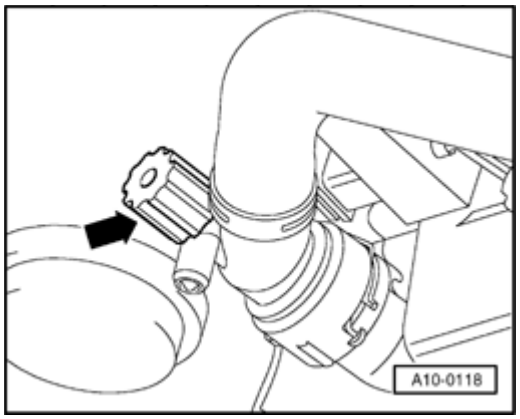

Fig. 13: Turning Drain Screw On Radiator
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Turn drain screw (arrow) on radiator counter-clockwise. If necessary, fit drain hose to connection.

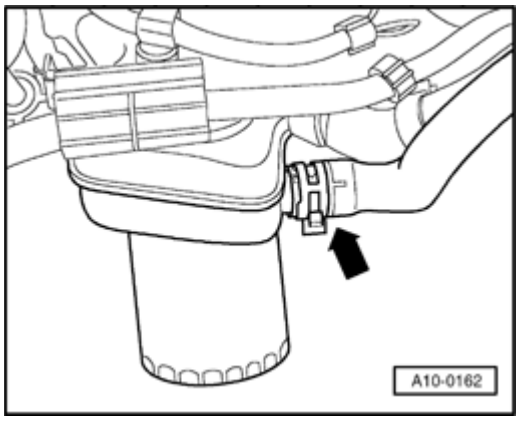

Fig. 14: Disconnecting Bottom Coolant Hose At Oil Cooler To Drain Off Remaining Coolant
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect bottom coolant hose from oil cooler (arrow) and allow remaining coolant to drain.

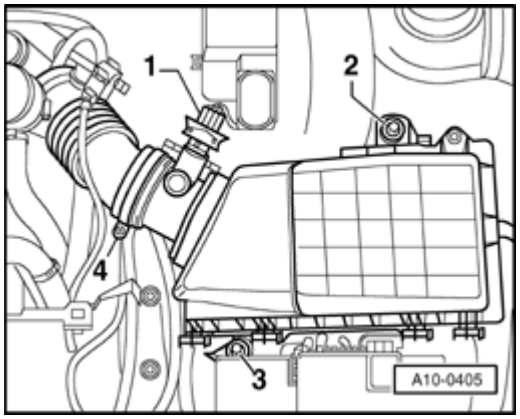

Fig. 15: Identifying Air Hose, Mass Air Flow Sensor & Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect air hose -4- from mass air flow sensor.
- Disconnect electrical connectors for mass air flow sensor -1-.
- Remove bolts -2- and -3- and take off air cleaner housing.

The air intake hose connection on the turbocharger is removed as follows:

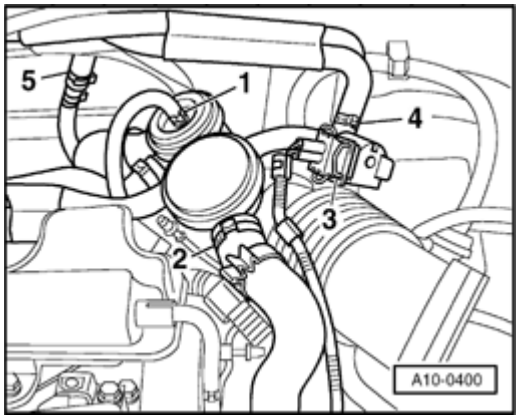

Fig. 16: Identifying Vacuum Hose, Crankcase Breather, Wastegate Bypass regulator valve & Hose
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect vacuum hose -1- from air recirculation valve.
- Disconnect hose from pressure control valve for crankcase breather -2-.
- Disconnect electrical connector from Wastegate bypass regulator valve -N75- (-3-).
- Disconnect hose -4- from Wastegate bypass regulator valve -N75-.

- Disconnect hose -5- at bulkhead (hose leads from solenoid valve to turbocharger).
- Remove wastegate bypass regulator valve from air intake hose and place it to one side on engine.
- Disconnect hose between EVAP canister and turbocharger on bulkhead.
- Pull retainer off turbocharger connection and disconnect air intake hose.

- Remove battery.

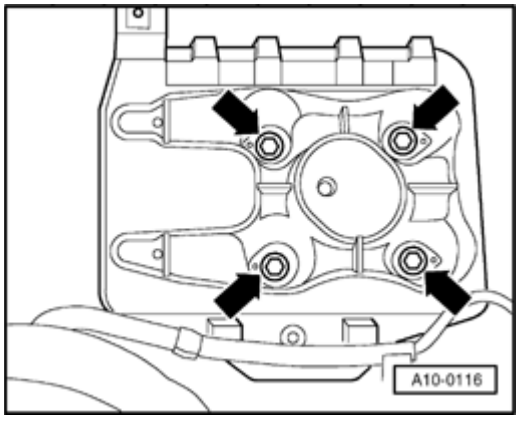

Fig. 17: Removing Battery Platform

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove battery platform (arrows).

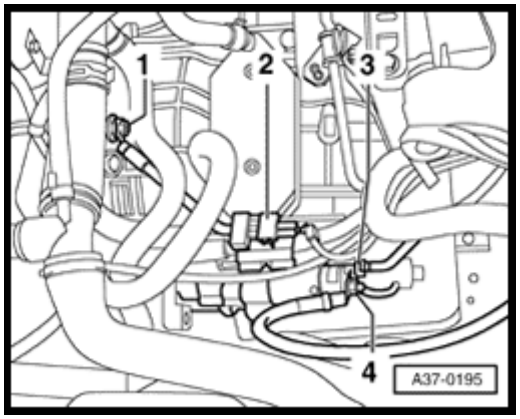

Fig. 18: Identifying Battery Ground Cable, Connector & Electrical Connections
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unbolt Ground wire -1- on engine/transmission flange.
- Disconnect wires -3- and -4- from starter.
- Disconnect connector -2- and pull out of retainer.
- Disengage wires from retainer on starter and move wires to one side.

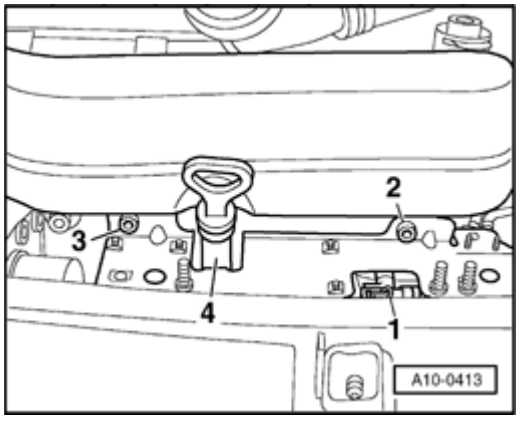

Fig. 19: Identifying Electrical Change-Over Valve Connector, Intake Manifold Brackets & Dipstick Tube
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect connector -1- for electrical change-over valve on underside of bracket.
- Unbolt bracket from intake manifold (-2- and -3-) and disengage dipstick tube -4-.

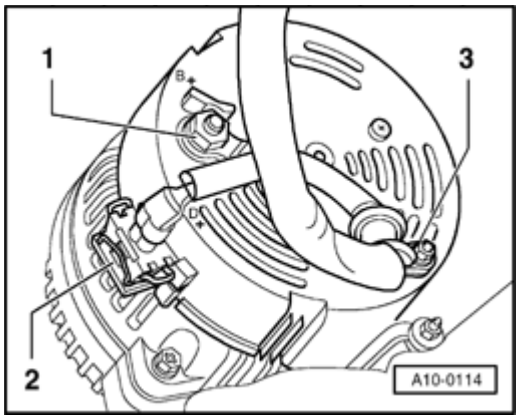

Fig. 20: Locating Generator Connections
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect wire -1- from terminal 30/B+ on generator.
- Disconnect connector -2- from terminal D+.
- Remove cable clip -3-.

Vehicles with air conditioning

- Disconnect connector from a/c compressor.

All models

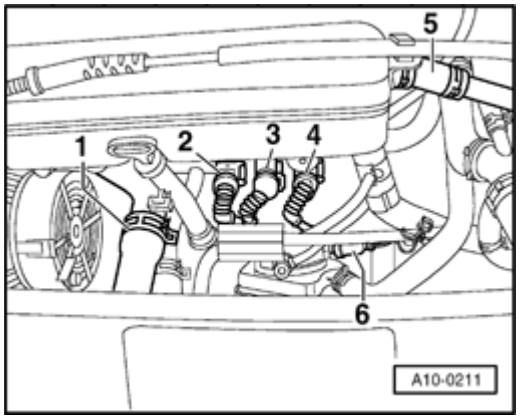

Fig. 21: Identifying Coolant Hose, Knock Sensor (KS) I -G61-, Engine Speed Sensor (RPM) -G28-, Knock Sensor (KS) II -G66-, Oil Pressure Switch -F1- & Vacuum Pipe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove coolant hose -1- (complete).
- Disconnect wires/connectors as follows:

2 - Knock Sensor (KS) I -G61-

3 - Engine speed sensor (RPM) -G28- (center, gray)

4 - Knock Sensor (KS) II -G66-

6 - Oil pressure switch -F1-

- Take Generator wire out of retainer.
- Disconnect vacuum pipe -5- from intake manifold.

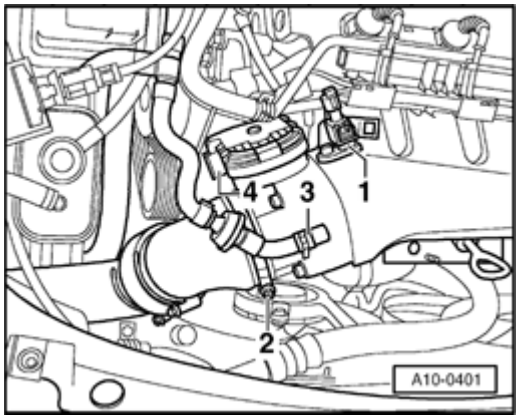

Fig. 22: Identifying Hose Clip, Intake Air Temperature (IAT) Sensor -G42 & Throttle Valve Control Module -J338-
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect connector -1- for Intake air temperature sensor -G42- and connector -4- for Throttle valve control module -J338- (under throttle valve control module).
- Disconnect air hose -2- from throttle valve control module.
- Disconnect vacuum hose -3- (for EVAP canister) from throttle valve control module.

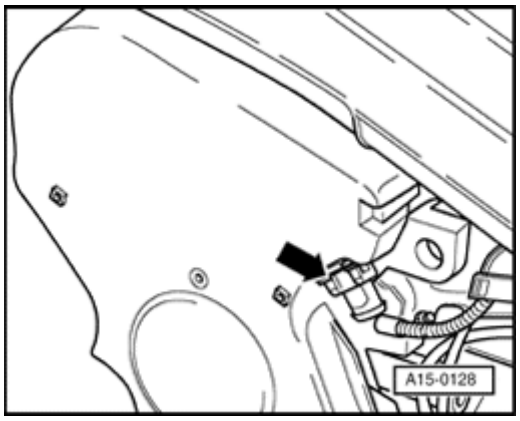

Fig. 23: Locating Connector At Camshaft Position Sensor G40
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect connector from Camshaft Position (CMP) sensor -G40- (arrow).

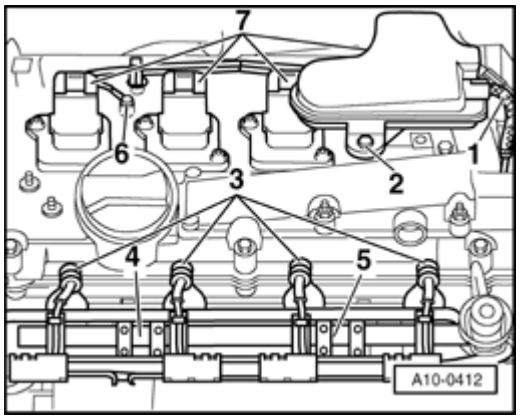

Fig. 24: Identifying Vacuum Pipe, Vacuum Reservoir, Connectors, Support Bar & Ground Wire
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect vacuum pipe -1- from vacuum reservoir.
- Unbolt vacuum reservoir -2- and remove from bracket.
- Disconnect connectors -3- from injectors and unclip support bar from fuel rail at points -4- and -5-.
- Unbolt Ground wire -6- between ignition coils 1 and 2.

- Disconnect connectors -7- from ignition coils.
- Disconnect connector from Engine Coolant Temperature (ECT) sensor -G62- (on coolant hose flange on left of cylinder head).
- Disconnect connector from Speedometer sensor -G22- (on rear of transmission).
- Move lines and hoses clear.

- Disconnect the following coolant hoses:

- On expansion tank (top and bottom)
- On cylinder head (top hose leading to radiator)
- On bulkhead (two hoses leading to heat exchanger for heater)
- On left of engine block, below cylinder head (hose joined to connection in upper coolant hose leading to radiator)

- On oil cooler (rear hose)

- Disengage wiring harness from retainers and place to one side.

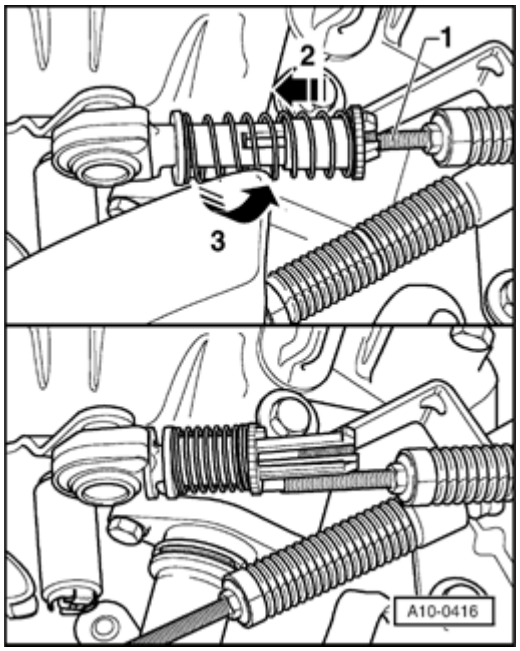

Fig. 25: Pulling Collar (Toward Ball Joint) To Compress Spring, Then Turning Collar Clockwise To Lock In Position
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Mark threaded sections of both selector cables -1- with a permanent marker pen so that they can be installed in same positions later.
- Pull collar in direction of arrow -2- (toward ball joint) to compress spring, then turn collar clockwise (arrow -3-) to lock in position.
- Disengage both threaded sections.

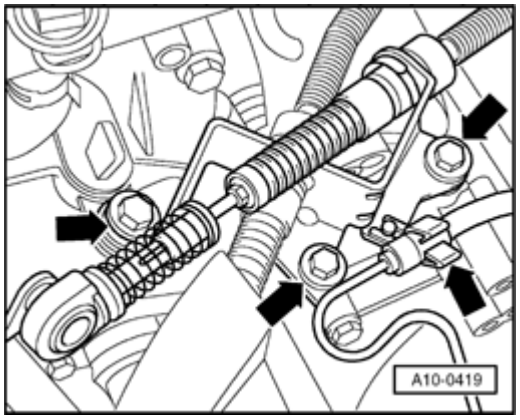

Fig. 26: Unclipping Clutch Slave Cylinder Hose From Selector Cable Support Bracket, Removing Bolts & Selector Cable Support Bracket From Transmission
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unclip clutch slave cylinder hose from selector cable support bracket (arrow).
- Remove bolts (arrows), remove selector cable support bracket from transmission and place to one side.

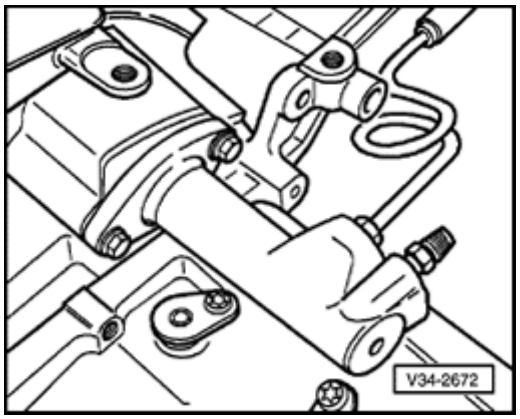

Fig. 27: Identifying Slave Cylinder
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove clutch slave cylinder from transmission and place to one side.

NOTE:

- **Do not open the hydraulic system.**
- **Do not depress the clutch.**

- Disconnect electrical wire from Back-up light switch -F4-.
- Disengage wiring harness from retainers and place to one side.

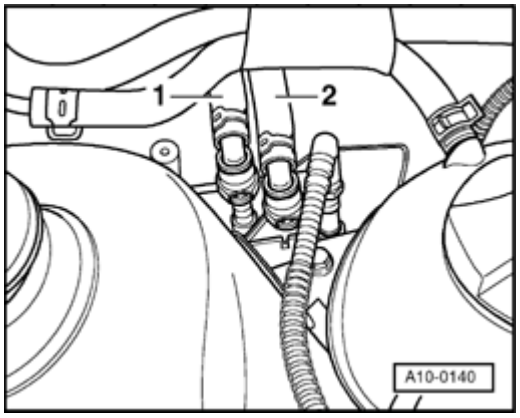

Fig. 28: Identifying Supply Line And Return Line
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect fuel supply line -1- and fuel return line -2- at connection point by pressing release tabs.

NOTE: **Check the colors of the connectors when connecting the fuel supply and return lines.**

WARNING: **The fuel system is under pressure! Before opening the system place a cloth around the connection, then release pressure by carefully loosening the connection.**

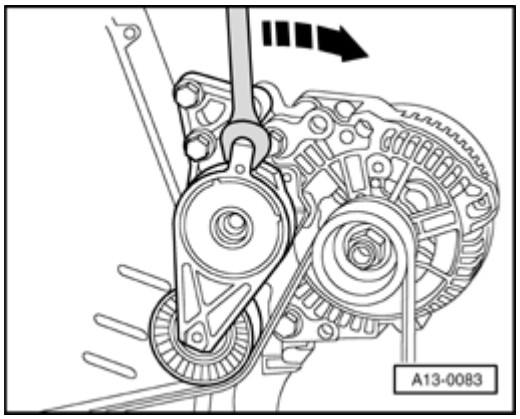

Fig. 29: Relieving Tension On Poly V-Belt
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen ribbed belt by turning tensioning element in direction indicated (arrow).

NOTE: Before removing the ribbed belt, mark the direction of rotation with chalk or a felt pen. If a used belt rotates in the wrong direction when reinstalled, this can result in breakage. When installing the belt, ensure it is correctly seated in the pulleys.

- Remove ribbed belt.

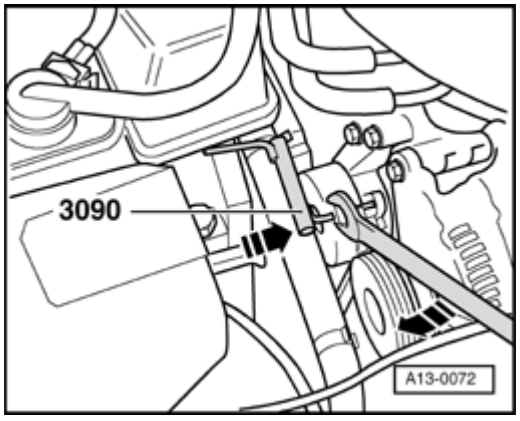

Fig. 30: Blocking Tensioner With 3090
Courtesy of VOLKSWAGEN UNITED STATES, INC.

The tensioning element can be locked in position with a suitable punch (4.5 mm diameter, approx. 55 mm long). Connecting rod support 3090 can also be used.

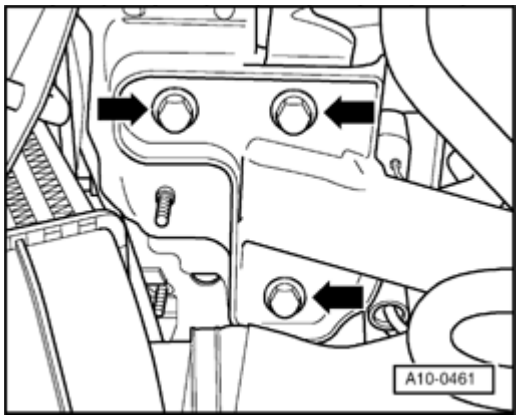

Fig. 31: Identifying Connecting Line Bolts (Left)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove connecting pipe between both left and right crossmembers.

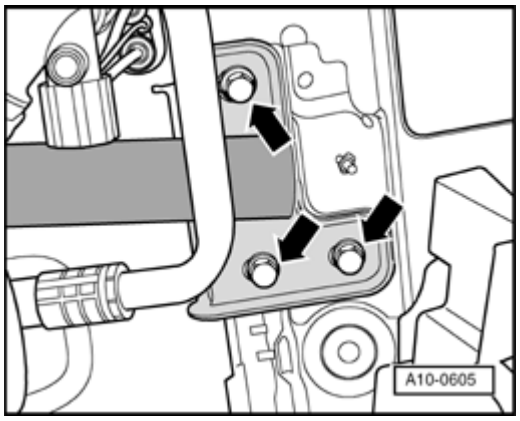

Fig. 32: Right Crossmember
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Right crossmember.

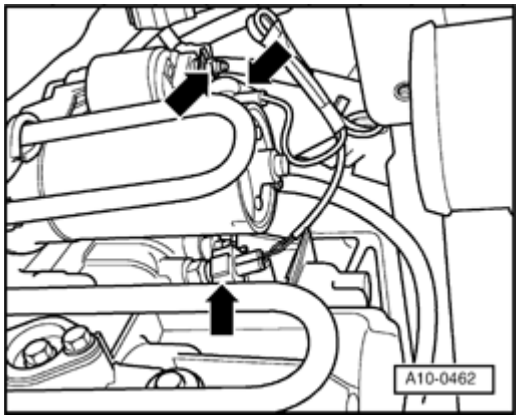

Fig. 33: Removing Connector At Starter And Transmission
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove connector at both starter and transmission.
- Remove B+ cable from starter.

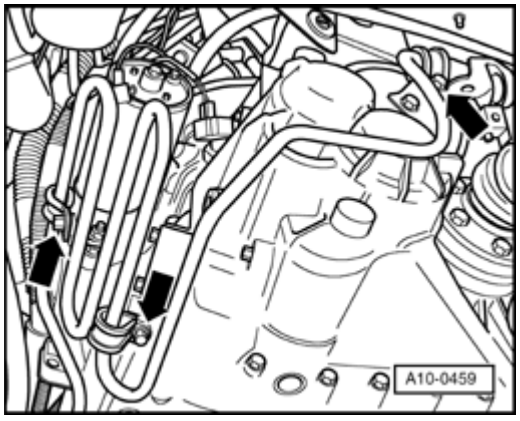

Fig. 34: Removing Cooling Line From Transmission
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove power steering fluid cooling line from transmission.
- Remove cooling line retaining clip at lower left and remove coolant hose.
- Open hose clamp at lower left of radiator and completely remove cooling line.

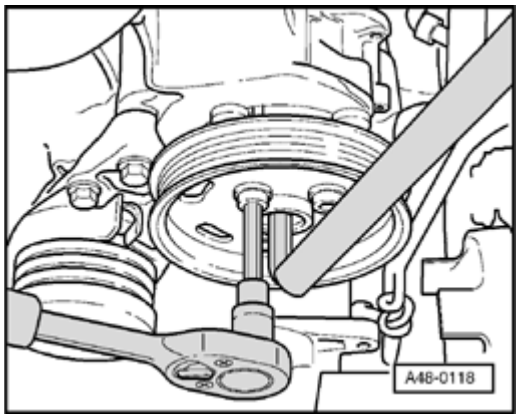

Fig. 35: Removing Pulley From Power Steering Pump
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove pulley from power steering pump (counterhold with socket wrench).

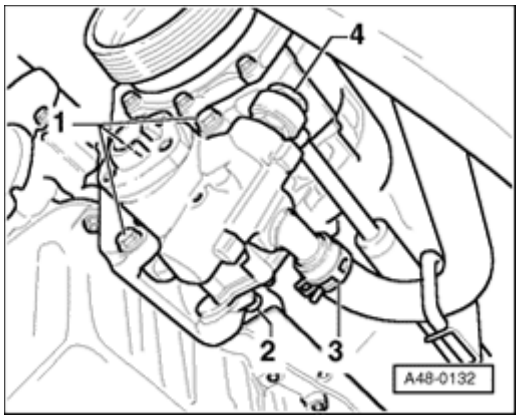

Fig. 36: Identifying Spring Clamp, Expansion Hose & Bracket
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place clean container under pump.
- Open spring clips -3- from intake hose and remove hose.
- Remove flexible hose -4-.

NOTE: For vehicles with pressure switch, remove connector first and remove switch.

- Unbolt pump bolts -1- and -2- from bracket (4x).

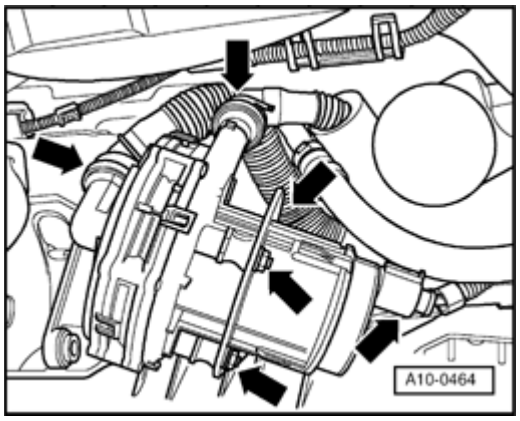

Fig. 37: Disconnecting Hoses And Connectors On Secondary Air Pump
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove connector and hoses at secondary air pump.
- Remove secondary air pump.

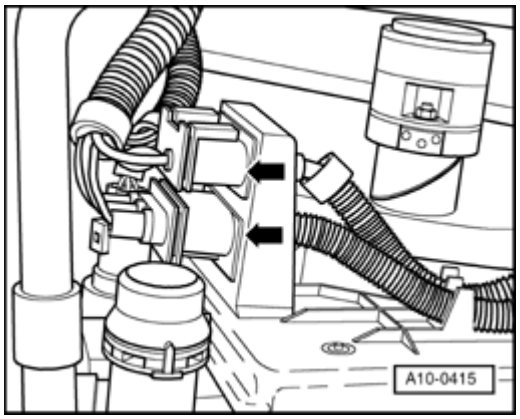

Fig. 38: Disconnecting Two Coolant Fan Connectors On Radiator Cowl
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect two coolant fan connectors on radiator cowl (bottom left).
- Remove cowl from radiator (4 bolts) together with both fans and remove by pulling downward.

Vehicles with air conditioning

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

- Remove retainers for refrigerant hoses.

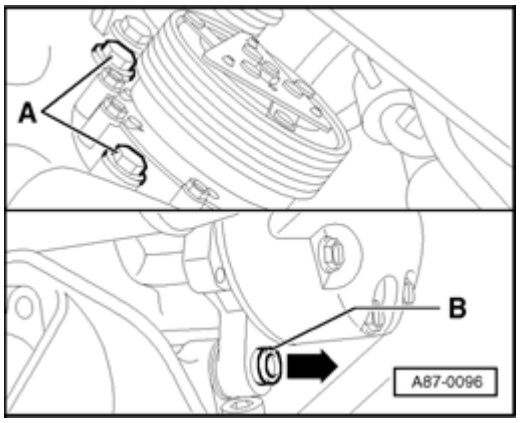

Fig. 39: Unbolting A/C Compressor & Pressing Sliding Bushing Back Into Hole
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unbolt A/C compressor, lift clear together with refrigerant hoses (do not disconnect) and tie in place on hood lock.

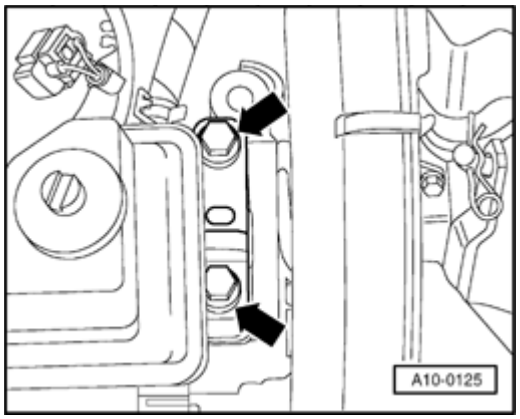

Fig. 40: Locating Engine Carrier Bolts (Engine Side)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen engine/transmission mounting (about two turns only) on engine side. Do not remove bolts completely.

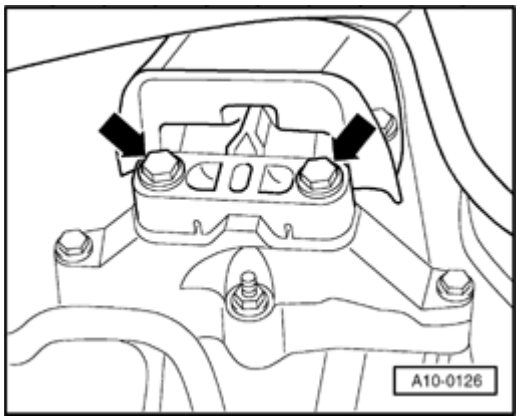

Fig. 41: Locating Engine Carrier Bolts (Transmission Side)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen engine/transmission mounting (about two turns only) on transmission side. Do not remove bolts completely.
- Raise vehicle.

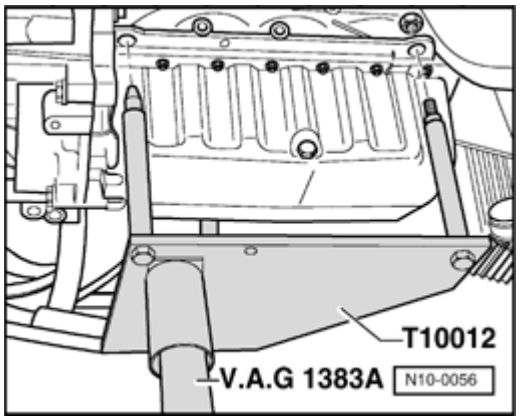

Fig. 42: Identifying Engine Bracket T10012 & Engine/Transmission Jack V.A.G. 1383A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Bolt engine bracket T10012 to cylinder block with securing nut and bolt (M10 x 25/8.8). Tighten to approx. 20 Nm.
- Install engine/transmission jack V.A.G 1383A to engine bracket and raise engine/transmission slightly.

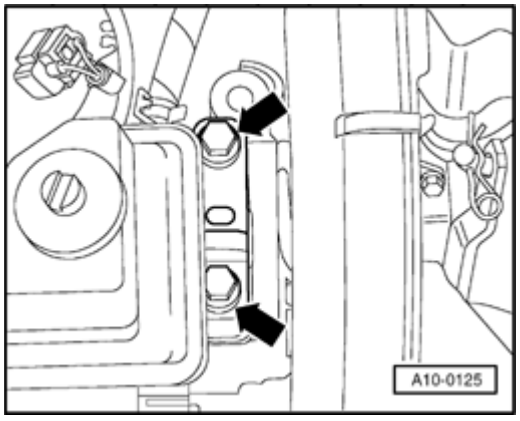

Fig. 43: Locating Engine Carrier Bolts (Engine Side)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unbolt engine/transmission mounting on engine side. (Use step ladder VAS 5085 or equivalent for access to engine compartment from above.)

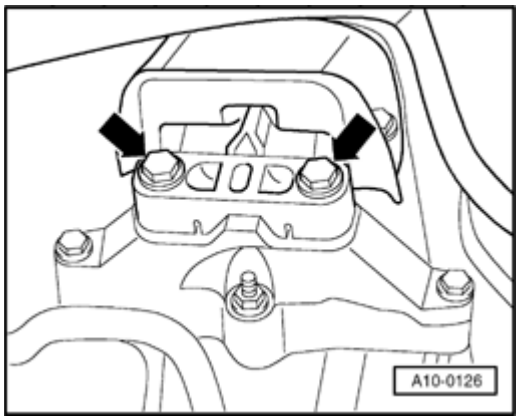

Fig. 44: Locating Engine Carrier Bolts (Transmission Side)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unbolt engine/transmission mounting on transmission side.
- Carefully lower engine/transmission assembly.

NOTE:

- **Check to make sure that all connections between engine and body have been disconnected.**
- **The engine/transmission assembly must be carefully guided by a second technician while it is being lowered so as to avoid damaging the body**

panels.

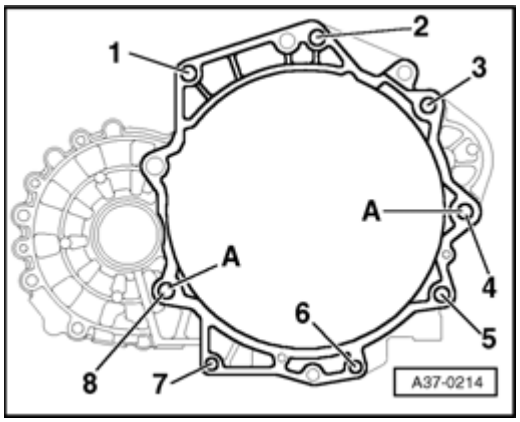

Fig. 45: Removing Bolts On Engine/Transmission Flange
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts -1- to -8- on engine/transmission flange.
- Separate engine from transmission.

Engine, attaching to engine stand

Before performing repair work, attach the engine to support clamp VW 313 with engine and transmission support VW 540.

Work sequence

- Unbolt transmission.

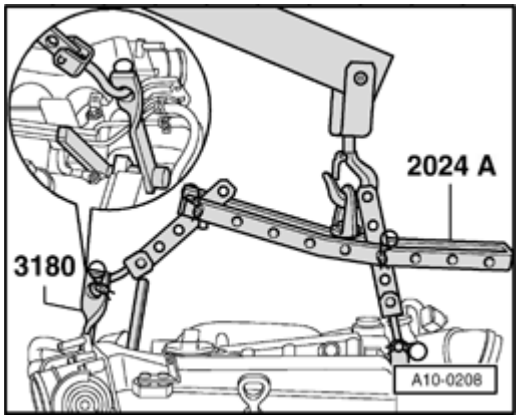

Fig. 46: Attaching Engine Sling 2024 A With Retainer 3180 And Lifting Off Engine/Transmission Jack V.A.G 1383 A With Workshop Crane V.A.G 1202 A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Engage lifting tackle 2024A with retainer 3180 as shown in illustration and lift engine off engine/transmission jack V.A.G1383A using workshop crane V.A.G 1202A.

Pulley end:

- 2nd hole on support bar in position 1

Flywheel end:

- 3rd hole on support bar in position 5

CAUTION: Always use split pins to secure hooks and retainer pins.

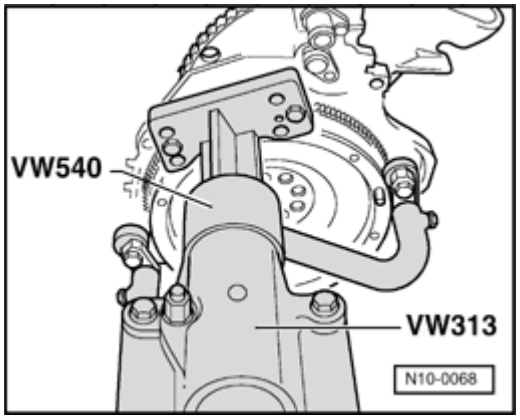

Fig. 47: Identifying Engine Fastened Using Holding Fixture VW 540 & Holding Fixture VW 313
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Secure engine to engine/transmission support VW 540 and fit to support clamp.

Engine, installing

NOTE: When performing repairs, always replace seals and gaskets as well as self-locking nuts and bolts which have a specified tightening torque.

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

- Check whether dowel sleeves for centralizing engine/transmission are in cylinder block and install if necessary.

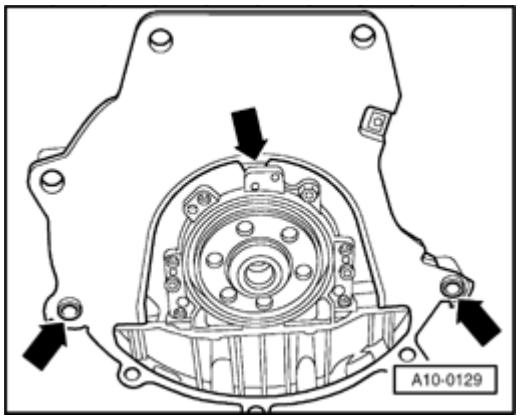

Fig. 48: Identifying Intermediate Plate, Sealing Flange And Dowel Sleeves
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Engage intermediate plate on sealing flange, and press onto dowel sleeves (arrows).

Make sure that clutch plate is properly centered.

- Check clutch release bearing for wear. Replace if necessary.
- Lightly grease clutch release bearing, release bearing guide sleeve and splines on input shaft with G 000 100.
- Install slave cylinder for hydraulic clutch release mechanism:

Refer to

- **30 CLUTCH** for 5 AND 6 SPD. MANUAL TRANSMISSION 02M, 02Y ALL WHEEL DRIVE
- **30 CLUTCH** for 5 SPD. MANUAL TRANSMISSION 02J FRONT WHEEL DRIVE

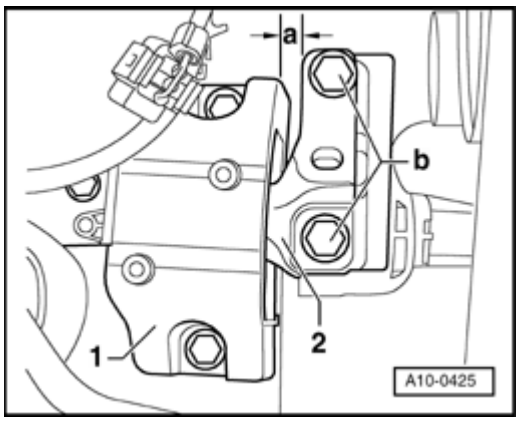

Fig. 49: Identifying Engine Supports Bolts & Distance Between Engine Console & Support Arm
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Adjust engine mounting so that distance -a- (on right side mounting) is about 13 mm. It should be possible to insert a 12 mm flat metal bar (e.g. special tool 2011) without any difficulty.
- To move engine within engine console, first loosen bolts -b- on left and right engine supports by about 2

turns each.

Adjusting engine mounting. Refer to **Engine mountings, adjusting**.

- Attach selector cables to transmission and adjust:

Refer to

- **34 MANUAL TRANSMISSION - CONTROLS, HOUSING** for 5 AND 6 SPD. MANUAL TRANSMISSION 02M, 02Y ALL WHEEL DRIVE
- **34 MANUAL TRANSMISSION - CONTROLS, HOUSING** for 5 SPD. MANUAL TRANSMISSION 02J FRONT WHEEL DRIVE

- Install power steering pump:

Refer to **48 STEERING**

Installing drive axle

- Insert drive axle.
- Insert outer CV joint as far as possible.
- Lower vehicle making sure wheels do not touch ground.

NOTE: Wheel bearings can be damaged.

- Depress brake pedal (second technician needed).
- Tighten 12-point nut.

NOTE: Tightening torques for 12-point nuts vary.

Refer to **40 FRONT SUSPENSION**

Vehicles with air conditioning

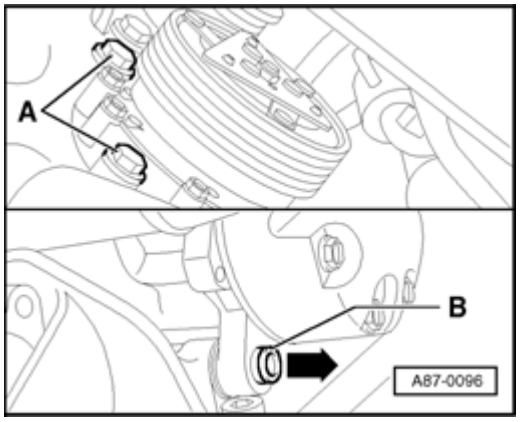

Fig. 50: Unbolting A/C Compressor & Pressing Sliding Bushing Back Into Hole
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- To facilitate installing air conditioning compressor, knock back threaded bushes -B- for mounting bolts -A- slightly in direction indicated (arrow).

All vehicles

- Install ribbed belt. Refer to **Installing ribbed belt**.
- Install front exhaust pipe. Refer to **Front exhaust pipe, removing and installing**.

NOTE: Avoid excessive bending of the de-coupling element (no more than 10°).

Stress-free alignment of exhaust system. Refer to **Exhaust system, aligning stress-free**.

- Connect coolant hoses. Refer to **Engine cooling system components, overview**.
- Connect vacuum hoses. Refer to **Charge air pressure control system and vacuum system connections, diagram**.
- Fill up with coolant. Refer to **Filling**.

NOTE:

- **Drained-off coolant may only be used again if the original cylinder head and cylinder block are re-installed.**
- **Do not use coolant that is dirty or contaminated.**

- Check oil level before starting engine. Refer to **Engine oil level, checking**.

Electrical connections and routing:

Refer to Electrical Wiring Diagrams, Troubleshooting & Component Locations

- After connecting battery terminals, enter anti-theft code for radio.

Refer to Radio operating instructions

CAUTION: If a battery charger is used to give the engine an assisted start, there is a risk that the control modules in the vehicle will be damaged.

- Close power windows in front doors to their top positions using electric switches.
- Operate all power window switches again for at least one second in "close" direction to activate automatic one-touch function.
- Set clock to correct time.
- Perform adaptation of throttle valve control module.

Refer to

- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

  - Check DTC memory.

Refer to

- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

NOTE: **DTCs will be stored in the memory because connectors have been disconnected. Therefore, check and erase DTC memory after installing the engine.**

Tightening torques

NOTE:

- **The tightening torques listed on this Article apply only to lightly greased, oiled, phosphated, or black-finished nuts and bolts.**
- **Additional lubricant such as engine and transmission oil may be used, but do not use molybdenum lubricant.**
- **Do not use degreased parts.**
- **Tolerance for tightening torques is ± 15%.**

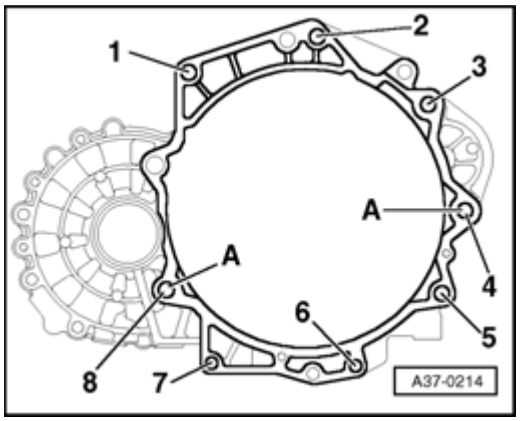

Fig. 51: Removing Bolts On Engine/Transmission Flange
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Engine/transmission mountings (manual transmission)

A: centering sleeves

Item No.	Bolt	Nm
1	M12 x 55	65
2	M12 x 55 1)	65
3	M12 x 140 1)	65
4	M12 x 140 1)	65
5	M10 x 50	45
6	M10 x 70	45
7	M10 x 50	45
8	M12 x 55	65

1) Bolt with M8 stud

Components		Nm
Bolts/nuts	M6	10
	M8	20
	M10	45
	M12	65
Screw clamps		2
Except for the following:		
Axle shafts to transmission	M8	40
Engine support to engine console 1)		85
Transmission support to transmission console 1)		60 + 90° 2)
Drive plate to torque converter	M10 x 1	85
Pendulum support to transmission 1)		40 + 90° 2)

Pendulum support to subframe 1)		20 + 90° 2)
Front exhaust pipe to turbocharger		40
A/C compressor to bracket		45
Drive axle heat shield to cylinder block		35
Nuts for clamp		40

1) Stretch bolts - replace

2) 90° is one quarter turn

Engine mountings, adjusting

- Unbolt hydraulic fluid reservoir above right side engine mounting and pull to one side.

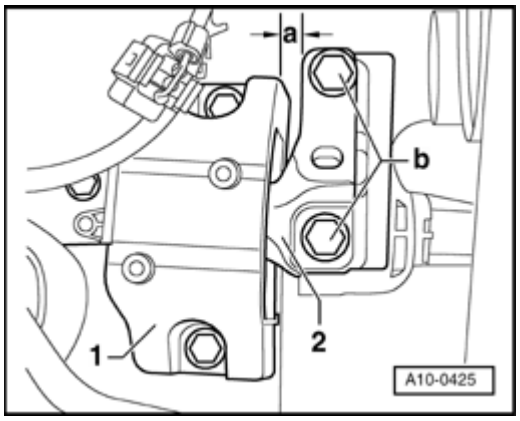

Fig. 52: Identifying Engine Supports Bolts & Distance Between Engine Console & Support Arm
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Distance -a- between engine console -1- and support arm -2- of right side engine mounting should be about 13 mm. It should be possible to insert a 12 mm flat iron bar without difficulty (e.g. special tool 2011).

If the gap is too narrow or too wide, proceed as follows:

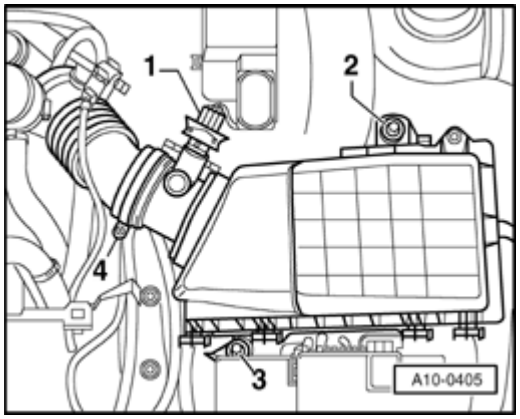

Fig. 53: Identifying Air Hose, Mass Air Flow Sensor & Bolts

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove air hose -4- from mass air flow sensor.
- Disconnect electrical connectors for mass air flow sensor -1-.
- Remove bolts -2- and -3- and remove air cleaner housing.

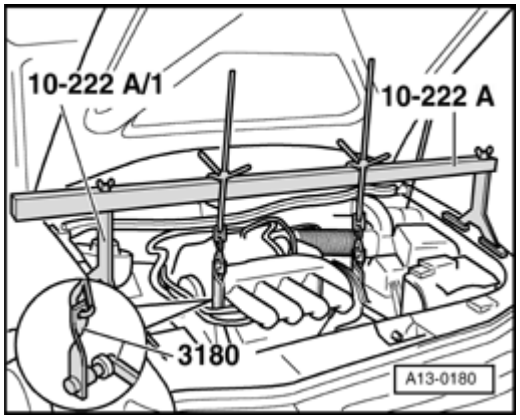

Fig. 54: Setting Up Engine Support 10-222A On Two Wing Panel Flanges And Set Up With Supports 10-222A/1 And Two Spindles
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Set up engine support 10-222A onto fender panel flanges with supports10-222A/1 and two spindles.
- Bolt retainer 3180 to right side lifting eye and engage on hook at end of right side spindle.
- Engage hook at end of left side spindle in left side lifting eye.
- Raise engine slightly, taking up weight evenly on both spindles.

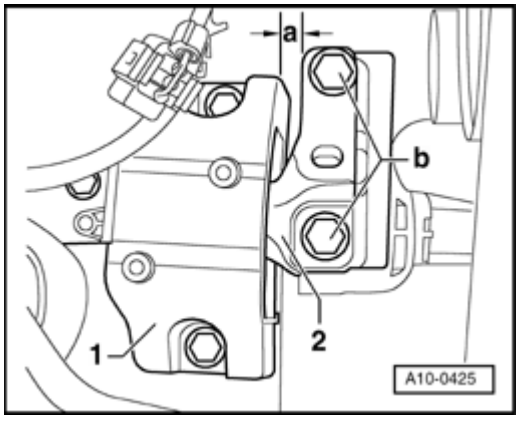

Fig. 55: Identifying Engine Supports Bolts & Distance Between Engine Console & Support Arm
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen bolts -b- on left and right side support arms by about two turns each.
- Insert an iron bar between engine console and support arm, then move engine until gap -a- measures 13 mm.
- Tighten (by hand) all four bolts -b- on left and right side support arms.

- Tighten all four bolts to 85 Nm.

13 ENGINE - CRANKSHAFT, CYLINDER BLOCK

ENGINE, DISASSEMBLING AND ASSEMBLING

Ribbed belt, removing and installing

NOTE:

- **The following illustration shows the belt drive on vehicles without air conditioning.**
- **Before removing the ribbed belt, mark the direction of rotation using chalk or a felt marker pen. If the belt rotates in the wrong direction when it is reinstalled, this can cause breakage. Ensure that the belt is properly seated in the pulleys when installing.**
- **Installing air conditioning compressor. Refer to Installing air conditioning compressor, Fig. 3.**

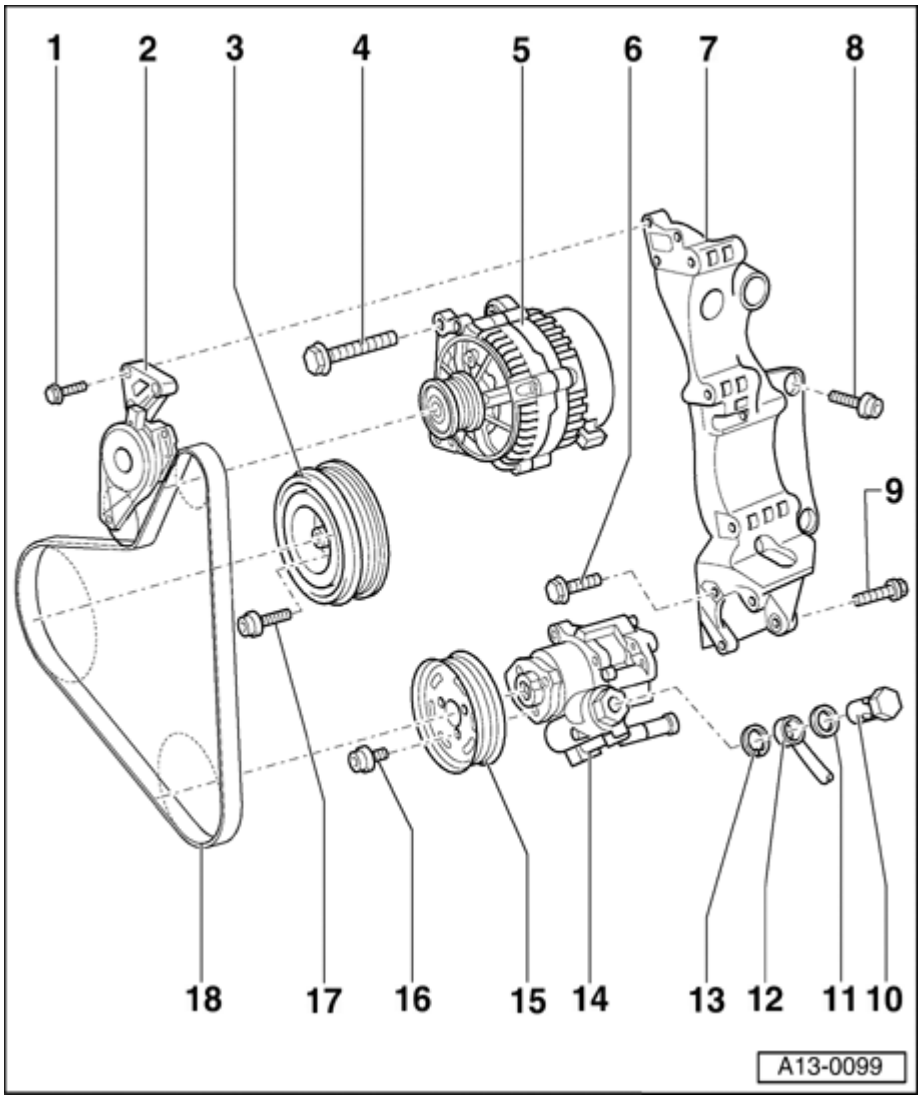

Fig. 56: Ribbed Belt Remove/Install Components
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 25 Nm

2 - Tensioning element for ribbed belt

- Turn with open-end wrench to loosen ribbed belt. Refer to **Removing ribbed belt**.

3 - Vibration damper

- With pulley for ribbed belt
- Can only be installed in one position

4 - 25 Nm

5 - Generator

- Removing and installing:

Refer to **27 BATTERY, STARTER, GENERATOR, CRUISE CONTROL**

- To facilitate positioning of Generator on bracket, knock back threaded bushings for retaining bolts slightly.

6 - 25 Nm

7 - Bracket

- Illustration shows version for vehicles without air conditioning

8 - 45 Nm

9 - 25 Nm

10 - Banjo bolt, 30 Nm

11 - Sealing ring

- Replace

12 - Pressure line

13 - Sealing ring

- Replace

14 - Power steering pump

- Removing and installing:

Refer to **48 STEERING**

- To facilitate positioning of pump on bracket, knock back threaded bushings for retaining bolts slightly.

15 - Pulley

- For power steering pump

16 - 25 Nm

17 - 25 Nm

18 - Ribbed belt

- Position of ribbed belt on vehicles without air conditioning. See **Ribbed belt on vehicles without air conditioning**
- Position of ribbed belt on vehicles with air conditioning. See **Ribbed belt on vehicles with air conditioning**
- A double ribbed belt is installed on engines with an A/C compressor
- Mark direction of rotation before removing.

- Check for wear.
- Do not kink
- Removing ribbed belt. Refer to **Removing ribbed belt**
- Installing ribbed belt. Refer to **Installing ribbed belt**

Ribbed belt on vehicles without air conditioning

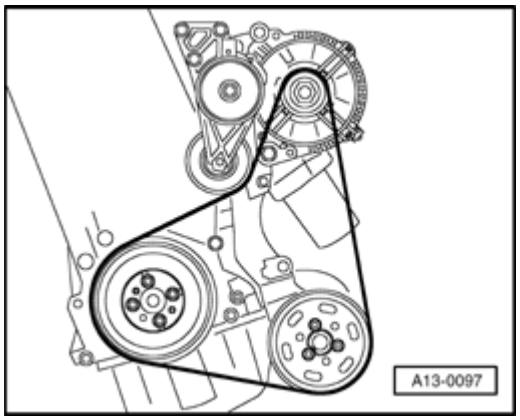

Fig. 57: Ribbed Belt On Vehicles Without Air Conditioning
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Ribbed belt on vehicles with air conditioning

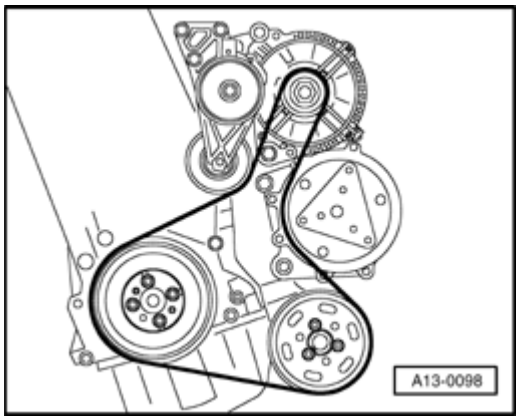

Fig. 58: Ribbed Belt On Vehicles With Air Conditioning
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE: Engines with an air conditioning compressor have a double ribbed belt installed.

Installing air conditioning compressor

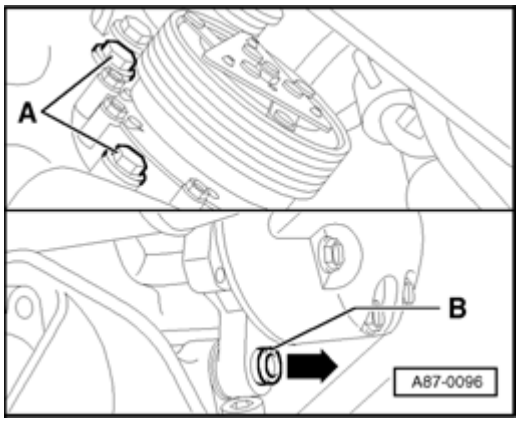

Fig. 59: Unbolting A/C Compressor & Pressing Sliding Bushing Back Into Hole
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- To facilitate positioning of A/C compressor, knock back threaded bushings -B- for retaining bolts -A- slightly in direction indicated (arrow).
- Tighten bolts to 45 Nm.

Removing ribbed belt

NOTE: Before removing the ribbed belt, mark the direction of rotation using chalk or a felt marker pen. If the belt rotates in the wrong direction when it is reinstalled, this can cause breakage. Ensure that the belt is properly seated in the pulleys when installing.

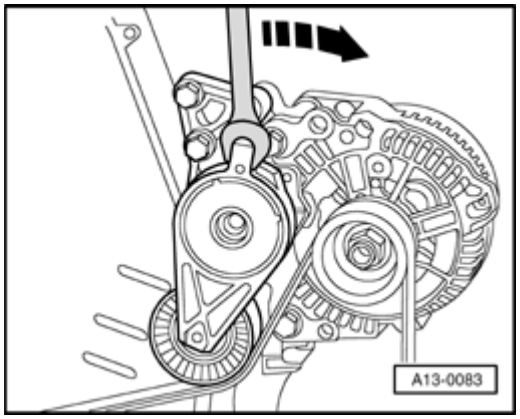

Fig. 60: Relieving Tension On Poly V-Belt
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- To loosen ribbed belt turn tensioning element in direction of arrow.

- Remove ribbed belt.

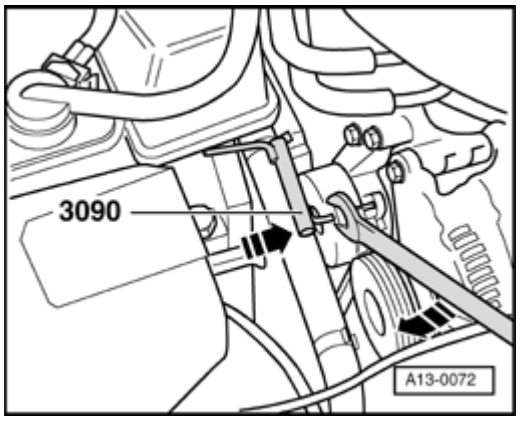

Fig. 61: Blocking Tensioner With 3090
Courtesy of VOLKSWAGEN UNITED STATES, INC.

The tensioning element can be locked in position with a suitable punch (4.5 mm diameter, approx. 55 mm long). Connecting rod support 3090 can also be used.

Installing ribbed belt

NOTE: Before installing the ribbed belt ensure that all accessories (Generator, air conditioning compressor, power steering pump) are properly secured.

- Install ribbed belt.

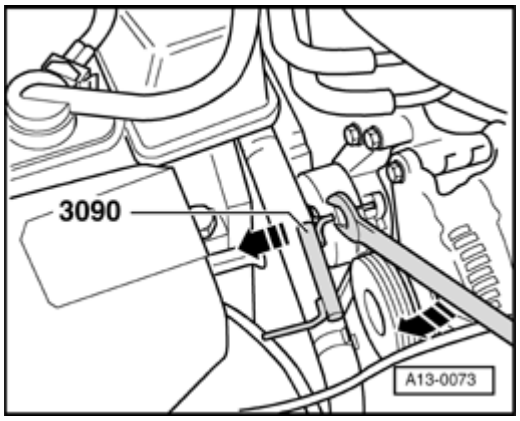

Fig. 62: Pulling Out Punch Or Connecting Rod Support 3090
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen tensioning element for ribbed belt. Pull out punch or connecting rod support 3090 (arrows).
- Start engine and check that belt runs properly.

NOTE: Engines with an air conditioning compressor have a double ribbed belt installed.

Toothed belt, removing and installing

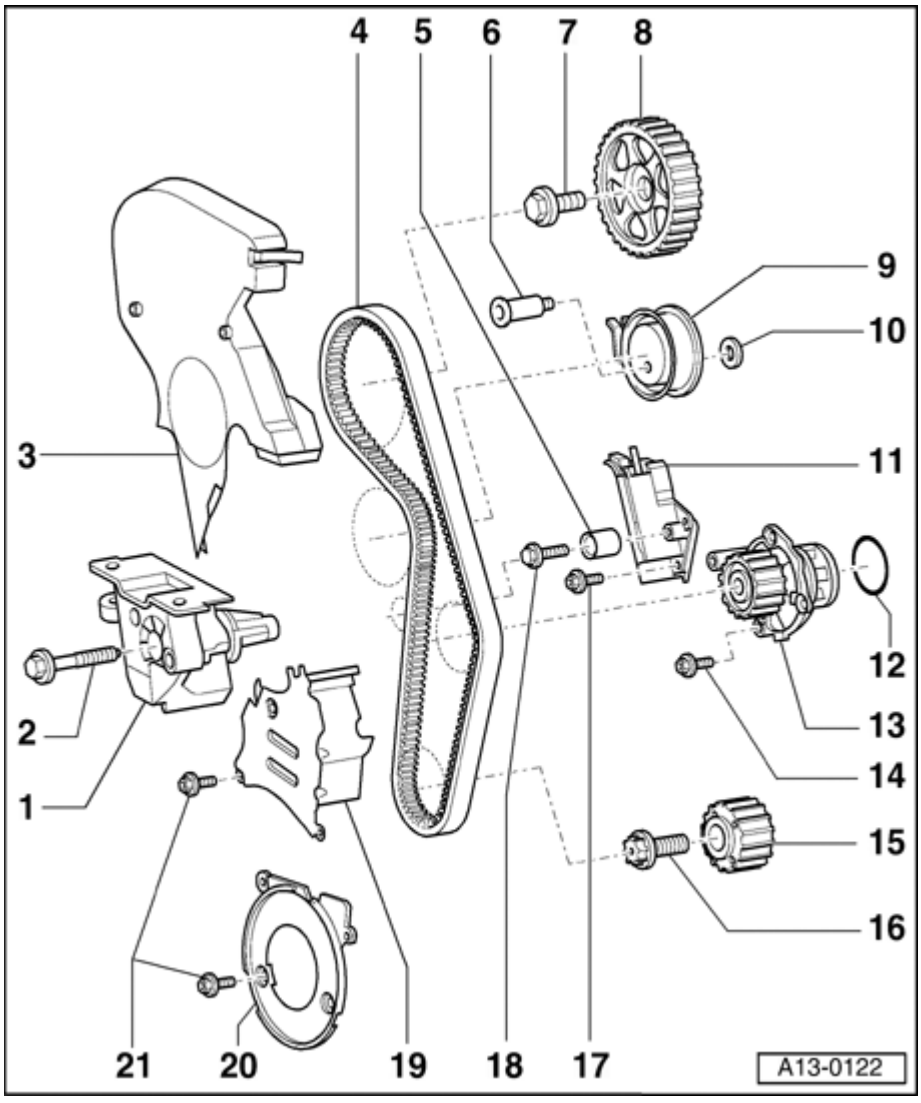

Fig. 63: Identifying Special Tools - Toothed Belt, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE: Mark the direction of rotation before removing the toothed belt. If a used belt rotates in the wrong direction when reinstalled, this can result in breakage.

1 - Engine support

- Removing (removing toothed belt). Refer to **Removing toothed belt**

2 - 45 Nm

3 - Toothed belt guard, top

- To remove belt guard, it may be necessary to unbolt retainer for coolant return line (for turbocharger).

4 - Toothed belt

- Mark direction of rotation before removing
- Check for wear
- Do not kink
- Removing. Refer to **Toothed belt, removing and installing**
- Installing belt and adjusting timing. Refer to **Installing toothed belt (setting camshaft timing)**

5 - Idler roller

6 - 27 Nm

7 - 65 Nm

- Use counter-hold 3036 to loosen and tighten

8 - Camshaft sprocket

- For exhaust camshaft
- To remove and install, first remove toothed belt. Refer to **Toothed belt, removing and installing**
- Note installation position: camshaft sprocket is installed with smaller side facing out and TDC marking for cylinder 1 visible

9 - Tensioner

10 - Washer

11 - Tensioner for toothed belt

12 - O-ring

- Replace
- Lightly coat with coolant G 012 A8 D before installing

13 - Coolant pump

- Removing and installing. Refer to **Coolant pump, removing and installing**

14 - 15 Nm

15 - Crankshaft sprocket

- Contact surface between sprocket and crankshaft must be free of oil
- Can only be installed in one position

16 - 90 Nm + 1/4 turn (90°) further

- Replace
- Counter-hold with 3099 retainer to loosen and tighten
- Place 2 washers between sprocket and retainer when mounting retainer: Refer to **Front sealing flange, removing and installing**

17 - 15 Nm

18 - 20 Nm

19 - Toothed belt guard, center

20 - Toothed belt guard, bottom

21 - 10 Nm

Removing toothed belt

Special tools, testers and workshop equipment required:

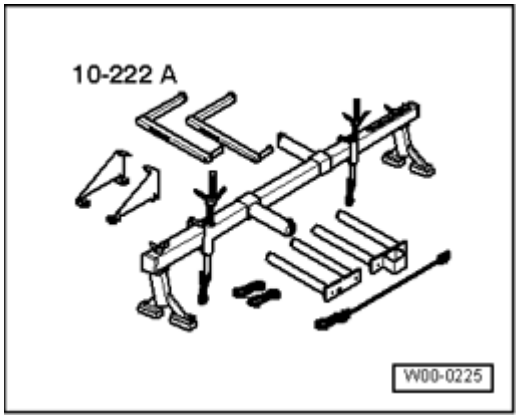

Fig. 64: Identifying Support Assembly 10-222A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- 10-222A Engine support bridge

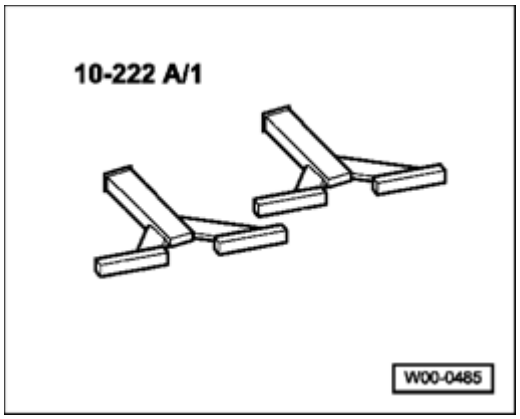

Fig. 65: Identifying Support Assembly 10-222A/1
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- 10-222A/1 Bracket for engine
- Engine in vehicle

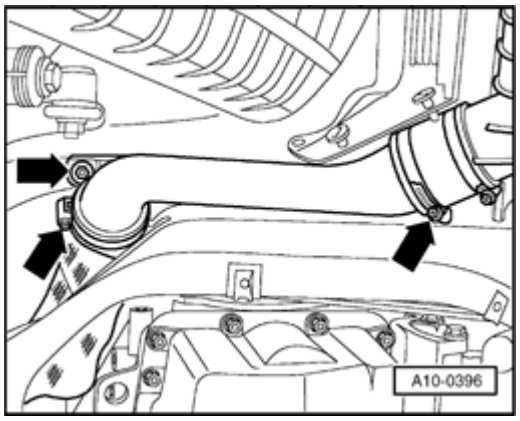

Fig. 66: Disconnecting Air Duct At Bottom Of Right Side Longitudinal Member
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect air duct at bottom of right-hand longitudinal member (air duct leads to charge air cooler).

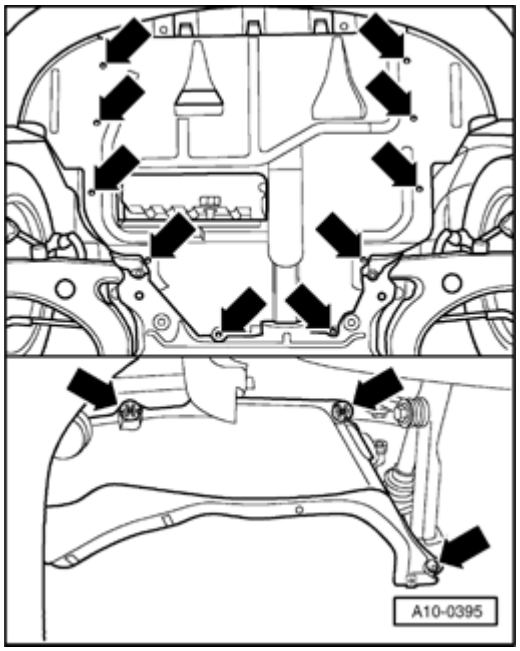

Fig. 67: Removing Noise Insulation Panels (Center, Left And Right)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove sound insulation panels in center and on right (arrows).
- Remove ribbed belt and tensioning element. Refer to **Ribbed belt, removing and installing**.

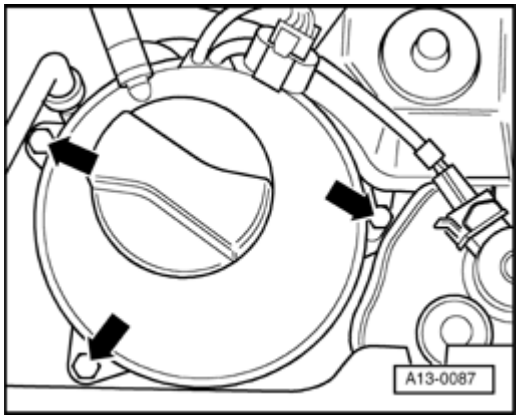

Fig. 68: Detaching Coolant Expansion Tank And Power Steering Reservoir
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove coolant expansion tank and power steering reservoir (arrows) and move to one side with hoses connected.
- Disconnect vacuum hose from EVAP canister and from connection on throttle valve.
- Disconnect electrical connectors on coolant expansion tank and EVAP canister.
- Remove toothed belt guard (top).

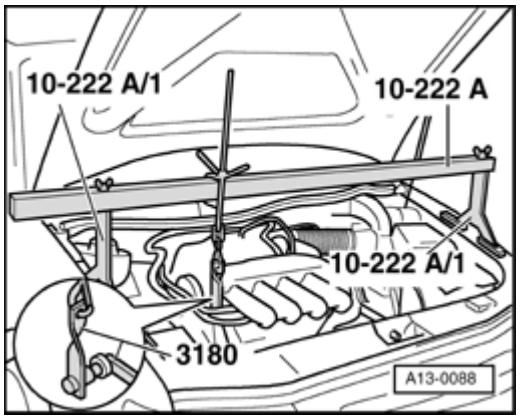

Fig. 69: Engine Support Bridge 10 - 222 A Install With Bracket For Engine 10 - 222 A/1
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Set up engine support bracket 10-222 A with supports 10-222 A/1.
- Install retainer 3180 to right lifting eye and attach to engine support bracket 10-222 A.
- Lift engine slightly with spindle of engine support bracket 10-222 A.

NOTE: Lift coolant expansion tank and power steering reservoir and tie them in place on the engine support bracket.

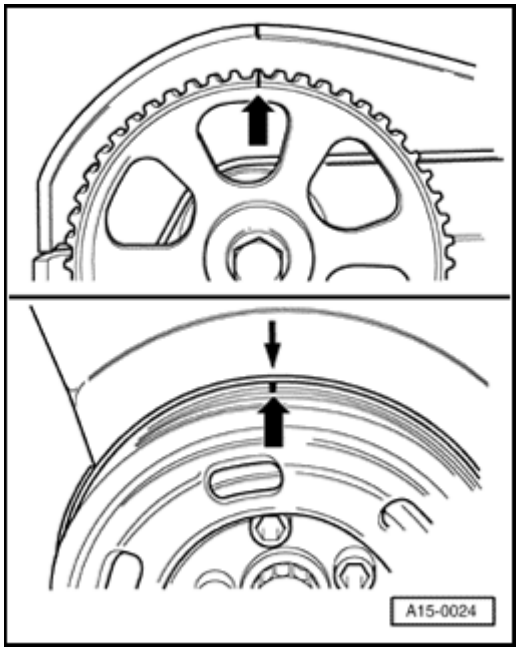

Fig. 70: Setting Crankshaft To Markings For TDC Of No. 1 Cylinder
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Set crankshaft to markings for TDC of No. 1 cylinder (arrows) by turning central bolt on crankshaft sprocket in direction of rotation.
- Remove vibration damper, making sure not to change TDC position.

- Remove center and bottom sections of toothed belt guard.

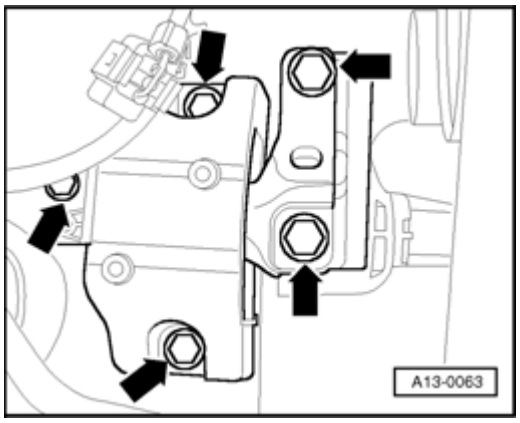

Fig. 71: Unbolting Engine Support From Engine Console And Engine Console From Body
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unbolt engine support from engine console and engine console from body (arrows).
- Unbolt connecting piece between engine console and body.
- Take out engine console.

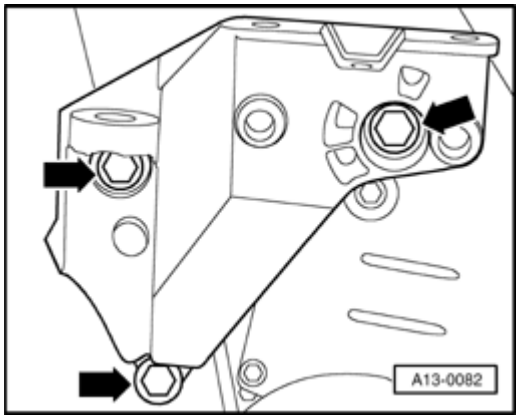

Fig. 72: Removing Engine Bracket Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts for engine support (arrows), but do not take out engine support.

NOTE: To remove the bolts for the engine support, raise or lower the engine slightly as necessary via the spindles on engine support bracket 10-222A.

- Mark direction of rotation of toothed belt with chalk or felt pen.

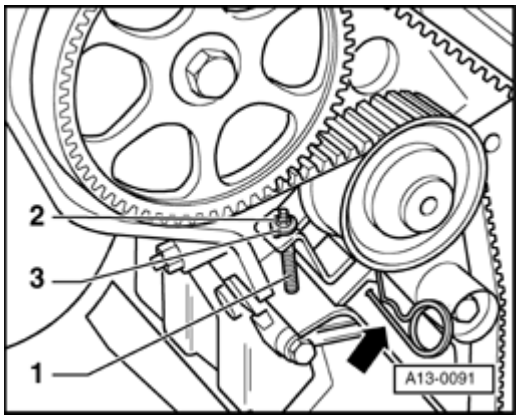

Fig. 73: Screwing Stud Into Toothed Belt Tensioning Element & Hex Nut Onto Stud Using Large Washer
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Screw M5 x 55 stud -1- into toothed belt tensioning element. Screw hex nut -2- onto stud -1- using a large washer -3-.
- Only tension piston of tensioning element as far as necessary to secure it with a locking pin (e.g. from lifting appliance 2024A) -arrow-.
- Pull out toothed belt through space between engine support and cylinder block.

Installing toothed belt (setting camshaft timing)

NOTE:

- **The position of the toothed belt must be set as described below, even after repairs in which the belt is only taken off the camshaft sprocket.**
- **When turning the camshaft the crankshaft must not be at TDC (danger of damage valves/piston crown).**

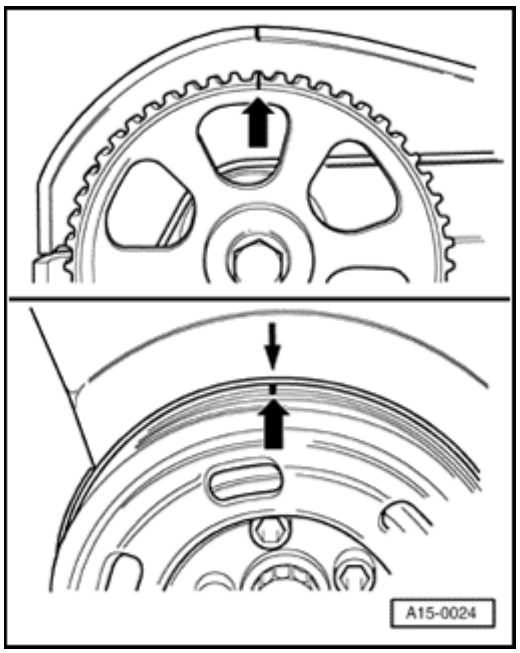

Fig. 74: Setting Crankshaft To Markings For TDC Of No. 1 Cylinder

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Align camshaft sprocket mark with marking on cylinder head cover.
- Place toothed belt on crankshaft sprocket (mark direction of rotation using chalk or paint).
- Install toothed belt guard, lower part.
- Install vibration damper (note installation position: hole in vibration damper is over projection on toothed belt sprocket).

- Align vibration damper marking with marking on lower part of toothed belt guard.
- Install toothed belt onto coolant pump, then tensioning roller, and finally camshaft sprocket.

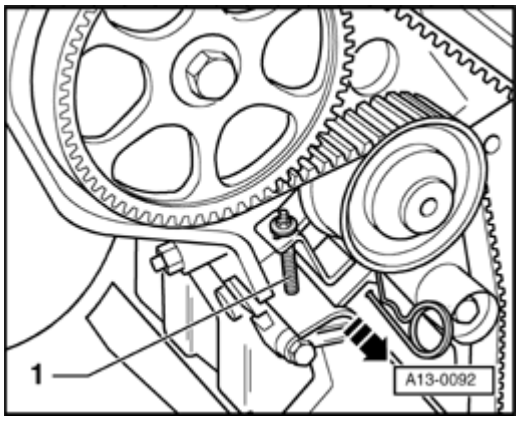

Fig. 75: Pulling Out Locking Pin, Loosening Piston Of Toothed Belt Tensioning Element & Removing Stud
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull out locking pin (arrow) and loosen piston of toothed belt tensioning element.
- Remove stud -1-.
- Turn crankshaft two complete turns in engine direction of rotation, set again to TDC and check adjustment.
- Install engine support and console.

- Remove engine support bracket 10-222 A with retainer 3180.
- Install toothed belt guard (center and top sections).
- Install ribbed belt and tensioning element. Refer to **Ribbed belt, removing and installing**.
- Install and secure coolant expansion tank and power assisted steering reservoir.

Tightening torques

Component		Nm
Bottom section of toothed belt guard to cylinder block		10
Center section of toothed belt guard to cylinder block		10
Vibration damper to crankshaft		25

Engine support to cylinder block		45
Engine support to engine console 1)		60 + 90° 2)
Engine console to body 1)		40 + 90° 2)
Coolant expansion tank to body		10
Power steering reservoir to body		10
Screw clamps		2

1) Stretch bolts - replace

2) 90° is a quarter turn

SEALING FLANGES AND FLYWHEEL, REMOVING AND INSTALLING

Sealing flanges and flywheel, removing and installing

NOTE:

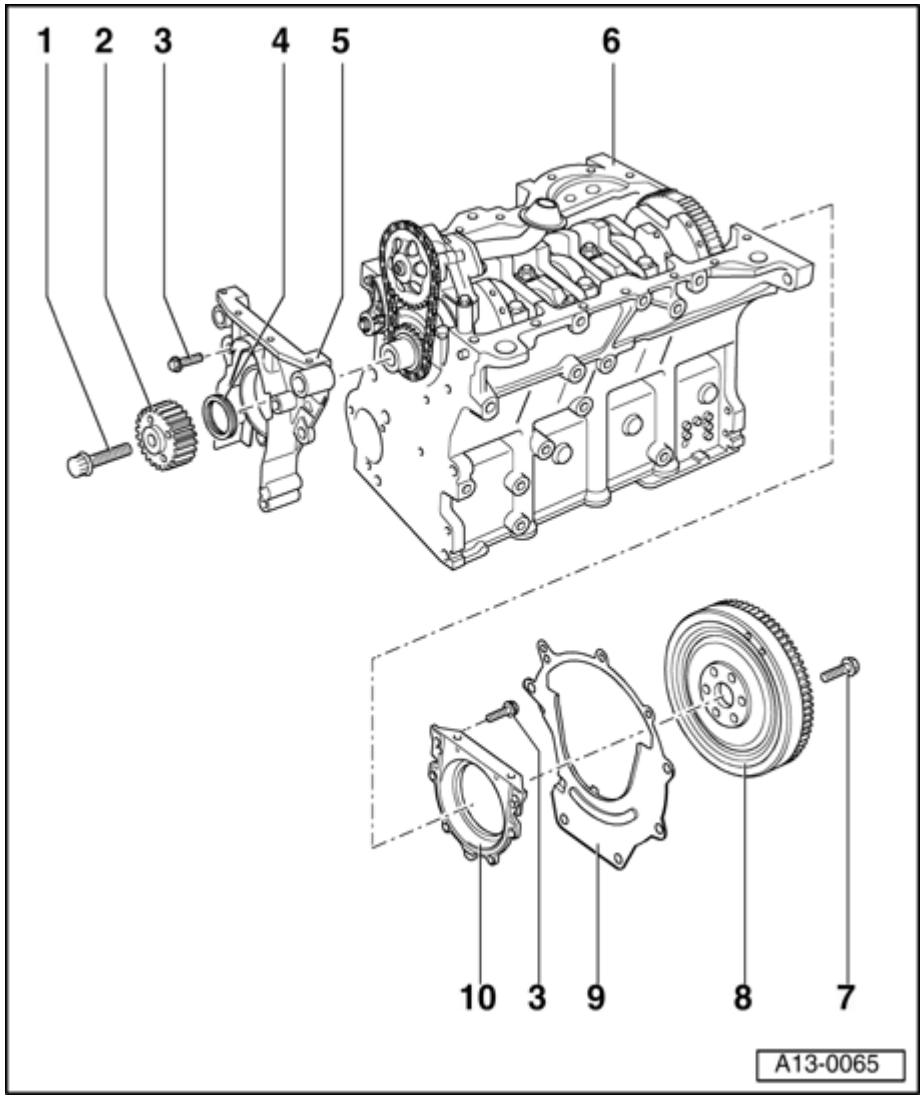

Fig. 76: Identifying Sealing Flanges And Flywheel/Drive Plate

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- For repairs to the clutch:

Refer to

- **30 CLUTCH** for 5 AND 6 SPD. MANUAL TRANSMISSION 02M, 02Y ALL WHEEL DRIVE
- **30 CLUTCH** for 5 SPEED MANUAL TRANSMISSION 02J (FRONT WHEEL DRIVE)

- When working on the engine, it should be secured to the engine stand using the engine bracket VW 540.

1 - 90 Nm + 1/4 turn (90°) further

- Replace
- Counter-hold with 3099 retainer to loosen and tighten
- Place 2 washers between pulley and retainer when mounting retainer: Refer to **Front sealing flange, removing and installing**

2 - Crankshaft sprocket

- Can only be installed in one position
- Contact surface between sprocket and crankshaft must be free of oil
- Removing and installing toothed belt. Refer to **Toothed belt, removing and installing**

3 - 15 Nm

4 - Oil seal

- Replacing. Refer to **Crankshaft oil seal (pulley end), replacing**

5 - Sealing flange, front

- Must be located on dowel sleeves
- Removing and installing. Refer to **Front sealing flange, removing and installing**

6 - Cylinder block

- Removing and installing crankshaft. Refer to **Crankshaft, removing and installing**
- Disassembling and assembling pistons and connecting rods. Refer to **Pistons and connecting rods, disassembling and assembling**

7 - 60 Nm + 1/4turn (90°) further

- Turn further can be done in several stages
- Replace

8 - Dual mass flywheel/drive plate

- Can only be installed in one position (holes are offset)
- Removing and installing dual mass flywheel. Refer to **Dual mass flywheel, removing and installing**
- Removing and installing drive plate. Refer to **Drive plate, removing and installing**

9 - Intermediate plate

- Must be located on dowel sleeves
- Do not damage or bend when assembling
- Is installed on sealing flange. See **Installing intermediate plate**

10 - Rear sealing flange with oil seal

- With gasket for cylinder block
- Replacement sealing flange has oil seal in different position
- Remove oil pan in order to remove and install. Refer to **Oil pan, removing and installing**.
- Clean sealing surface before installing.

- Must be located on dowel sleeves
- Lightly oil sealing lip of oil seal.
- When installing, push guide sleeve from repair kit onto crankshaft

Installing intermediate plate

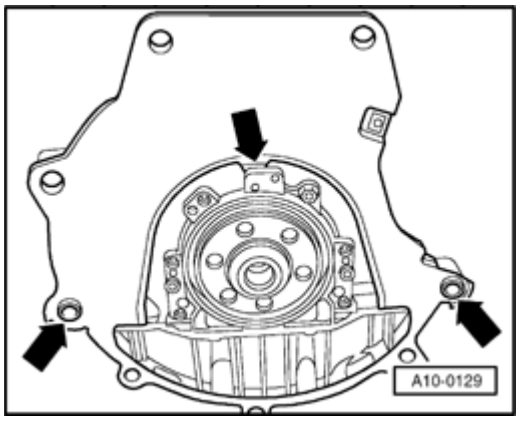

Fig. 77: Identifying Intermediate Plate, Sealing Flange And Dowel Sleeves
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Engage intermediate plate on sealing flange and press onto dowel sleeves (arrows).

Crankshaft oil seal (pulley end), replacing

Removing

- Remove ribbed belt. Refer to **Removing ribbed belt**.
- Remove toothed belt. Refer to **Toothed belt, removing and installing**.
- Remove lower air duct.

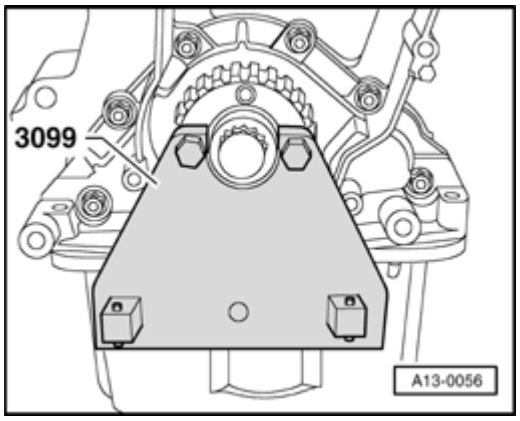

Fig. 78: Identifying Counterhold 3099
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove crankshaft sprocket. To do this counter-hold sprocket with 3099 retainer.
- When installing retainer, place 2 washers between sprocket and retainer.

NOTE: On some engines there is a rib on the oil pan flange which prevents retainer 3099 from being attached as shown. In this case proceed as follows:

- Remove bolts from retainer, and screw back in from the reverse side.
- Knock the fitted pins in the square bars downward until they are flush with the top surface of the bars.
- Bolt the retainer to the crankshaft (fit 2 washers between sprocket and retainer).
- Screw central bolt from sprocket back into crankshaft in order to remove oil seal.

- Remove inner part of oil seal extractor 3203 two turns (approx. 3 mm) out of outer part and lock with knurled screw.

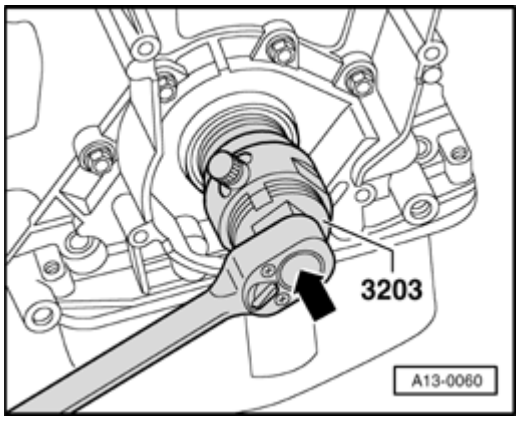

Fig. 79: Loosening Knurled Screw And Turning Inner Part Against Crankshaft Until Oil Seal Is Pulled

Out
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Lubricate threaded head of oil seal extractor, place it in position and exerting firm pressure screw it as far as possible into oil seal.
- Loosen knurled screw and turn inner part against crankshaft until oil seal is pulled out.

Installing

- Lightly oil sealing lip of oil seal.

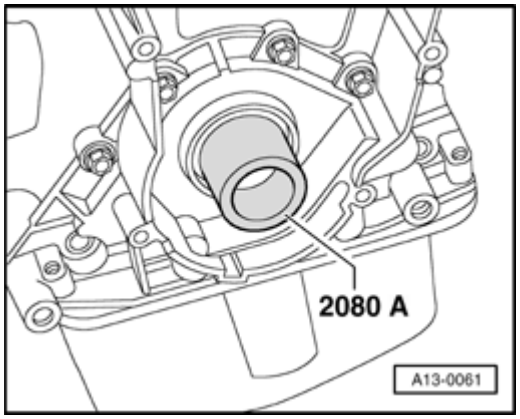

Fig. 80: Identifying Guide Sleeve 2080 A Mount Onto Crankshaft Journal
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place guide sleeve from 2080 A onto crankshaft journal.
- Slide oil seal over guide sleeve.

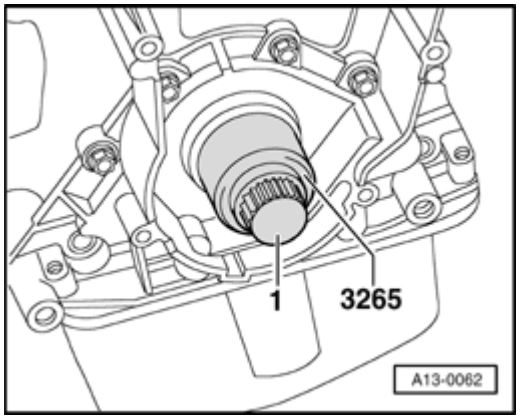

Fig. 81: Pressing Seal With Center Bolt Into Sealing Flange Using Seal Installer 3265
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press oil seal in until flush with press sleeve from 3265, using central bolt -1- for toothed belt sprocket.
- Install crankshaft sprocket and lock in position with retainer 3099.

NOTE: Replace central bolt for toothed belt sprocket.

- Tighten central bolt.
- Install toothed belt. Refer to **Installing toothed belt (setting camshaft timing)**.
- Install ribbed belt. Refer to **Installing ribbed belt**.

Tightening torque

Toothed belt sprocket to crankshaft: 90 Nm + 1/4 turn (90°) further

Dual mass flywheel, removing and installing

Removing

- Mark installing position of dual mass flywheel on crankshaft with a permanent felt-marker.

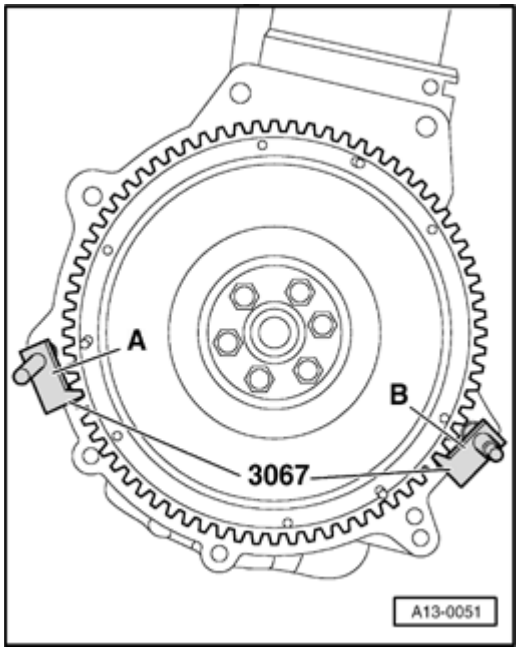

Fig. 82: Inserting Retainer 3067 In Hole On Cylinder Block
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert counter-hold tool 3067 in drilling in cylinder block, and engage on flywheel.

Insertion position for counter-hold tool:

- A: to tighten
- B: to loosen

- Loosen flywheel bolts.

Installing

- Install dual mass flywheel to crankshaft in position marked when removing it.
- Install new bolts and tighten.

Tightening torque

Flywheel to crankshaft: 60 Nm + 1/4 turn (90°) further

Drive plate, removing and installing

Removing

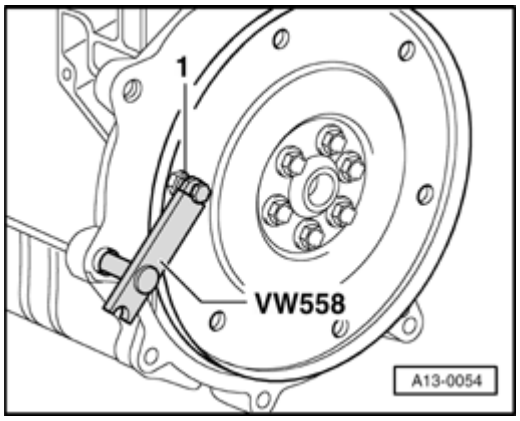

Fig. 83: Securing Counter-Hold Tool VW 558 To Drive Plate With Hexagon Bolt
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Secure counter-hold tool VW 558 to drive plate with a hex bolt M8 x 45. Place two M10 hex nuts -1- between counter-hold tool and drive plate.
- Loosen securing bolts on drive plate.

Installing

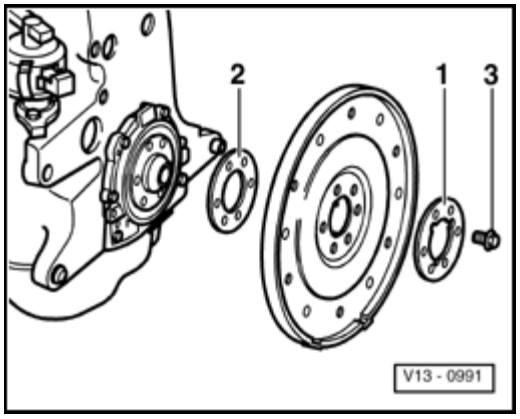

Fig. 84: Identifying Drive Plate, Grooved Washer & Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install drive plate using packing plate with notches -1-.
- Insert at least 3 of old securing bolts -3- and tighten to 30 Nm.

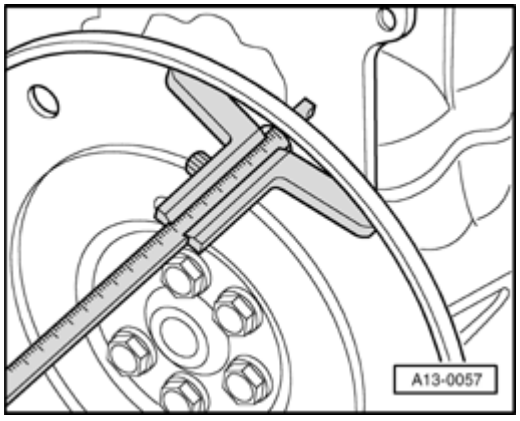

Fig. 85: Checking Installation Position Of Drive Plate By Measuring At Three Points And Calculate Average
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Check installation position of drive plate by measuring at three points and calculate average.

Specification: 19.5-21.1 mm

NOTE: Measurement is taken through the hole in the drive plate to the machined surface of the cylinder block.

If the distance is too large:

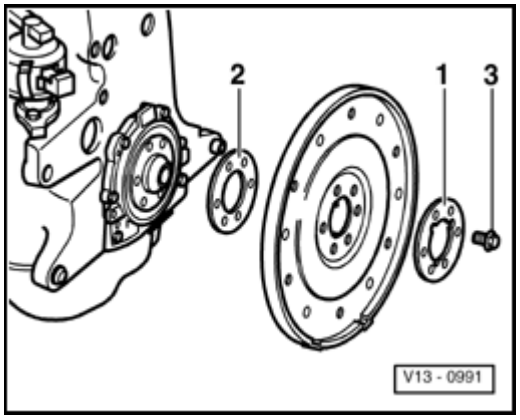

Fig. 86: Identifying Drive Plate, Grooved Washer & Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove drive plate again and install appropriate shim -2-.
- Measure distance again.

If specification is achieved:

- Install new bolts and tighten.

Tightening torque

Driveplate to crankshaft: 60 Nm + 1/4 turn (90°) further

Front sealing flange, removing and installing

Special tools, testers and auxiliary items required

- Electric drill with plastic brush attachment
- Silicone sealant D 176 404 A2

Removing

- Remove ribbed belt and tensioning element. Refer to **Ribbed belt, removing and installing**.
- Remove toothed belt. Refer to **Toothed belt, removing and installing**.
- Remove lower air duct. Refer to **Charge air cooling system components, removing and installing**, item 11.

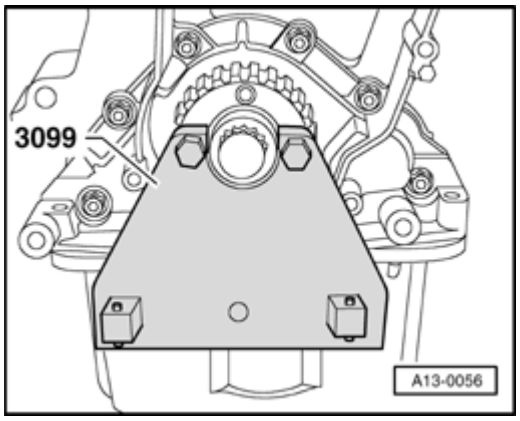

Fig. 87: Identifying Counterhold 3099
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove crankshaft sprocket. To do this counter-hold sprocket with 3099 retainer.
- When installing retainer, place 2 washers between sprocket and retainer.

NOTE: On some engines there is a rib on the oil pan flange which prevents retainer 3099 from being attached as shown. In this case proceed as follows:

- Remove bolts from retainer, and screw back in from the reverse side.
- Knock the fitted pins in the square bars downward until they are flush with the top surface of the bars.
- Bolt the retainer to the crankshaft (install 2 washers between sprocket and retainer).
- Drain engine oil.

- Remove oil pan. Refer to **Oil pan, removing and installing**.
- Unbolt front sealing flange.
- Remove sealing flange. Release flange by tapping lightly with a rubber hammer if necessary.
- Remove sealant remaining on cylinder block with flat scraper.

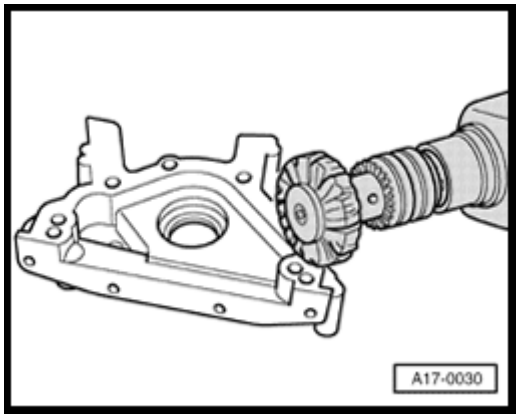

Fig. 88: Removing Sealant Remains On Sealing Flange With Rotating Plastic Brush
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove sealant remaining on sealing flange (with rotating plastic brush or similar).

WARNING: Wear eye protection

- Clean sealing surfaces; they must be free of oil and grease.

Installing

NOTE: The sealing flange must be installed within 5 minutes after applying silicone sealant.

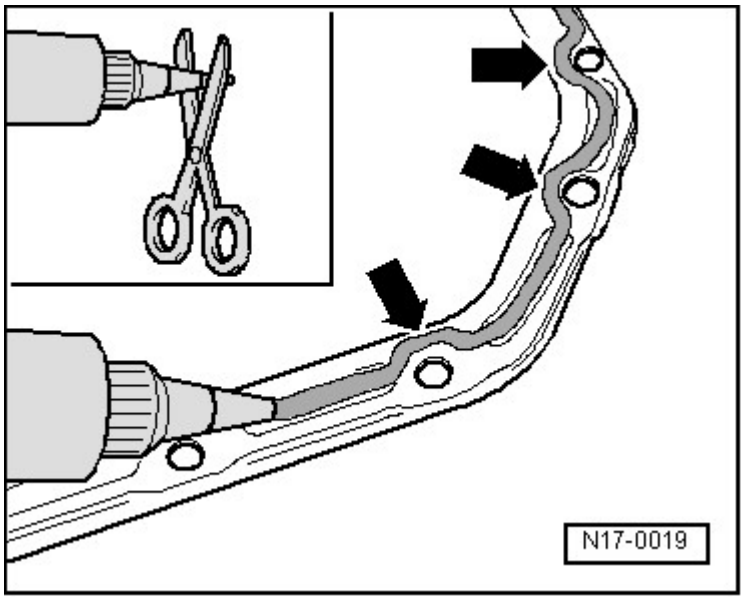

Fig. 89: Cutting Off Tube Nozzle & Applying Silicone Sealing Compound To Oil Pan Sealing Surface
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Cut off nozzle of tube at front marking (nozzle diameter approx. 3 mm).

Sealant should applied in a bead 2 - 3 mm wide (arrows).

NOTE: The bead of sealant must not be thicker than 3 mm, otherwise excess sealant can enter the oil pan and obstruct the filter screen in the oil intake line.

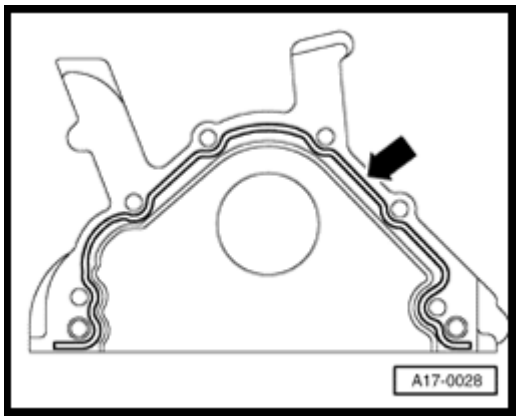

Fig. 90: Applying Silicone Sealant Bead To Clean Sealing Surface Of Sealing Flange
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Apply bead of silicone sealant onto clean sealing surfaces of sealing flange, as illustrated.
- Install sealing flange immediately, and tighten all bolts lightly.

NOTE:

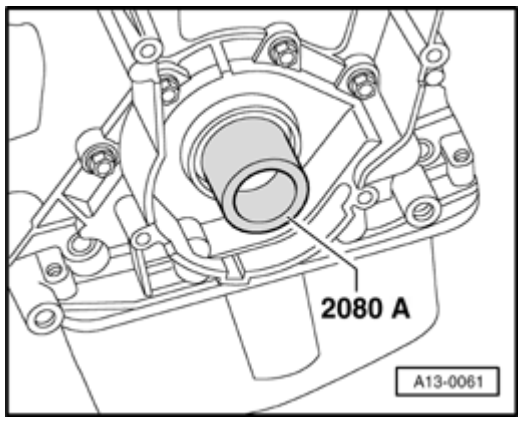

Fig. 91: Identifying Guide Sleeve 2080 A Mount Onto Crankshaft Journal
Courtesy of VOLKSWAGEN UNITED STATES, INC.

To install sealing flange with the oil seal already installed, use guide sleeve from 2080A.

- Tighten bolts on sealing flange in diagonal sequence.
- Install oil sump. Refer to **Installing**.

NOTE: After installing, the sealant must be allowed to dry for about 30 minutes before filling with engine oil.

- Install crankshaft sprocket.

NOTE: Replace central bolt for sprocket.

- Install toothed belt (adjust valve timing). Refer to **Installing toothed belt (setting camshaft timing)**.
- Install ribbed belt and tensioning element. Refer to **Ribbed belt, removing and installing**.

Tightening torques

- Sealing flange to cylinder block: 15 Nm
- Toothed belt sprocket to crankshaft: 90 Nm + 1/4 turn (90°) further

Chain sprocket, removing and installing

Removing

- Remove oil pan. Refer to **Oil pan, removing and installing**.
- Remove front sealing flange. Refer to **Front sealing flange, removing and installing**.
- Remove chain tensioner, oil pump sprocket and chain.

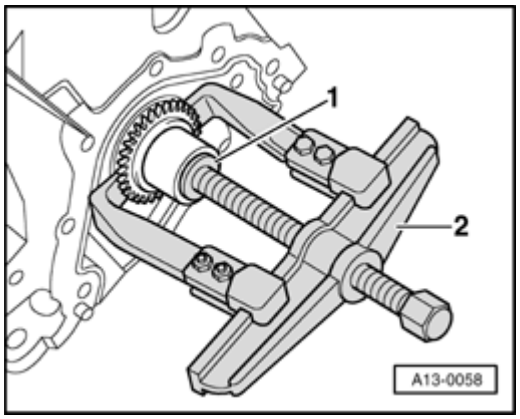

Fig. 92: Pulling Off Chain Sprocket From Crankshaft
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull chain sprocket off crankshaft with puller -2-. Use suitable washer -1- to protect end of crankshaft.

Installing

- Heat chain sprocket to 220° C in oven.

WARNING: Wear protective gloves.

NOTE: Installation position: wide collar on sprocket facing toward engine.

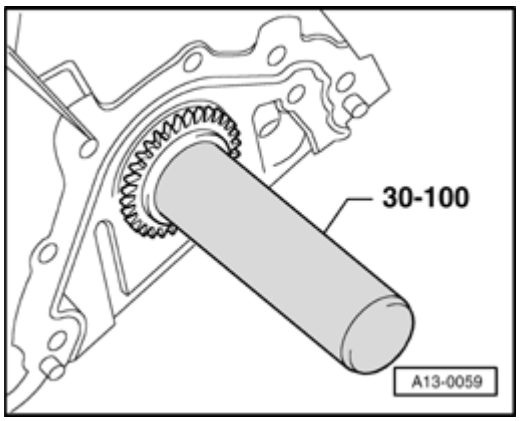

Fig. 93: Installing Chain Sprocket Onto Crankshaft Up To Limit Stop Using Press Tube 30-100
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Using pliers, locate sprocket on end of crankshaft and push onto seat on crankshaft with drift sleeve 30-100.

CRANKSHAFT, REMOVING AND INSTALLING

Crankshaft, removing and installing

NOTE: When working on the engine it should be secured to the engine stand with engine bracket VW 540.

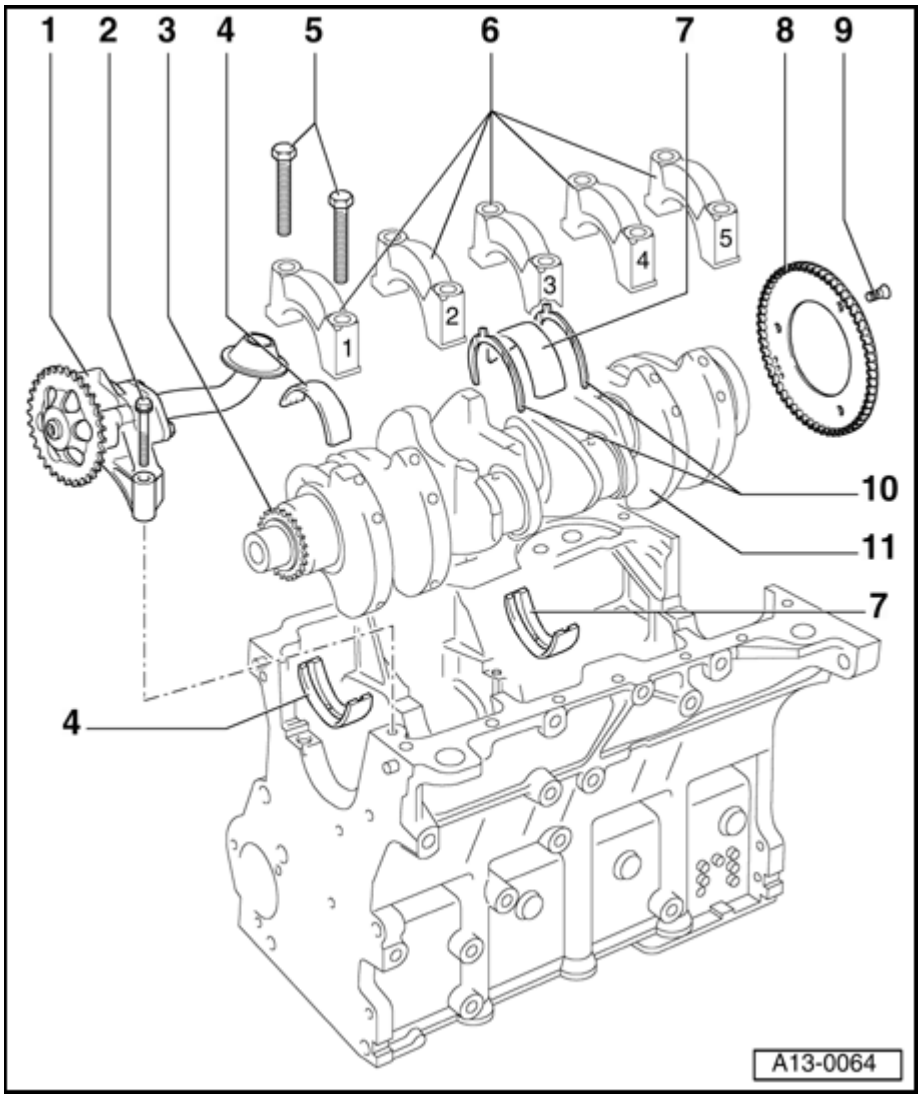

Fig. 94: Crankshaft, Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Oil pump

- Removing and installing. Refer to **Lubrication system components, removing and installing**

2 - 15 Nm

3 - Chain sprocket

- For oil pump drive
- Removing and installing. Refer to **Chain sprocket, removing and installing**

4 - Bearing caps 1, 2, 4 and 5

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

5 - 65 Nm + 1/4 turn (90°) further

- Replace
- Tighten to 65 Nm to measure crankshaft radial play

6 - Bearing cap

- Bearing cap 1: pulley end
- Bearing cap 3 with recesses for thrust washers
- Bearing shell retaining lugs (cylinder block/bearing cap) must be on same side

7 - Bearing shell 3

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

8 - Sensor wheel

- For Engine speed (RPM) sensor -G28-
- Always replace sensor wheel if securing bolts have been unscrewed
- Can only be installed in one position (holes are offset)

9 - 10 Nm + 1/4 turn (90°) further

- Replace

10 - Thrust washer

- For bearing cap and cylinder block, bearing 3
- Note installation arrangement

11 - Crankshaft

- Axial clearance, New: 0.07 - 0.21 mm; Wear limit: 0.30 mm
- Check radial clearance with Plastigage ™ , New: 0.01 - 0.04 mm; Wear limit: 0.15 mm
- Do not rotate crankshaft when checking radial clearance
- Crankshaft dimensions. Refer to **Crankshaft dimensions**

Crankshaft dimensions

Honing dimension	Main journal diameter (mm)			Connecting rod journal diameter (mm)		
		-0.022			-0.022	
Basic dimension		54.00			47.80	
		-0.042			-0.042	
		-0.022			-0.022	
1st undersize		53.75			47.55	
		-0.042			-0.042	
		-0.022			-0.022	
2nd undersize		53.50			47.30	
		-0.042			-0.042	
		-0.022			-0.022	
3rd undersize		53.25			47.05	
		-0.042			-0.042	

PISTONS AND CONNECTING RODS, DISASSEMBLING AND ASSEMBLING

Pistons and connecting rods, disassembling and assembling

NOTE: When working on the engine it should be secured to engine stand with engine bracket VW 540.

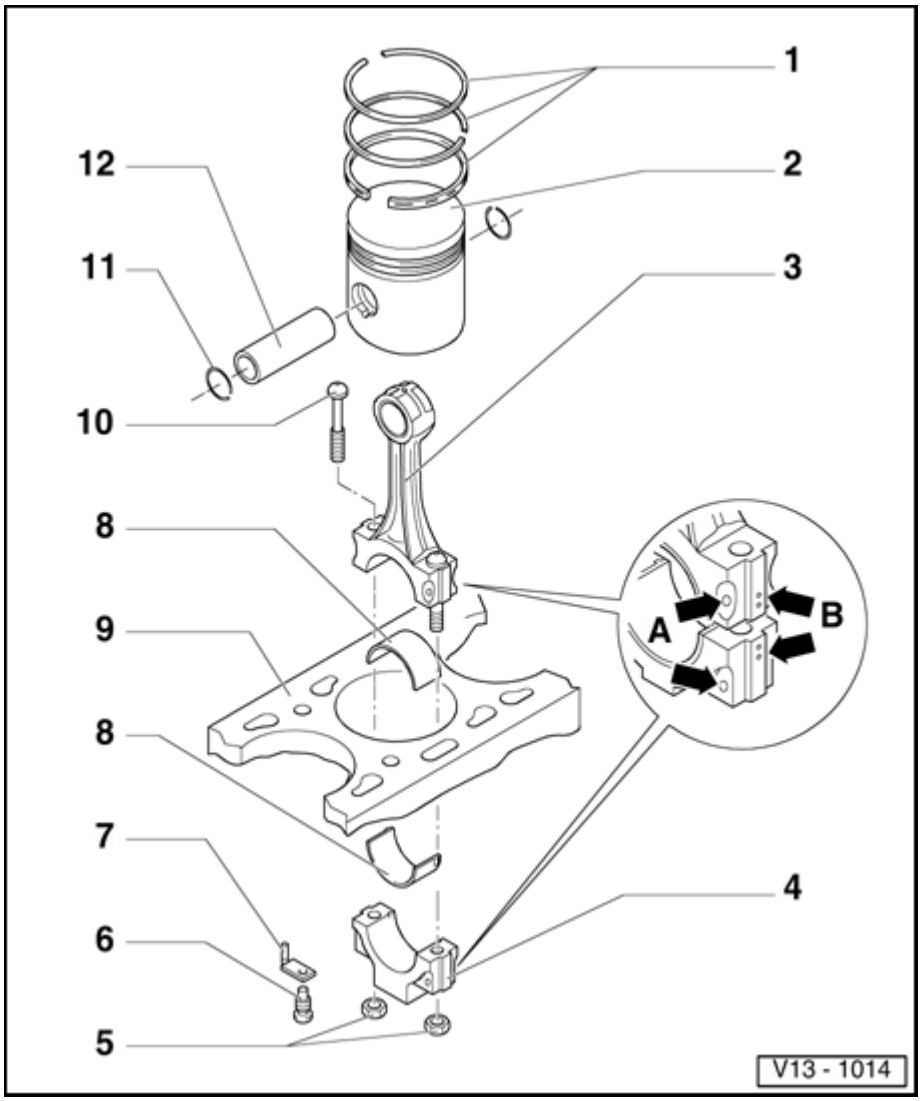

Fig. 95: Pistons And Connecting Rods, Assembly Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Piston ring

- Offset gaps by 120°
- Remove and install with piston ring pliers
- "TOP" faces toward piston crown
- Checking ring gap. See **Checking piston ring gap**
- Checking ring to groove clearance. See **Checking ring to groove clearance**

2 - Piston

- Checking. See **Checking piston**
- Mark installation position in relation to connecting rod and cylinder number with a permanent felt

marker.
- Arrow on piston crown points to pulley end
- Install using piston ring clamp

- Piston and cylinder dimensions. Refer to **Piston and cylinder, dimensions**

3 - Connecting rod

- Only replace as a set
- Mark cylinder number -B-.
- Installation position: Marks -A- must be aligned and facing belt pulley side
- With hole for lubricating piston pin

4 - Connecting rod bearing cap

- Mark cylinder number -B-.
- Installation position: Marks -A- must be aligned and facing belt pulley side

5 - 30 Nm + 1/4 turn (90°) further

- Replace
- Oil threads and contact surface
- To measure radial clearance tighten to 30 Nm, but not further

6 - Pressure relief valve, 27 Nm

- Opens at 2.5-3.2 bar
- Do not apply sealant when installing

7 - Oil spray jet

- For piston cooling

8 - Bearing shell

- Note installation position
- Do not interchange used bearing shells (mark)
- Ensure retaining lugs fit tightly in recesses
- Axial clearance, New: 0.10 - 0.35 mm; Wear limit: 0.40 mm

- Check radial clearance with Plastigage, New: 0.01 - 0.05 mm; Wear limit: 0.12 mm
- Do not rotate crankshaft when checking radial clearance
- With hole for lubricating piston pin

9 - Cylinder block

- Checking cylinder bores. See **Checking cylinder bores**
- Piston and cylinder dimensions. Refer to **Piston and cylinder, dimensions**

10 - Connecting rod bolt

- Replace together with item - 5 under **Pistons and connecting rods, disassembling and assembling**

11 - Circlip

12 - Piston pin

- If difficult to move, heat piston to approx. 60° C.
- Remove and install with drift VW 222a

Checking piston ring gap

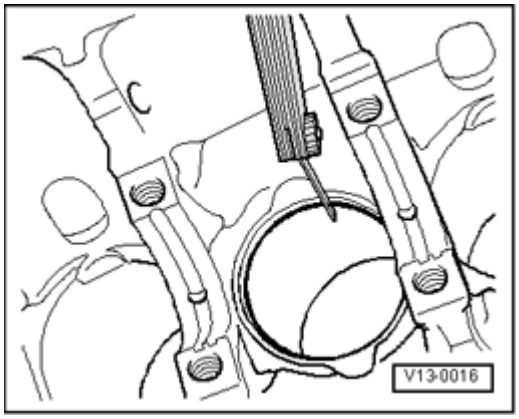

Fig. 96: Checking Piston Ring Gap
Courtesy of VOLKSWAGEN UNITED STATES, INC.

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

Piston ring		Gap	
		New	Wear limit
Compression rings	mm	0.15 - 0.40	0.80
Oil scraper ring	mm	0.25 - 0.50	1.00

Checking ring to groove clearance

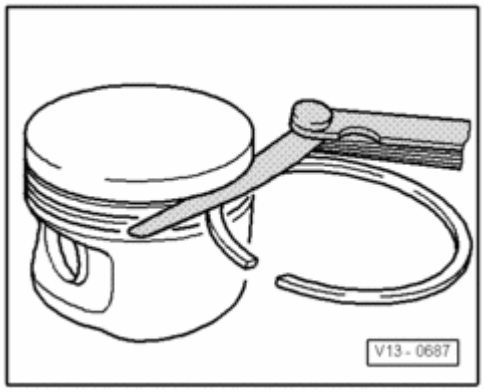

Fig. 97: Checking Ring To Groove Clearance
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Clean groove before checking clearance.

Piston ring		Clearance	
		New	Wear limit
Compression rings	mm	0.02 - 0.07	0.12
Oil scraper ring	mm	0.02 - 0.06	0.12

Checking piston

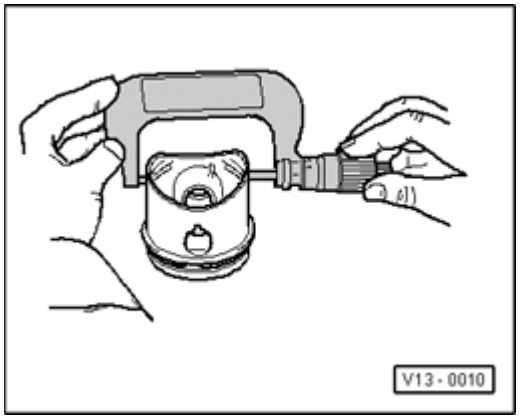

Fig. 98: Checking Piston
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Measure pistons approx. 10 mm from lower edge of skirt, at 90° to piston pin axis.

Permissible deviation from nominal dimension: max. 0.04 mm

Checking cylinder bores

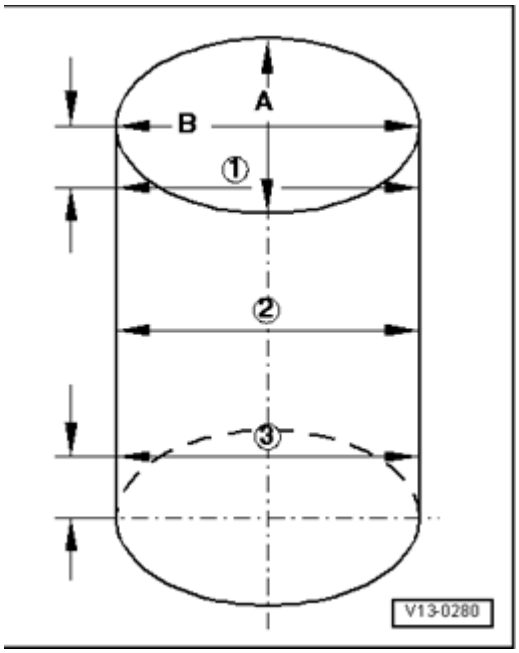

Fig. 99: Checking Cylinder Bores
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Use internal dial indicator (50-100 mm).

- Take measurements at 3 positions in both lateral direction -A- and longitudinal direction -B-.

Permissible deviation from nominal dimension: max. 0.10 mm

NOTE: Measuring the cylinder bores must not be done when the cylinder block is mounted on a repair stand with adapter bracket VW 540, as incorrect measurements would then be possible.

Piston and cylinder, dimensions

Honing dimension		Piston diameter	Cylinder bore
Basic dimension	mm	80.985	81.01
Oversize	mm	81.485	81.51

15 ENGINE - CYLINDER HEAD, VALVETRAIN

CYLINDER HEAD, REMOVING AND INSTALLING

Cylinder head, removing and installing

NOTE:

- **Always replace cylinder head bolts when assembling.**
- **Replace self-locking nuts.**

- **Always replace bolts that are tightened to a specified angle.**
- **Always replace sealing rings and gaskets when assembling.**
- **When installing an exchange cylinder head with the camshafts fitted, the contact surfaces between valve lifter and cam running surface must be oiled after installation of the cylinder head.**
- **The plastic protectors fitted to protect the open valves must only be removed immediately before installing the cylinder head.**
- **When installing a new cylinder head or cylinder head gasket, drain off all the old coolant and re-fill with new coolant.**
- **Cylinder heads which have cracks between the valve seats or between valve seat inserts and the spark plug thread can be used further without reducing service life, provided the cracks do not exceed a maximum of 0.3 mm in width, or when no more than the first 4 turns of the spark plug threads are cracked.**

Removing and installing toothed belt. Refer to **Toothed belt, removing and installing**.

Checking cylinder compression. Refer to **Compression, checking**.

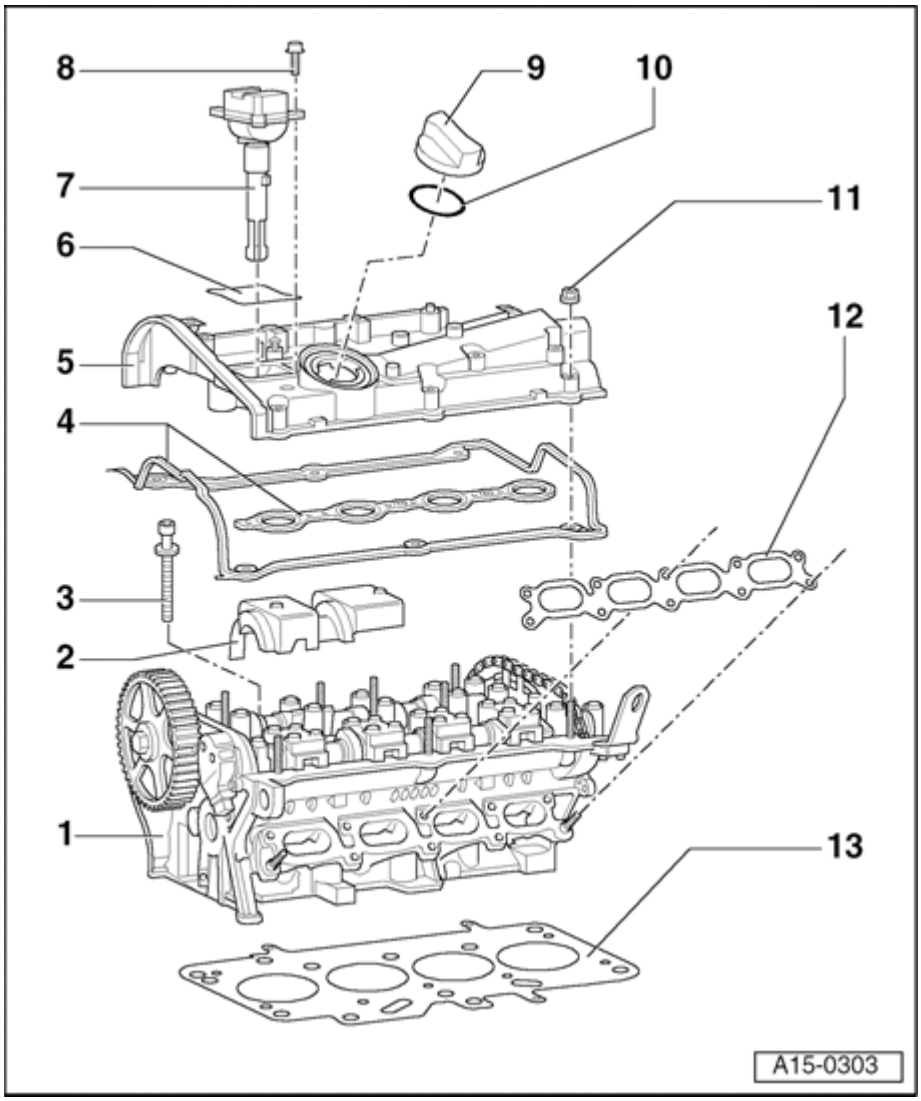

Fig. 100: Cylinder Head, Removing And Installing - Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Cylinder head

- If replaced, replace coolant completely.
- Removing cylinder head. Refer to **Cylinder head, removing**
- Installing cylinder head. Refer to **Cylinder head, installing**
- Checking for distortion. See **Checking cylinder head for distortion**
- Reworking limit. See **Cylinder head reworking limit**

2 - Oil deflector

- Note installation position: above intake camshaft between No. 1 and No. 2 cylinders

3 - Cylinder head bolt

- Replace
- Note sequence when loosening. Refer to **Cylinder head, removing**
- Note sequence when tightening. Refer to **Cylinder head, installing**

4 - Cylinder head cover gasket

- Replace if damaged or leaking

- Before installing gasket, apply sealant D 454 300 02 to sides of sealing surfaces:

- Between double bearing cap and cylinder head. See **Sealing transition points between double bearing cap and cylinder head**
- Between hydraulic chain tensioner and cylinder head. See **Sealing points for hydraulic chain tensioner/cylinder head**

5 - Cylinder head cover

6 - Gasket

- For ignition coil
- Replace if damaged

7 - Ignition coil

- Checking

Refer to

- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

8 - 10 Nm

9 - Filler cap

10 - Seal

- Replace if damaged

11 - 10 Nm

12 - Intake manifold gasket

- Replace

13 - Cylinder head gasket

- Removing cylinder head. Refer to **Cylinder head, removing**
- Position: Part No. toward cylinder head
- If replaced, replace coolant completely.

Checking cylinder head for distortion

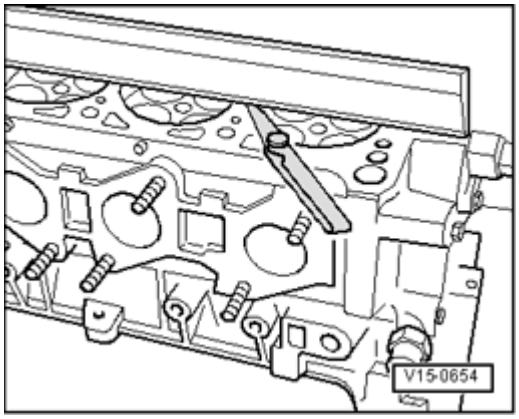

Fig. 101: Checking Cylinder Head For Distortion
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Use knife-edge straightedge and feeler gauge to measure at several points.

Max. permissible distortion: 0.1 mm

Cylinder head reworking limit

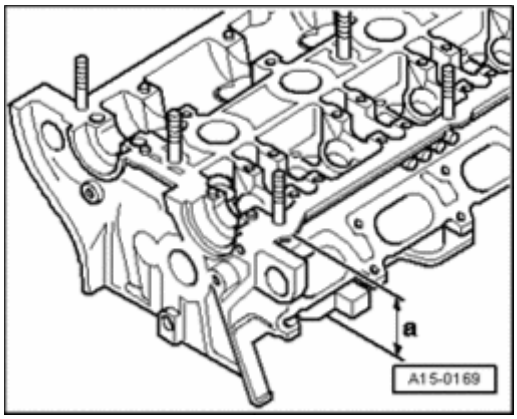

Fig. 102: Cylinder Head Reworking Limit
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Reworking cylinder head (shaving) is only permitted down to minimum dimension -a-.

Minimum dimension -a- = 139.25 mm

Sealing transition points between double bearing cap and cylinder head

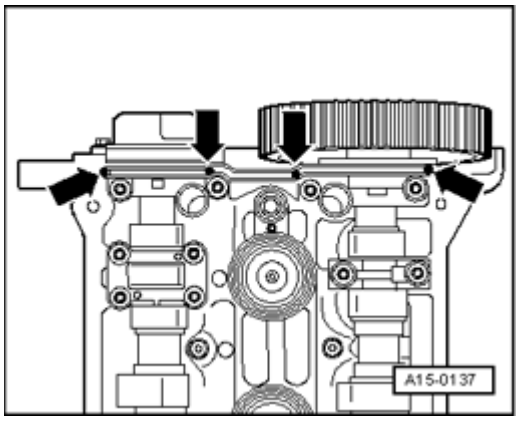

Fig. 103: Sealing Transition Points Between Double Bearing Cap And Cylinder Head
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Carefully apply a thin coat of sealant D 454 300 02 to both edges of sealing surfaces between double bearing cap and cylinder head (arrows) using a small screwdriver.

Sealing points for hydraulic chain tensioner/cylinder head

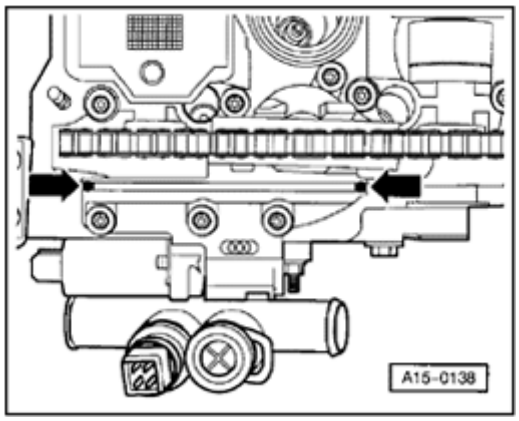

Fig. 104: Sealing Points For Hydraulic Chain Tensioner/Cylinder Head
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Carefully apply a thin coat of sealant D 454 300 02 to both edges of sealing surfaces between hydraulic chain tensioner and cylinder head (arrows) using a small screwdriver.

Intake manifold, removing and installing

Removing

NOTE: All cable ties which are released or cut open when removing must be fitted in the same position when installing.

- Obtain radio anti-theft code on vehicles with coded radio.
- With ignition switched off, disconnect battery Ground strap.
- Remove engine cover.

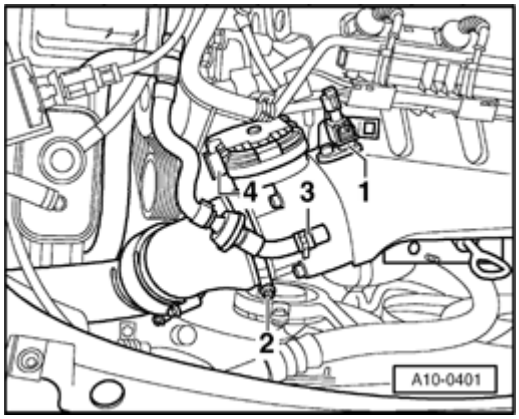

Fig. 105: Identifying Hose Clip, Intake Air Temperature (IAT) Sensor -G42 & Throttle Valve Control Module -J338-
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect connector -1- for Intake Air Temperature (IAT) sensor -G42- and connector -4- for Throttle valve control module -J338- (located under throttle valve control module).

- Disconnect air hose -2- from throttle valve control module.
- Disconnect vacuum hose -3- from throttle valve control module (hose leads to EVAP canister).

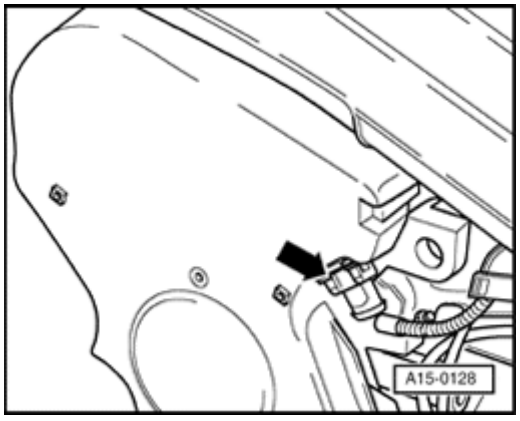

Fig. 106: Locating Connector At Camshaft Position Sensor G40
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect connector off Camshaft Position (CMP) sensor -G40- (arrow).

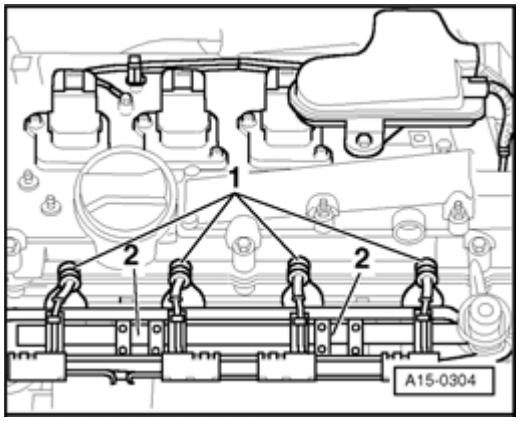

Fig. 107: Disconnecting Connectors For Injectors And Unclip Support Bar From Fuel Rail
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect connectors -1- for injectors and unclip support bar from fuel rail -2-.

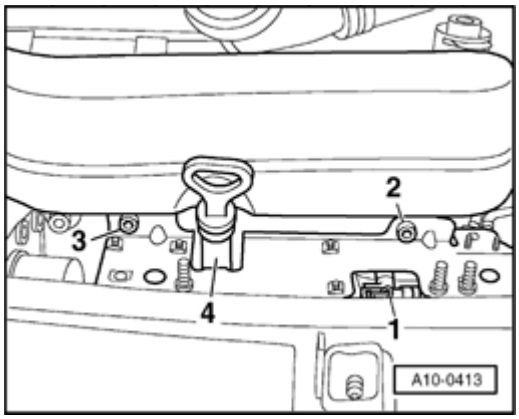

Fig. 108: Identifying Electrical Change-Over Valve Connector, Intake Manifold Brackets & Dipstick Tube
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect connector -1- for electrical change-over valve on underside of bracket.
- Unbolt bracket from intake manifold (-2- and -3-) and disengage dipstick tube -4-.

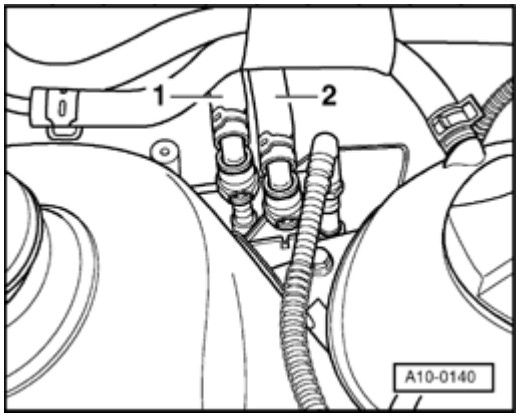

Fig. 109: Identifying Supply Line And Return Line
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press release tabs and pull fuel supply line -1- and fuel return line -2- off connections.

WARNING: Fuel system is under pressure! Before opening the system place a cloth around the connection. Then release pressure by carefully loosening the connection.

- Disconnect crankcase breather hose from T-piece.
- Unbolt intake manifold support from intake manifold.
- Pull out oil dipstick.
- Unbolt intake manifold at flange and remove.

Installing

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

- After connecting battery terminals, enter anti-theft code for radio.

Refer to Radio operating instructions

- Close power windows in front doors to their top positions using electrical switches.
- Operate all power window switches again for at least one second in "close" direction to activate automatic one-touch function.
- Set clock to correct time.
- Perform adaptation of throttle valve control module:

Refer to

- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

- Check DTC memory:

Refer to

- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

NOTE: DTCs will be stored in the memory because connectors have been disconnected. Therefore, check and erase DTC memory after installing the engine.

Cylinder head, removing

- Engine in vehicle

NOTE:

- **Secure all hose connections with the correct hose clips (same as original equipment)**

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

- Obtain radio anti-theft code on vehicles with coded radio.
- With ignition switched off disconnect battery Ground strap.
- Drain cooling system. Refer to **Draining**.
- Remove intake manifold. Refer to **Intake manifold, removing and installing**.

- Disconnect coolant line from thermostat housing only. Refer to **Coolant line, removing and installing**.
- Unbolt coolant line flange from cylinder head (left) and place it to one side.
- Disconnect connectors on ignition coils.
- Unclip/release all lines and hoses on cylinder head and move clear.

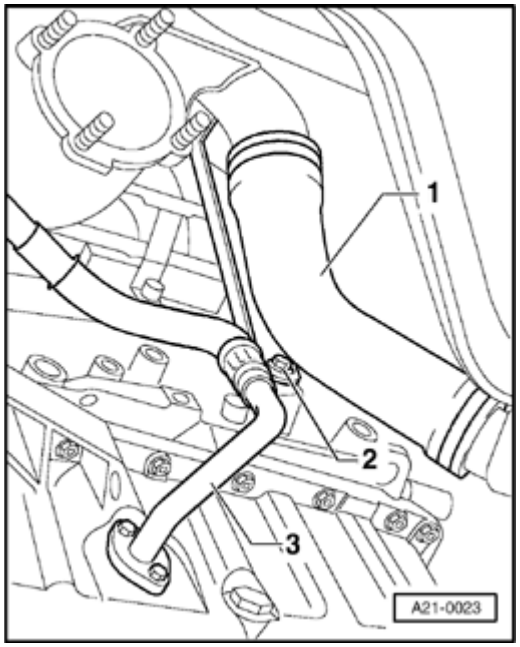

Fig. 110: Identifying Upper Air Line Air Hose & Oil Return Line
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect air hose -1- from upper air line.
- Unbolt retainer for oil return line -2-.

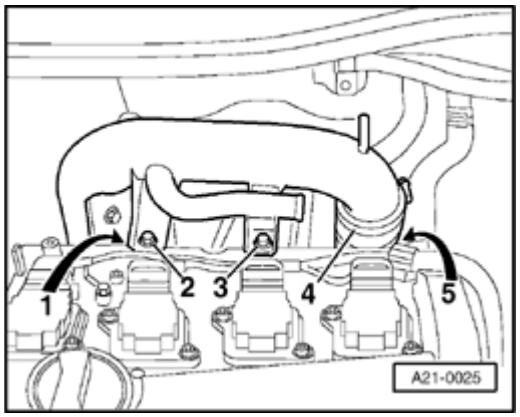

Fig. 111: Identifying Upper Air Line Hose, Heat Shield Bolts & Upper Air Line Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Release hose -4- from upper air line (hose leads to turbocharger).
- Remove bolts -1- and -5- for heat shield on back of cylinder head.
- Remove bolts -2- and -3- for upper air line.
- Remove upper air line and heat shield.

- Unbolt turbocharger from exhaust manifold.
- Remove ribbed belt and tensioning element. Refer to **Ribbed belt, removing and installing**.
- Remove toothed belt guard (upper). Refer to **Toothed belt, removing and installing**.

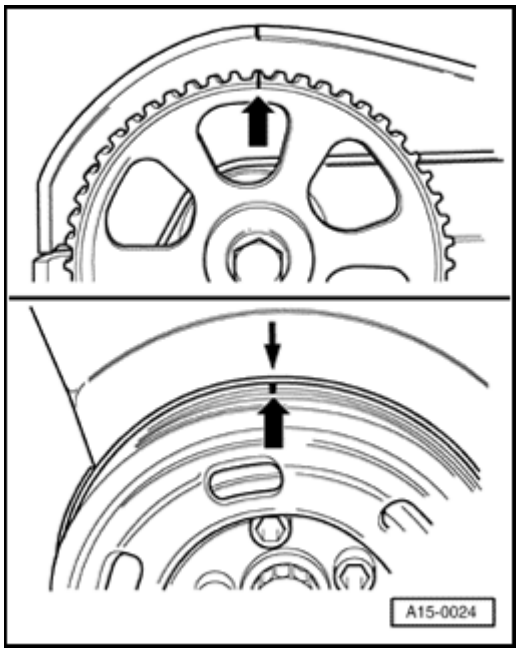

Fig. 112: Setting Crankshaft To Markings For TDC Of No. 1 Cylinder
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Set crankshaft to markings for TDC of No. 1 cylinder (arrows) by turning central bolt on crankshaft sprocket in direction of rotation.

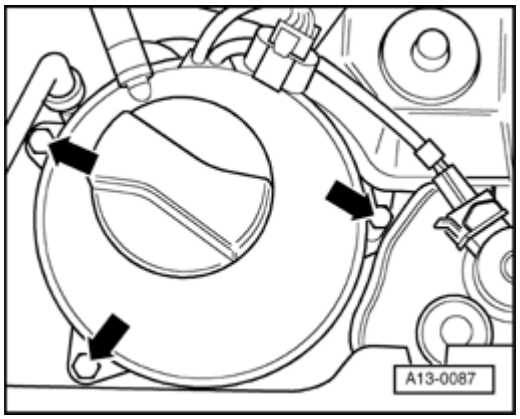

Fig. 113: Detaching Coolant Expansion Tank And Power Steering Reservoir
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts (left arrows) and remove coolant expansion tank together with hoses.
- Remove bolt (right arrow) and remove power steering reservoir. Do not disconnect hoses.

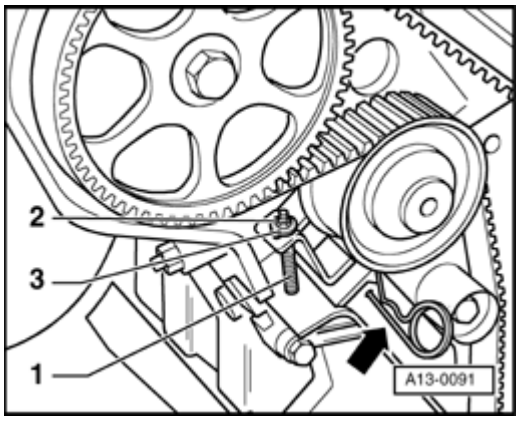

Fig. 114: Screwing Stud Into Toothed Belt Tensioning Element & Hex Nut Onto Stud Using Large Washer
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Screw M5 x 55 stud -1- into toothed belt tensioning element.
- Screw hex nut -2- onto stud -1- using large washer -3-.
- Tension pressure piston of tensioning element only until it can be secured with a locking pin (e.g. from lifting appliance 2024 A) -arrow-.

NOTE: If it is not possible to insert the locking pin, carefully tension the pressure piston of the tensioning element just enough to allow the toothed belt to be removed.

- Take toothed belt off camshaft sprocket.
- Unbolt ignition coils.
- Remove cylinder head cover. Refer to **Cylinder head, removing and installing**.

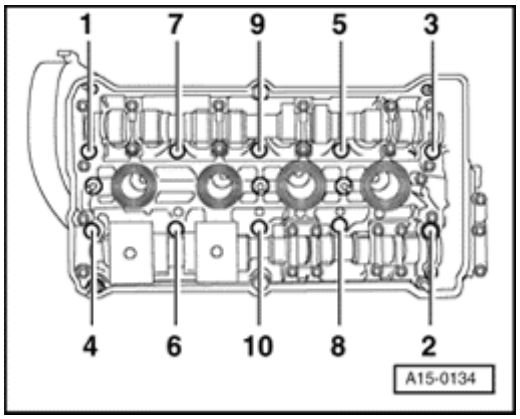

Fig. 115: Cylinder Head Bolts Loosening Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Maintain sequence when loosening and tightening cylinder head bolts.
- Remove cylinder head.

Cylinder head, installing

NOTE:

- **Always replace cylinder head bolts when assembling.**
- **Replace self-locking nuts.**
- **Always replace bolts that are tightened to a specified angle.**
- **If repairing, carefully remove any remains of gasket material from the cylinder head and cylinder block. Make sure that no long scores or scratches are made on the surfaces.**
- **Carefully remove any remaining emery and abrasive material.**
- **Remove new cylinder head gasket from packaging, just before installation.**
- **Handle gasket extremely carefully. Damaging the silicone layer or the indented area will lead to leaks.**
- **No oil or coolant must be allowed to remain in the blind holes for the cylinder head bolts in the cylinder head.**
- **Ensure fuel hoses are tight.**

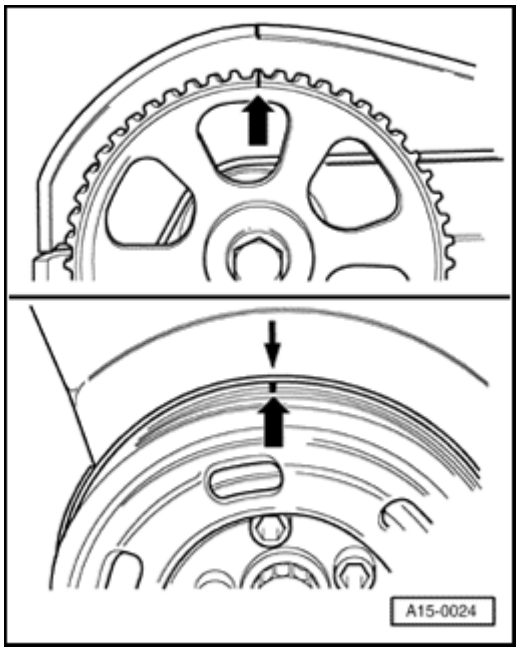

Fig. 116: Setting Crankshaft To Markings For TDC Of No. 1 Cylinder
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Before positioning cylinder head, set crankshaft and camshaft to TDC of No. 1 cylinder.

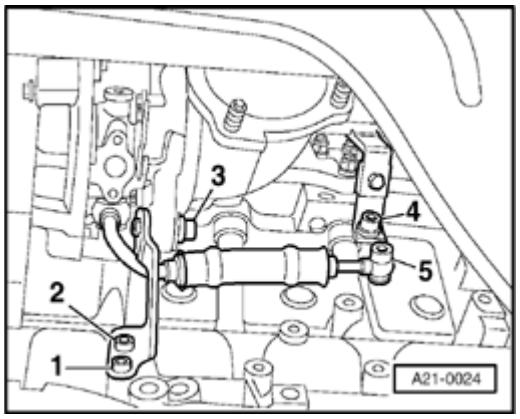

Fig. 117: Identifying Turbocharger Bracket Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts -1- and -2- on turbocharger bracket (about 2 full turns each) to avoid stressing when installing cylinder head.

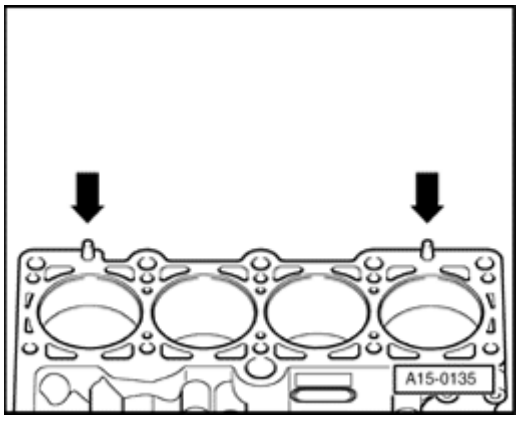

Fig. 118: Identifying Cylinder Block Centering Pins
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place cylinder head gasket in position.

NOTE: Note position of centralizing pins in cylinder block (arrows).

- Check installation position of cylinder head gasket.

Part No. should be legible from intake side.

- Place cylinder head in position.
- Insert cylinder head bolts and tighten by hand.

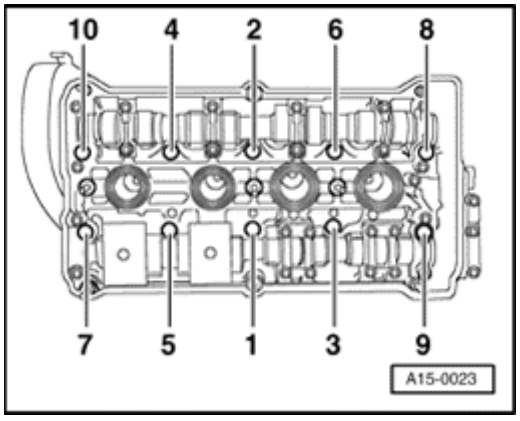

Fig. 119: Cylinder Head Bolt Tightening Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tighten cylinder head bolts in two stages in sequence shown as follows:

- Stage 1: 40 Nm
- Stage 2: additional 1/2 turn (180°) using rigid wrench (in two 1/4 turns (90°) if necessary).

NOTE: It is not necessary to re-tighten cylinder head bolts after repairs have been

performed.

- Install turbocharger with new gasket and bolt bracket to cylinder block. Refer to **Installing**.
- Install toothed belt (adjust valve timing). Refer to **Installing toothed belt (setting camshaft timing)**.

NOTE: Follow all instructions for removing and installing toothed belt. Refer to Toothed belt, removing and installing.

- Install cylinder head cover. Refer to **Cylinder head, removing and installing**.
- Installing ribbed belt and tensioning element. Refer to **Ribbed belt, removing and installing**.
- After connecting battery terminals, enter anti-theft code for radio

Refer to Radio operating instructions

- Close power windows in front doors to their top positions using electrical switches.
- Operate all power window switches again for at least one second in "close" direction to activate automatic one-touch function.
- Set clock to correct time.
- Perform adaptation of throttle valve control module:

Refer to

- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

- Check DTC memory:

Refer to

- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

NOTE: DTCs will be stored in the memory because connectors have been disconnected. Therefore, check and erase DTC memory after installing the engine.

Electrical connections and routing:

Refer to Electrical Wiring Diagrams, Troubleshooting & Component Locations

Compression, checking

Requirements

- Engine oil temperature not less than 30° C

- Remove engine cover.

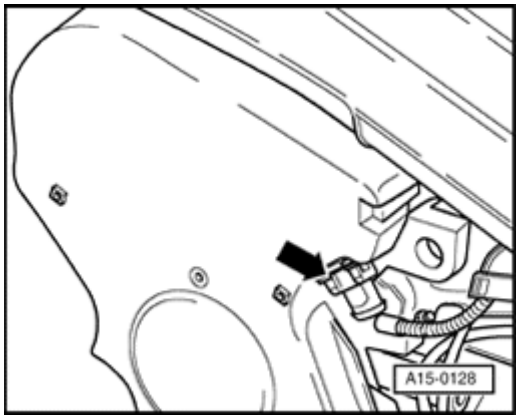

Fig. 120: Locating Connector At Camshaft Position Sensor G40
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull connector from Camshaft Position (CMP) sensor -G40- (arrow).
- With ignition switched off, disconnect connectors from ignition coils.
- Unbolt ignition coils.
- Remove spark plugs with spark plug spanner 3122B.

- Fully open throttle valve.
- Check compressions with compression tester V.A.G 1381 or V.A.G 1763.

NOTE: Using the compression tester:

Refer to Operating instructions

- Operate starter until tester shows no further pressure increase.

Compression pressure

New (bar)	Wear limit (bar)	Permissible difference between cylinders (bar)
10.0 - 13.0	7.0	max. 3.0

- Install spark plugs and ignition coils.
- Check DTC memory:

Refer to

- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

NOTE: DTCs will be stored in the memory because connectors have been disconnected. Therefore, check and erase DTC memory after installing the engine.

Tightening torque

Component	ft lb	Nm
Ignition coils to cylinder head	7	10
Spark plugs to cylinder head	22	30
Vacuum reservoir to cylinder head	22	30

VALVE GEAR, SERVICING

Valve gear, servicing

NOTE:

- **Cylinder heads which have cracks between the valve seats or between valve seat inserts and the spark plug thread can be used further without reducing service life, provided the cracks do not exceed a maximum of 0.3 mm in width, or when no more than the first 4 turns of the spark plug threads are cracked.**
- **After installing new lifters wait for approx. 30 minutes before starting engine. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).**
- **After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.**

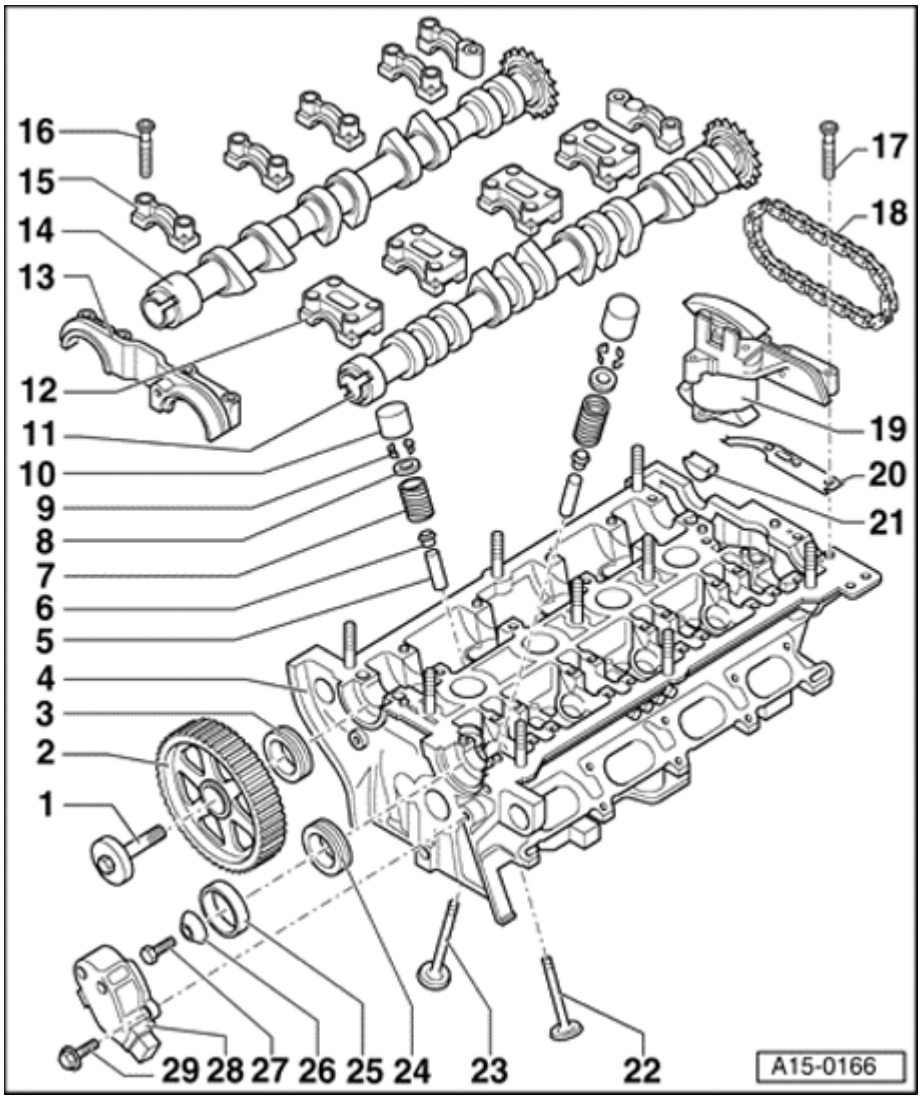

Fig. 121: Valve Gear, Servicing Remove/Install Components
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 65 Nm

- Use counter-hold 3036 to loosen and tighten

2 - Camshaft sprocket

- For exhaust camshaft
- Note installation position: camshaft sprocket is installed with smaller side facing out and TDC marking for cylinder 1 visible

3 - Oil seal

- For exhaust camshaft

- Replacing. Refer to **Camshaft oil seals, replacing**

4 - Cylinder head

- Removing. Refer to **Cylinder head, removing**
- Checking cylinder head for distortion. Refer to Fig. 1 under **Checking cylinder head for distortion**
- Reworking cylinder head. Refer to Fig. 2 under **Cylinder head reworking limit**
- Checking valve guides, grinding-in valve seats. Refer to **Valve guides, checking**

- Installing. Refer to **Cylinder head, installing**
- Sealing connections. Refer to Fig. 3 under **Sealing transition points between double bearing cap and cylinder head** and Fig. 4 under **Sealing points for hydraulic chain tensioner/cylinder head**

5 - Valve guide

- Checking. Refer to **Valve guides, checking**
- Replacing. Refer to **Valve guides, replacing**

6 - Valve stem seal

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

7 - Valve springs

- Removing and installing. Refer to **Valve stem seals, replacing**

8 - Valve spring plate

9 - Valve keepers

10 - Hydraulic valve lifter

- Do not interchange
- Oil contact surface
- Store with cam contact surface downward
- Before installing check camshaft axial clearance. Refer to **Camshaft axial clearance, checking**.

- Checking. Refer to **Hydraulic valve lifters, checking**
- Removing and installing. Refer to **Valve stem seals, replacing**

11 - Intake camshaft

- Valve timing. Refer to **Engine data**
- Checking axial clearance. Refer to **Camshaft axial clearance, checking**

- Removing and installing camshafts. Refer to **Camshafts and hydraulic chain tensioner, removing and installing**
- Check radial clearance with Plastigage ™ (valve lifters not installed) Wear limit: 0.1 mm; Run-out max: 0.01 mm

12 - Bearing cap/intake camshaft

- Must be located on dowel sleeves
- Note installation position
- Installation sequence. Refer to **Camshafts and hydraulic chain tensioner, removing and installing**

13 - Double bearing cap

- Must be located on dowel sleeves
- Seal connections between double bearing cap and cylinder head. Refer to Fig. 3 under **Sealing transition points between double bearing cap and cylinder head**
- Coat sealing surface lightly with D 454 300 02 before installation. Refer to **Camshafts and hydraulic chain tensioner, removing and installing**.

14 - Exhaust camshaft

- Valve timing. Refer to **Engine data**, Engine data
- Checking axial clearance. Refer to **Camshaft axial clearance, checking**
- Removing and installing camshafts. Refer to **Camshafts and hydraulic chain tensioner, removing and installing**
- Check radial clearance with Plastigage ™ (valve lifter not installed) Wear limit: 0.1 mm; Run-out max: 0.01 mm

15 - Bearing cap/exhaust camshaft

- Must be located on dowel sleeves
- Note installation position
- Installation sequence. Refer to **Camshafts and hydraulic chain tensioner, removing and installing**

16 - 10 Nm

17 - 10 Nm

18 - Drive chain

- Check for wear
- Before removing, mark running direction (installation position). Refer to **Camshafts and hydraulic chain tensioner, removing and installing**.

19 - Hydraulic chain tensioner

- Before removing, lock in position with retainer V.A.G 3366
- Removing and installing. Refer to **Camshafts and hydraulic chain tensioner, removing and installing**
- Seal connections between hydraulic chain tensioner and cylinder head. Refer to Fig. 4 under **Sealing points for hydraulic chain tensioner/cylinder head**.

20 - Metal/rubber gasket

- Replace. Refer to **Camshafts and hydraulic chain tensioner, removing and installing**

21 - Gasket

- Replace

22 - Exhaust valve

- With sodium filling
- Note instructions on scrapping valves with a sodium filling. Refer to **Valve dimensions**
- Do not rework; only grinding-in is permitted
- Valve dimensions. See **Valve dimensions**
- Checking valve guides, grinding in valve seats. Refer to **Valve guides, checking**

23 - Intake valve

- Do not rework; only grinding-in is permitted
- Valve dimensions. See **Valve dimensions**
- Checking valve guides, grinding in valve seats. Refer to **Valve guides, checking**

24 - Oil seal

- For intake camshaft
- Replacing. Refer to **Camshaft oil seals, replacing**

25 - Hall sensor rotor

- Note installation position: locate notch in camshaft

26 - Washer

- With conical taper
- Note installation position

27 - 25 Nm

28 - Camshaft Position (CMP) sensor -G40-

29 - 10 Nm

Valve dimensions

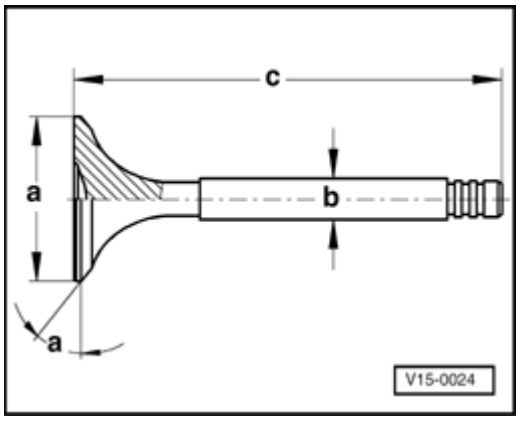

Fig. 122: Identifying Valve Dimensions
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE: Intake and exhaust valves must not be reworked. Only grinding-in is permitted.

Dimension		Intake valve	Exhaust valve
Diameter-a-	mm	26.80 - 27.00	29.80 - 30.00
Diameter	mm	5.95 - 5.97	5.94 - 5.95
Length -c-	mm	104.84 - 105.34	103.64 - 104.14
Angle - a -	Angle°	45	45

CAUTION: Worn exhaust valves with sodium filling must not be disposed of until they have been treated as follows:

- **The valves must be sawn into two sections with a metal saw at a point between the center of the shaft and the valve head. They must not come into contact with water when this is done.**
- **Throw the valves into a bucket of water (not more than ten at time). Then step back because a chemical reaction occurs when the sodium filling burns. After this treatment the valves can be disposed of in the normal way.**

Camshaft axial clearance, checking

Perform measurement with valve lifters removed and with bearing cap at chain sprocket end and double bearing cap at camshaft sprocket end installed.

- Attach dial indicator with universal dial indicator holder VW 387 to cylinder head.

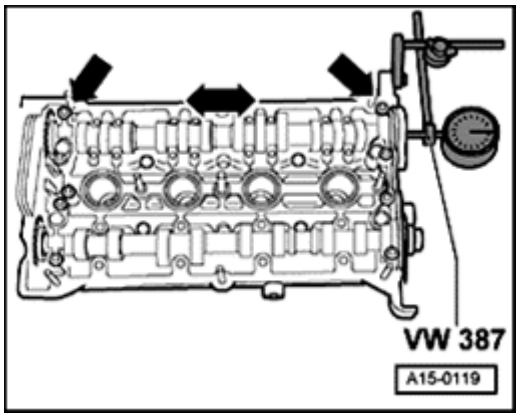

Fig. 123: Camshaft Axial Clearance, Checking - Intake Camshaft
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Intake camshaft

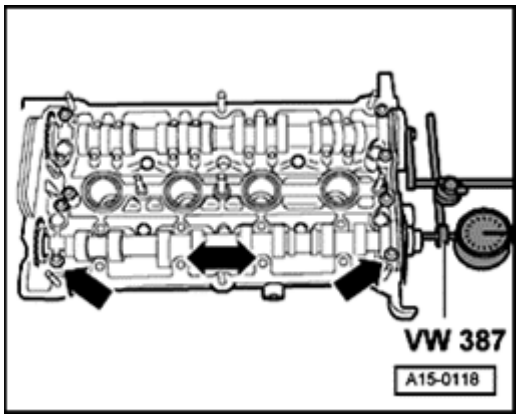

Fig. 124: Camshaft Axial Clearance, Checking - Exhaust Camshaft
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Exhaust camshaft

Wear limit for intake and exhaust camshaft (axial play): no more than 0.20 mm

Camshaft oil seals, replacing

Replacing exhaust camshaft oil seal

Removing

- Remove sound insulation in center and on right side.
- Remove ribbed belt and tensioning element. Refer to **Ribbed belt, removing and installing**.
- Remove upper toothed belt guard. Refer to **Toothed belt, removing and installing**.

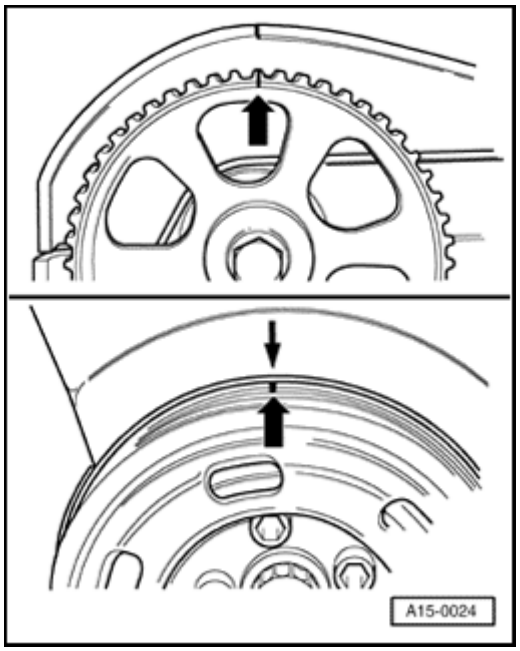

Fig. 125: Setting Crankshaft To Markings For TDC Of No. 1 Cylinder
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Set crankshaft to markings for TDC of No. 1 cylinder (arrows) by turning central bolt on crankshaft sprocket in direction of rotation.
- Disconnect vacuum hose from EVAP canister and from throttle valve connection.
- Unbolt coolant expansion tank and power steering reservoir, but do not disconnect hoses.

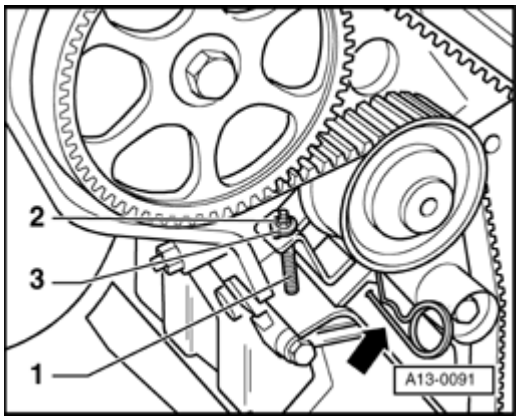

Fig. 126: Screwing Stud Into Toothed Belt Tensioning Element & Hex Nut Onto Stud Using Large Washer
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Screw M5 x 55 stud -1- into toothed belt tensioning element.
- Screw hex nut -2- with a large washer -3- onto stud -1-.
- Tension pressure piston of tensioning element just enough so that it can be secured with a suitable locking pin (e.g. from lifting appliance 2024 A).

NOTE: If it is not possible to insert the locking pin, carefully tension the pressure piston of the tensioning element just enough to allow the toothed belt to be removed.

- Take toothed belt off camshaft sprocket.
- Loosen camshaft sprocket (counter-hold with 3036).
- Pull off camshaft sprocket.

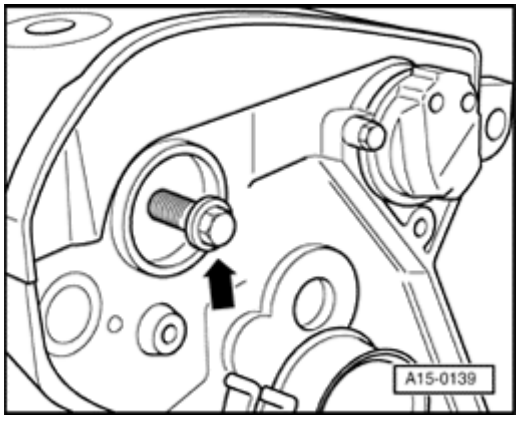

Fig. 127: Camshaft Gear Retaining Bolt Installed Into Camshaft To Stop
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- To guide oil seal extractor, screw securing bolt for camshaft sprocket (arrow) into camshaft as far as it will go (by hand).
- Remove inner part of oil seal extractor 2085 two turns (approx. 3 mm) out of outer part and lock in position with knurled screw.

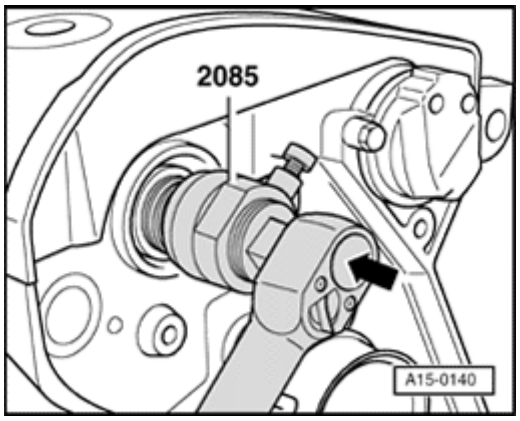

Fig. 128: Loosening Knurled Screw And Turning Inner Part Of Extractor Against Camshaft Until Oil Seal Has Been Extracted
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Lubricate threaded head of oil seal extractor 2085, place it in position, and exerting firm pressure, screw it into oil seal as far as possible.
- Loosen knurled screw and turn inner part of extractor against camshaft until oil seal has been extracted.

Installing

- Lightly oil sealing lip of oil seal.

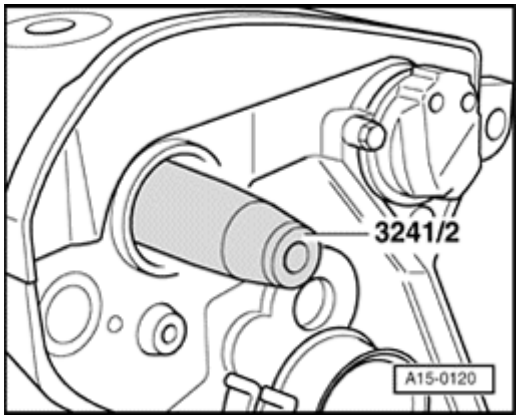

Fig. 129: Installing Guide Sleeve 3241/2 Onto Camshaft Journal
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install guide sleeve 3241/2 onto camshaft journal.
- Slide oil seal over guide sleeve.

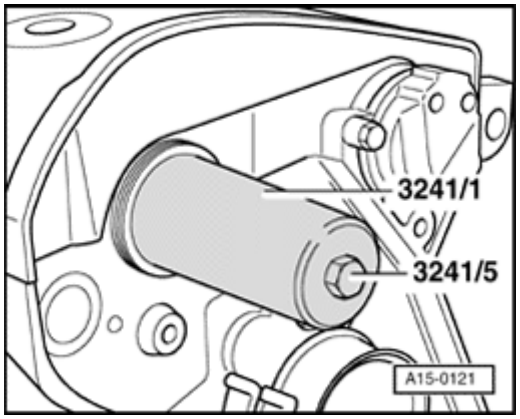

Fig. 130: Pressing Oil Seal In Onto Stop With Press Sleeve 3241/1
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press oil seal in onto stop with press sleeve 3241/1. To do this use bolt 3241/5.

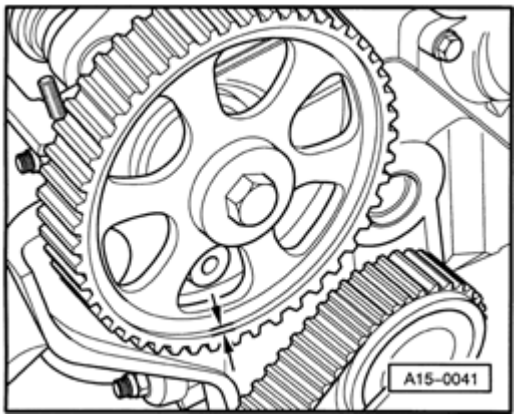

Fig. 131: Checking Camshaft Sprocket Installation Position
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install camshaft sprocket.
- Check installation position.

Narrow web of camshaft sprocket faces outward (arrows) and marking for No. 1 cylinder TDC is visible.

- Install securing bolt for camshaft sprocket (use counter-hold tool 3036).

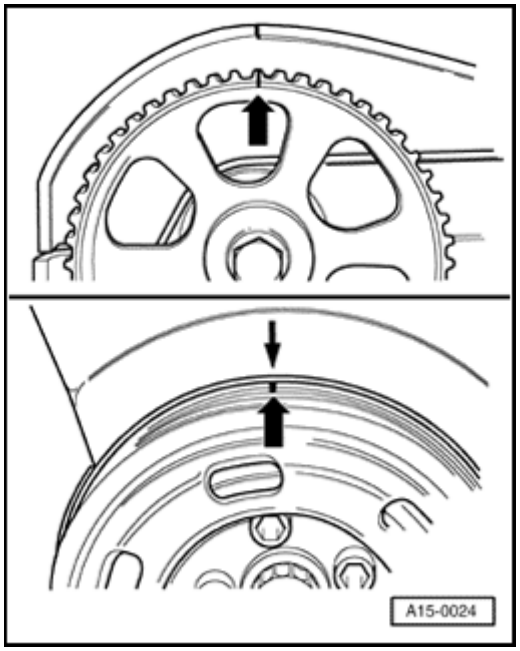

Fig. 132: Setting Crankshaft To Markings For TDC Of No. 1 Cylinder
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Align camshaft sprocket mark with marking on cylinder head cover.
- Align vibration damper marking with marking on lower part of toothed belt guard.

NOTE: If a piston is at TDC the valves could strike the piston when turning the

camshaft. To avoid damage to valves and pistons the pistons must not be at TDC.

- Install toothed belt onto camshaft sprocket.

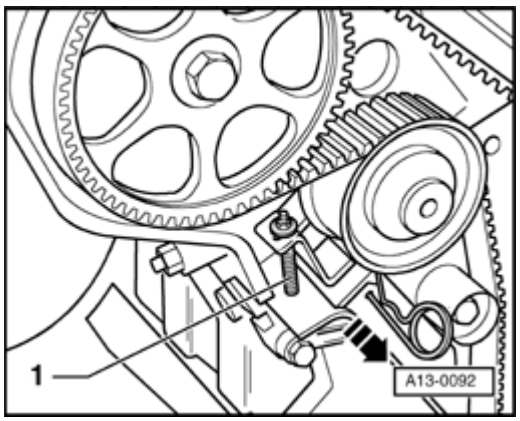

Fig. 133: Pulling Out Locking Pin, Loosening Piston Of Toothed Belt Tensioning Element & Removing Stud
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull out locking pin (arrow) and loosen piston of toothed belt tensioning element.
- Remove stud -1-.
- Turn crankshaft two complete turns in engine direction of rotation, set again to TDC and check adjustment.
- Install upper toothed belt guard.

- Installing ribbed belt and tensioning element. Refer to **Ribbed belt, removing and installing**.

Tightening torques

Component	Nm
Camshaft sprocket to camshaft	65
Ribbed belt tensioner to bracket	25

Replacing intake camshaft oil seal

Removing

- Remove ribbed belt. Refer to **Removing ribbed belt**.

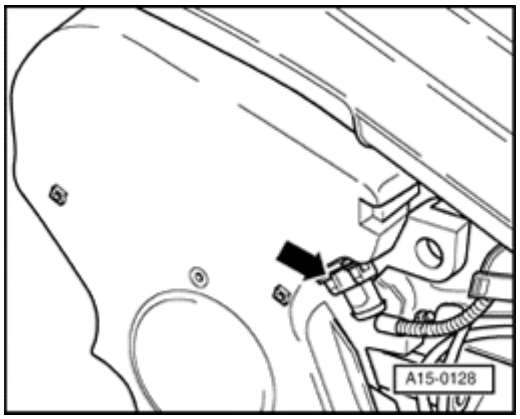

Fig. 134: Locating Connector At Camshaft Position Sensor G40
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect connector from Camshaft Position (CMP) -G40- (arrow).
- Remove toothed belt guard (upper section). Refer to **Toothed belt, removing and installing**.
- Remove CMP sensor housing.
- Remove sensor rotor and washer.

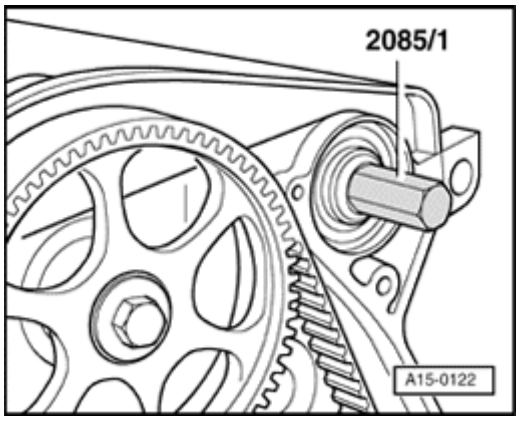

Fig. 135: Adapter 2085/1 Threaded In Camshaft
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- To guide oil seal extractor, screw bolt 2085/1 by hand into camshaft as far as it will go.
- Remove inner part of oil seal extractor 2085 two turns (approx. 3 mm) out of outer part and lock in position with knurled screw.

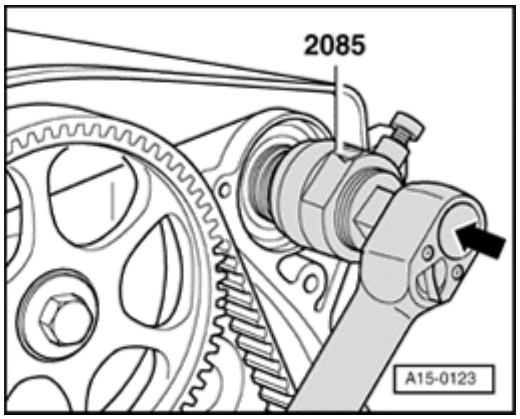

Fig. 136: Screwing Threaded Head Of Seal Extractor With Forced Pressure Into Oil Seal
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Lubricate threaded head of oil seal extractor 2085, place it in position and, exerting firm pressure, screw it into oil seal as far as possible.
- Loosen knurled screw and turn inner part of extractor against camshaft until oil seal has been extracted.

Installing

- Lightly oil sealing lip of oil seal.

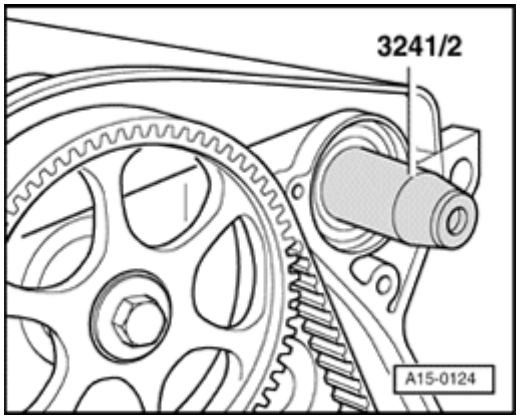

Fig. 137: Installing Guide Sleeve 3241/2 Onto Camshaft Journal
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install guide sleeve 3241/2 onto camshaft journal.
- Slide oil seal over guide sleeve.

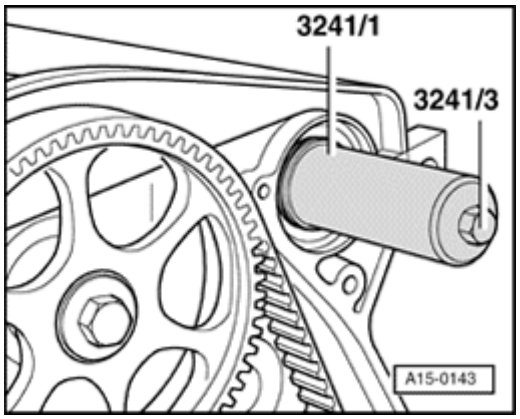

Fig. 138: Pressing In Gasket Up To Stop Using Thrust Sleeve 3241/1 And Bolt 3241/3
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press oil seal in onto stop with press sleeve 3241/1. To do this use bolt 3241/3.
- Install notch in Hall sensor rotor into intake camshaft.
- Install washer (conical taper facing outward).
- Install CMP sensor housing.

- Install toothed belt guard (upper section).
- Plug in connector for CMP sensor.
- Install ribbed belt. Refer to **Installing ribbed belt**.

Tightening torques

Component		Nm
Hall sensor rotor to camshaft		25
Hall sensor housing to cylinder head		10

Camshafts and hydraulic chain tensioner, removing and installing

- Cylinder head installed

Special tools, testers and auxiliary items

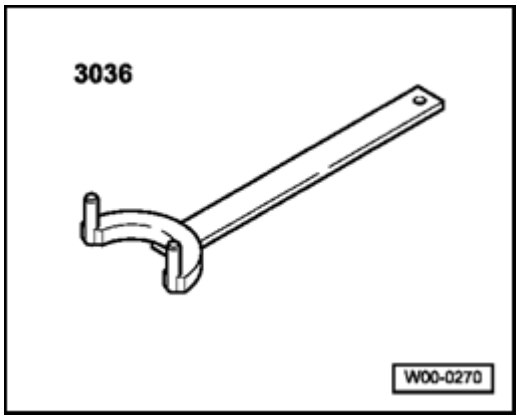

Fig. 139: Identifying Counter-Hold Tool 3036
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Counter-hold tool 3036

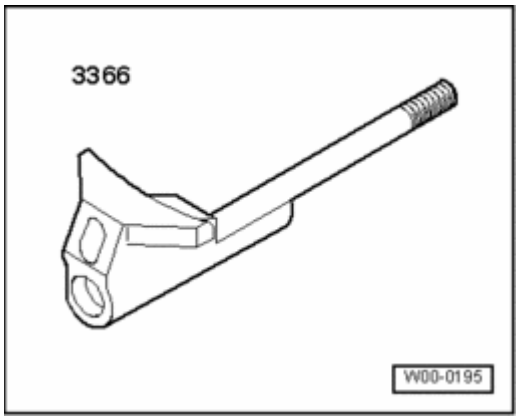

Fig. 140: Identifying Retainer For Chain Tensioner 3366
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Retainer for chain tensioner 3366

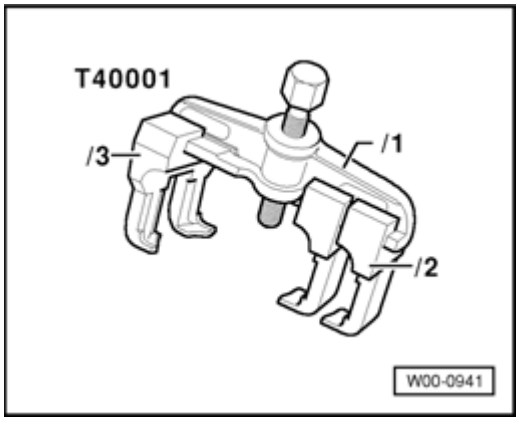

Fig. 141: Identifying Puller T40001
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Puller T40001

Removing

- Remove ribbed belt and tensioning element for ribbed belt. Refer to **Removing ribbed belt**.

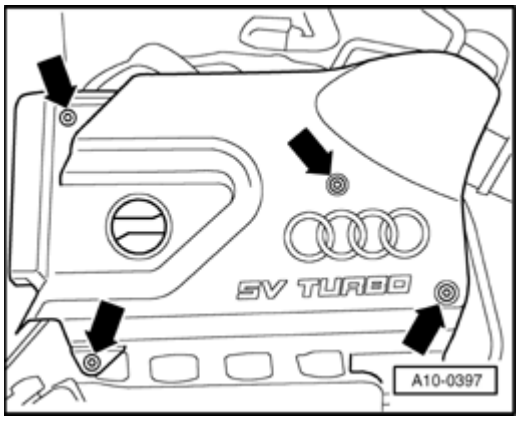

Fig. 142: Removing Engine Cover Panel Above Cylinder Head
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove engine cover panel above cylinder head.
- Remove toothed belt guard (upper section). Refer to **Toothed belt, removing and installing**.

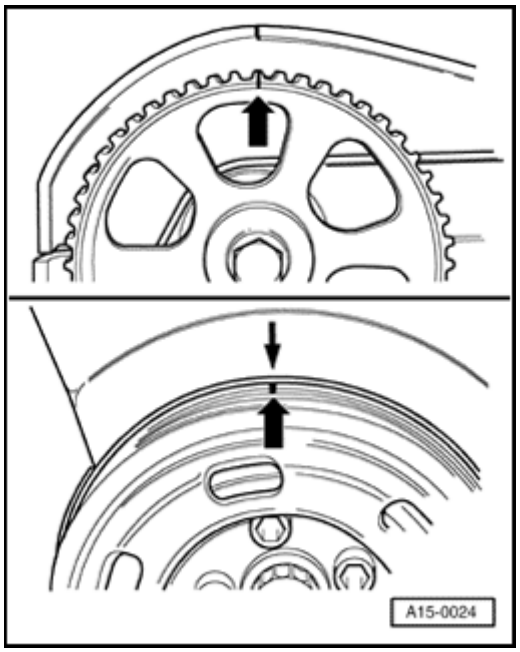

Fig. 143: Setting Crankshaft To Markings For TDC Of No. 1 Cylinder
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Set crankshaft to markings for TDC of No. 1 cylinder (arrows) by turning central bolt on crankshaft sprocket in direction of rotation.

- Remove cylinder head cover. Refer to **Cylinder head, removing and installing**.

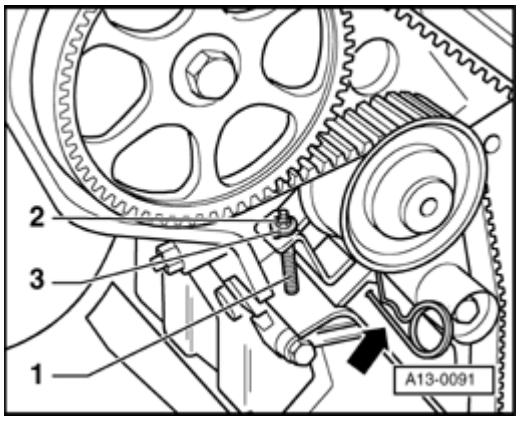

Fig. 144: Screwing Stud Into Toothed Belt Tensioning Element & Hex Nut Onto Stud Using Large Washer
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Screw M5 x 55 stud -1- into toothed belt tensioning element.
- Screw hex nut -2- onto stud -1- using large washer -3-.
- Only tension piston of tensioning element as far as necessary to secure it with a locking pin (e. g. from lifting appliance 2024 A) -arrow-.

NOTE: If it is not possible to insert the locking pin, carefully tension the pressure piston of the tensioning element just enough to allow the toothed belt to be removed.

- Take toothed belt off camshaft sprocket.
- Loosen camshaft sprocket (using 3036).
- Remove camshaft sprocket using puller T40001.
- Remove CMP sensor housing.

- Remove rotor for CMP sensor.

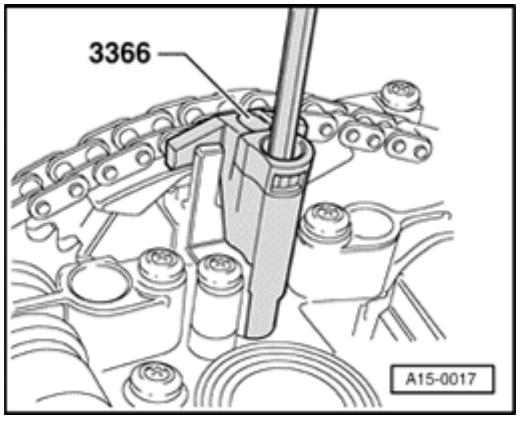

Fig. 145: Securing Camshaft Adjuster Or Chain Tensioner Using Bracket For Chain Adjustment 3366
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Secure hydraulic chain tensioner with retainer for chain tensioner 3366.

NOTE: If the retainer for chain tensioner is tightened excessively, this can damage the hydraulic chain tensioner.

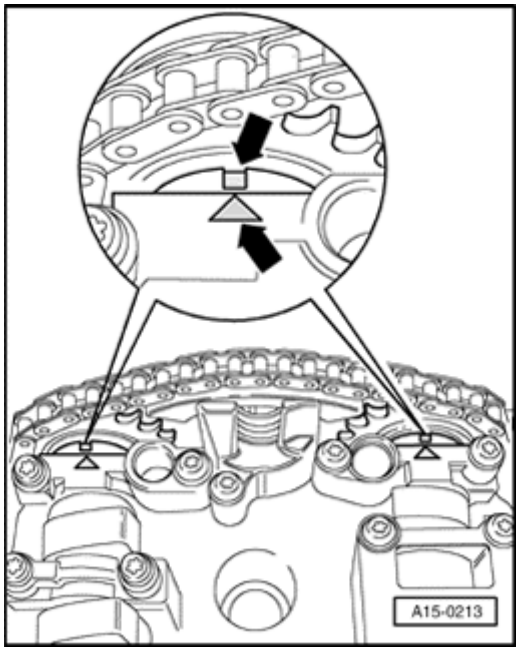

Fig. 146: Checking Position Of Camshafts To Each Other
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Recheck TDC position of camshafts.

Marks on camshafts must be in line with arrows on bearing caps.

- Clean chain and camshaft sprockets opposite two arrows on bearing caps and mark installation position with colored marks.

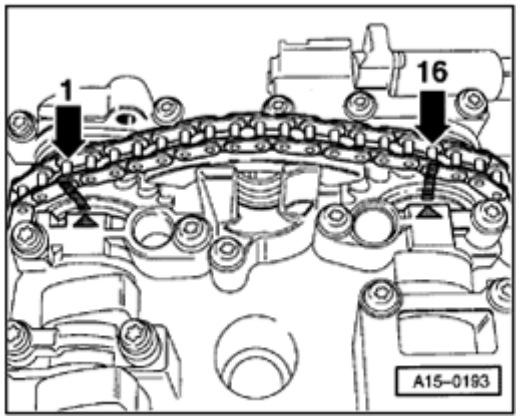

Fig. 147: Checking Distance Between Markings Consists Of 16 Rollers Of Drive Chain
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- The distance between the two arrows (and thus between the colored markings) is 16 rollers on the chain.
- The notch on the exhaust camshaft is offset slightly toward the inside in relation to chain roller -1-.

NOTE: Do not mark chain with a center punch or by making a notch or similar.

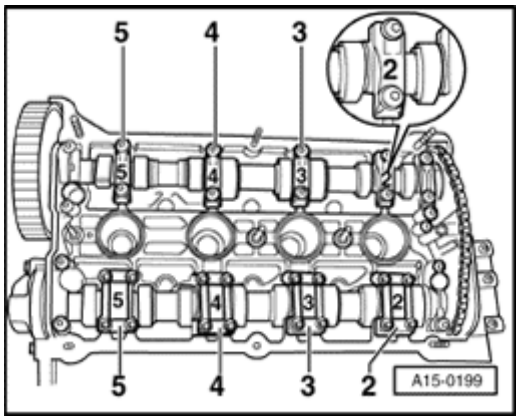

Fig. 148: Identifying Bearing Cap Positions
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- First remove bearing caps 3 and 5 on intake and exhaust camshafts.
- Remove double bearing cap.
- Remove both bearing caps next to intake and exhaust camshaft chain sprockets.
- Remove securing bolts of hydraulic chain tensioner.

- Loosen bearing caps 2 and 4 of intake and exhaust camshafts alternately and diagonally, and remove.
- Remove intake and exhaust camshafts with hydraulic chain tensioner.

Installing

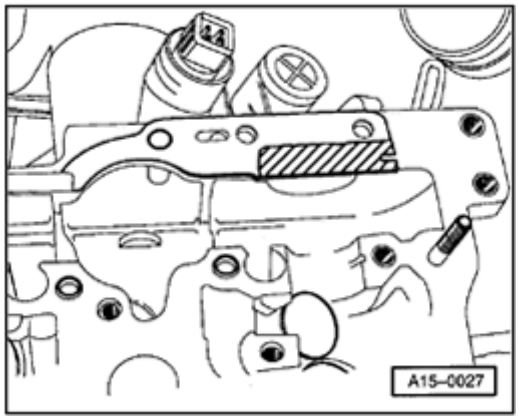

Fig. 149: Sealant Application Area Identified By Hatched Surface
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Replace rubber/metal gasket for hydraulic chain tensioner and apply a thin coat of sealant D 454 300 A2 to shaded area.
- Install drive chain on camshaft sprockets as follows:

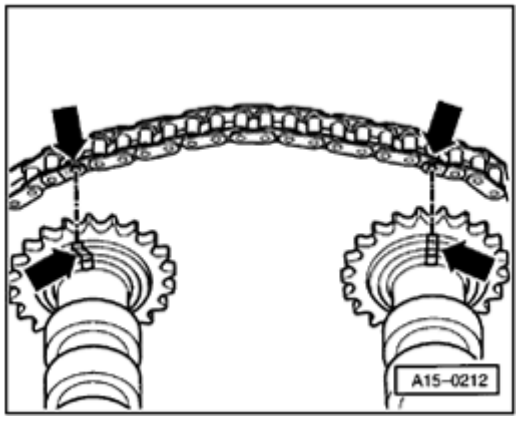

Fig. 150: Installing Chain So That Colored Markings Are In Line
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- When the old chain is being re-installed, Install the chain so that the colored markings are in line (arrows).

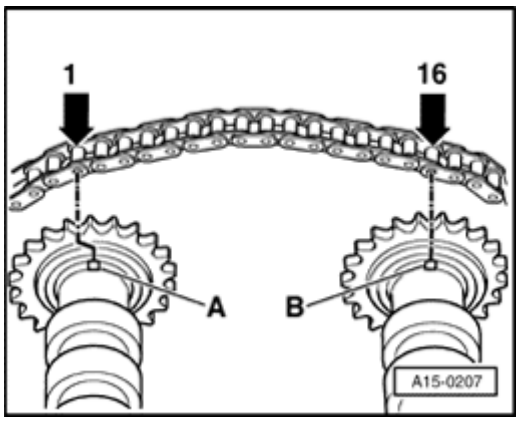

Fig. 151: First And Sixteenth Drive Chain Rollers Installed On Chain Gears
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- When a new chain is being installed, the distance between the notches -A- and -B- on the camshafts must be 16 rollers on the chain. The illustration shows the exact positions of the 1st and 16th rollers on the sprockets.
- Notch -A- is offset slightly toward the inside in relation to chain roller -1-.

- Insert hydraulic chain tensioner into chain.
- Locate camshafts together with chain and hydraulic chain tensioner on cylinder head.
- Oil running surfaces of both camshafts.

NOTE:

- **Dowel sleeves for bearing caps and hydraulic chain tensioner must be located in cylinder head.**
- **When installing bearing caps ensure that the identification mark is readable from the intake side of cylinder head.**

- Tighten mountings of hydraulic chain tensioner (watch position of dowel sleeves).

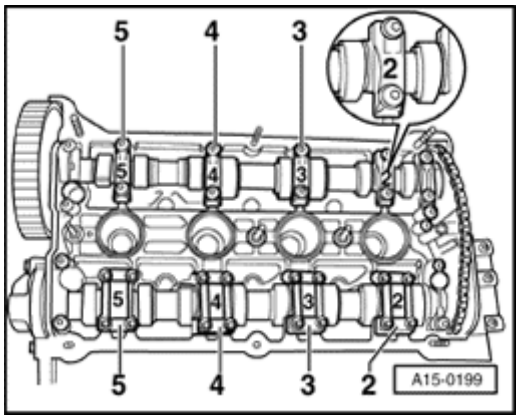

Fig. 152: Identifying Bearing Cap Positions
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tighten bearing caps 2 and 4 of intake and exhaust camshafts in stages and in diagonal sequence (watch position of dowel sleeves).
- Install bearing caps next to chain sprockets on intake and exhaust camshafts.
- Check correct setting of camshafts:

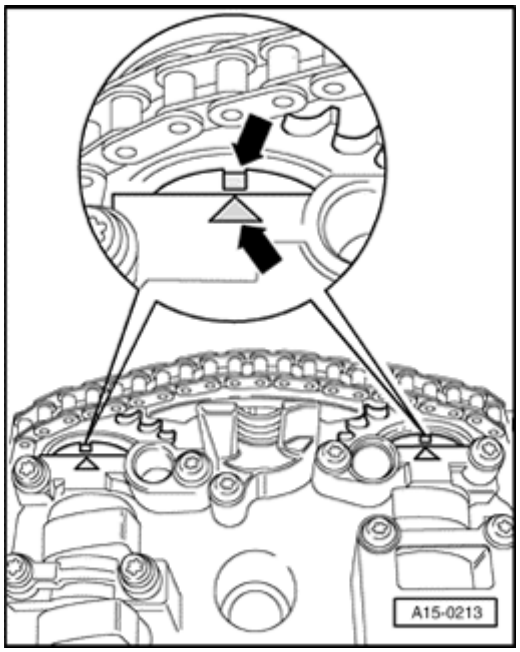

Fig. 153: Checking Position Of Camshafts To Each Other

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- The two markings on the camshafts must be in line with the two arrows on the bearing caps (arrows).

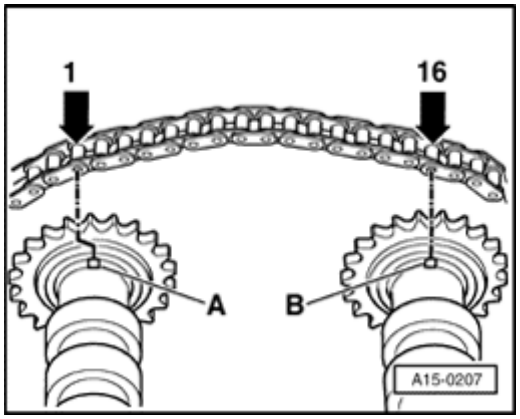

Fig. 154: First And Sixteenth Drive Chain Rollers Installed On Chain Gears
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- The distance between the two arrows on the bearing caps (or between the colored markings) is 16 rollers on the chain.
- The notch on the exhaust camshaft is offset slightly toward the inside in relation to chain roller -1-.

- Remove holder for chain tensioner 3366.

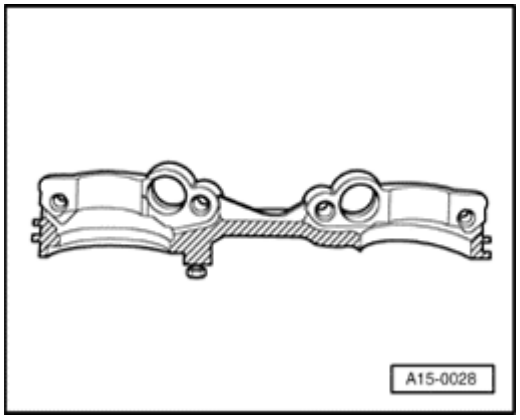

Fig. 155: Identifying Double Bearing Cap Sealant Application Area
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Apply a thin coat of sealant D 454 300 A2 to shaded area on double bearing cap and install bearing cap (watch position of dowel sleeves).

- Install remaining bearing caps (watch position of dowel sleeves).
- Install new intake and exhaust camshaft oil seals. Refer to **Camshaft oil seals, replacing**.

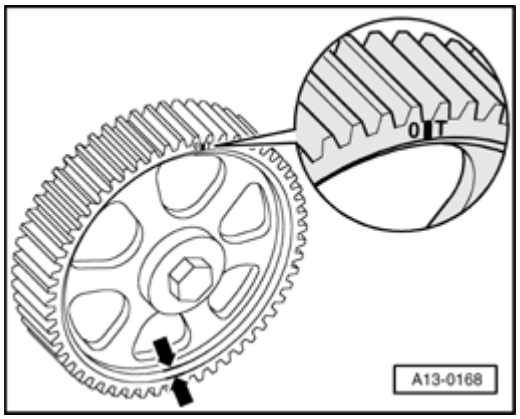

Fig. 156: Identifying Camshaft Gear Thin Rib Toward Outside And TDC Marking Visible
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install camshaft sprocket.

Check installation position: Narrow web of camshaft sprocket faces outward (arrows) and marking for No.1 cylinder TDC is visible from front.

- Install securing bolt for camshaft sprocket (hold in place with retainer 3036).
- Install camshaft position sensor.
- Install cylinder head cover. Refer to **Cylinder head, removing and installing**.

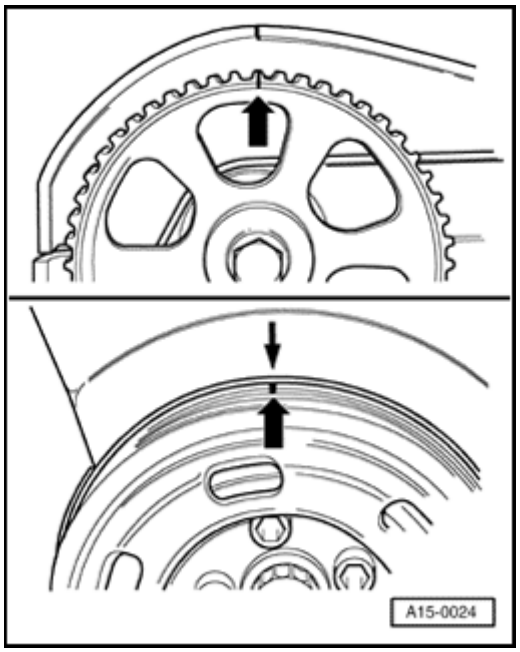

Fig. 157: Setting Crankshaft To Markings For TDC Of No. 1 Cylinder
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Align camshaft sprocket mark with marking on cylinder head cover.
- Align marking on vibration damper with marking on lower part of toothed belt guard.

NOTE: The crankshaft must not be at TDC when the camshaft is rotated, otherwise valves can contact pistons and cause damage.

- Install toothed belt (adjust valve timing). Refer to **Installing toothed belt (setting camshaft timing)**.
- Install ribbed belt and ribbed belt tensioning element. Refer to **Installing ribbed belt**.

NOTE:

- **Follow all instructions for removing and installing toothed belt. Refer to Toothed belt, removing and installing.**
- **Wait about 30 minutes after installing the camshafts before starting the engine. The hydraulic valve compensating elements must settle (otherwise the valves will strike the pistons).**
- **After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.**

Hydraulic valve lifters, checking

NOTE:

- **Replace malfunctioning lifters (they cannot be adjusted or repaired).**
- **Irregular valve noises when starting the engine is normal.**

- Start engine and run until coolant fan has switched on once.
- Increase engine speed to about 2500 rpm for 2 minutes (perform road test if necessary).

NOTE: If the irregular valve noises stop but reoccurs repeatedly during short journeys, a new oil retention valve must be installed. The oil retention valve is located in the oil filter bracket. Refer to Lubrication system components, Part II.

If the hydraulic lifters are still noisy, locate malfunctioning lifters as follows:

- Remove cylinder head cover. Refer to **Cylinder head, removing and installing**.
- Rotate crankshaft clockwise by turning central securing bolt on crankshaft toothed belt sprocket until cams of lifter to be checked are pointing upward.
- Determine play between cam and valve lifter.

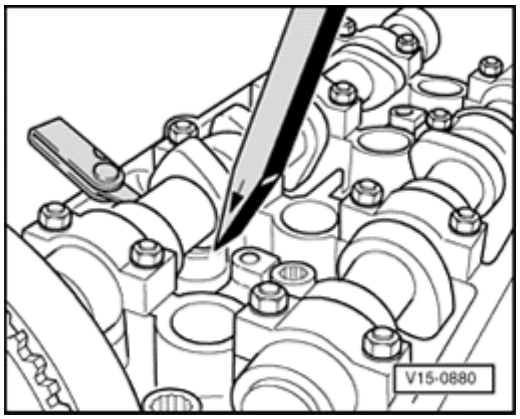

Fig. 158: Pressing Valve Lifter Down With Wooden Or Plastic Wedge
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press lifter down with a wooden or plastic wedge. If a 0.20 mm feeler gauge can be inserted between camshaft and lifter, replace lifter.

Replacing lifter. Refer to **Camshafts and hydraulic chain tensioner, removing and installing**.

NOTE:

- **After installing new lifters the engine must not be started for approx. 30 minutes (otherwise valves will strike pistons).**
- **After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.**

Valve stem seals, replacing

- Cylinder head installed

Removing

- Remove camshafts. Refer to **Camshafts and hydraulic chain tensioner, removing and installing**.
- Remove valve lifters and place them down with contact surface facing downward. When doing this ensure that lifters are not interchanged.
- Remove spark plugs with spark plug spanner 3122B.
- Set piston of appropriate cylinder to bottom dead center (BDC).
- Screw pressure hose VW 653/3 into spark plug thread.

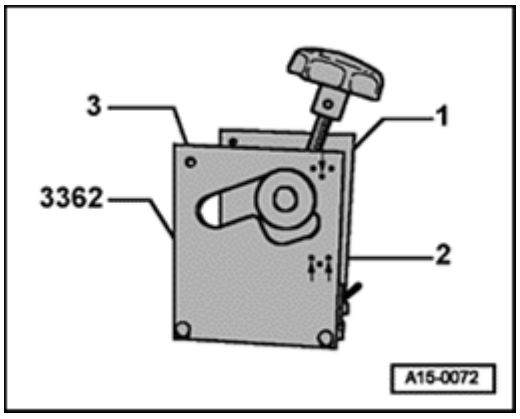

Fig. 159: Identifying Intake And Exhaust Valves Installation Position
Courtesy of VOLKSWAGEN UNITED STATES, INC.

The intake and exhaust valves are fitted at different angles in the cylinder head. Valve spring compressor 3362 can be set accordingly to two different positions:

1 - Upper position for center intake valve

2 - Lower position for the two outer intake valves and the two exhaust valves

3 - Threaded holes on each side to take two M6 x 25 bolts for securing spring compressor to cylinder head

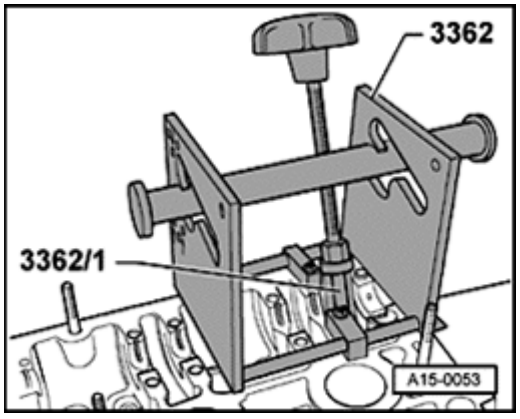

Fig. 160: Mounting Fitting Tool 3362 On Cylinder Head With Fitting Tool Securing Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Mount fitting tool 3362 on cylinder head with fitting tool securing bolts.

NOTE: To install assembly tool 2036 on the exhaust side the studs at the back of the exhaust side have to be unscrewed.

- Set correct position for valve concerned.
- Connect pressure hose to compressed air supply.

Air pressure: at least 6 bar

- Press valve springs down with threaded spindle and thrust piece 3362/1 and remove.

NOTE: Tight keepers can be loosened by tapping lightly on the valve spring plate.

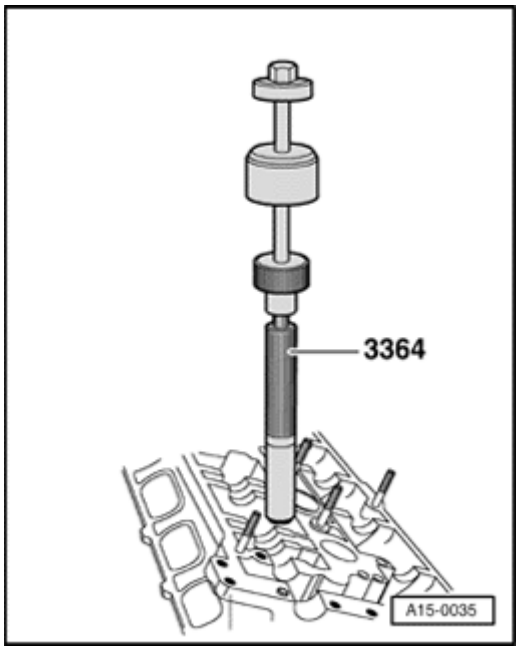

Fig. 161: Removing Valve Stem Seals Using Valve Stem Removal Tool 3364
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull off valve stem seals with extractor 3364.

Installing

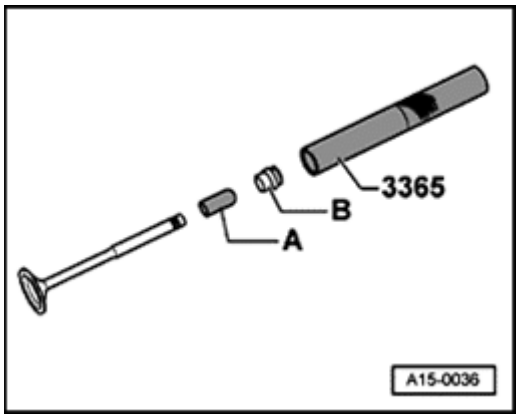

Fig. 162: Placing Plastic Sleeve On Valve Stem & Placing Valve Stem Seal In The Tool 3365
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- To prevent damage to new valve stem seals, place plastic sleeve -A- on valve stem.
- Lightly oil sealing lip of valve stem seal.
- Place valve stem seal -B- in the tool 3365 and push carefully onto valve guide.

NOTE: When replacing intake and exhaust valves, lightly oil valve stems before installing.

- Install camshafts. Refer to **Camshafts and hydraulic chain tensioner, removing and installing**.

NOTE:

- **After installing new lifters wait for approx. 30 minutes before starting engine. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).**
- **After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.**

Valve guides, checking

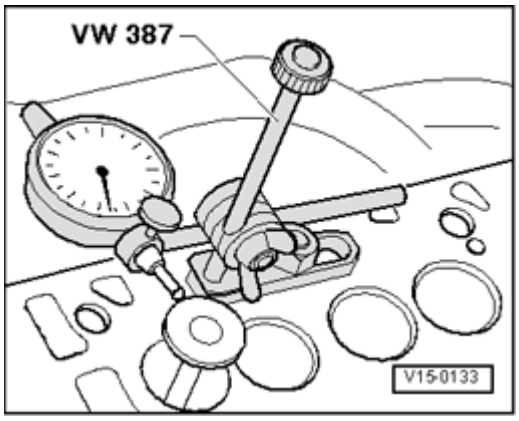

Fig. 163: Identifying Special Tool - VW 387 Installed
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert valve into valve guide until end of valve stem is flush with end of guide. Due to slight difference in stem diameters, ensure that only an intake valve is used in intake guide and an exhaust valve in exhaust guide.
- Measure amount of sideways play.

Wear limit

Intake valve guide	Exhaust valve guide
0.80 mm	0.80 mm

NOTE:

- **If the wear limit is exceeded, repeat the measurement with new valves. If the wear limit is again exceeded, replace the valve guide.**
- **If the valve is to be replaced as part of a repair, use a new valve for the measurement.**

Grinding in valve seats

- Grind in valve seats only as far as necessary to achieve a good seating pattern.

Valve guides, replacing

Special tools, testers, measuring instruments and auxiliary items required

- Drift 3360
- Support 3361
- Hand reamer 3363 and cutting fluid
- Press tool VW 411

Removing

- First check whether valve seat insert rings and, if necessary, cylinder head sealing surface can be reworked. If not, then valve guide should not be replaced.

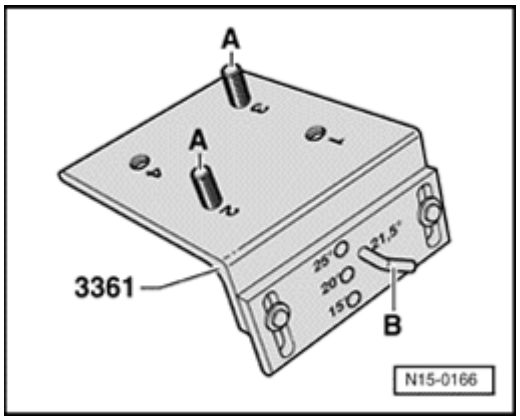

Fig. 164: Inserting Locating Pins For Cylinder Head Bolt Holes In Appropriate Holes
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Set up the support as follows:

- Insert locating pins for cylinder head bolt drillings -A- in holes 2 and 3.
- Insert pin -B- in appropriate hole (marked according to valve angle).

- Outer intake valves: 21.5 Angle°
- Central intake valve: 15 Angle°
- Exhaust valves: 20 Angle°

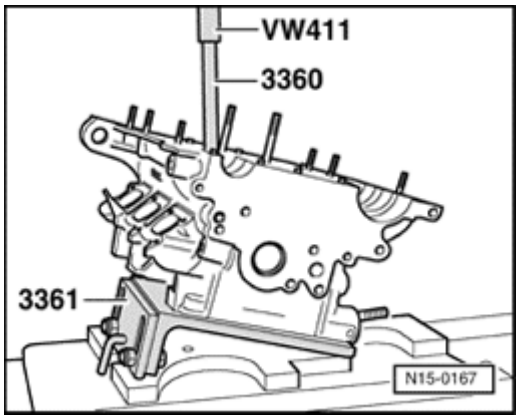

Fig. 165: Pressing Out Worn Valve Guides Using Drift 3360
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press out worn valve guides as follows using drift 3360:

- Valve guides without shoulder from camshaft side
- Valve guides with shoulder (repair version) from combustion chamber side

Installing

NOTE: When the shoulder on guide makes contact, the pressure must not exceed 10 kN (approx. 1.0 t), otherwise the shoulder may break off.

- Coat new valve guides with oil and press with drift 3360 into cold cylinder head from camshaft side until shoulder makes contact.
- Ream guides out with hand reamer 3363 using plenty of cutting fluid.
- Rework valve seats. Refer to **Valve seats, reworking**.
- Replace valve stem seals. Refer to **Valve stem seals, replacing**.

Valve seats, reworking

Special tools, testers, measuring instruments and auxiliary items required

- Depth gauge
- Valve seat refacing tool

NOTE:

- **When repairing engines with leaking valves, it is not sufficient to reface the valve seats and replace the valves. The valve guides must also be checked for wear. This is particularly important on high mileage engines. Refer to Valve guides, checking.**
- **Only rework the valve seats as far as is necessary to ensure a good seating pattern.**
- **Before starting to rework the valve seats, calculate the maximum**

permissible reworking dimension.

- **If the maximum reworking dimension is exceeded, the hydraulic lifters will not work properly and the cylinder head will have to be replaced.**

Calculating maximum permissible reworking dimension

- Insert valve and press firmly against valve seat.

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

- Measure distance between end of valve stem and central axis of camshaft (central axis of camshaft is level with top of cylinder head.)
- Calculate max. permissible reworking dimension from measured distance and minimum dimension.

Minimum dimensions		
Outer intake valves	Central intake valve	Exhaust valves
34.0 mm	33.7 mm	34.4 mm

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

Example (for outer intake valve):		
	Measured distance	34.4 mm
-	Minimum dimension	- 34.0 mm
=	Max. permissible reworking dimension 1)	= 0.4 mm

1) The maximum permissible reworking dimension is shown in the illustration under **Reworking valve seats** as dimension "b."

NOTE: If the maximum permissible reworking dimension is 0 mm or less than 0 mm, repeat the measurement with a new valve. If the measured result is again 0 mm or less than 0 mm, replace the cylinder head.

Reworking valve seats

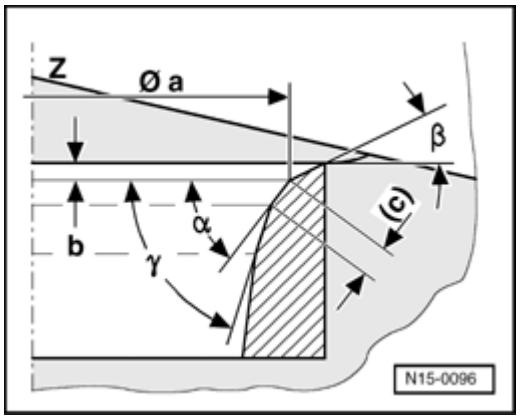

Fig. 166: Intake/Exhaust Valve Seat Measurements
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Intake valve seat		
a	=	26.2 mm diameter
b	=	Max. permissible reworking dimension 1)
c	=	1.5-1.8 mm
Z	=	Bottom surface of cylinder head
a	=	45° valve seat angle
ß	=	30° upper correction angle
gamma	=	60° lower correction angle

Exhaust valve seat		
a	=	29.0 mm diameter
b	=	Max. permissible reworking dimension 1)
c	=	Approx. 1.8 mm
Z	=	Bottom surface of cylinder head
a	=	45° valve seat angle
ß	=	30° upper correction angle
gamma	=	60° lower correction angle

1) Calculating maximum permissible reworking dimension. Refer to **Calculating maximum permissible reworking dimension**.

17 ENGINE - LUBRICATION

LUBRICATION SYSTEM COMPONENTS, REMOVING AND INSTALLING

Lubrication system components, removing and installing

NOTE:

- **If large quantities of metal shavings or particles are found in the engine oil when repairing the engine, carefully clean the oil passages and replace the oil cooler and all the oil spray jets in order to prevent further damage occurring later.**
- **The oil level must not be above the "Max." mark, otherwise there is a risk that the catalytic converter may be damaged.**
- **Checking oil pressure and oil pressure switch. Refer to Oil pressure and oil pressure switch, checking**
- **Viscosity grades and oil specifications. Refer to Engine oil.**
- **Checking engine oil level. Refer to Engine oil level, checking.**
- **Oil system capacity with filter change: 4.8 qts. (4.5 liters)**
- **Oil system capacity without filter change: 4.2 qts. (4.0 liters)**

Lubrication system components, Part I

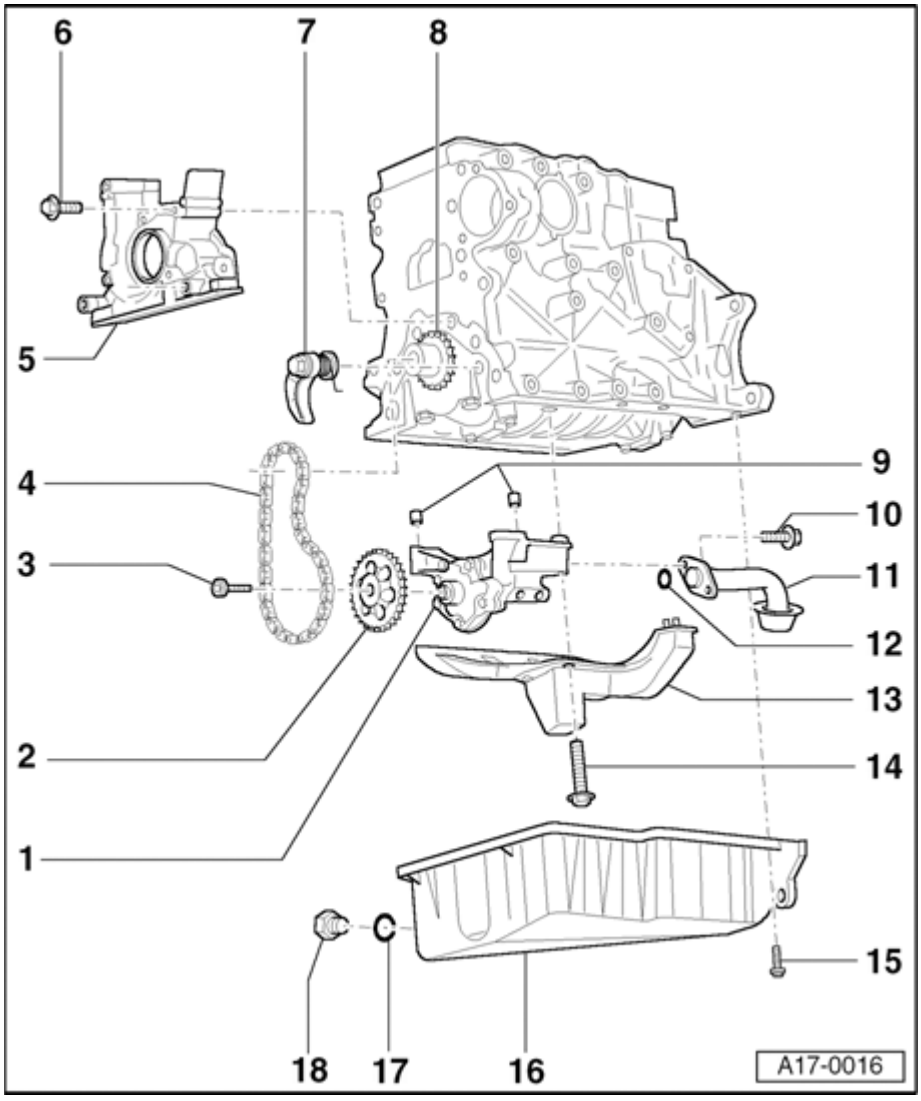

Fig. 167: Lubrication System Components, Removing And Installing Overview - Part I
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Oil pump

- With pressure relief valve (12 bar)
- Removing and installing. Refer to **Oil pump, removing and installing**
- Before installing, check that both dowel sleeves for centering oil pump/cylinder block are fitted.
- Replace pump if there is scoring on moving surfaces and gear teeth
- Tightening torque for oil pump cover to oil pump housing: 10 Nm

2 - Chain sprocket for oil pump

- Note correct position
- Sprocket can only be fitted on oil pump shaft in one position

3 - 25 Nm

4 - Drive chain for oil pump

- Mark running direction before removing.
- Check for wear.

5 - Sealing flange

- Apply silicone sealant D 176 404 A2 before installing. Refer to **Installing**.
- Replacing crankshaft oil seal on pulley end. Refer to **Crankshaft oil seal (pulley end), replacing**

6 - 15 Nm

7 - Chain tensioner

- Tighten to 15 Nm
- Do not disassemble
- Note installed position
- Pre-tension spring and engage before installing
- If spring is broken replace entire chain tensioner.

8 - Chain sprocket

- Removing and installing. Refer to **Chain sprocket, removing and installing**

9 - Dowel sleeves

10 - 15 Nm

11 - Suction line

- Clean strainer if soiled.

12 - O-ring

- Replace

13 - Baffle plate

- Only install with oil pump installed

14 - 15 Nm

15 - 15 Nm

16 - Oil pan

- Apply silicone sealant D 176 404 A2 when installing. Refer to **Installing**

17 - Seal

- Replace

18 - Oil drain plug, 30 Nm

Lubrication system components, Part II

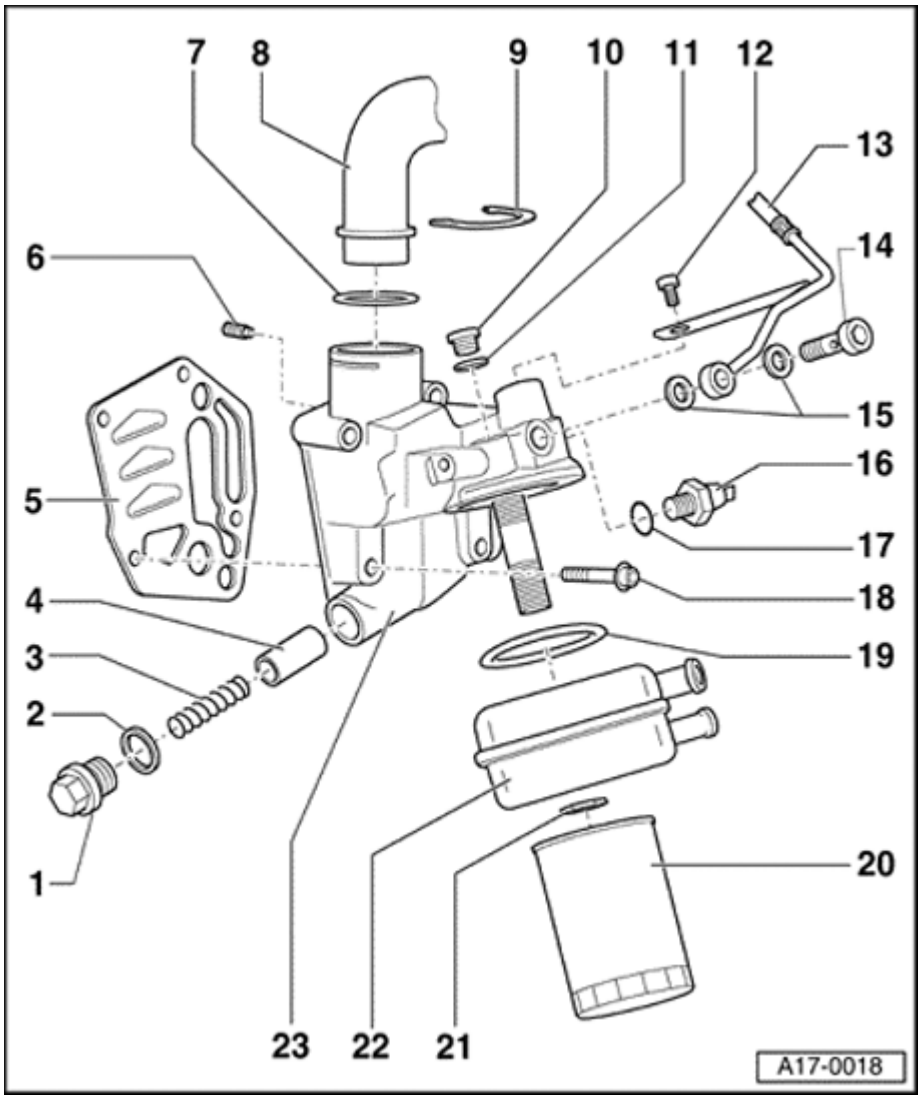

Fig. 168: Lubrication System Components, Removing And Installing Overview - Part II
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Plug, 40 Nm

2 - Seal

- Replace

3 - Spring

- For pressure relief valve, approx. 4 bar

4 - Piston

- For pressure relief valve, approx. 4 bar

5 - Gasket

- Replace

6 - Oil retention valve

- Tightening torque: 8 Nm
- Built into oil filter bracket

7 - O-ring

- Replace
- Slide on until flush with collar on line - **Lubrication system components, Part II**

8 - Line

9 - Retaining clip

10 - Screw plug, 15 Nm

11 - Seal

- If seal is leaking, cut open and replace.

12 - 20 Nm

13 - Oil supply line

- To turbocharger

14 - Banjo bolt, 30 Nm

15 - Seals

- Replace

16 - Oil pressure switch -F1-, 1.4 bar, 25 Nm

- Black insulation
- Checking. Refer to **Oil pressure and oil pressure switch, checking**

17 - Seal

- If seal is leaking, cut open and replace.

18 - 15 Nm + 1/4 turn (90°) further

- Replace

19 - Gasket

- Replace
- Engage in projections on oil cooler

20 - Oil filter

- Loosen with oil filter wrench 3417
- Tighten to 20 Nm
- Observe installation instructions on oil filter
- Observe change intervals

21 - 25 Nm

22 - Oil cooler

- See note. Refer to **Lubrication system components, removing and installing**
- Ensure clearance to adjacent components
- Coolant hose connection diagram. Refer to **Engine cooling system components, overview**

23 - Oil filter bracket

- With pressure relief valve (approx. 4 bar)

Oil pan, removing and installing

Special tools, testers and auxiliary items required

- Electric drill with plastic brush attachment
- Silicone sealant D 176 404 A2

Removing

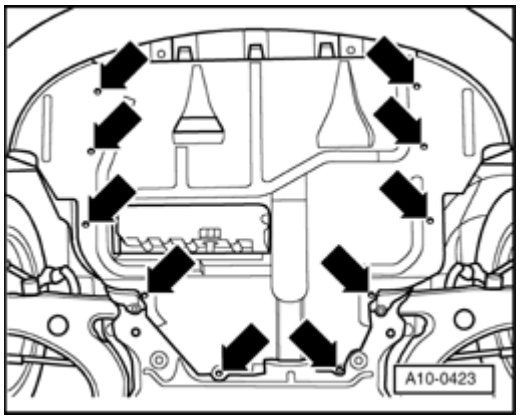

Fig. 169: Locating Center Sound Insulation Fasteners
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove center sound insulation panel (arrows).
- Drain engine oil.

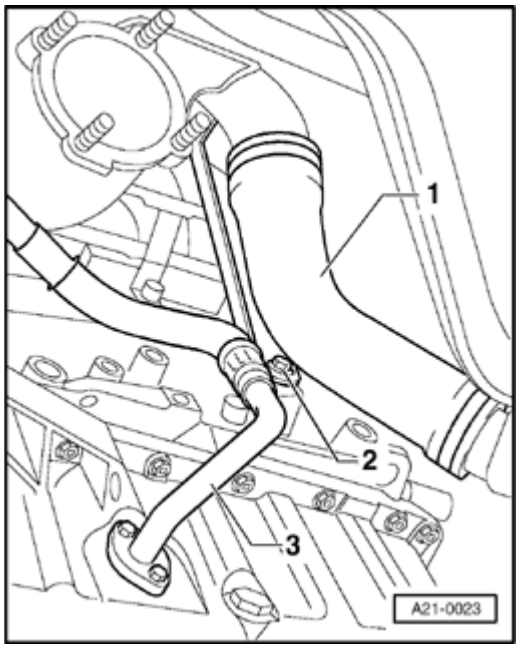

Fig. 170: Removing Oil Return Line From Oil Pan
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bracket -2- for oil return line.
- Remove oil return line from oil pan.
- Remove oil pan.

NOTE: Use special tool 3185 to loosen and tighten oil pan screws. Remove using 3249 hex ball socket.

- Remove oil pan (if necessary, loosen pan by lightly tapping with rubber mallet).

- Remove sealant remaining on cylinder block with flat scraper.

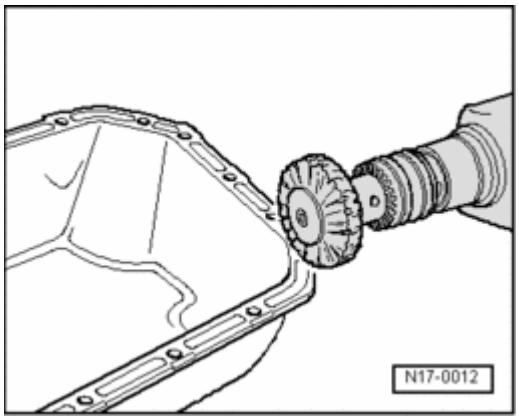

Fig. 171: Removing Sealant Residue From Oil Pan With A Rotating Brush
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove remaining sealant from oil pan (with rotating plastic brush or similar).

WARNING: Wear eye protection.

- Clean sealing surfaces: they must be free of oil and grease.

Installing

NOTE: The oil pan must be installed within 5 minutes after applying the silicone sealant D 176 404 A2.

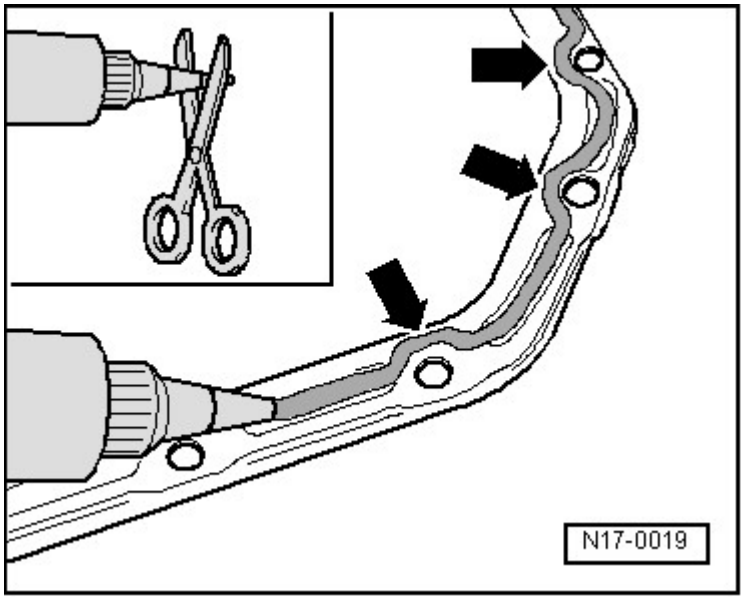

Fig. 172: Cutting Off Tube Nozzle & Applying Silicone Sealing Compound To Oil Pan Sealing Surface

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Cut off nozzle on tube at front marking (nozzle diameter approx. 3 mm).

Thickness of sealant bead: 2-3 mm

NOTE: The bead of sealant must not be thicker than 3 mm, otherwise excess sealant will enter the oil pan and obstruct the strainer in the oil intake line.

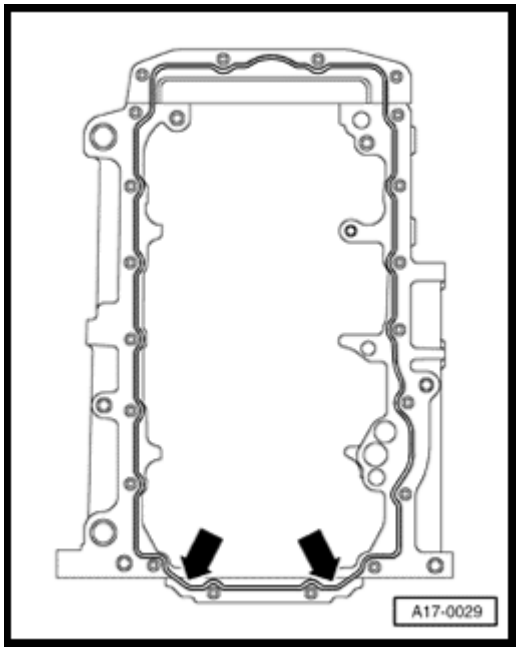

Fig. 173: Identifying Clean Sealing Surfaces Sealant Application Areas
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Apply silicone sealant to clean sealing surface on oil pan as illustrated. Illustration shows position of sealant bead on cylinder block.

NOTE: Apply sealant bead with particular care around rear sealing flange (arrows).

- Install oil pan immediately and bolt to cylinder block. Start by tightening all bolts by hand.
- Tighten 3 bolts securing oil pan to transmission.
- Tighten bolts securing oil pan to cylinder block in two stages in diagonal sequence.

Tightening torques

Component	ft lb	Nm
Oil pan to cylinder block	11	15
Oil pan to transmission	33	45

NOTE:

- **When installing the oil pan with the engine out of the vehicle, ensure that the oil pan is flush with the cylinder block at the flywheel end.**
- **After installing the oil pan, wait for about 30 minutes for the sealant to dry before putting in engine oil.**

Oil pump, removing and installing

Removing

- Remove oil pan. Refer to **Oil pan, removing and installing**.

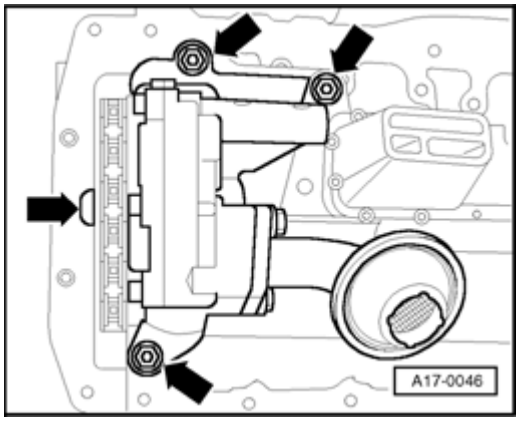

Fig. 174: Detaching Oil Pump
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen bolts (arrows).
- Remove oil pump but leave chain sprocket in place.

Installing

- Insert dowel sleeves at top of oil pump.

Chain sprocket can only be installed in one position on oil pump shaft.

- Install oil pan. Refer to **Installing**.

Tightening torques

Component		ft lb	Nm
Chain sprocket to oil pump shaft		18	25
Oil pump to cylinder block		11	15

Oil pressure and oil pressure switch, checking

Function of dynamic oil pressure warning system

Checking warning lamp

The oil pressure warning lamp lights up when the ignition is switched on ("Terminal 15 on") with the engine not running (this does not apply to vehicles with auto-check system).

Conditions for activation of warning

- Engine not running; oil pressure switch closed.
- Coolant temperature above 60° C, engine speed above 1500 rpm and oil pressure switch open.
- When engine speed is above 5000 rpm an active oil pressure warning is not cancelled, irrespective of the condition of the oil pressure switch.
- If the power supply to the control unit is OK (Terminal 15) and the oil pressure switch is open for longer than 0.5 seconds at engine speeds above 1500 rpm, this condition is stored in the memory. If this condition occurs three times with "Terminal 15 on," the warning will also become active or remain active at engine speeds below 1300 rpm.

Requirements

- Oil level OK
- Oil pressure warning lamp -K3- must come on when ignition is switched on
- In vehicles with auto-check system the "OK" display must appear (call up symbol)
- Engine oil temperature approx. 80° C (coolant fan must have cut in once)

Checking oil pressure switch

- Disconnect wire from oil pressure switch.

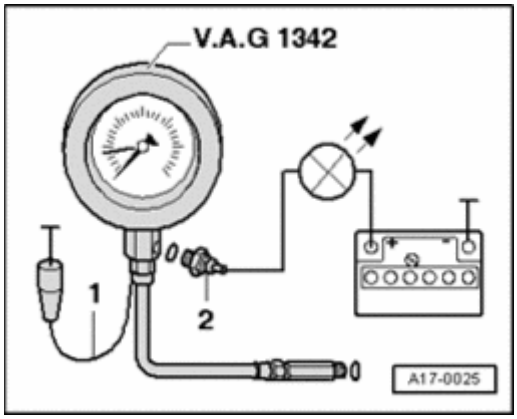

Fig. 175: Removing Oil Pressure Switch And Screwing In Oil Pressure Tester V.A.G 1342
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove oil pressure switch and screw in oil pressure tester V.A.G 1342.
- Screw oil pressure switch -2- intoV.A.G 1342.

- Connect brown wire -1- of tester to Ground (-).
- Connect LED voltage tester V.A.G 1527 to oil pressure switch and positive side of battery (+).

LED voltage tester should not light up.

If the LED voltage tester lights up:

- Replace oil pressure switch.
- Start engine.

LED voltage tester should light up at 1.2-1.6 bar.

If the LED voltage tester does not light up:

- Replace oil pressure switch.

NOTE: The oil pressure switch may reach its switching point while the engine is being turned over by the starter. It is therefore important to watch the tester and the LED voltage tester while starting the engine.

Checking oil pressure

- Disconnect wire from oil pressure switch.

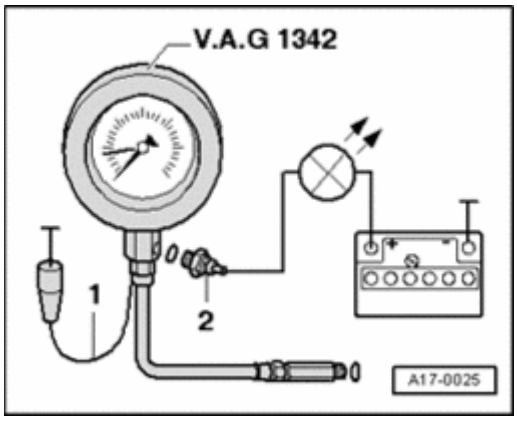

Fig. 176: Removing Oil Pressure Switch And Screwing In Oil Pressure Tester V.A.G 1342
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove oil pressure switch and screw in oil pressure tester V.A.G 1342.
- Screw oil pressure switch -2- intoV.A.G 1342.
- Start engine (engine oil temperature at least 80° C).

- Oil pressure at idling speed: at least 1.0 bar
- Oil pressure at 3000 rpm: between 3.5 and 4.5 bar

If the specifications are not obtained:

- Replace oil filter bracket with pressure relief valve (Refer to **Lubrication system components, Part II**) or replace oil pump (Refer to **Oil pump, removing and installing**).

Engine oil

A high-quality multigrade oil is put in at the factory. This oil may be used all year round, except in extremely cold climates.

Viscosity grades and oil specifications

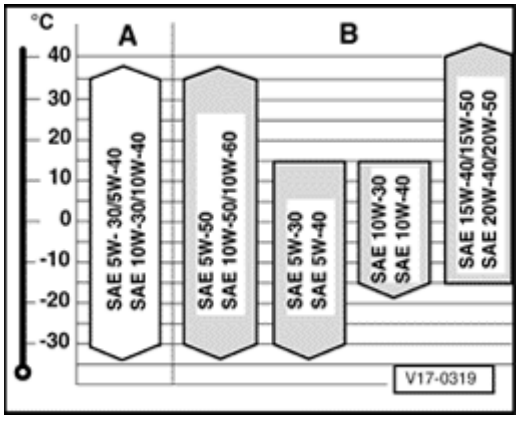

Fig. 177: Viscosity Grades And Oil Specifications
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Select the viscosity grade of the oil according to the chart. The oil does not need changing for brief variations of temperature outside the temperature ranges shown.

The specifications listed here must appear on the container - either singly or together with other specifications.

A - High lubricity multigrade oils, specification VW 500 001

B - Multigrade oils, specification VW 501 011

- Multigrade oils, specification API-SJ or API-SL2

1) The date given after the VW specification must be not earlier than 10.91.

2) Only use these grades of oil if the approved grades are not available.

Different types of oil may be mixed if necessary when topping up.

Engine oil level, checking

Conditions

- Check the oil level only when the engine is warm (oil temperature above 60° C)
- Vehicle must be standing on level ground when checking the oil level. Wait a few minutes after switching off the engine to allow the oil to flow back into the oil pan

Work sequence

- Pull out dipstick, wipe off with a clean cloth and insert again as far as it will go.
- Pull out dipstick again and read oil level.

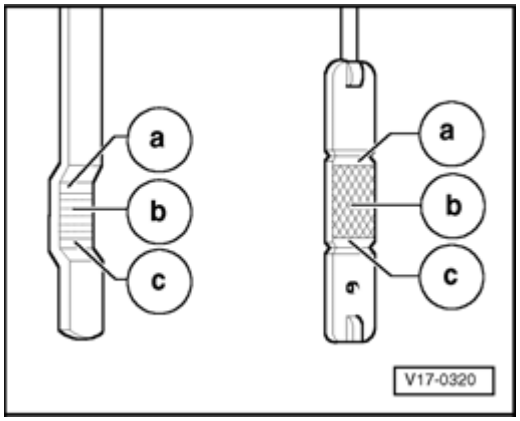

Fig. 178: Markings On Oil Dipstick
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Markings on oil dipstick:

a - Do not top up oil.

b - Oil can be topped up. Oil level may rise as far as area -a- after topping up.

c - Oil must be topped up. It is sufficient if oil level is somewhere in area -b- (grooved area on dipstick) after topping up.

NOTE: The oil level must not be above the max. marking on the dipstick.

19 ENGINE - COOLING SYSTEM

ENGINE COOLING SYSTEM COMPONENTS, REMOVING AND INSTALLING

Engine cooling system components, removing and installing

NOTE:

- **When the engine is warm the cooling system is under pressure. If necessary release pressure before commencing repair work.**
- **Secure all hose connections with hose clamps of the same type as those installed at the factory.**

- V.A.G 1921 hose clip pliers are recommended when installing spring-type clips.
- Replace all gaskets and seals.
- The arrow markings on the coolant lines and on the ends of the hoses must be aligned with each other.
- Draining and filling cooling system. Refer to **Draining**.
- Anti-freeze concentration. Refer to **Filling**.
- Coolant hose connection diagram. Refer to **Engine cooling system components, overview**.
- Checking cooling system for leaks with V.A.G 1274 and 1274/8. Refer to **Cooling system, checking for leaks**.
- Removing coolant pump. Refer to **Coolant pump, removing and installing**.
- Removing coolant thermostat. Refer to **Coolant thermostat, checking, removing and installing**.

Engine cooling system components, overview

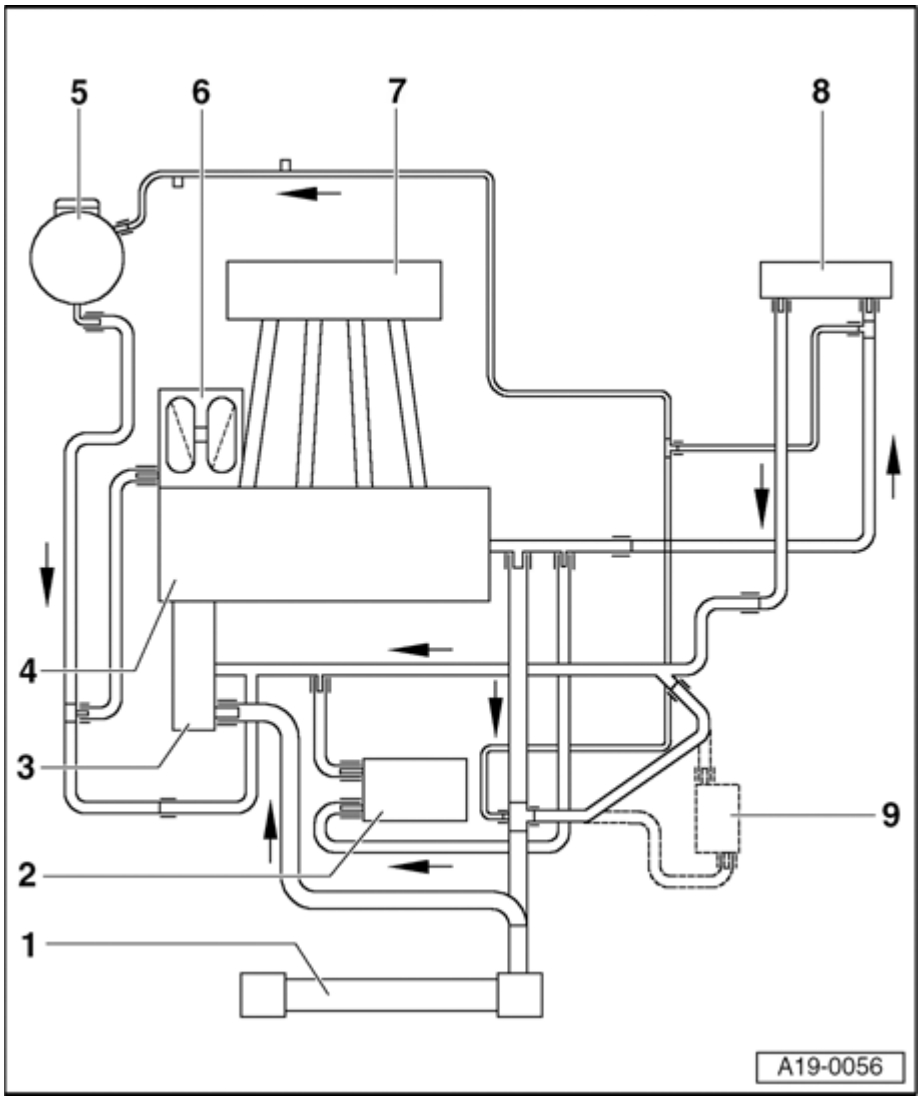

Fig. 179: Engine Cooling System Components, Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Radiator

- After replacing replace entire coolant

2 - Oil cooler

- Removing and installing. Refer to **Lubrication system components, Part II**, item 22

3 - Coolant pump, coolant thermostat

- Removing and installing coolant pump. Refer to **Coolant pump, removing and installing**
- Check for ease of movement.
- Removing and installing coolant thermostat. Refer to **Coolant thermostat, checking, removing and installing**
- Testing, operating data. Refer to **Checking coolant thermostat**

4 - Cylinder block

5 - Expansion tank

- Checking filler cap. Refer to **Checking pressure relief valve in filler cap**

6 - Turbocharger

7 - Intake manifold

8 - Heating system heat exchanger

9 - Transmission oil cooler

- For ATF in automatic transmission

Engine cooling system, draining and filling

Draining

NOTE:

- **Collect drained coolant in a clean container for re-use or disposal.**
- **Coolant must only be mixed with clean drinking water.**

- Remove cap from coolant expansion tank.

WARNING: Hot steam can escape when the cap on the expansion tank is opened.

Cover the cap with a cloth, and open it carefully.

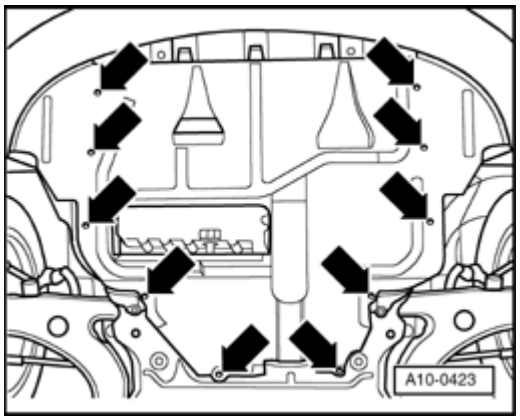

Fig. 180: Locating Center Sound Insulation Fasteners
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove center sound insulation panel.
- Place drip tray V.A.G 1306 below engine.

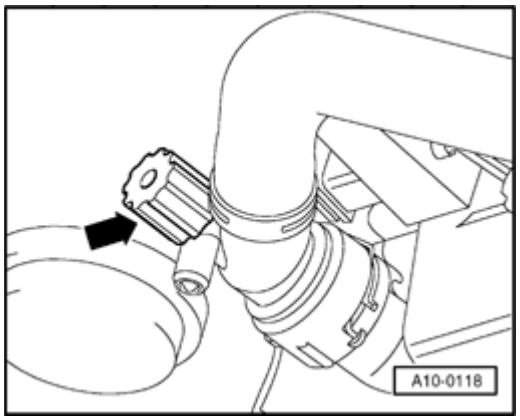

Fig. 181: Turning Drain Screw On Radiator
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Turn drain screw (arrow) on radiator counter-clockwise (install an extension hose to connection if necessary).

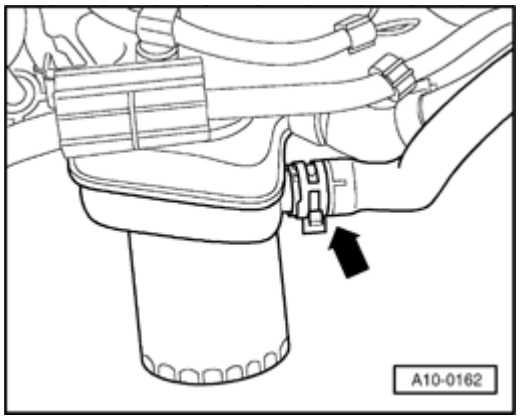

Fig. 182: Disconnecting Bottom Coolant Hose At Oil Cooler To Drain Off Remaining Coolant
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Also disconnect bottom coolant hose from oil cooler (arrow), and drain remaining coolant.

Filling

NOTE:

- **Only use coolant additive G 012 A8 D which meets specification TL VW 774 D (identifiable by red color).**

CAUTION: Do not use G 011 A8 C. The two different coolant additives G 011 A8 C and G 012 A8 D must not be mixed together. Otherwise this can result in serious damage to the engine.

- If the fluid in the expansion tank is brown it means G 012 A8 D has been mixed with another type of coolant. In this case, flush out the cooling system and put in fresh coolant. To flush the system, fill it with clean drinking water and run the engine for about 2 minutes. This should remove very nearly all of the old coolant.
- G 012 A8 D and coolant additives marked "meeting specification TL VW 774 D" prevent frost and corrosion damage, stop scaling, and at the same time raise the boiling point of coolant. For these reasons the cooling system must be filled all year round with the correct anti-freeze and anti-corrosion additive.
- Because of its high boiling point, the cooling improves engine reliability under heavy loads, particularly in countries with tropical climates.
- Frost protection is required down to about -25° C (or to about -35° C in countries with arctic climates).
- The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. The anti-freeze ratio must be at least 40%.
- If greater frost protection is required in very cold climates, the amount of G 012 A8 D can be increased, but only up to 60% (this gives frost protection to about -40° C), as otherwise frost protection is reduced again and cooling effectiveness is also reduced.
- If the radiator, heat exchanger, cylinder head or cylinder head gasket are replaced, do not re-use old coolant.

Recommended mixture ratios:

Frost protection to	Anti-freeze concentration	Quantity of G 012 A8 D 1)	Quantity of water1)
-25° C	40 %	2.0 ltr.	3.0 ltr.
-35° C	50 %	2.5 ltr.	2.5 ltr.

1) Coolant quantity: 5.0 liters (may vary depending upon the vehicle equipment)

NOTE: Use clean drinking water in addition to coolant to top off cooling system.

- Screw in coolant drain plug.

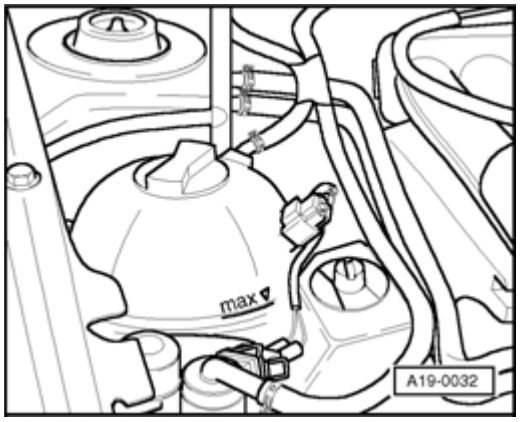

Fig. 183: Identifying Expansion Tank
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Top up coolant to max. mark on expansion tank.
- Start engine and run at approx. 1500 rpm for max. 2 minutes and at same time fill with coolant up to overflow hole on expansion tank.
- Install expansion tank cap.
- Run engine until coolant fan cuts in.
- Stop engine.
- Check coolant level and top-up if necessary.

- When the engine is at normal operating temperature, the coolant level must be on the max. mark
- When the engine is cold, coolant level must be between the min. and max. marks

WARNING: Hot steam can escape when the cap on the expansion tank is opened. Cover the cap with a cloth, and open it carefully.

Coolant pump, removing and installing

NOTE: Always replace seals and gaskets.

Removing

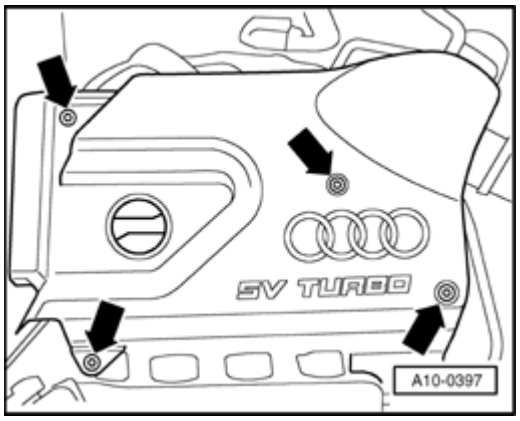

Fig. 184: Removing Engine Cover Panel Above Cylinder Head
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove engine cover.

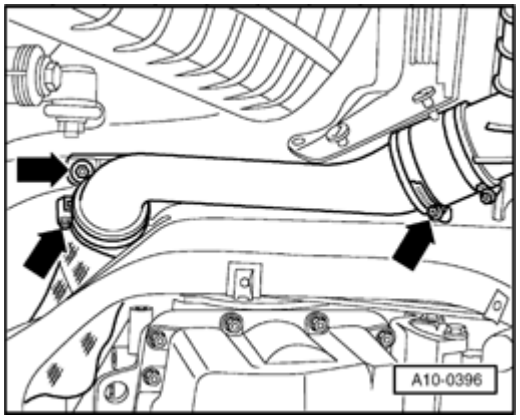

Fig. 185: Disconnecting Air Duct At Bottom Of Right Side Longitudinal Member
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect air duct at bottom of right side longitudinal member (air duct leads to charge air cooler).
- Drain cooling system. Refer to **Draining**.

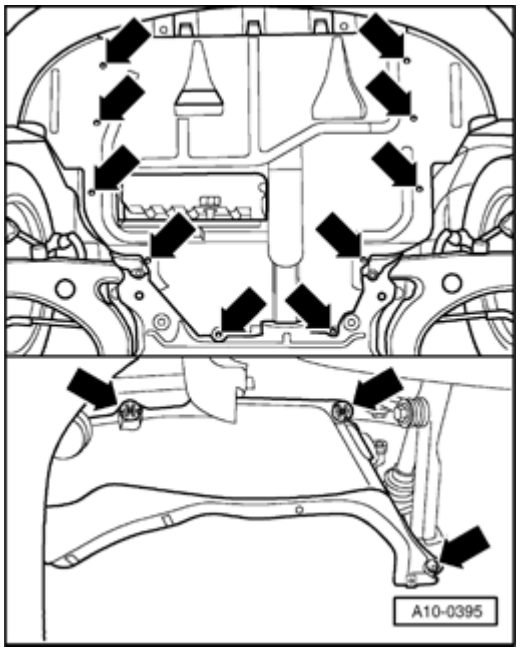

Fig. 186: Removing Noise Insulation Panels (Center, Left And Right)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove center and right side sections of sound insulation (arrows).
- Remove ribbed belt and tensioning element. Refer to **Ribbed belt, removing and installing**.
- Disconnect vacuum hose from EVAP canister and from throttle valve connection.

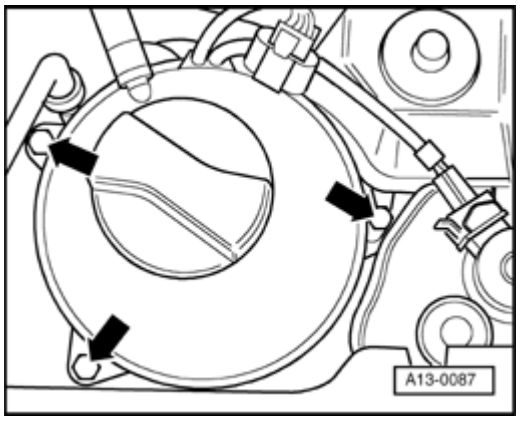

Fig. 187: Detaching Coolant Expansion Tank And Power Steering Reservoir
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove coolant expansion tank (left arrows) together with hoses.
- Unbolt power steering reservoir (right arrow). Do not disconnect hoses.
- Remove toothed belt guards (upper and center). Refer to **Toothed belt, removing and installing**.

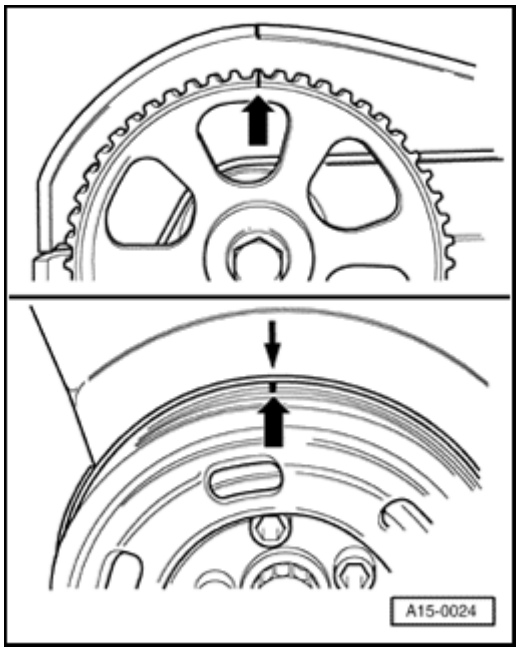

Fig. 188: Setting Crankshaft To Markings For TDC Of No. 1 Cylinder
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Set crankshaft to markings for TDC of No. 1 cylinder (arrows) by turning central bolt on crankshaft sprocket in direction of rotation.

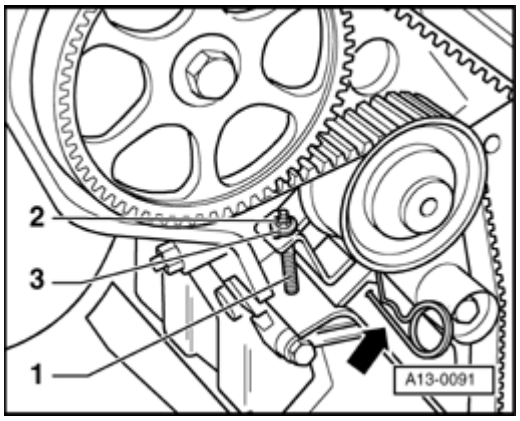

Fig. 189: Screwing Stud Into Toothed Belt Tensioning Element & Hex Nut Onto Stud Using Large Washer
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Screw M5 x 55 stud -1- into toothed belt tensioning element. Screw hex nut -2- onto stud -1- using large washer -3-.
- Tension pressure piston of tensioning element only until it can be secured with a locking pin (e.g. from lifting appliance 2024 A) -arrow-.

NOTE: If it is not possible to insert the locking pin, carefully tension the pressure piston of the tensioning element just enough to allow the toothed belt to be

removed.

- Remove toothed belt from camshaft sprocket.

NOTE:

- **The vibration damper and bottom toothed belt guard do not have to be removed.**
- **The toothed belt should be left in position on the crankshaft sprocket.**
- **Cover toothed belt with a cloth to protect it from coolant before removing coolant pump.**

Vehicles with air conditioning

- Remove lower air duct (Refer to **Charge air cooling system components, removing and installing**, item 11).

All models

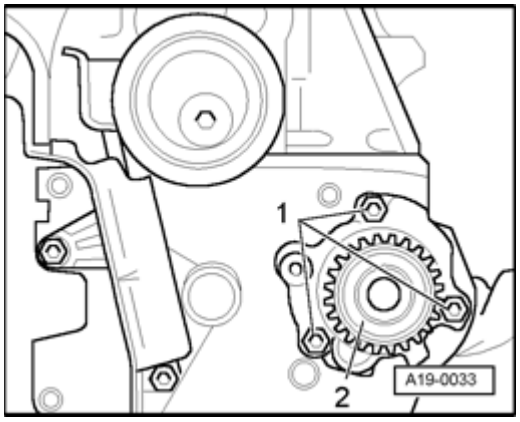

Fig. 190: Identifying Coolant Pump & Securing Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

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

Installing

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

- Clean and smooth down sealing surface for O-ring as required.
- Moisten new O-ring with coolant G 012 A8 D.
- Install coolant pump. Installation position: plug in housing faces downward.
- Install toothed belt (adjust valve timing). Refer to **Installing toothed belt (setting camshaft timing)**.

NOTE: **Follow all the instructions on removing and installing the toothed belt. Refer to Toothed belt, removing and installing.**

- Install ribbed belt and tensioning element. Refer to **Ribbed belt, removing and installing**.
- Fill with coolant. Refer to **Filling**.

Tightening torque

Component	ft lb	Nm
Coolant pump to cylinder block	11	15

Coolant thermostat, checking, removing and installing

NOTE: Always replace seals and gaskets.

Removing

- Drain cooling system. Refer to **Draining**.

Vehicles with air conditioning

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

- Unbolt front engine cover support from intake manifold.
- Remove retainers for refrigerant hoses.

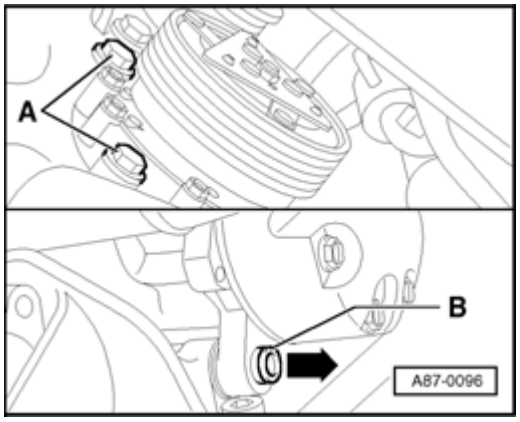

Fig. 191: Unbolting A/C Compressor & Pressing Sliding Bushing Back Into Hole
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unbolt A/C compressor, lift clear together with refrigerant hoses (do not disconnect) and tie in place on hood lock.

All vehicles

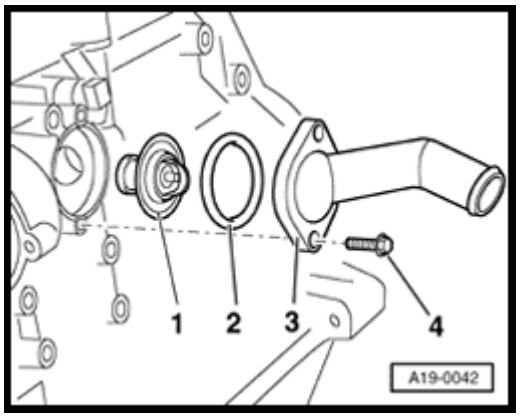

Fig. 192: Identifying Elbow Connection, Bolts, O-Ring & Thermostat
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect coolant hose from connection -3-.
- Remove bolts -4- and remove connection, O-ring -2- and coolant thermostat -1-.

Installing

- Clean and smooth down sealing surface for O-ring as required.
- Insert coolant thermostat.

Installation position: bowed metal strip on thermostat must be vertical.

- Moisten new O ring with coolant G 012 A8 D.
- Tighten bolts.
- Fill with coolant. Refer to **Filling**.

Tightening torque

Connection to cylinder block: 15 Nm

Checking coolant thermostat

- Heat thermostat in water bath.

Starts to open	Fully open	Opening travel
approx. 87° C	approx. 102° C 1)	at least 7 mm

1) Cannot be tested

Coolant line, removing and installing

Removing

NOTE: Always replace seals and gaskets.

- Obtain radio anti-theft code on vehicles with coded radio.
- With ignition switched off, disconnect battery Ground strap.
- Drain cooling system. Refer to **Draining**.
- Remove intake manifold. Refer to **Intake manifold, removing and installing**.

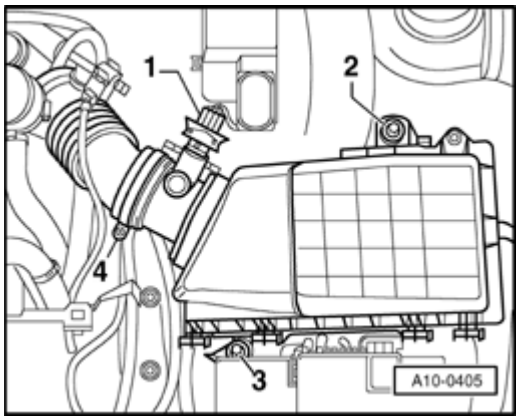

Fig. 193: Identifying Air Hose, Mass Air Flow Sensor & Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect air duct -4- from mass air flow sensor.
- Disconnect electrical connectors for mass air flow sensor -1-.
- Remove bolts -2- and -3- and take off air cleaner housing.

Remove air intake hose from connection on turbocharger as follows:

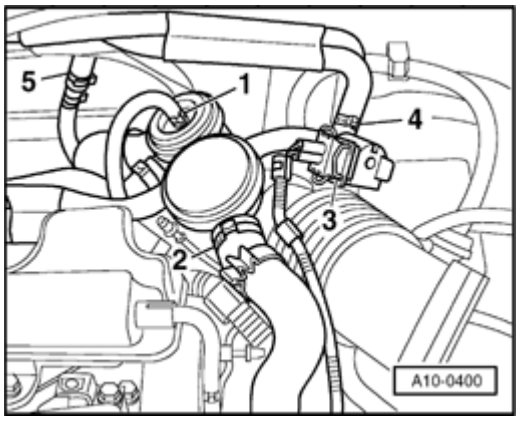

Fig. 194: Identifying Vacuum Hose, Crankcase Breather, Wastegate Bypass regulator valve & Hose
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect vacuum hose -1- from air recirculation valve.
- Disconnect hose from pressure control valve for crankcase breather -2-.
- Disconnect electrical connector from Wastegate bypass regulator valve -3- -N75.

- Disconnect hose -4- from Wastegate bypass regulator valve -N75-.

- Disconnect hose -5- at bulkhead (hose leads from solenoid valve to turbocharger).
- Take solenoid charge pressure control valve out of air intake hose and place it to one side on engine.
- Pull retainer off turbocharger connection and remove air intake hose.
- Disconnect coolant hose from coolant line (hose leads to heat exchanger for heater).

Vehicles with automatic transmission

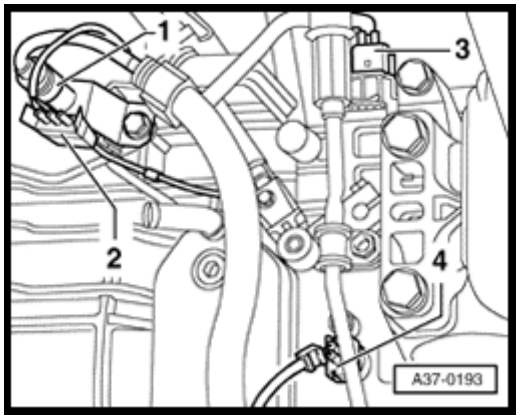

Fig. 195: Identifying Transmission Electrical Connections
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect connectors:

1 - for solenoid valves (10-pin connector)

2 - for Vehicle speed sensor (VSS) -G68-

All vehicles

- Unbolt coolant line retainer from coolant line flange on left of cylinder head.
- Disconnect hose (leading to oil cooler) from coolant line.
- Remove crankcase breather line.
- Unbolt coolant line retainer from cylinder block.

- Disconnect hose (leading to coolant expansion tank) from coolant line (right).
- Unbolt coolant line retainer from tensioning element for ribbed belt.
- Pull tapered collar off oil dipstick tube.
- Disconnect wires/connectors as follows:

- Knock Sensor (KS) 1 -G61-
- Engine speed (RPM) sensor -G28- (middle, gray)
- Knock sensor (KS) 2 -G66-

- Take connectors out of retainer.
- Remove oil line leading to turbocharger and unbolt retainer for oil line (both are attached to oil filter bracket).
- Unbolt retainer for connectors.
- Unbolt knock sensors 1 and 2.

- Unbolt left side coolant line flange from cylinder head.
- Remove coolant line.

Installing

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

- Before installing, clean and smooth down sealing surface for O-ring as required.

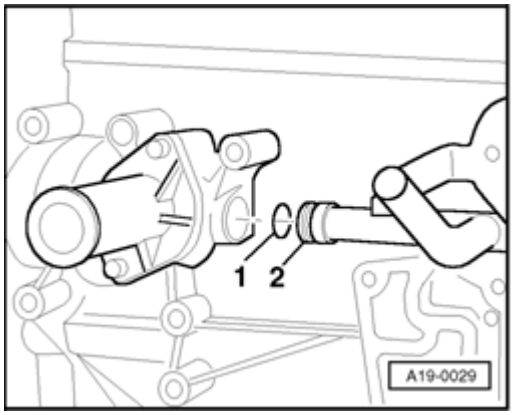

Fig. 196: Identifying O-Ring & Coolant Pipe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Moisten new O-ring -1- with G 012 A8 D and slide onto coolant line -2-.
- Push coolant line into opening in cylinder block.
- Fill with coolant. Refer to **Filling**.
- After connecting battery terminals, enter anti-theft code for radio

Refer to Radio operating instructions

- Close power windows in front doors to their top positions using electrical switches.
- Operate all power window switches again for at least one second in "close" direction to activate automatic one-touch function.
- Set clock to correct time.
- Check DTC memory:

Refer to

- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

NOTE: DTCs will be stored in the memory because connectors have been unplugged. Therefore, check and erase DTC memory after installing the engine.

Tightening torques

Component		ft lb	Nm
Coolant line bracket to cylinder block		7	10
Coolant line bracket to oil filter bracket		15	20
Coolant line bracket to coolant line flange		7	10

Radiator, removing and installing

NOTE: Always replace gaskets and seals.

Removing

- Obtain radio anti-theft code on vehicles with coded radio.
- With ignition switched off, disconnect battery Ground strap.

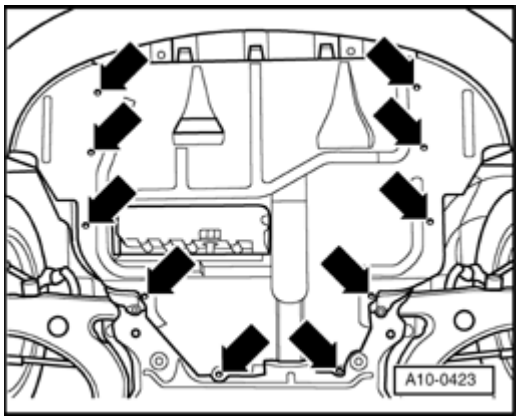

Fig. 197: Locating Center Sound Insulation Fasteners
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove sound insulation (arrows).
- Drain cooling system. Refer to **Draining**

- Release clamps and disconnect coolant hoses from connections on radiator (top and bottom).
- Remove front bumper (cover section only):

Refer to **63 BUMPERS**

NOTE: Only remove the cover section for the front bumper.

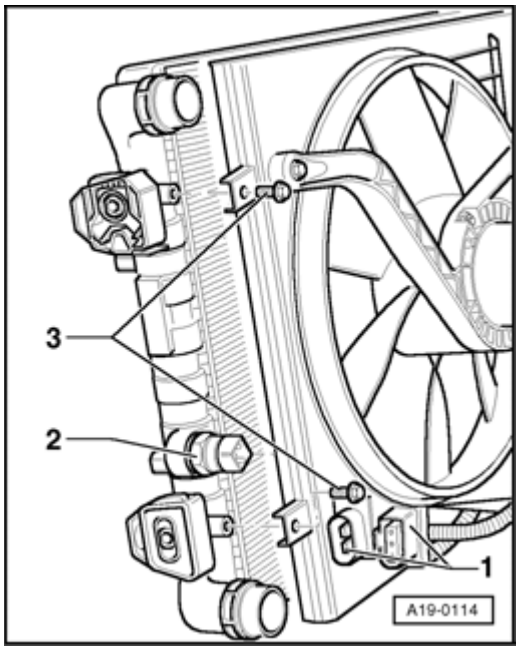

Fig. 198: Identifying Radiator Fan Cowl Connectors, Coolant Fan Control (FC) Thermal Switch -F18- Connectors & Radiator Cowl
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect connectors -1- on radiator cowl.
- Disconnect connector -2- from Coolant Fan Control (FC) Thermal Switch -F18-.
- Unbolt radiator cowl -3- together with coolant fans (4 bolts) and pull downward to remove.

Vehicles without air conditioning

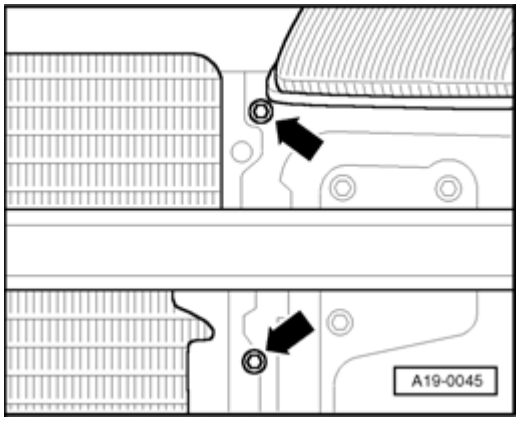

Fig. 199: Removing Securing Bolts On Radiator
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove 4 securing bolts (arrows) on radiator.
- Lower radiator out of vehicle.

Vehicles with air conditioning

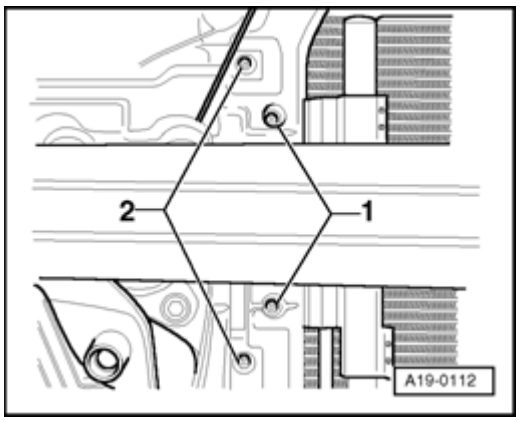

Fig. 200: Removing Four Securing Bolts For Condenser & Radiator
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove four securing bolts -1- for condenser.
- Remove four securing bolts -2- for radiator.

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

NOTE: To prevent damage to the condenser and refrigerant lines/hoses, ensure that the lines and hoses are not stretched, kinked or bent.

- Unbolt Coolant Fan Control (FC) control module -J293- from left side longitudinal member (in front of battery).
- Carefully lower radiator between engine and condenser and remove from below.

Installing

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

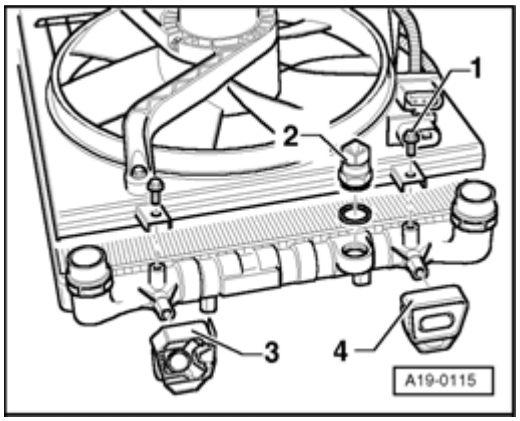

Fig. 201: Installing Mounts And On Radiator
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install mountings -3- and -4- on radiator as illustrated.
- Install radiator securing bolts (help of a 2nd technician is required).
- Install front bumper:

Refer to **63 BUMPERS**

- Replace O-rings in coolant hose connections.
- Fill with coolant. Refer to **Filling**.
- After connecting battery terminals, enter anti-theft code for radio

Refer to Radio operating instructions

- Close power windows in front doors to their top positions using electrical switches.
- Operate all power window switches again for at least one second in "close" direction to activate automatic one-touch function.
- Set clock to correct time.
- Check DTC memory:

Refer to

- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

NOTE: DTCs will be stored in the memory because connectors have been

disconnected. Therefore, check and erase DTC memory after installing the engine.

Tightening torques

Components	ft lb	Nm
Radiator cowl to radiator	7	10
Thermal switch to radiator	26	35
Radiator to lock carrier	7	10
Condenser to radiator	7	10
Control module to longitudinal member	7	10

Cooling system, checking for leaks

Requirement

- Engine at operating temperature

WARNING: Hot steam can escape when the cap on the expansion tank is opened. Cover the cap with a cloth, and open it carefully.

- Remove cap from coolant expansion tank.

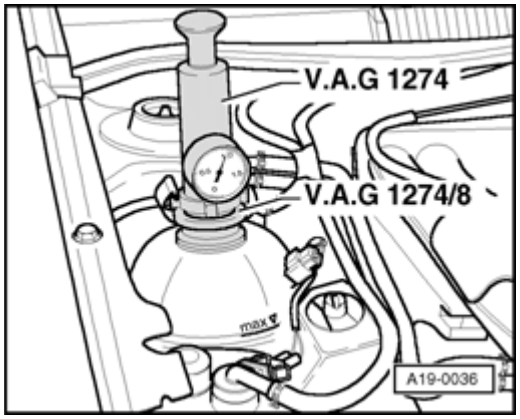

Fig. 202: Positioning Cooling System Tester V.A.G 1274 With Adapter V.A.G 1274/8 On Expansion Tank
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install tester V.A.G 1274 with adapter V.A.G 1274/8 onto expansion tank.
- Using hand pump on tester, build up a pressure of approx. 1.0 bar.

If this pressure drops:

- Locate leak and repair malfunction.

Checking pressure relief valve in filler cap

- Screw filler cap onto tester with adapter V.A.G 1274/9.

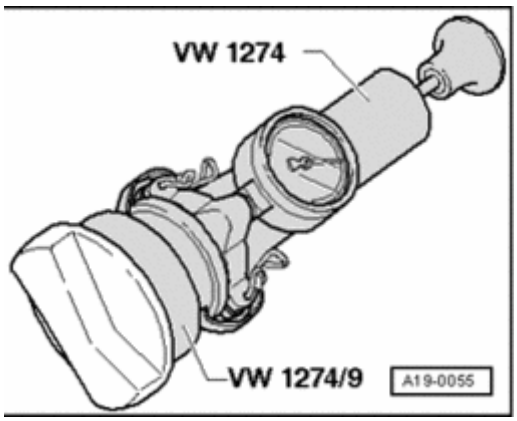

Fig. 203: Checking Pressure Relief Valve In Filler Cap
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Attach hand pump and build up pressure.

Pressure relief valve should open at a pressure of 1.4 - 1.6 bar.

21 TURBOCHARGER, G-CHARGER

CHARGE AIR PRESSURE SYSTEM WITH TURBOCHARGER

Charge air pressure system with turbocharger

NOTE:

- **Observe rules for cleanliness. Refer to Rules for cleanliness.**
- **When performing repairs, replace seals, gaskets, self-locking nuts and bolts which have a specified tightening torque.**
- **Secure all hose connections with the correct hose clips (same as original equipment).**

- Before performing checks or repair work, make sure that all lines and hoses are securely connected and that there are no leaks.

Scan Tool (ST) and test equipment safety precautions

WARNING:

- **Due to weight, size and need for manual operation of test instruments while vehicle is driven on public roads, instrument must be used only with a Driver operating the vehicle and an Instrument Operator operating the test equipment.**
- **Do not use Instrument with Driver only. Always use two persons to conduct test.**

- **Do not place Instrument on lap of Driver or front seat passenger because emergency stop may dislodge Instrument and cause airbag deployment with risk of injury to Instrument Operator.**

Model specific WARNINGS! continued. Refer to **Scan Tool (ST) and test equipment safety precautions**.

WARNING: Use of Instrument in Audi TT Coupe:

- **Place Instrument in rear seating area and secure by available safety belt.**
- **Instrument Operator must be seated in the other rear seating position, after sliding front passenger seat and moving the seat back as far forward as possible. Do not activate the seat back release lever.**
- **Instrument Operator must wear safety belt.**

Use of Instrument in Audi TT Roadster:

- **Use only Instrument V.A.G 1551 Scan Tool (ST). DO NOT USE VAS 5051.**
- **Before test, deactivate passenger's airbag using key operated switch in glove compartment or via OBD program. Refer to**
  - **01 ON BOARD DIAGNOSTIC (OBD) for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU**
  - **01 ON BOARD DIAGNOSTIC (OBD) for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC**
  - **01 ON BOARD DIAGNOSTIC (OBD) for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP**
  - **01 ON BOARD DIAGNOSTIC (OBD) for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA**

  ; Repair Group 01, Function 10 (Adaptation).
- **Instrument Operator must be seated on passenger seat with safety belt worn.**
- **Place Instrument in foot well in front of passenger seat in a manner allowing the Operator to use the Instrument in a safe manner.**
- **After completion of test, re-activate front passenger airbag.**

Charge air pressure control system and vacuum system connections, diagram

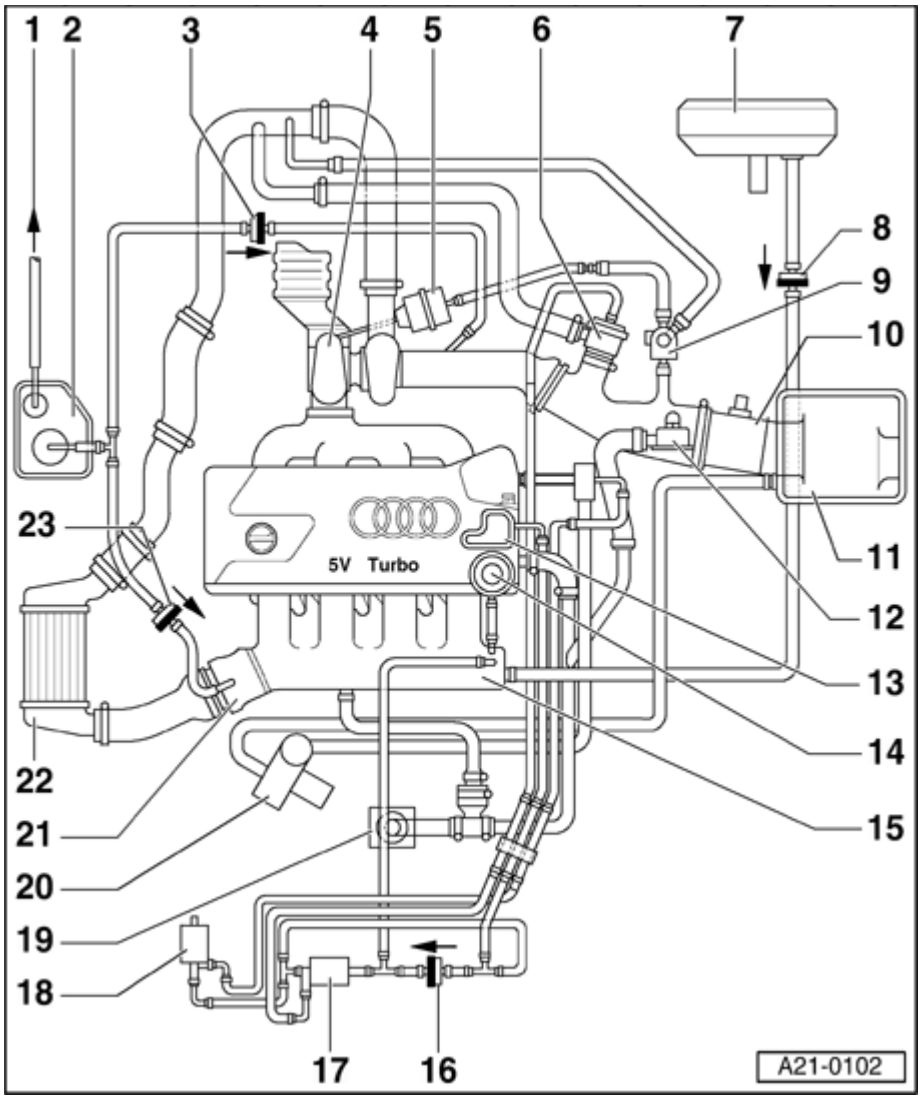

Fig. 204: Charge Air Pressure Control System And Vacuum System Connections, Diagram
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - From fuel tank

2 - Evaporative Emission (EVAP) canister

- With EVAP canister purge regulator valve -N80-

3 - Non-return valve for EVAP canister

- Between EVAP canister and intake line upstream of turbocharger
- Install with light and dark sides in positions shown in illustration. Arrow points in direction of flow.

4 - Turbocharger

- Checking charge air pressure. Refer to **Turbocharger and charge air pressure regulating valve,**

checking

5 - Pressure unit for charge air pressure control

6 - Charge air pressure bypass valve

- Checking. Refer to **Charge air pressure bypass valve, testing**

7 - Brake servo

8 - Non-return valve

- Between brake servo and intake manifold
- Install with light and dark sides in positions shown in illustration. Arrow points in direction of flow.

9 - Wastegate bypass regulator valve -N75-

10 - Mass Air Flow (MAF) sensor-G70-

11 - Air cleaner

12 - Crankcase breather pressure regulating valve

13 - Vacuum reservoir

- Bolted to cylinder head cover

14 - Fuel pressure regulator

15 - Intake manifold

- With Intake Air Temperature (IAT) sensor -G42-

16 - Non-return valve

- Install with light and dark sides in positions shown in illustration. Arrow points in direction of flow.

17 - Recirculating valve for turbocharger -N249-

- Checking. Refer to **Recirculating valve for turbocharger -N249-, checking**

18 - Secondary Air Injection (AIR) solenoid valve -N112-

19 - Crankcase breather

20 - Secondary Air Injection (AIR) pump motor -V101-

21 - Throttle valve control module-J338-

22 - Charge air cooler

- With Charge air pressure sensor -G31-

23 - Non-return valve

- Between EVAP canister and intake manifold
- Install with light and dark sides in positions shown in illustration. Arrow points in direction of flow.

Charge air pressure bypass valve, testing

NOTE:

- **The charge air pressure bypass valve is located upstream of the turbocharger. It is opened by vacuum from the electrically operated Recirculating valve for turbocharger -N249- when the engine is on overrun, under part load, or when idling. This disperses the pressurized air (charge air pressure) upstream of the throttle valve, and thus keeps the turbocharger rotating at a higher speed.**
- **Check the charge air pressure bypass valve if the engine is not producing full power, or jerking when the throttle is opened and closed.**

Special tools, testers and auxiliary items required

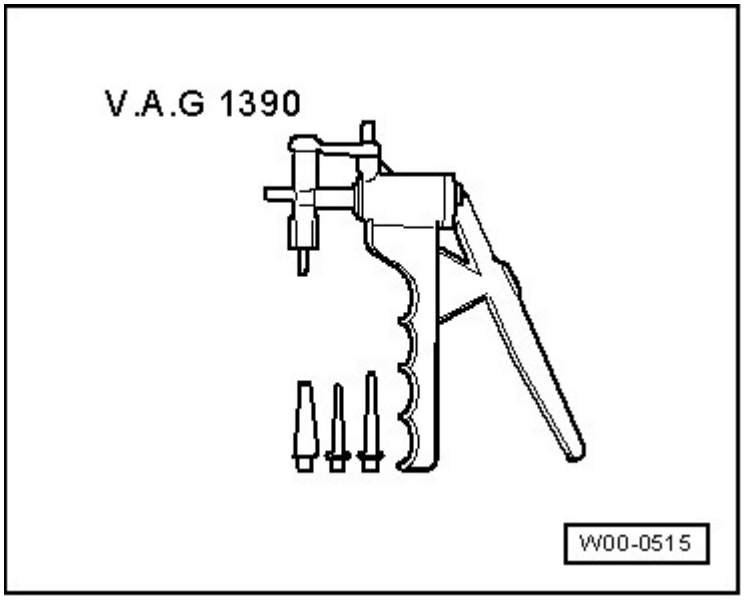

Fig. 205: Hand Vacuum Pump V.A.G 1390
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- V.A.G 1390 Vacuum pump

Work sequence

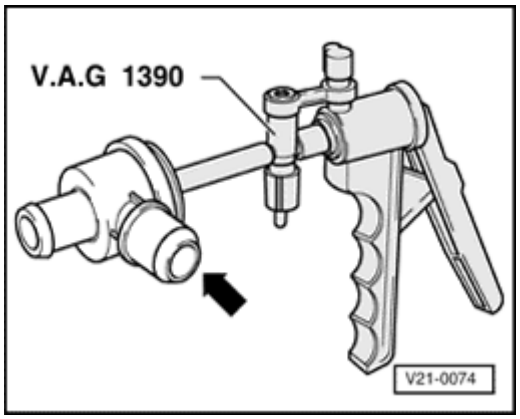

Fig. 206: Connecting Vacuum Pump V.A.G 1390 To Charge Air Pressure Bypass Valve
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect vacuum pump V.A.G 1390 to charge air pressure bypass valve.
- Operate vacuum pump.

Charge air pressure bypass valve should open (arrow).

- Operate air vent valve on vacuum pump after about 30 seconds.

Charge air pressure bypass valve should close (arrow).

If the charge air pressure bypass valve does not open and close as specified, or if the valve plate does not seal properly when the valve is closed:

- Replace charge air pressure bypass valve. Secure connections on valve with screw-type clips.

Recirculating valve for turbocharger -N249-, checking

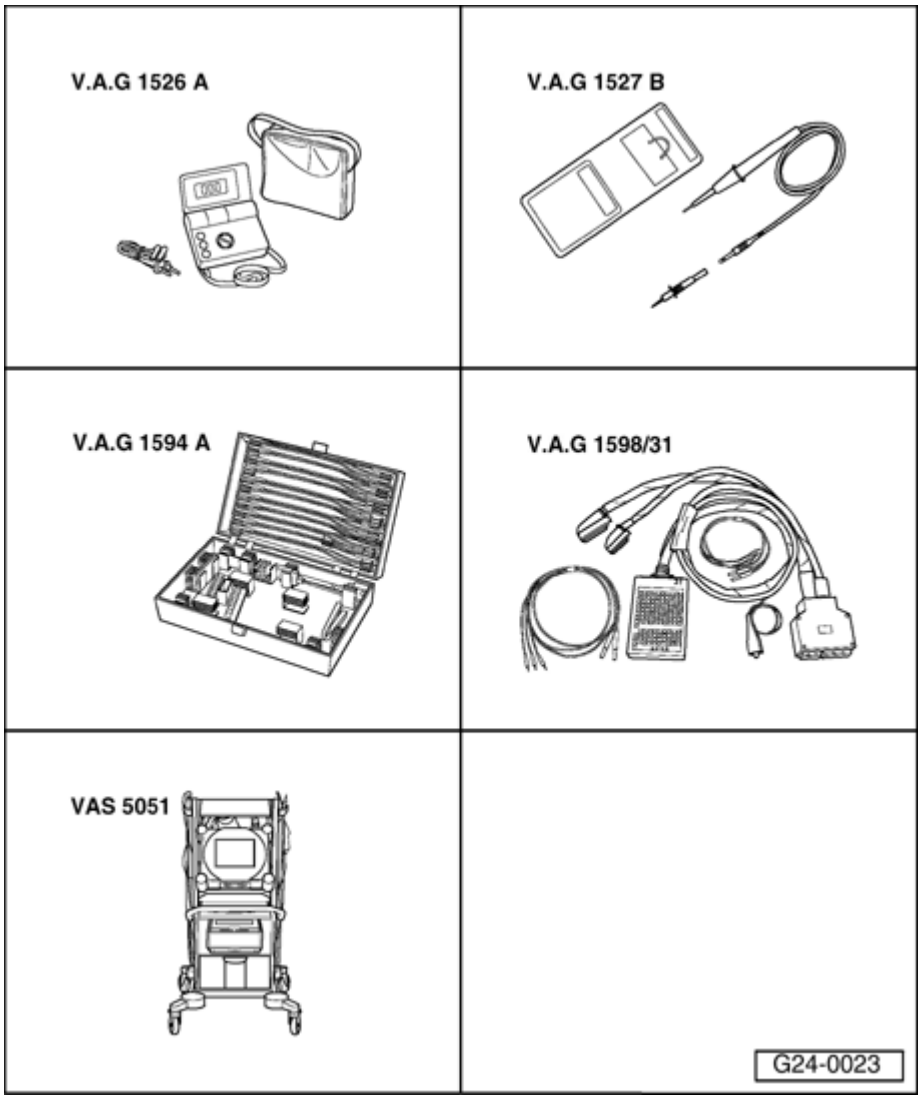

Fig. 207: Identifying Special Tools - Recirculating Valve For Turbocharger -N249-, Checking
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and other equipment required

- V.A.G 1526 A Multimeter
- V.A.G 1527 B Voltage tester
- V.A.G 1594 A Connector test kit
- V.A.G 1598/31 Test box
- VAS 5051 Vehicle diagnosis, testing and information system with VAS 5051/1 Adapter
  - or
- V.A.G 1551 Scan Tool with V.A.G 1551/3 A Adapter

NOTE: The Recirculating valve for turbocharger -N249 and its wiring are monitored by the engine control module.

- Connect vehicle diagnostic, testing and information system VAS 5051 (or scan tool V.A.G 1551) and select "Engine Electronics" control module by entering address word 01. Engine must be running at idling speed.

Refer to

- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

- Check DTC memory of engine control module:

Refer to

- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

If the display shows a malfunction relating to Recirculating valve for turbocharger -N249-:

- Disconnect hoses from valve but leave electrical connector connected.
- Install an auxiliary hose to one of connections on valve.
- Start output diagnostic test mode and activate Recirculating valve for turbocharger -N249-:

Refer to

- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP

- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

Output Diagnostic Test Mode --> Air recirc. valve for turbocharger -N249

Indicated on display

Valve should click and open and close (test by blowing into auxiliary hose).

If the valve does not click:

- Check internal resistance of valve.

If the valve does not open and close properly:

- Replace Recirculating valve for turbocharger -N249-.

Checking internal resistance

- Disconnect connector from valve.

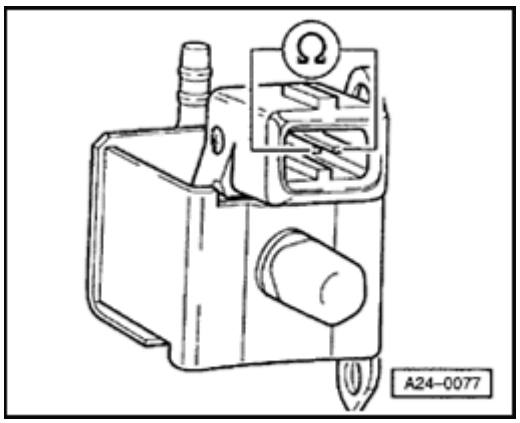

Fig. 208: Connecting Multimeter To Valve (Resistance Measurement Range)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect multimeter to valve (resistance measurement range).

Specification: 27 - 30 ohms

If the specification is not obtained:

- Replace Recirculating valve for turbocharger -N249-.

If the specification is obtained:

- Check voltage supply.

Checking voltage supply

NOTE: The recirculating valve for turbocharger receives its power supply via the fuel pump relay.

Requirement

- Fuse for recirculating valve must be OK
- Disconnect connector from valve.

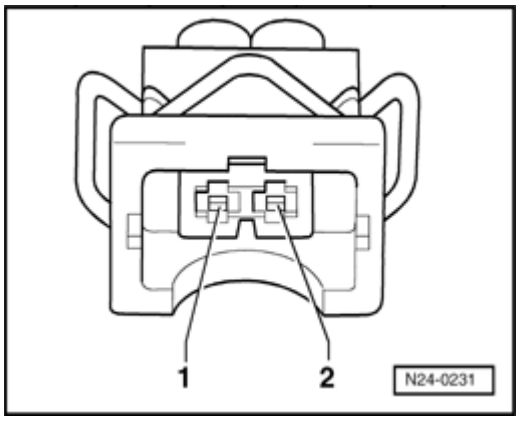

Fig. 209: 2-Pin Electrical Harness Connector & Terminals
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect voltage tester V.A.G 1527 B as follows:

Connector terminal	Measure against
1	Engine ground (GND)

- Operate starter briefly.

LED should light up.

If the LED does not light up:

- Check for open circuit in wiring from terminal 1 to fuel pump relay via fuse:

Refer to Electrical Wiring Diagrams, Troubleshooting & Component Locations

- Repair any open circuits.

If the wiring is OK:

- Check fuel pump relay.

Refer to

- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

If the LED lights up:

- Check activation.

Checking activation

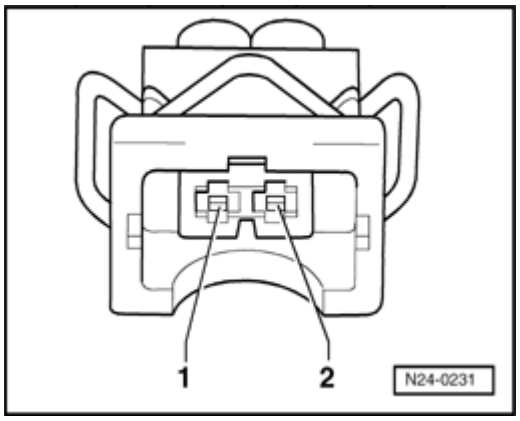

Fig. 210: 2-Pin Electrical Harness Connector & Terminals
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect voltage tester V.A.G 1527 B to terminal 1 (positive) and terminal 2 of connector.
- Start output diagnostic test mode and activate Recirculating valve for turbocharger -N249-:

Refer to

- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION &

IGNITION, ENGINE CODE(S): BEA

LED must flash.

If the LED lamp does not flash or lights up continuously:

- Connect test box V.A.G 1598/31 to wiring harness for engine control module. Do not connect engine control module itself.

Refer to

- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

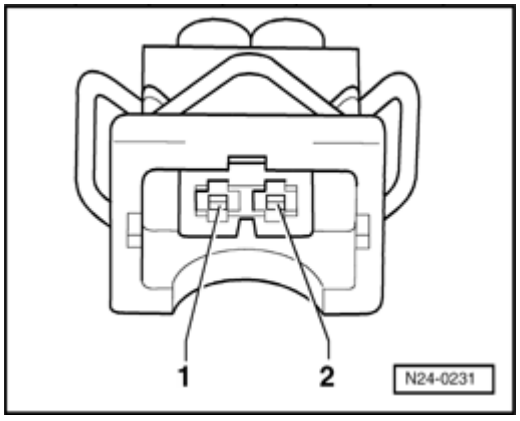

Fig. 211: 2-Pin Electrical Harness Connector & Terminals
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Check for open circuit and short to positive or Ground (GND) in following wiring connection:

Connector terminal	Test box V.A.G 1598/31 terminal
2	105

- Repair short circuit or open circuit if necessary.

If the wiring is OK:

- Replace engine control module:

Refer to

- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

Turbocharger and charge air pressure regulating valve, checking

Special tools, testers and auxiliary items required

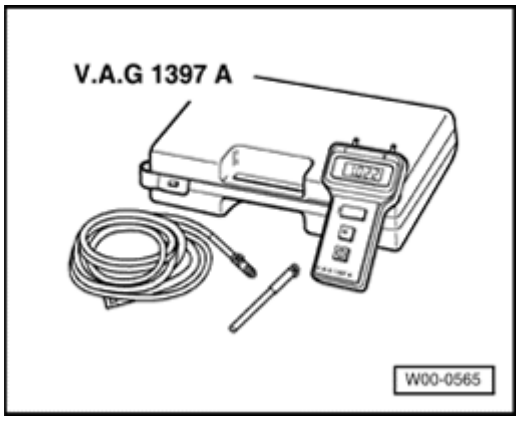

Fig. 212: Identifying Turbocharger Tester V.A.G 1397A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- V.A.G 1397 A Turbocharger tester

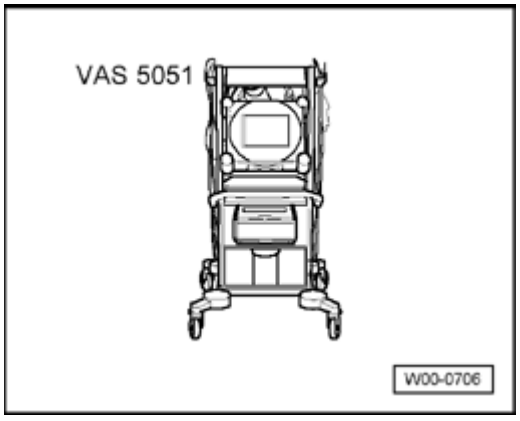

Fig. 213: VAS 5051 Vehicle Diagnosis, Testing & Information System
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- VAS 5051 Vehicle diagnosis, testing and information system with VAS 5051/1 Adapter

or

- Scan tool V.A.G 1551 with V.A.G 1551/3 A Adapter

Requirements

- All hoses and lines must be securely installed and free of leaks
- DTC memory has been checked

Refer to

- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

- Output diagnostic test mode has been performed

Refer to

- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

- Vehicle diagnosis, testing and information system VAS 5051 or scan tool V.A.G 1551 must be connected

Work sequence

WARNING: To avoid any risk of accident, observe the safety precautions when using test instruments while road testing the vehicle. Refer to Scan Tool (ST) and test equipment safety precautions

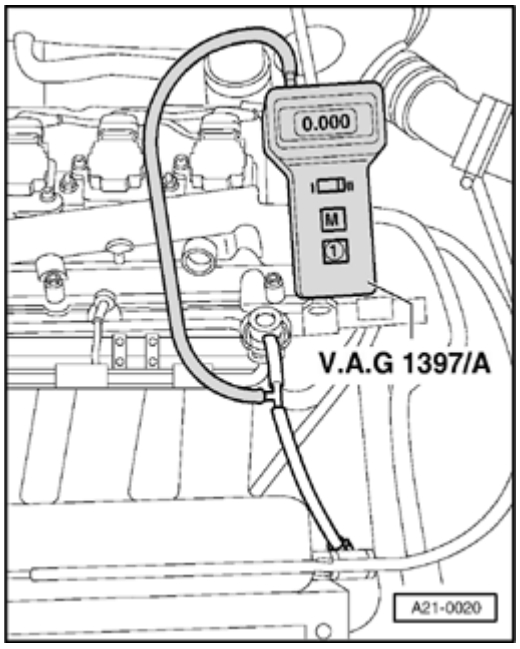

Fig. 214: Connecting T-Piece And Measuring Hose Of Turbocharger Tester V.A.G 1397 A To Intake Manifold
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect T-piece and measuring hose of turbocharger tester V.A.G 1397 A to intake manifold (front).
- Route measuring hose under rear edge of hood and into passenger compartment via right side window.

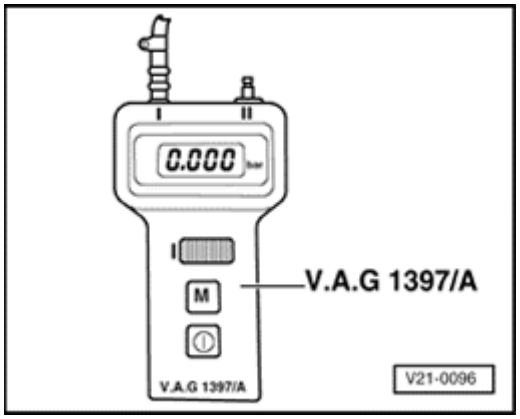

Fig. 215: Identifying Turbocharger Tester V.A.G 1397 A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Switch on turbocharger tester and set measuring range selector switch to position -I- (absolute pressure).
- Connect measuring hose to connection -I-.

NOTE:

- **Hose connections must be completely airtight, otherwise measurements will not be correct.**
- **Ensure that measuring hose is not pinched at hood or side window.**

- **Pressing memory key M on turbocharger tester will store the last measured value until memory key M is pressed again or the tester is switched off.**
- **The decimal point in the display flashes to indicate that the value is being stored.**
- **If the battery voltage of the turbocharger tester drops below the minimum level, an arrow will appear at the top left of the display.**
- **Before performing the test, drive the vehicle at a brisk speed for at least 3 km (without stopping, e.g. at traffic lights etc.).**
- **A second technician is required to note the readings on the tester when the vehicle is moving.**

Rapid data transfer HELP Select function XX

Indicated on display

- Enter "08" to select function "Read Measured Value Block" and confirm entry with -Q- button.

Read Measured Value Block Q Enter display group number XXX

Indicated on display

- Enter "004" to select display group 004 and confirm entry with -Q- button.

Read Measured Value Block 4 --> 1 2 3 4

Indicated on display

Do not proceed with the test until the intake air temperature shown in display zone 4 is between 20 and 50° C. If necessary, run the engine until the required temperature is reached.

- Press -C- button.

Read Measured Value Block Q Enter display group number XXX

Indicated on display

- Enter "115" to select display group 115 and confirm entry with -Q- button.

Read Measured Value Block 115 -->

1 2 3 4

Indicated on display (1-4 = display zones)

- Accelerate vehicle from 2000 rpm at wide open throttle in third gear, and watch rev counter.
- When engine speed reaches 3000 rpm, press "PRINT" button on VAS 5051 (or V.A.G 1551) and at same time press memory button "M" on V.A.G 1397 A.

NOTE: The charge air pressure should be measured using turbocharger tester V.A.G 1397/A. Vehicle diagnosis, testing and information system VAS 5051 (or scan tool V.A.G 1551) is used to check whether the charge air pressure is being registered by the control module.

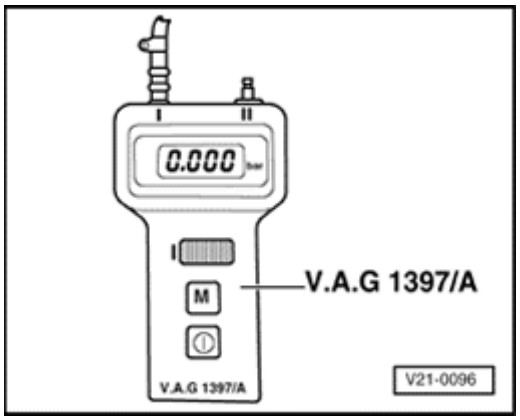

Fig. 216: Identifying Turbocharger Tester V.A.G 1397 A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Specification for V.A.G 1397 A: 1.700 - 1.900 bar

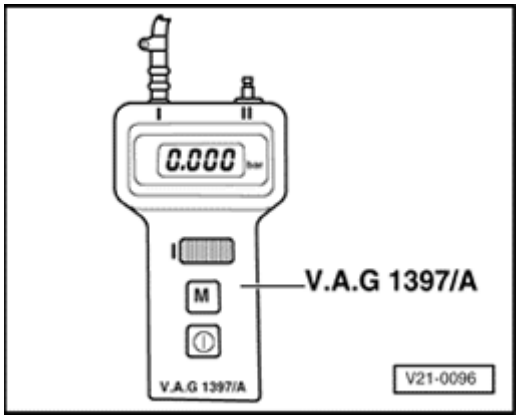

Fig. 217: Identifying Turbocharger Tester V.A.G 1397 A
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Specification for VAS 5051 or V.A.G 1551: display zone 4 1700-1900 mbar

If the specification is not obtained or is exceeded:

- Check DTC memory of engine control module:

Refer to

- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

Malfunctions in charge air pressure control function

Malfunction	Charge air pressure	Possible cause
Charge air pressure too low	• Measured value less than 1.700 bar or 1700 mbar	• Wastegate bypass regulator valve -N75- malfunctioning • Malfunction in wiring to charge air pressure control valve • Charge air pressure control valve in turbocharger is sticking in the "open" position • Leak between turbocharger and intake manifold • Charge air pressure control valve malfunctioning • Turbocharger malfunctioning
Charge air pressure too high 1)	• Measured value more than 1.900 bar or 1900 mbar	• Pressure unit for charge air pressure control valve malfunctioning • Leak in hose to pressure unit for charge air pressure control (via -N75-) • Charge air pressure control valve in turbocharger is sticking in the "closed"

		position

1) If the charge air pressure is too high the fuel supply will be interrupted in order to protect the engine, resulting in the misfiring at high engine speeds.

CHARGE PRESSURE LEAK TEST WITH V.A.G 1687

Intake system, checking for leaks using V.A.G 1687 Diagnostic Tool

Diagnostic trouble codes (DTCs) related to fuel trim, charge pressure or mass air flow (MAF) may be caused by:

- Leaking (worn/torn) intake hoses during charge conditions
- Incorrectly torqued or improperly placed clamps on intake hoses etc. causing leaks during charge conditions

Fig. 218: Checking Charge Air Pressure System Using V.A.G 1687 Charge Air System Tester
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Check the charge air pressure system using the V.A.G 1687 Charge air system tester.

Special tool V.A.G 1687 Charge air system tester preliminary set-up

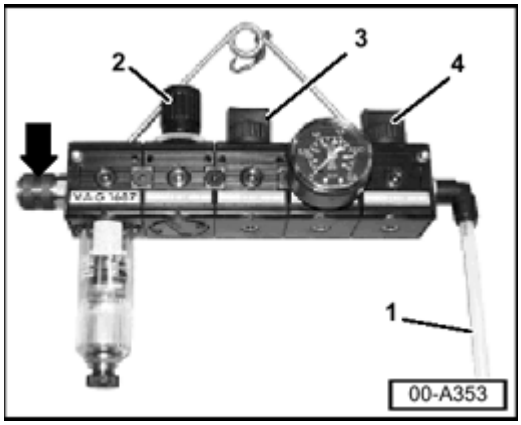

Fig. 219: Special Tool V.A.G 1687 Charge Air System Tester Preliminary Set-Up

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Back off pressure regulator knob -2- of V.A.G 1687 fully to protect gauge when shop air supply is applied to assembly.
- Close valve -3- before gauge.
- Close valve -4- after gauge.

The shop air supply line will later be attached to the inlet of V.A.G 1687.

- Remove female fitting from tester (arrow) and install an appropriate "male" air fitting that will connect to your shop air supply line (see WARNING! under **Special tool V.A.G 1687/1 pressure adapter, installing (1.8L Turbo)**).

CAUTION: Use only approved air fittings to adapt shop air supply line to V.A.G 1687 tester.

Special tool V.A.G 1687/1 pressure adapter, installing (1.8L Turbo)

- Separate intake hose from Mass Air Flow (MAF) sensor assembly.

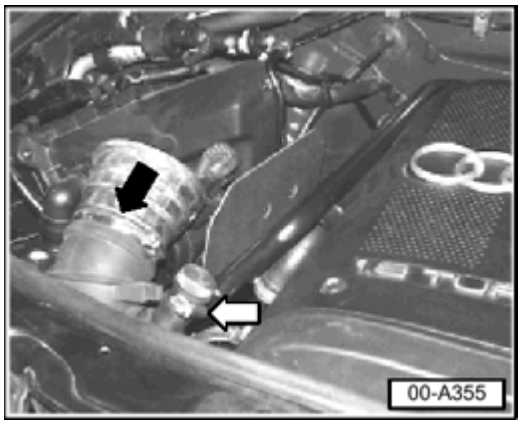

Fig. 220: Special Tool V.A.G 1687/1 Pressure Adapter, Installing (1.8L Turbo)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert V.A.G 1687/1 pressure adapter in intake hose (black arrow) using existing clamp (as shown).
- Remove crankcase ventilation tube from intake hose at (white arrow).

NOTE:

- **To help find small leaks, BEFORE pressurizing the system fill system with smoke using special tool KLI9210 and adapter KLI9210/50 as described on. Refer to Special tool KLI9210 (Evaporative system leak detector), connecting to 1.8L Turbo.**
- **An ultrasonic detector may also be used to detect extremely small leaks where smoke may not be visible.**

Special tool KLI9210 (Evaporative system leak detector), connecting to 1.8L Turbo

- Install optional fitting KLI9210/50 on hose of special tool KLI9210.

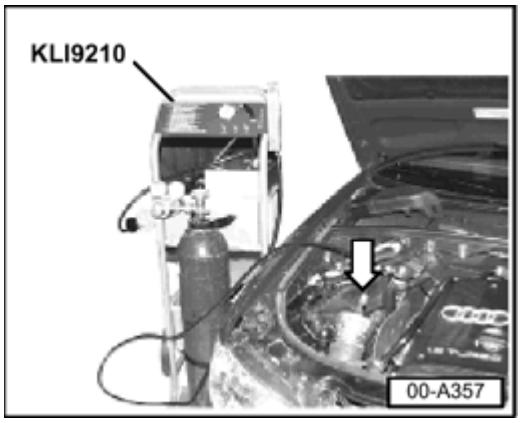

Fig. 221: Special Tool KLI9210 (Evaporative System Leak Detector), Connecting To 1.8L Turbo
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect KLI9210 to V.A.G 1687/1 adapter (KLI9210 is shown attached to V.A.G 1687/1 at (arrow) on 1.8L Turbo).

Special tool KLI9210 (Evaporative system leak detector), preliminary set-up

- Connect smoke generator leads to vehicle battery.

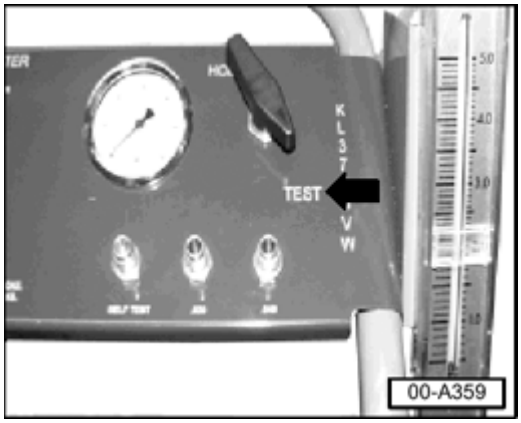

Fig. 222: Special Tool KLI9210 (Evaporative System Leak Detector), Preliminary Set-Up
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Turn valve to test (black arrow).
- Press smoke generator button to fill system with smoke (see instructions printed on tester).

With system filled with smoke:

- Remove smoke generator hose and connect V.A.G 1687 quickly to prevent smoke from leaking out. Refer to **Special tool KLI9210 (Evaporative system leak detector), preliminary set-up**.

Special tool V.A.G 1687, connecting to pressure adapter V.A.G 1687/1 (1.8L Turbo)

For illustrations purposes V.A.G 1687 is shown lying in the engine compartment. In practice the tool should be hung from the hood.

- Connect V.A.G 1687 quickly to prevent smoke from leaking out.

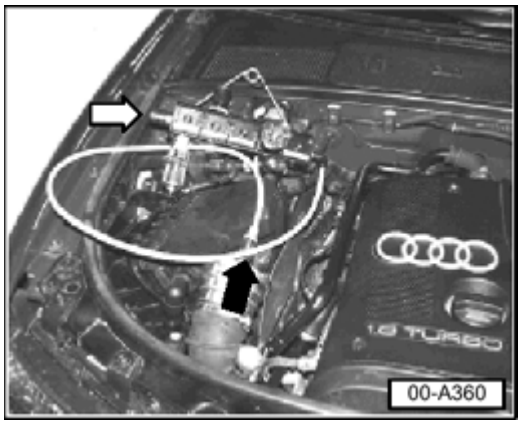

Fig. 223: Special Tool V.A.G 1687, Connecting To Pressure Adapter V.A.G 1687/1 (1.8L Turbo)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

V.A.G 1687 is shown connected to V.A.G 1687/1 (black arrow)

Shop air supply will be connected to V.A.G 1687 at (white arrow)

- Perform pressure test. Refer to **Performing pressure test**.

Performing pressure test

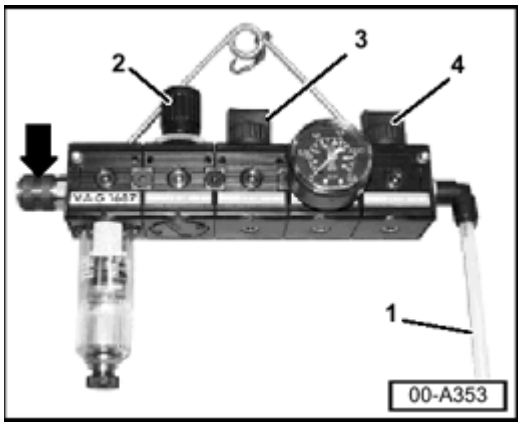

Fig. 224: Special Tool V.A.G 1687 Charge Air System Tester Preliminary Set-Up
Courtesy of VOLKSWAGEN UNITED STATES, INC.

With outlet hose -1- of V.A.G 1687 connected to air pressure adapter:

- Attach shop air supply line to previously installed male fitting. Refer to **Intake system, checking for leaks using V.A.G 1687 Diagnostic Tool**.

- Open valve -3- between regulator valve and gauge.
- Adjust test pressure up to 0.5 bar by turning regulator valve -2-. (see CAUTION below)

CAUTION:
- **DO NOT pressurize the system above 0.5 bar!**
- **Doing so may force oil into the intake system which can damage the engine.**

- Slowly open outlet valve -4- (after gauge) to test hose connections.
- Observe pressure gauge for a drop in pressure.

NOTE: Some pressure will be lost past the throttle plate.

- Readjust test pressure to 0.5 bar (Refer to CAUTION listed under **Performing pressure test**) by turning regulator valve -2-.
- Listen for any very large intake leaks.

If smoke generator was used to fill the system with smoke:

- Inspect intake system connections for smoke at leaks.

NOTE: An ultrasonic detector may also be used to detect extremely small leaks where smoke may not be visible.

- Repair any leaks found.
- Remove tester.
- Remove plug from crankcase ventilation hose.
- Remove air pressure adapter.

With VAS 5051 diagnostic tool connected:

- Erase DTC memory.

If smoke generator was not used to fill the system with smoke:

- Apply soapy water solution or equivalent to intake system connections.

NOTE: An ultrasonic detector may also be used to detect extremely small leaks.

- Inspect intake system connections for leaks.
- Repair any leaks found.
- Remove tester.
- Remove plug from crankcase ventilation hose.

- Remove air pressure adapter.

With VAS 5051 diagnostic tool connected:

- Erase DTC memory.

Wastegate bypass regulator valve -N75-, checking

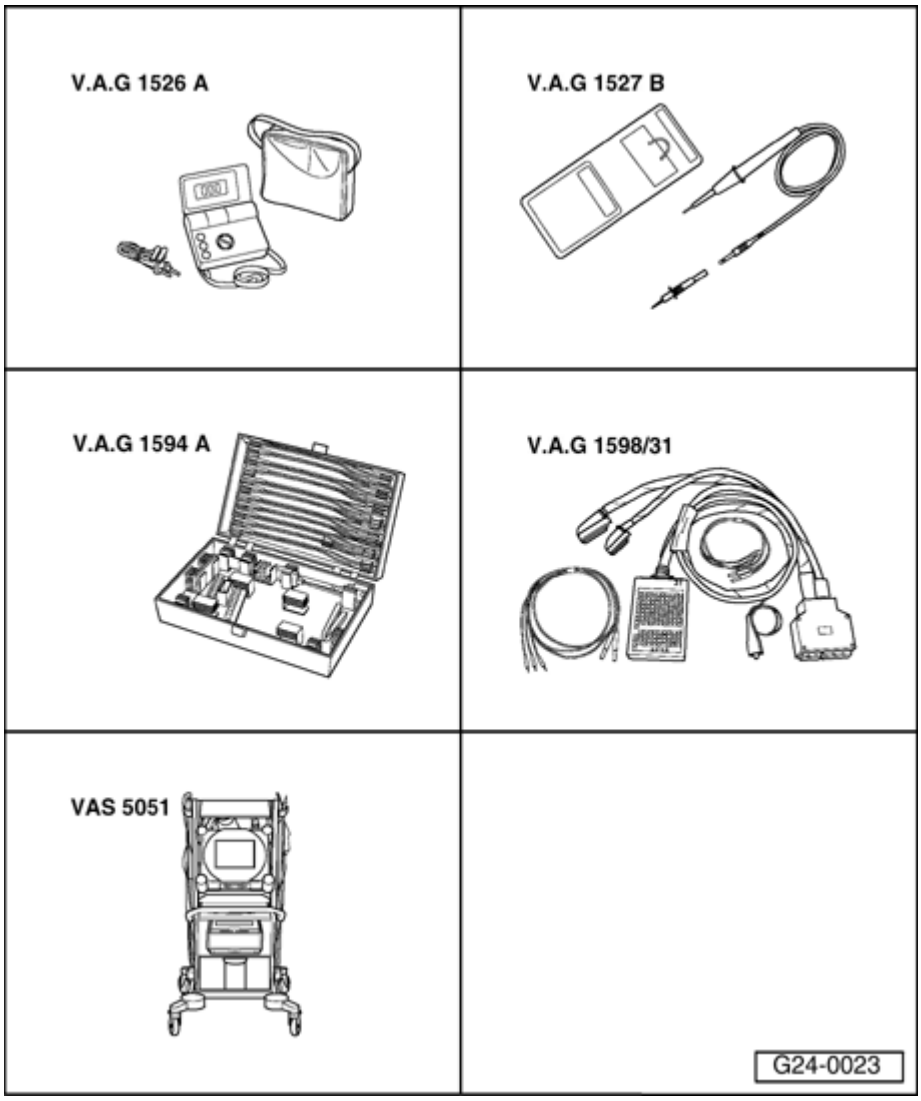

Fig. 225: Identifying Special Tools - Wastegate Bypass regulator valve -N75-, Checking
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and other equipment required

- V.A.G 1526 A Multimeter
- V.A.G 1527 B Voltage tester
- V.A.G 1594 A Connector test kit

- V.A.G 1598/31 Test box
- VAS 5051 Vehicle diagnosis, testing and information system with VAS 5051/1 Adapter
  - or
- V.A.G 1551 Scan Tool with V.A.G 1551/3 A Adapter

NOTE: Wastegate bypass regulator valve -N75- and its wiring are monitored by the engine control module.

- Connect vehicle diagnosis, testing and information system VAS 5051 (or scan tool V.A.G 1551) and select "Engine Electronics" control module by entering address word 01. Engine must be running at idling speed:

Refer to

- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

- Check DTC memory of engine control module:

Refer to

- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

If the display shows a malfunction relating to Wastegate bypass regulator valve -N75-:

- Disconnect hoses from valve but leave electrical connector connected.
- Install an auxiliary hose to one of connections on valve.
- Start output diagnostic test mode and activate Wastegate bypass regulator valve -N75-:

Refer to

- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

Output Diagnostic Test Mode --> Wastegate bypass regulator valve -N75

Indicated on display

Valve should click and open and close (test by blowing into auxiliary hose).

If the valve does not click:

- Check internal resistance of valve.

If the valve does not open and close properly:

- Replace Wastegate bypass regulator valve -N75-.

Checking internal resistance

- Disconnect connector from valve.

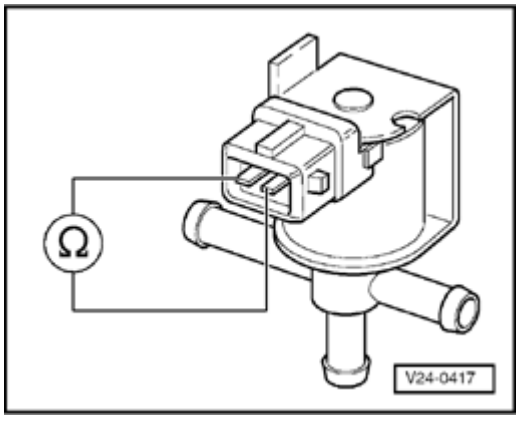

Fig. 226: Connecting Multimeter To Valve (Resistance Measurement Range)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect multimeter to valve (resistance measurement range).

Specification: 25-35 ohms

If the specification is not obtained:

- Replace Wastegate bypass regulator valve -N75-.

If the specification is obtained:

Checking voltage supply

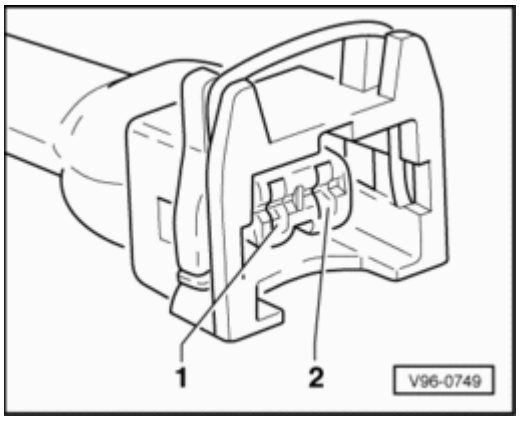

Fig. 227: 2-Pin Electrical Harness Connector & Terminals
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect voltage tester V.A.G 1527 B as follows:

Connector terminal	Measure against
1	Engine ground (GND)

- Operate starter briefly.

LED should light up.

If the LED does not light up:

- Check for open circuit in wiring from terminal 1 to fuel pump relay via fuse:

Refer to Electrical Wiring Diagrams, Troubleshooting & Component Locations

- Repair any open circuits.

If the wiring is OK:

- Check fuel pump relay:

Refer to

- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

If the LED lights up:

- Check activation.

Checking activation

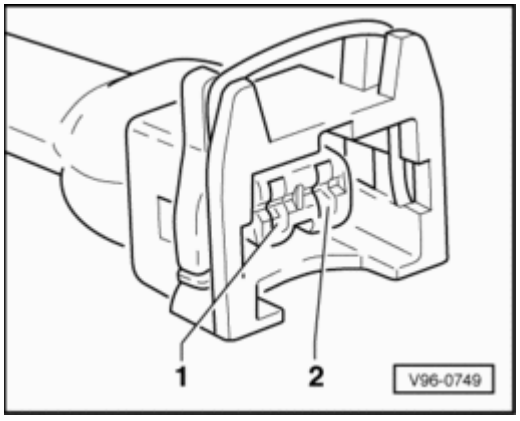

Fig. 228: 2-Pin Electrical Harness Connector & Terminals
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect voltage tester V.A.G 1527 B to terminal 1 (positive) and terminal 2 of connector.
- Start Output Diagnostic Test Mode (DTM) and activate Wastegate bypass regulator valve -N75-:

Refer to

- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

LED should flash.

If the LED lamp does not flash or lights up continuously:

- Connect test box V.A.G 1598/31 to wiring harness for engine control module. Do not connect engine control module itself.

Refer to

- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

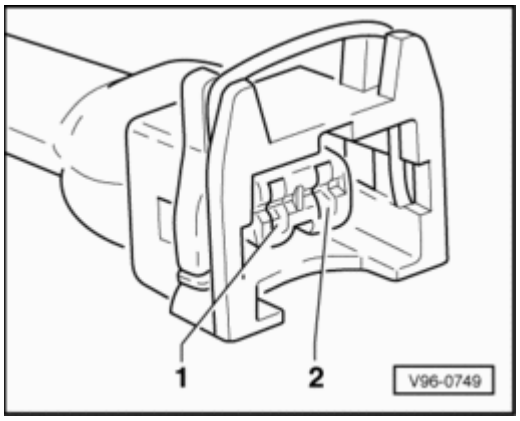

Fig. 229: 2-Pin Electrical Harness Connector & Terminals
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Check for open circuit and short to positive or ground (GND) in following wiring connections:

Connector terminal	Measure against
2	104

- Repair short circuit or open circuit if necessary.

If the wiring is OK:

- Replace engine control module:

Refer to

- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU

- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

Charge air pressure sensor -G31-, checking

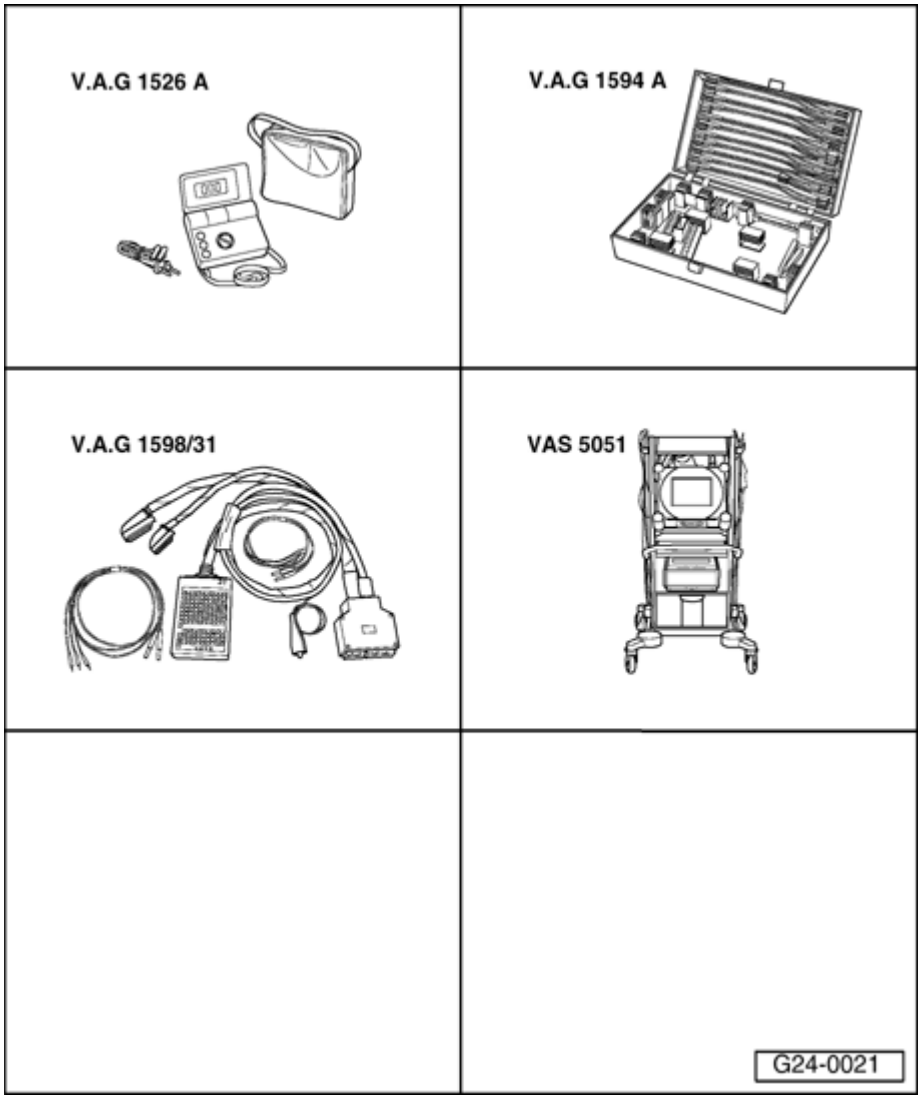

Fig. 230: Identifying Special Tools - Charge Air Pressure Sensor -G31-, Checking
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and other equipment required

- V.A.G 1526 A Multimeter
- V.A.G 1594 A Connector test kit

- V.A.G 1598/31 Test box
- VAS 5051 Vehicle diagnosis, testing and information system with VAS 5051/1 Adapter

- or

- V.A.G 1551 Scan Tool with V.A.G 1551/3 A Adapter

NOTE: Charge air pressure sensor -G31- and its wiring are monitored by the engine control module.

- Connect vehicle diagnosis, testing and information system VAS 5051 (or scan tool V.A.G 1551) and select "Engine Electronics" control module by entering address word 01. Engine must be running at idling speed.

Refer to

- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

- Check DTC memory of engine control module:

Refer to

- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

If the display shows a malfunction relating to charge air pressure control valve -G31-:

- Check voltage supply.

Checking voltage supply

- Disconnect connector on charge air pressure sensor.

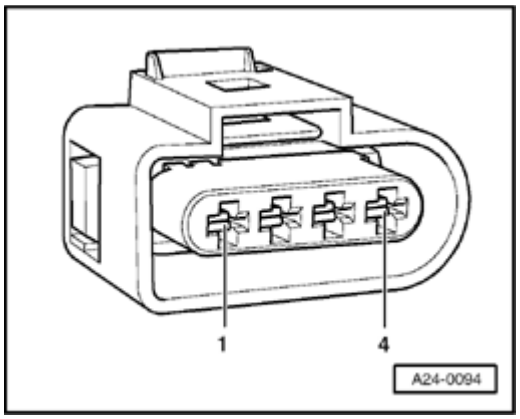

Fig. 231: Identifying Connector Terminals 1 And 4
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect multimeter (voltage measurement range) between terminals 1 and 3 on connector.
- Switch ignition on.

Specification: approx. 5 V

If the specification is not obtained:

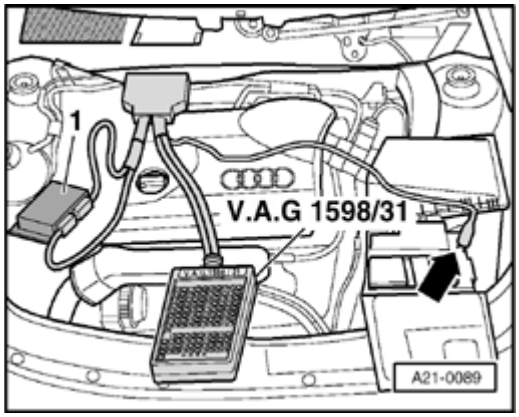

Fig. 232: Connecting Test Box V.A.G 1598/31 To Wiring Harness For Engine Control Module
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect test box V.A.G 1598/31 to wiring harness for engine control module and also to engine control module itself (-1-).

Refer to

- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP

- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

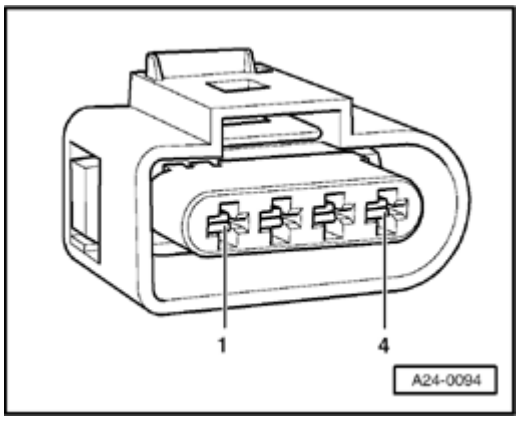

Fig. 233: Identifying Connector Terminals 1 And 4
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Check for open circuit and short to positive or ground (GND) in following wiring connections:

Connector terminal	Test box V.A.G 1598/31 terminal
1	108
3	98

- Repair short circuit or open circuit if necessary.

If the specification is obtained:

- Check signal wire. Refer to **Checking signal wire**.

Checking signal wire

- Plug in connector on charge air pressure sensor.
- Connect multimeter (voltage measurement range) between sockets 101 and 108 on test box.
- Start engine and run at idling speed.

Specification: approx. 1.90 V

- Increase engine speed by operating throttle quickly.

Specification: 2.00-3.00 V

If the specifications are not obtained:

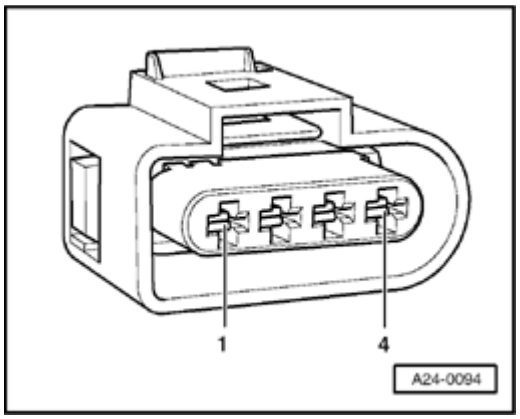

Fig. 234: Identifying Connector Terminals 1 And 4
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Check for open circuit and short to positive or ground (GND) in following wiring connections:

Connector terminal	Test box V.A.G 1598/31 terminal
4	101

- Repair short circuit or open circuit if necessary.

If the wiring is OK:

- Replace Charge air pressure sensor -G31-.

Rules for cleanliness

When working on the exhaust gas turbocharger, pay careful attention to the following "5 rules:"

- Thoroughly clean all unions and the adjacent areas before disconnecting.
- Place parts that have been removed on a clean surface and cover. Do not use fluffy cloths!
- If the repair cannot be carried out immediately, carefully cover or seal any components that have been opened.
- 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, do not work with compressed air if this can be avoided. Do not move vehicle unless absolutely necessary.

Turbocharger, assembly overview

Part I

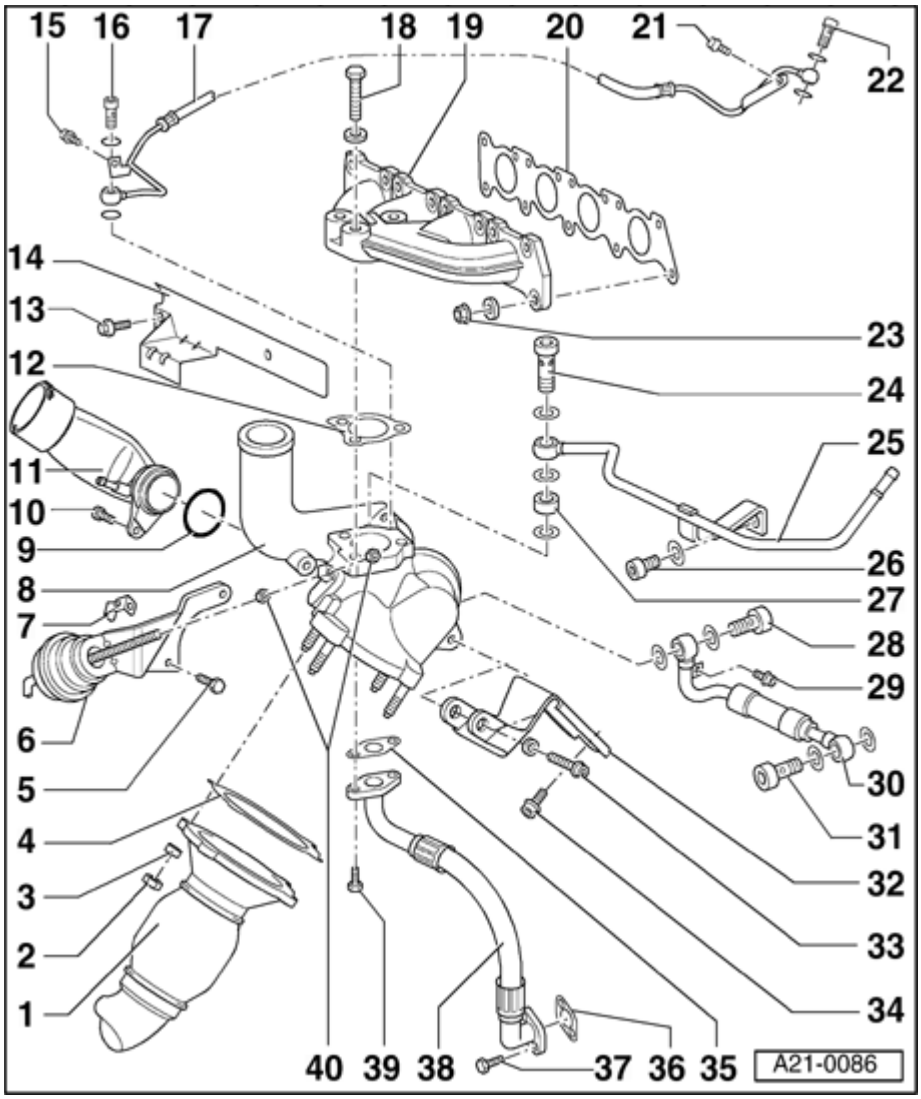

Fig. 235: Turbocharger, Assembly Overview - Part I
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE: Replace all gaskets and seals.

1 - Front exhaust pipe

2 - 40 Nm

- Replace

3 - Spacer sleeve

4 - Gasket

- Replace

5 - 10 Nm

- Install with locking fluid D 000 600 A2

6 - Pressure unit

- For charge air pressure regulating valve

7 - Securing clip

8 - Turbocharger

9 - O-ring

- Replace

10 - 10 Nm

11 - Connection

12 - Gasket

- Replace
- Note installed position

13 - 20 Nm

14 - Heat shield

15 - 10 Nm

16 - Banjo bolt, 30 Nm

17 - Oil supply line

- From oil filter bracket. Refer to **Lubrication system components, Part II**, item - 23

18 - 30 Nm

- Replace
- Coat threads and bolt head seating surface with G 000 500

19 - Exhaust manifold

20 - Gasket

- Replace

- Note installed position

21 - 20 Nm

22 - Banjo bolt, 30 Nm

23 - 25 Nm

- Replace

24 - Banjo bolt, 35 Nm

25 - Coolant return line

26 - 25 Nm

27 - Spacer sleeve

28 - Banjo bolt, 35 Nm

29 - 10 Nm

30 - Coolant supply hose/line

31 - Banjo bolt, 35 Nm

32 - Bracket

33 - 30 Nm

- Use only genuine bolts

Refer to Parts catalog

34 - 25 Nm

35 - Gasket

- Replace

36 - Gasket

- Replace

37 - 10 Nm

38 - Oil return line

- To oil pan

39 - 10 Nm

40 - 10 Nm

- Install with locking fluid D 000 600 A2

Part II

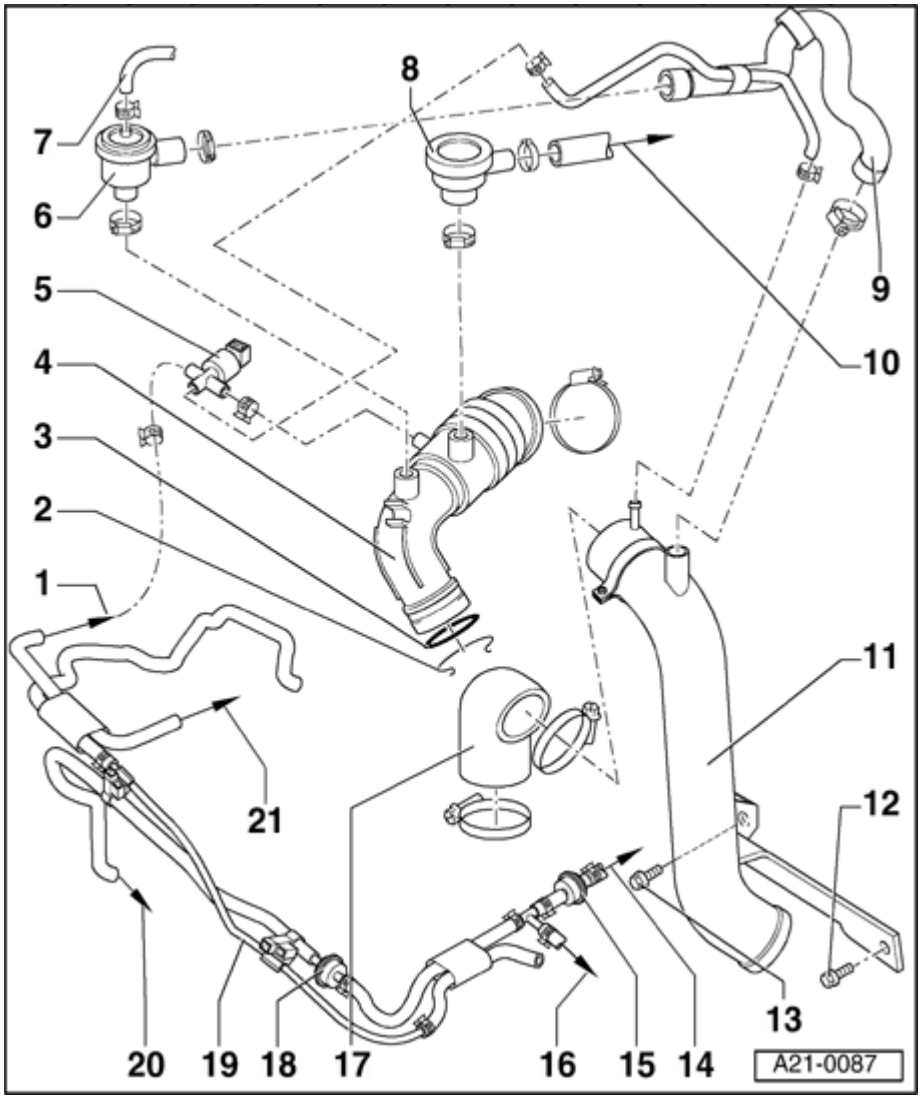

Fig. 236: Turbocharger, Assembly Overview - Part II
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - To charge air pressure control valve

2 - Locking clip

3 - O-ring

- Replace

4 - Air intake hose

- To connection on turbocharger

5 - Wastegate bypass regulator valve -N75-

6 - Charge air pressure bypass valve

7 - Hose

- To Recirculating valve for turbocharger -N249-

8 - Pressure regulating valve

- For crankcase breather

9 - Hose

- Between charge air pressure bypass valve and upper air line

10 - To crankcase breather

11 - Upper air line

12 - 25 Nm

13 - 25 Nm

14 - To throttle valve housing

15 - Non-return valve

- Install with light and dark sides in positions shown in illustration

16 - To EVAP canister purge regulator valve -N80-

17 - Hose

18 - Non-return valve

- Install with light and dark sides in positions shown in illustration

19 - Coolant line

20 - To connection on turbocharger

21 - To pressure unit for charge air pressure control valve

Turbocharger, removing and installing

Removing

NOTE: The turbocharger is removed from below after taking out the exhaust manifold.

- Remove engine cover (complete).

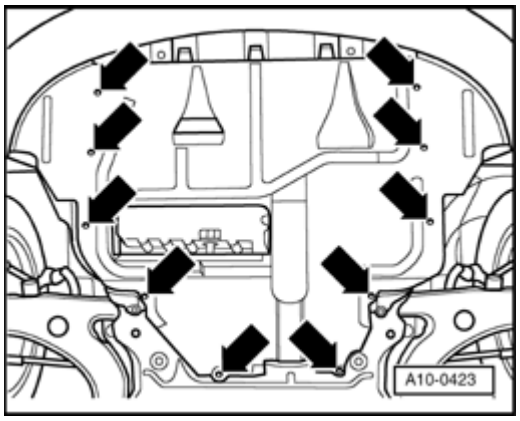

Fig. 237: Locating Center Sound Insulation Fasteners
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove sound insulation (arrows).
- Unbolt heat shield for right drive axle.
- Remove right drive axle:

Refer to **40 FRONT SUSPENSION**

- Remove front exhaust pipe. Refer to **Exhaust system, vehicles with front wheel drive**.

NOTE: Do not bend the flexible connection (de-coupling element) in the exhaust system more than 10° , otherwise it may be damaged.

- Drain cooling system. Refer to **Draining**.
- Drain engine oil.

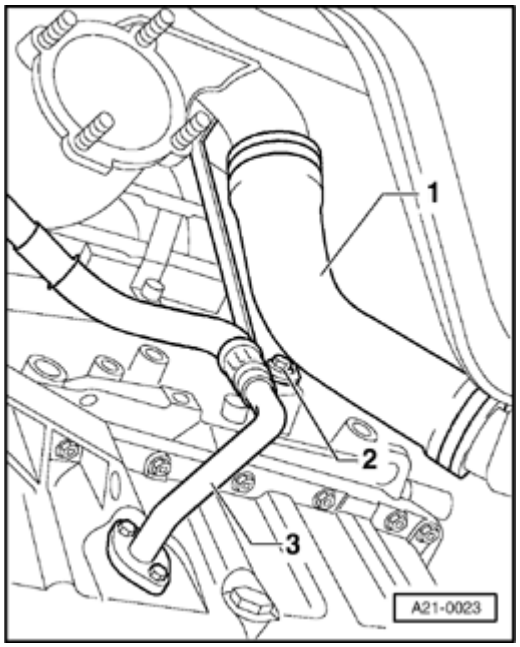

Fig. 238: Removing Oil Return Line From Oil Pan
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove air hose -1- between upper air line and lower air line.
- Unbolt bracket -2- for upper air line.
- Remove oil return line -3-.

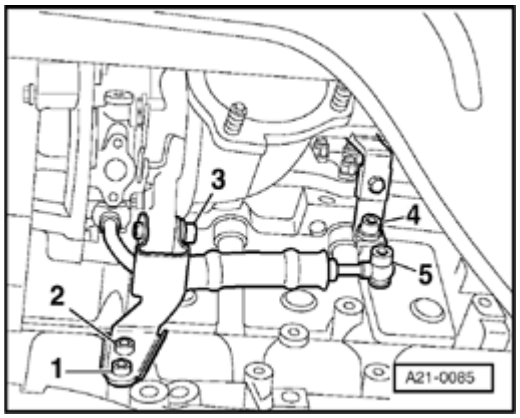

Fig. 239: Identifying Turbocharger Bracket, Coolant Return Line, Coolant Supply Line & Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen bolted connection -3- for turbocharger bracket by a few turns.
- Remove turbocharger bracket from cylinder block (bolts -1- and -2-).
- Unbolt bracket for coolant return line (bolt -4-).
- Unbolt coolant supply line from cylinder block (bolt -5-).

- Disconnect hose from pressure unit for charge air pressure control valve (on turbocharger).

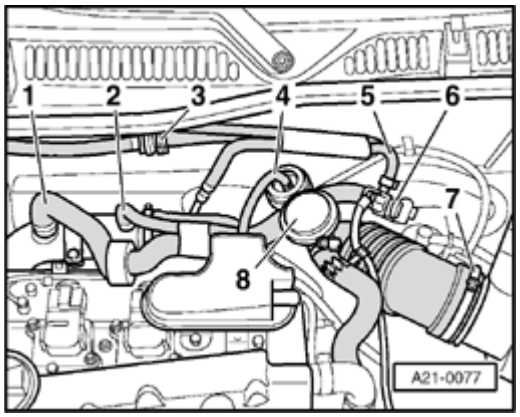

Fig. 240: Air Intake From Connection On Turbocharger Hose Removal Components
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Air intake hose is removed from connection on turbocharger as follows:

- Remove pressure control valve -8- (for crankcase breather) from hose.
- Disconnect connector -6- from Wastegate bypass regulator valve -N75-.
- Disconnect hose -2- from upper air line (hose leads to -N75-).
- Disconnect hose -5- from Wastegate bypass regulator valve -N75-.

- Disconnect hose -1- from air line.
- Disconnect vacuum line -4- from recirculating valve for turbocharger.
- Disconnect air intake hose -7- from air cleaner.
- Pull locking clip out of turbocharger connection and take off air intake hose.

- Disconnect hose -3- from non-return valve (hose leads to turbocharger).
- Disconnect coolant return hose from Y connection on right next to cylinder head (hose leads to turbocharger).

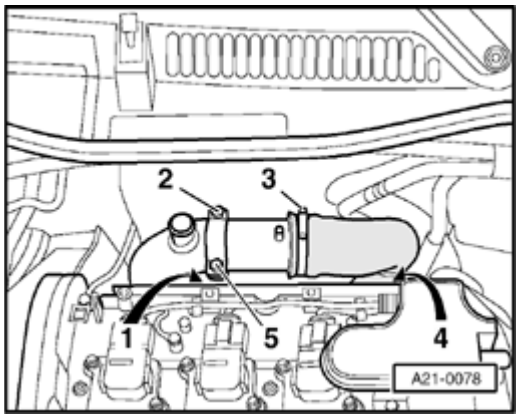

Fig. 241: Identifying Upper Air Line Bolts, Heat Shield Bolts & Upper Air Line Hose
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect hose -3- from upper air line (hose leads to turbocharger).
- Remove bolts -1- and -4- for heat shield on back of cylinder head.
- Remove bolts -2- and -5- on upper air line.
- Remove upper air line and heat shield.

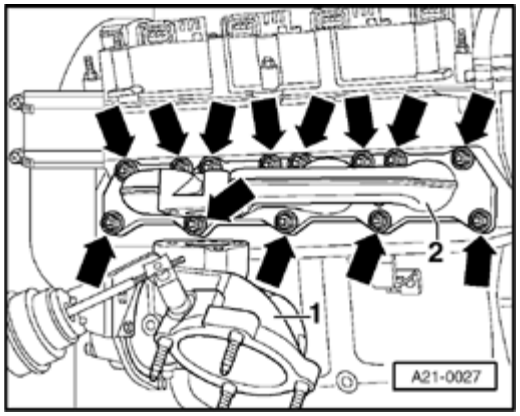

Fig. 242: Removing Exhaust Manifold Nuts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unbolt turbocharger -1- from exhaust manifold -2-.
- Remove gasket. Turbocharger will drop down slightly.
- Remove all nuts (arrows) on exhaust manifold (nuts can be reached from above).
- Remove washers and take off exhaust manifold.

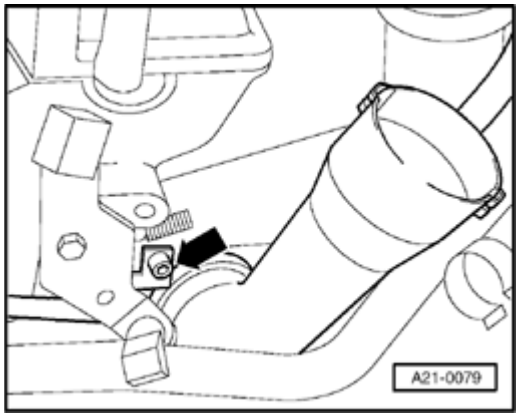

Fig. 243: Unbolting Retainer Piece For Oil Supply Line From Turbocharger
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unbolt retainer piece for oil supply line from turbocharger (arrow).
- Bolt turbocharger bracket back onto cylinder block.

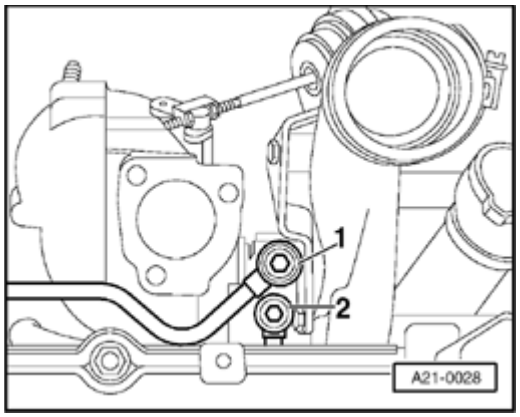

Fig. 244: Removing/Installing Coolant Return Pipe & Oil Supply Pipe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unbolt oil supply line (bolt -2-) and coolant return line (bolt -1-) from turbocharger.
- Remove spacer sleeve from connection for coolant return line.
- Disconnect coolant return line.
- Unbolt turbocharger bracket from cylinder block and remove turbocharger.

Installing

NOTE: Fill the turbocharger with engine oil via the oil supply connection.

- Bolt turbocharger bracket onto turbocharger but do not tighten bolts.
- Position turbocharger against engine from below, then tighten bolts by hand to secure bracket to cylinder block.

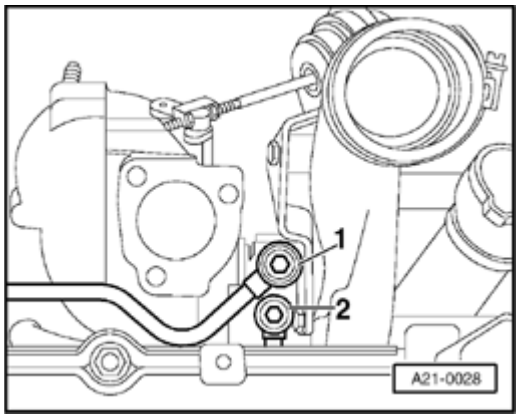

Fig. 245: Removing/Installing Coolant Return Pipe & Oil Supply Pipe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tighten bolts for oil supply line -2-.

- Banjo bolt: 30 Nm
- Bolt for retainer piece: 10 Nm

- Install coolant return line -1- with spacer sleeve and bolt it to turbocharger (35 Nm).
- Unbolt turbocharger bracket from cylinder block again.
- Install exhaust manifold (25 Nm).
- Bolt turbocharger to exhaust manifold.

The remaining installation steps are performed in the reverse sequence. Note the following points:

- Install heat shield sleeves on hoses around turbocharger.
- Fill with coolant. Refer to **Filling**.
- Fill with engine oil.

NOTE: After installing the turbocharger, run the engine for approx.1 minute at idling speed; do not rev up immediately. This ensures that the turbocharger is properly lubricated.

Tightening torques

Components	Nm
Oil return line to oil pan	10
Oil return line to turbocharger	10
Coolant supply line to cylinder block	35
Turbocharger bracket to turbocharger	30
Turbocharger bracket to cylinder block	25
Oil supply line to turbocharger	30
Oil supply line retainer piece to turbocharger	10
Coolant return line to turbocharger	35
Turbocharger to exhaust manifold	30
Exhaust manifold to cylinder head	25
Front exhaust pipe to turbocharger	40
Drive axle heat shield to cylinder block	35
Nuts for clamp	40

Charge air cooling system components, removing and installing

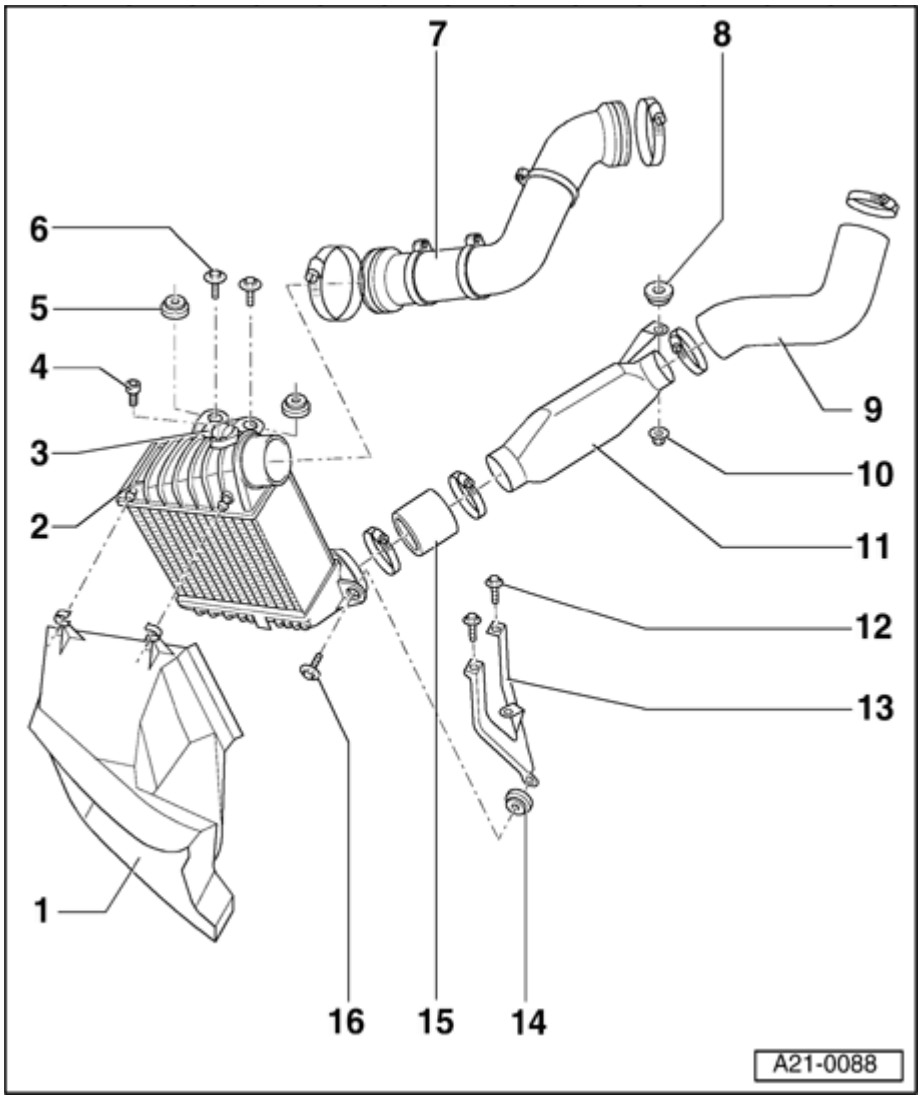

Fig. 246: Charge Air Cooling System Components, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE:

- **All hose connections must be secured with hose clips (same as original parts).**

- Before carrying out tests or repair work, make sure that all lines and hoses are securely connected and that there are no leaks.

1 - Air ducting

2 - Charge air cooler (intercooler)

- Removing and installing. Refer to **Charge air cooler (intercooler), removing and installing**

3 - Charge air pressure sensor -G31-

4 - 10 Nm

5 - Rubber grommet

- With sleeve

6 - 10 Nm

7 - Hose

- Between intake manifold and charge air cooler (intercooler)

8 - Rubber grommet

- With sleeve

9 - Hose

- Between upper air line and lower air line

10 - 10 Nm

11 - Lower air line

12 - 10 Nm

13 - Bracket

14 - Rubber grommet

- With sleeve

15 - Hose

16 - 10 Nm

Charge air cooler (intercooler), removing and installing

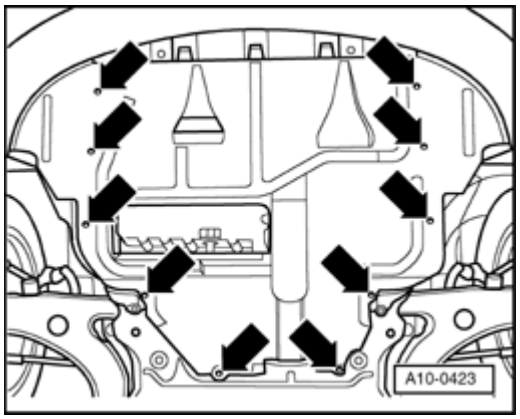

Fig. 247: Locating Center Sound Insulation Fasteners
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove sound insulation (arrows).
- Remove front bumper:

Refer to **63 BUMPERS**

- Remove right side headlight:

Refer to **94 LIGHTS, SWITCHES - EXTERIOR**

- Remove EVAP canister:

Refer to

- **20 - FUEL PUMP, FUEL SUPPLY, EVAPORATIVE EMISSIONS** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA
- **20 - FUEL SUPPLY** for 3.2 LITER V6 4V GENERIC SCAN TOOL, ENGINE CODE: BHE

- Disconnect air hose from top of charge air cooler.

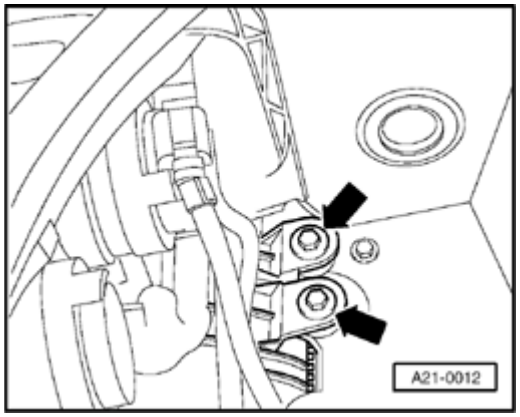

Fig. 248: Removing Bolts For Charge Air Cooler
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove 2 bolts (arrows) for charge air cooler.
- Unclip cowl from charge air cooler.

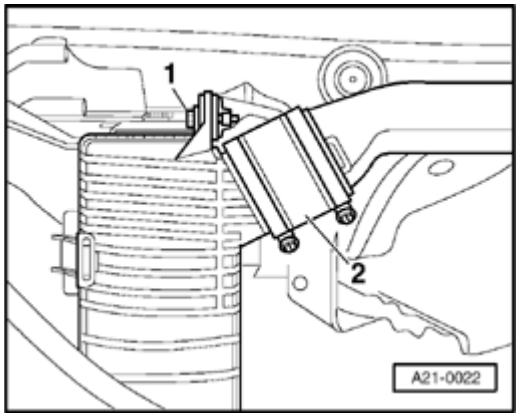

Fig. 249: Disconnecting Air Hose From Bottom Of Charge Air Cooler & Removing Lower Securing Bolt For Charge Air Cooler
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect air hose -2- from bottom of charge air cooler.
- Remove lower securing bolt -1- for charge air cooler.
- Take out charge air cooler from underneath.

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

- Adjust headlights:

Refer to **01 MAINTENANCE** ; Headlights (halogen), adjusting

or

Refer to **01 MAINTENANCE** ; Headlights (gas charged Xenon), adjusting

26 EXHAUST SYSTEM, EMISSION CONTROLS

EXHAUST SYSTEM COMPONENTS, REMOVING AND INSTALLING

Exhaust system components, removing and installing

NOTE:

- **Always replace seals and gaskets, self-locking nuts and clamps.**
- **After working on the exhaust system ensure that the system is not under stress, and that it has sufficient clearance from the bodywork. If necessary, loosen clamp and align silencers and exhaust pipe so that sufficient clearance is maintained to the bodywork at all points and the mountings are evenly loaded.**

- **Loosen and tighten clamping plates for heat shields with a screwdriver. Tightening torque: 2 Nm**
- **De-coupling element on front exhaust pipe may only be bent slightly (not more than 10°).**
- **If droning noises can be heard after aligning the exhaust system, adjust the engine mountings. Refer to Engine mountings, adjusting.**

Exhaust system, vehicles with front wheel drive

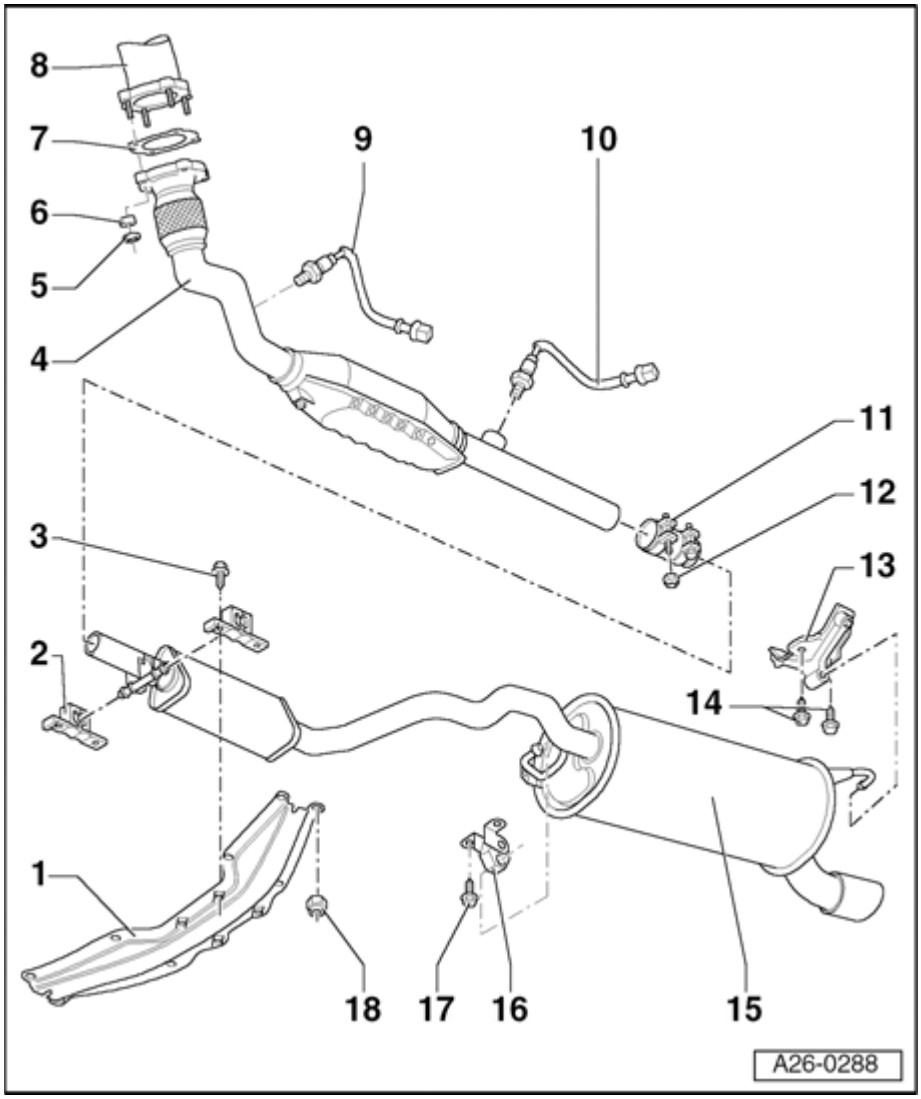

Fig. 250: Exhaust System, Vehicles With Front Wheel Drive Remove/Install Components
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Tunnel cross-piece

- With drilling for aligning exhaust system. Refer to **Exhaust system, aligning stress-free**

2 - Mounting

- Position. See Fig. 2

3 - 25 Nm

4 - Front exhaust pipe

- With catalytic converter
- With de-coupling element
- Protect from damage by knocks and impact
- De-coupling element may only be bent slightly (not more than 10°)
- Removing and installing. Refer to **Front exhaust pipe, removing and installing**

5 - 40 Nm

- Always replace

6 - Spacer sleeve

- For all four nuts

7 - Gasket

- Always replace

8 - Turbocharger

- Removing and installing. Refer to **Turbocharger, removing and installing**

9 - Heated Oxygen Sensor (HO2S), 55 Nm

- Grease only threads with part no. G 052 112 A3 hot bolt paste (anti-seize compound). Grease must not get into slots on sensor body

CAUTION: Part numbers are for reference only. Always check with your Parts Dept. for the latest parts information.

- Checking:

Refer to

- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU

- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

- Heated Oxygen Sensor (HO2S) connector is located under a protective cover. Refer to **Front exhaust pipe, removing and installing**

10 - Heated Oxygen Sensor (HO2S) after catalytic converter, 55 Nm

- Grease only threads with part no. G 052 112 A3 hot bolt paste (anti-seize compound). Grease must not get into slots on sensor body

CAUTION: Part numbers are for reference only. Always check with your Parts Dept. for the latest parts information.

- Checking:

Refer to

- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

- Heated Oxygen Sensor (HO2S) connector is located under a protective cover. Refer to **Front exhaust pipe, removing and installing**

11 - Clamp

- Align exhaust system so it is free of stress before tightening clamp. Refer to **Exhaust system, aligning stress-free**.
- Installation position: horizontal in vehicle, bolted connection facing to left
- Tighten bolted connections evenly.

12 - 40 Nm

13 - Mounting

14 - 25 Nm

15 - Front and rear mufflers

- Can be replaced separately
- Exhaust pipe with cutting point. See Fig. 1
- Aligning exhaust system free of stress. Refer to **Exhaust system, aligning stress-free**

16 - Mounting

17 - 25 Nm

18 - 25 Nm

Exhaust system, vehicles with all wheel drive

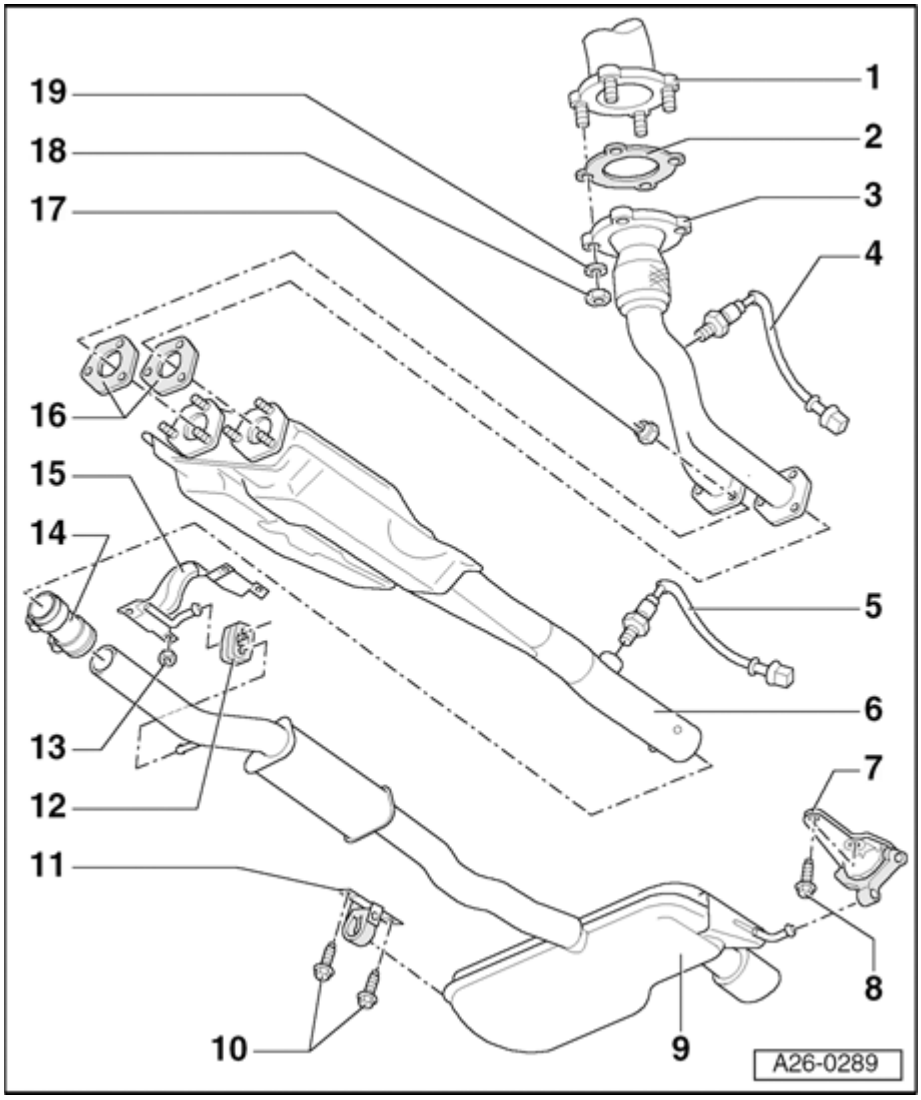

Fig. 251: Exploded View Of Exhaust System, Vehicles With All Wheel Drive
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Turbocharger

- Removing and installing. Refer to **Turbocharger, removing and installing**

2 - Gasket

- Always replace

3 - Front exhaust pipe

- With de-coupling element
- Protect from damage by knocks and impact
- De-coupling element may only be bent slightly (not more than 10°)
- Removing and installing. Refer to **Front exhaust pipe, removing and installing**

4 - Heated Oxygen Sensor (HO2S) before catalytic converter, 55 Nm

- Grease only threads with Part no. G 052 112 A3 hot bolt paste (anti-seize compound). Grease must not get into slots on sensor body

CAUTION: Part numbers are for reference only. Always check with your Parts Dept. for the latest parts information.

- Checking:

Refer to

- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

- Heated Oxygen Sensor (HO2S) connector is located under a protective cover. Refer to **Front exhaust pipe, removing and installing**

5 - Heated Oxygen Sensor (HO2S) after catalytic converter, 55 Nm

- Grease only threads with part no. G 052 112 A3 hot bolt paste (anti-seize compound). Grease must not

get into slots on sensor body

CAUTION: Part numbers are for reference only. Always check with your Parts Dept. for the latest parts information.

- Checking:

Refer to

- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **24 MULTIPORT FUEL INJECTION (MFI)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

- Heated Oxygen Sensor (HO2S) connector is located under a protective cover. Refer to **Front exhaust pipe, removing and installing**

6 - Catalytic converter

- Removing and installing. Refer to **Front exhaust pipe, removing and installing**

7 - Mounting

- Loosen mounting to center tailpipe in relation to bumper.

8 - 25 Nm

9 - Front and rear mufflers

- Can be replaced separately
- Exhaust pipe with cutting point. See Fig. 1
- Aligning exhaust system free of stress. Refer to **Exhaust system, aligning stress-free**

10 - 25 Nm

11 - Mounting

12 - Rubber hanger

13 - 25 Nm

14 - Retainer hose

15 - Clamp

- Align exhaust system so it is free of stress before tightening clamp. Refer to **Exhaust system, aligning stress-free**.
- Installed position: horizontal in vehicle, bolted connection facing left
- Tighten bolted connections evenly.

16 - Gaskets

- Replace
- Installed position: horizontal in vehicle, bolted connection facing left
- Tighten bolted connections evenly.

17 - 25 Nm

18 - 40 Nm

19 - Spacer sleeve

- For all four nuts

Marked position for cutting exhaust pipe

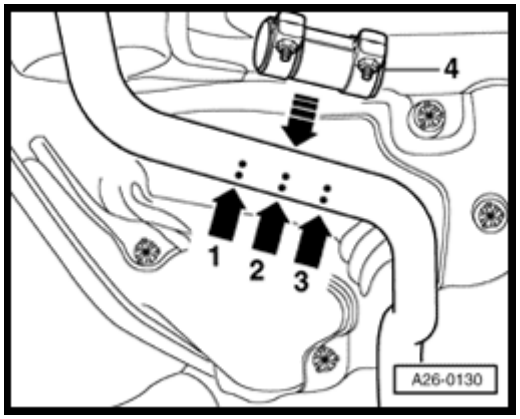

Fig. 252: Separating Point On Exhaust Pipe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- For individual replacement of front or rear muffler.
- Position is marked with three indentations on exhaust pipe.

- Cut through exhaust pipe at right angles with body saw (e.g. V.A.G 1523) at position marked (arrow -2-).
- Position clamp -4- between side markings (arrow -1- and arrow -3-) when installing.
- Align exhaust system free of stress. Refer to **Exhaust system, aligning stress-free**.

- Align rear muffler so it is horizontal.
- Tighten bolted connections on clamp evenly to 40 Nm.

Installed position of clamp: horizontal in vehicle, bolted connections facing front.

Vehicles with front wheel drive

Installed position of mounting

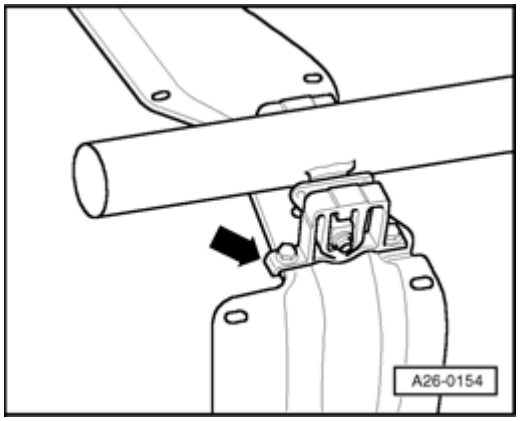

Fig. 253: Installed Position Of Mounting
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Angled end of base of mounting (arrow) faces in direction of travel.

Gap between exhaust pipe and heat shield for steering box: at least 24 mm

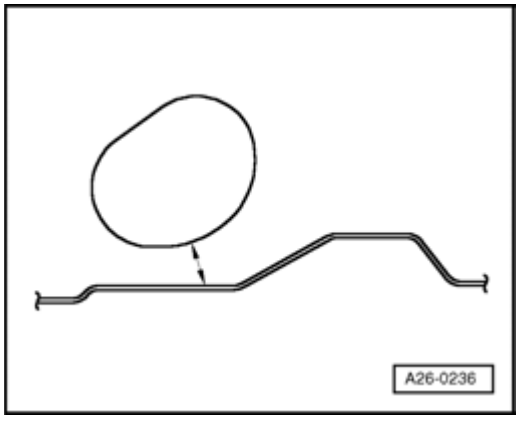

Fig. 254: Identifying Gap Between Exhaust Pipe And Heat Shield For Steering Box
Courtesy of VOLKSWAGEN UNITED STATES, INC.

To measure gap:

- Install a 17 mm 1/2"-drive socket (outside diameter approx. 24 mm) to a long extension and insert between front exhaust pipe and heat shield. Gap should be large enough to allow socket to be inserted

without difficulty.

Front exhaust pipe, removing and installing

Removing

NOTE:

- **Avoid excessive bending of the de-coupling element (no more than 10°).**
- **When performing repairs, replace all seals and gaskets as well as self-locking nuts and bolts that have a specified tightening angle.**

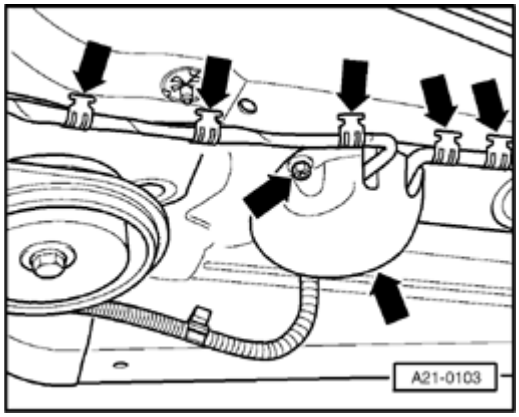

Fig. 255: Removing Cover For Both Heated Oxygen Sensor (Ho2S) Connectors And Pull Electrical Wire With Retaining Clips From Heat Shield
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove cover for both Heated Oxygen Sensor (HO2S) connectors and pull electrical wire with retaining clips from heat shield (arrows).
- Pull connector out of cover and disconnect.
- Unbolt front exhaust pipe from turbocharger.

Vehicles with front wheel drive

- Loosen bolted connections on clamp between catalytic converter and middle muffler, then move clamp toward rear.

Vehicles with all wheel drive

- Unbolt connecting flanges on catalytic converter.
- Remove front exhaust pipe.

Installing

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

- Align exhaust system free of stress. Refer to **Exhaust system, aligning stress-free**.

- Check DTC memory:

Refer to

- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AMU
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): ATC
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): AWP
- **01 ON BOARD DIAGNOSTIC (OBD)** for 1.8 LITER 4-CYL. 5V TURBO FUEL INJECTION & IGNITION, ENGINE CODE(S): BEA

NOTE: DTCs will have been stored in the memory because connectors have been disconnected. Therefore check and erase the DTC memory after installing the engine.

Vehicles with front wheel drive

Tightening torques

Components	Nm
Front exhaust pipe to turbocharger	40
Heated Oxygen Sensor (HO2S) to front exhaust pipe	55
Nuts on clamp	40

Vehicles with all wheel drive

Tightening torques

Components	Nm
Front exhaust pipe to turbocharger	40
Heated Oxygen Sensor (HO2S) to front exhaust pipe	55
Nuts on connecting flange of catalytic converter	25

Exhaust manifold, removing and installing

Removing

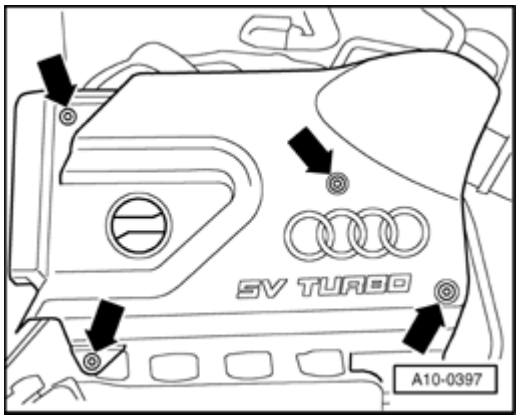

Fig. 256: Removing Engine Cover Panel Above Cylinder Head
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove section of engine cover from cylinder head cover.

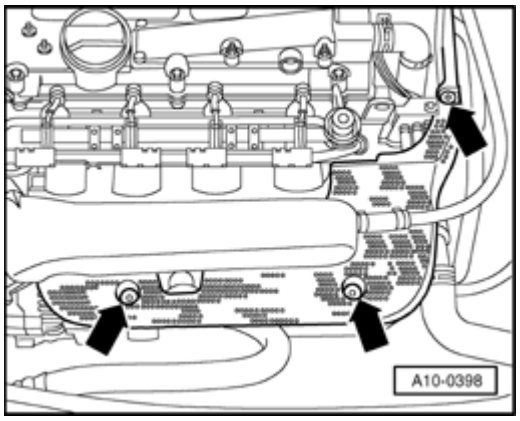

Fig. 257: Removing Cover In Front Of Intake Manifold
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove cover in front of intake manifold.

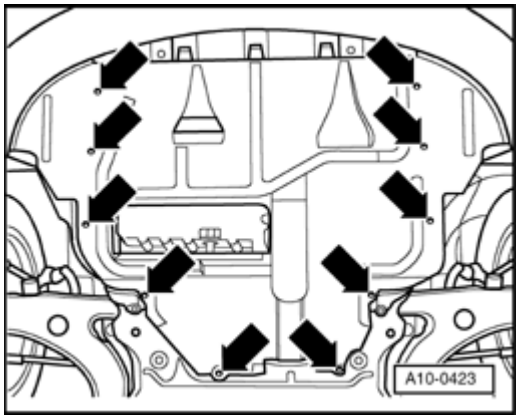

Fig. 258: Locating Center Sound Insulation Fasteners
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove sound insulation (arrows).
- Unbolt heat shield for right drive axle.
- Remove front exhaust pipe. Refer to **Exhaust system, vehicles with front wheel drive**.

NOTE: The de-coupling element on the front exhaust pipe may only be bent slightly (not more than 10°).

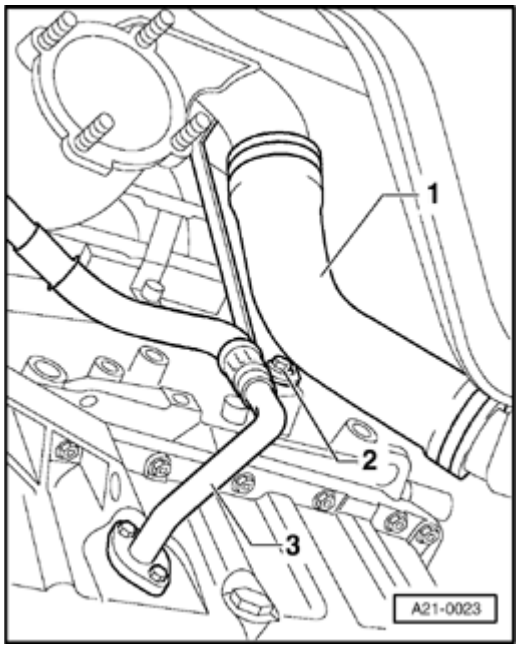

Fig. 259: Removing Oil Return Line From Oil Pan
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove air hose -1- between upper air line and lower air line.
- Unbolt bracket -2- for upper air line.

NOTE: Do not disconnect oil return line -3- for turbocharger.

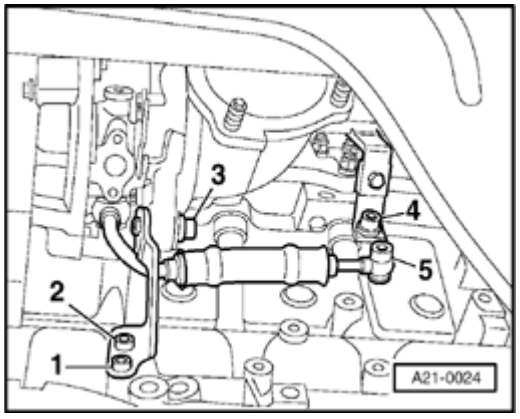

Fig. 260: Identifying Turbocharger Bracket Bolts

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen bolted connection -3- for turbocharger bracket by a few turns.
- Remove turbocharger bracket from cylinder block (bolts -1- and -2-).
- Unbolt bracket for coolant return line (bolt -4-).

Disconnect air intake hose from connection on turbocharger as follows:

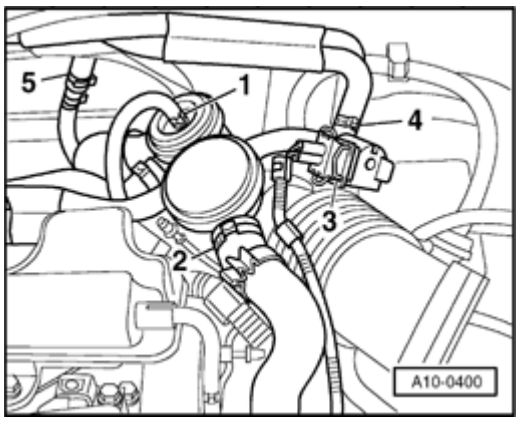

Fig. 261: Identifying Vacuum Hose, Crankcase Breather, Wastegate Bypass regulator valve & Hose
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect vacuum line -1- from air recirculation valve.
- Disconnect hose from pressure control valve -2- for crankcase breather.
- Disconnect connector -3- from Wastegate bypass regulator valve -N75-.
- Disconnect hose -4- from Wastegate bypass regulator valve -N75-.

- Remove hose -5- from bulkhead (hose runs between solenoid valve and turbocharger).
- Remove wastegate bypass regulator valve from intake air hose and place valve to one side on engine.
- Remove hose from bulkhead (hose runs between EVAP canister and turbocharger).
- Pull locking clip out of turbocharger connection and take off air intake hose.

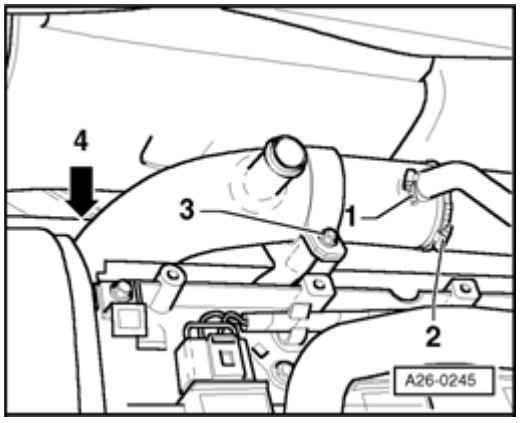

Fig. 262: Identifying Air Pipe Clamps, Turbocharger Hose & Upper Air Line Hose

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect hose -2- (leading to turbocharger) and remove hose -1- from upper air line.
- Remove bolts on heat shield on back of cylinder head.
- Release clamps -3- and -4- on air line.
- Remove upper air line and heat shield.

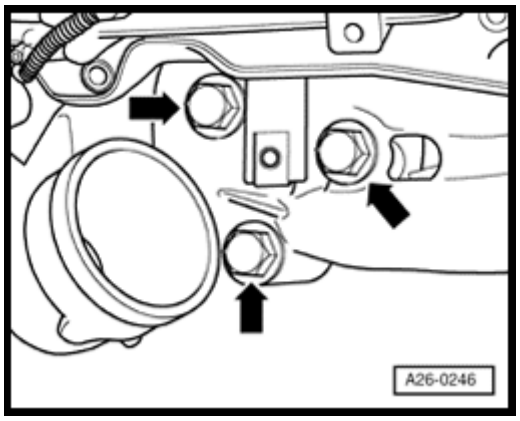

Fig. 263: Unbolting Turbocharger From Exhaust Manifold
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unbolt turbocharger (arrows) from exhaust manifold.
- Remove gasket.

Turbocharger will drop down slightly.

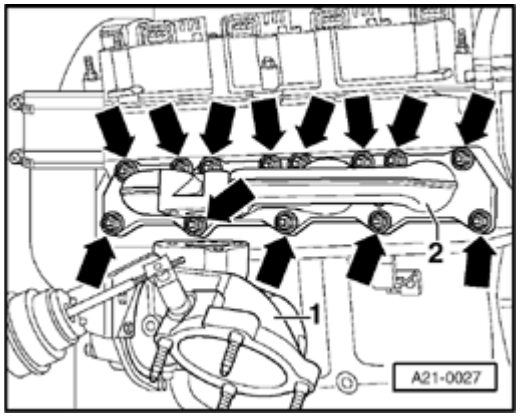

Fig. 264: Removing Exhaust Manifold Nuts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove all nuts (arrows) on exhaust manifold (nuts can be reached from above).
- Remove washers and exhaust manifold.

Installing

Installation is performed in the reverse order.

Tightening torques

Components	Nm
Clamps for air lines	10
Heat shield to manifold	10
Turbocharger bracket to turbocharger	30
Turbocharger bracket to cylinder block	25
Turbocharger to exhaust manifold	30
Exhaust manifold to cylinder head	25
Front exhaust pipe to turbocharger	40
Drive axle heat shield to cylinder block	35
Nuts for clamp	40
Nuts on connecting flange of catalytic converter	25
Heated Oxygen Sensor (HO2S) in front pipe	55

Exhaust system, aligning stress-free

- The exhaust system must be aligned when cold.

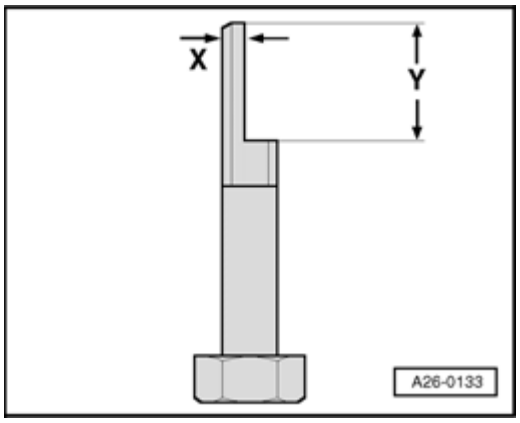

Fig. 265: Identifying Manufactured Alignment Tool
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- As a tool for aligning exhaust system, modify an M10 bolt according to the dimensions given.

- Dimension -x- = 4 mm
- Dimension -y- = 25 mm

NOTE: Two technicians are required to align the exhaust system.

- Loosen bolted connections on clamp. Refer to **Exhaust system, vehicles with front wheel drive**, item - 11.

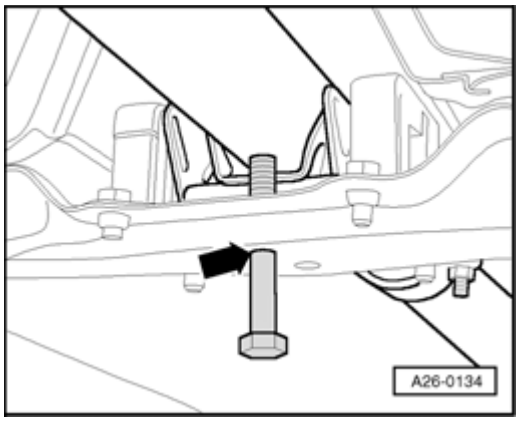

Fig. 266: Manufactured Tool Inserted Through Rearmost Hole In Tunnel Bridge
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert modified bolt (aligning tool) through rear drilling (arrow) in tunnel cross-piece, with flat part of bolt facing toward mounting pin on exhaust system.

NOTE: With bolt inserted, exhaust system is pre-tensioned in the direction of travel.

Vehicles with front wheel drive

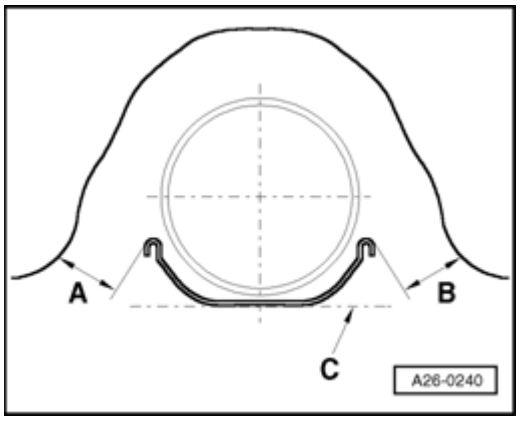

Fig. 267: Aligning Catalytic Converter Horizontally And Making Sure Gaps Between Catalytic Converter And Tunnel Are Equal
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Align catalytic converter horizontally -C- and make sure that gaps -A- and -B- between catalytic converter and tunnel are equal.

Vehicles with all wheel drive

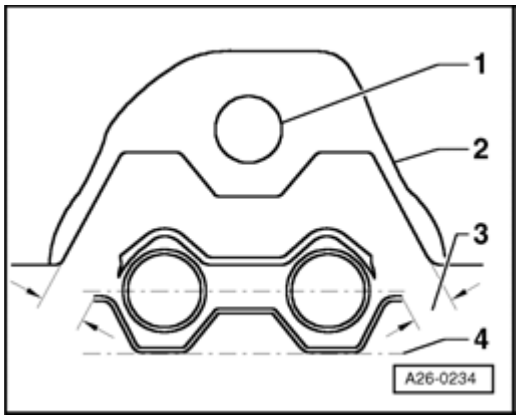

Fig. 268: Aligning Catalytic Converter Horizontally And With Equal Spacing From Heat Shield In Center Tunnel
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Align catalytic converter horizontally -4- and make sure that gaps -3- between catalytic converter and heat shield in tunnel -2- are equal.

All vehicles

- Align front and rear mufflers horizontally.

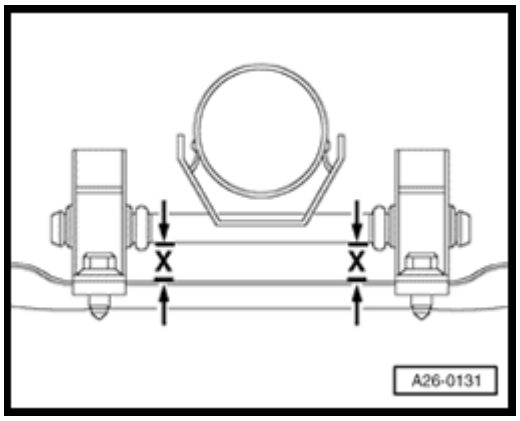

Fig. 269: Mounting Pin On Exhaust Pipe Must Be Parallel To Tunnel Cross-Piece
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Mounting pin on exhaust pipe must be parallel to tunnel cross-piece (dimension -x- must be same on left and right).

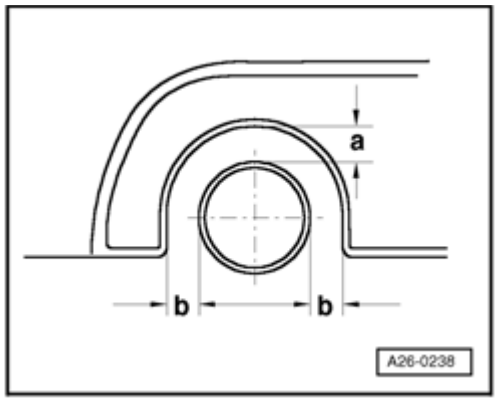

Fig. 270: Aligning Tailpipe In Bumper Cut-Out
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Aligning tailpipe in bumper cut-out

- Align rear muffler so that gaps -a- and -b- between muffler and bumper cut-out are equal. To do this, it may be necessary to loosen rear muffler mounting.

NOTE: On vehicles where the exhaust has been cut through between the front and rear mufflers, it may be necessary to loosen the clamp in order to achieve proper alignment.

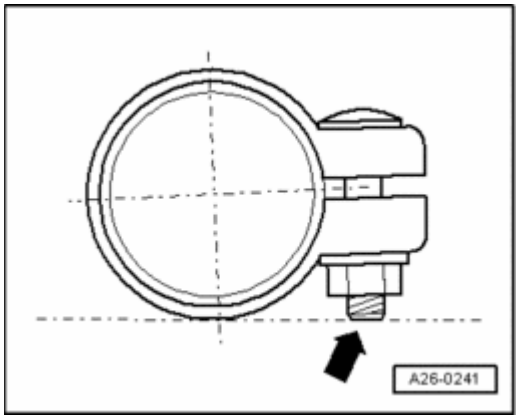

Fig. 271: Installing sleeve clamps so screws are at right and screw ends do not project out over lower edge
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install sleeve clamps so that screws are at right and screw ends do not project out over lower edge.

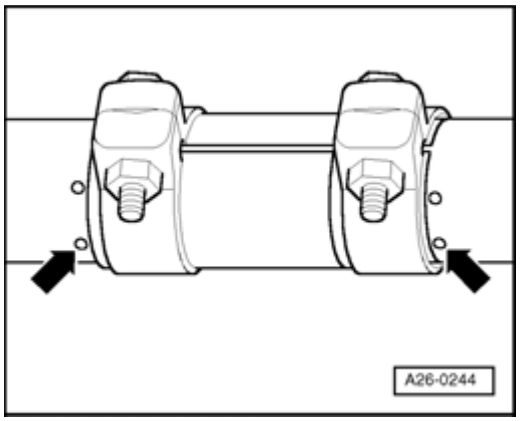

Fig. 272: Positioning Clamp At Distance Of About 5 mm From Notched Markings
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position each clamp at a distance of about 5 mm from notched markings. Arrange horizontally, then tighten evenly to 40 Nm.

Bolted connections on clamp point to left.

Exhaust system, checking for leaks

- Start engine and run at idling speed.
- Plug tailpipe (e. g. with rags or stoppers) and leave plugged until check is complete.
- Listen for noise at connection points (cylinder head/exhaust manifold, exhaust manifold/turbocharger, turbocharger/front exhaust pipe etc.) to determine whether there are any leaks.
- Repair any leaks that are found.

Secondary air system, components and function

The secondary air system results in quicker heating and therefore earlier operating readiness of the catalytic converter following a cold start.

Principle

Due to over-enrichment of the mixture during the cold start phase, there is an increased amount of uncombusted carbon monoxide in the exhaust. Secondary Air Injection (AIR) improves secondary oxidation in the catalytic converter and therefore reduces emissions. The heat produced by secondary oxidation greatly reduces start-up time for the catalytic converter, therefore improving exhaust quality during the cold start phase significantly.

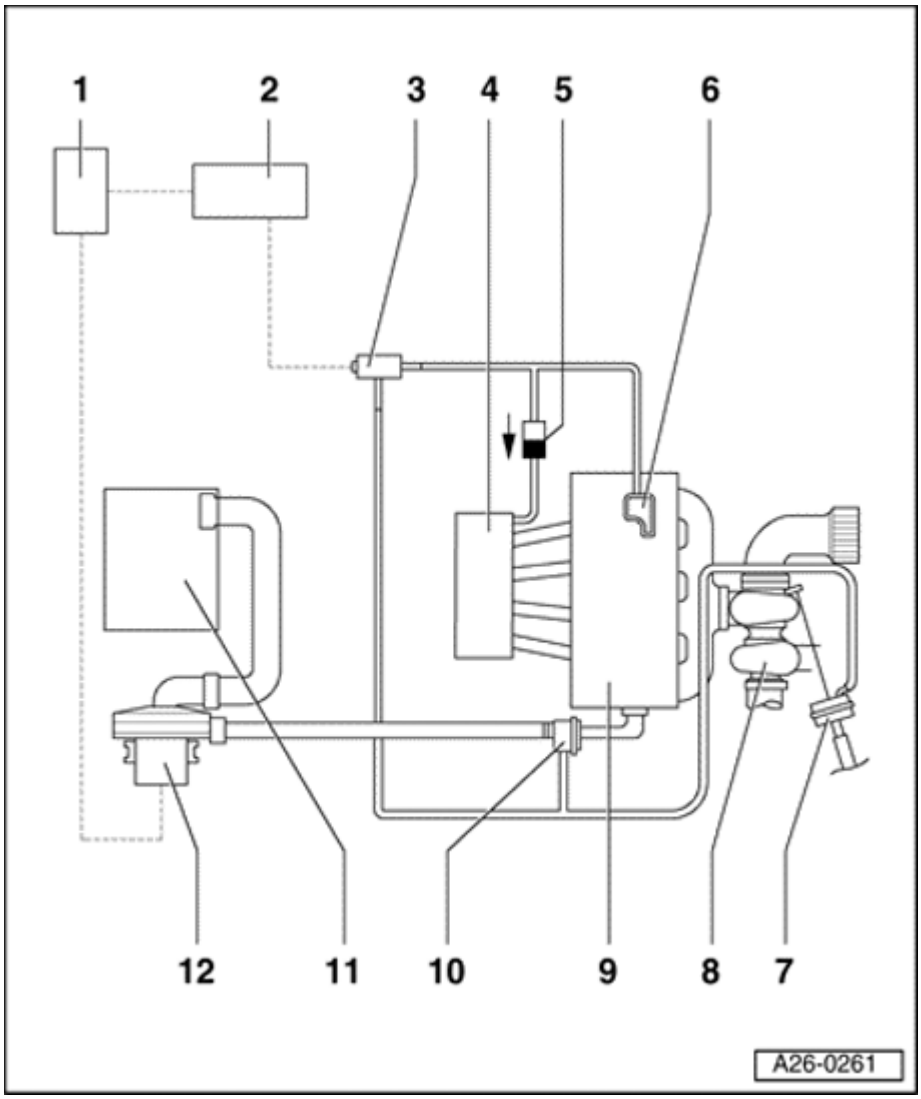

Fig. 273: Secondary Air System, Components And Function
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Function

- After cold start, the ECM -2- starts the secondary air pump -12- via the relay for Secondary Air Injection (AIR) -1-. Air is blown to the mechanical secondary air valve -10-.
- Parallel to this, the Secondary Air Injection (AIR) solenoid valve -3- is activated, which permits negative pressure to reach the mechanical secondary air valve -10- and the pressure unit for charge air pressure regulation -7-.
- The mechanical secondary air valve thereby opens the path for secondary air to the exhaust channels of the cylinder head.
- To prevent unnecessary heating, secondary air is led around the turbocharger. For this, the charge air pressure regulation pressure unit opens the charge air pressure valve. The pressure unit, designed as a double reservoir, has a vacuum connection for this on the intake side.

1 - Secondary Air Injection (AIR) pump relay -J299-

2 - Motronic Engine Control Module (ECM) -J220-

3 - Secondary Air Injection (AIR) solenoid valve -N112-

4 - Intake manifold

5 - Check valve

- Installed position (light/dark side): Arrow points in direction of flow as shown in diagram

6 - Vacuum reservoir

- Mounted at cylinder head cover

7 - Pressure can for charge air pressure regulation

8 - Turbocharger

- Checking. Refer to **Turbocharger and charge air pressure regulating valve, checking**

9 - Cylinder head

10 - Combination valve

- For Secondary Air Injection (AIR)

11 - Air filter

12 - Secondary Air Injection (AIR) pump motor -V101-

Secondary air injection system components, removing and installing

Checking secondary air injection system:

Refer to **26 - EXHAUST SYSTEM, EMISSION CONTROLS**

A- Secondary Air Injection (AIR) pump motor

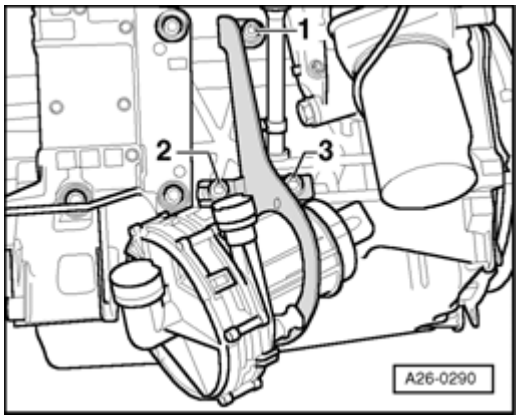

Fig. 274: Loosening Bolt Approx. Two Rotations From Engine Compartment Top
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen bolt -1- approx. two rotations from engine compartment top (visible through opening of dip stick at bracket of intake manifold).

NOTE: Diagram illustrates the bracket and Secondary Air Injection (AIR) pump on an uninstalled engine for photo/technical reasons.

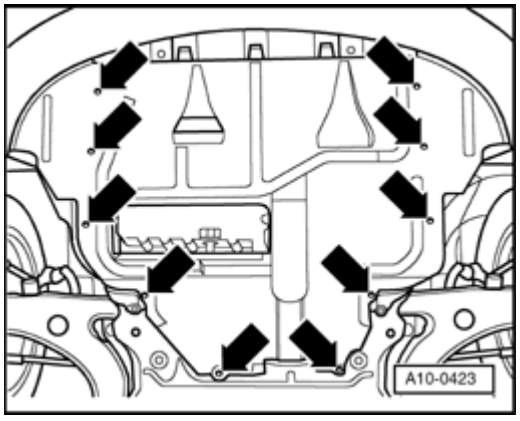

Fig. 275: Locating Center Sound Insulation Fasteners
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove center sound insulation.

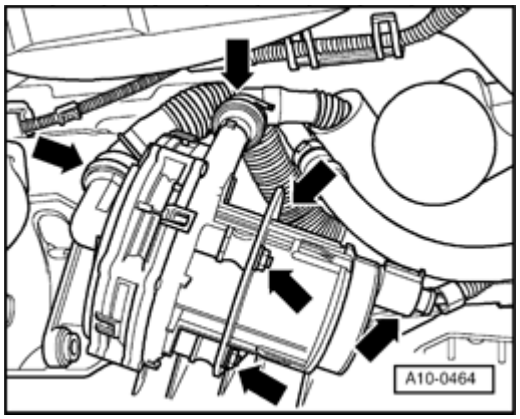

Fig. 276: Disconnecting Hoses And Connectors On Secondary Air Pump
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect connector and hoses at Secondary Air Injection (AIR) pump.

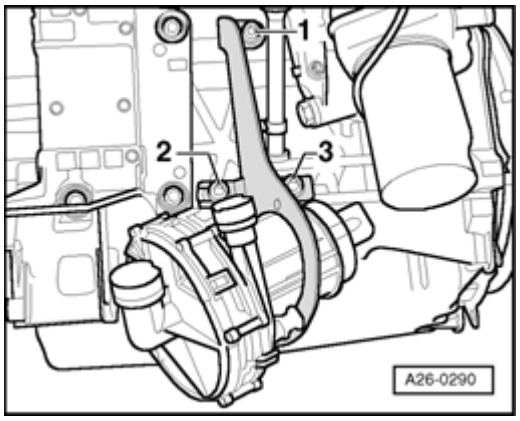

Fig. 277: Removing Bolts And Of Bracket For Secondary Air Injection (AIR) Pump
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts -2- and -3- of bracket for Secondary Air Injection (AIR) pump.
- Swing bracket to side and remove Secondary Air Injection (AIR) pump downward.

B- Combination valve

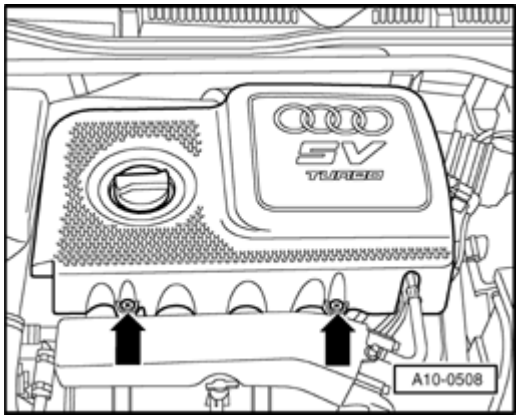

Fig. 278: Removing Engine Cover Panel
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove engine cover.

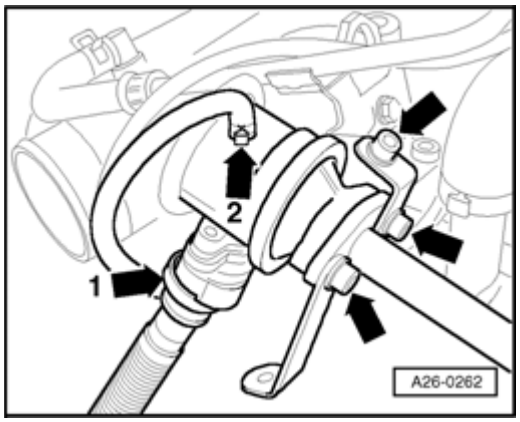

Fig. 279: Removing Vacuum Hose And Connecting Line At Combination Valve
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove vacuum hose -1- and connecting line -2- at combination valve.
- Remove combination valve from bracket (arrows).

