ENGINE

5.2 Liter 10-Cyl. 4V Engine Mechanical Engine Code(s): BXA

00 - GENERAL, TECHNICAL DATA

TECHNICAL DATA

Technical Data

--> **Engine Number**

--> **Engine Data**

Engine Number

Engine Number

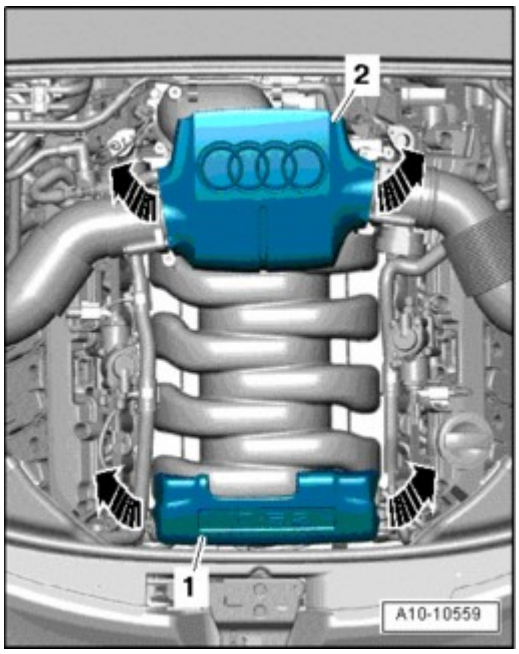

Fig. 1: Removing Rear Engine Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove front engine cover - **1** - - **arrows** -.

NOTE:

- **Ignore - 2 -.**

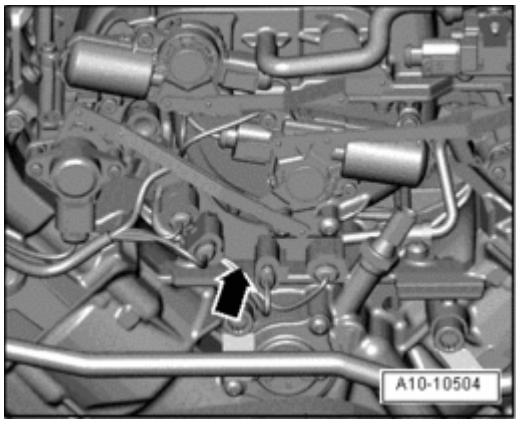

Fig. 2: Identifying Engine Number Stamped On Engine Block
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Engine number ("engine code" and "serial number") is located at front on cylinder block at top - **arrow** -.

NOTE:

- **The engine code is also located on the vehicle data plate.**

Engine Data

Engine Data

Code letters		**BXA**
Displacement	ltr.	5.204
Output	kW at 1/rpm	320/6800
Torque	Nm at rpm	540/3500
Bore	dia. mm	84.5
Stroke	mm	92.8
Compression ratio		12.5
RON		98 1)
Fuel injection and ignition system		Bosch Motronic
Ignition sequence		1-6-5-10-2-7-3-8-4-9
Exhaust gas recirculation		no
Turbocharger		no
Knock control		yes
Variable valve timing		yes
Variable intake manifold		yes
Secondary air injection (AIR) system		yes
1) Super unleaded RON 95 is permissible, although with reduced power.		

GENERAL INFORMATION

General Information

--> **Safety Precautions**

--> **Before Opening High-Pressure Fuel Injection System**

--> **Clean Working Conditions**

--> **Contact Corrosion**

--> **Lines, Routing and Securing**

Safety Precautions

Safety Precautions

Note the following when working on the fuel system:

CAUTION: There is a risk of injury because the fuel is under very high pressure.

- **Before opening high pressure area of the fuel injection system, fuel pressure must be relieved to residual pressure.**
- **To reduce remaining residual pressure, lay a clean cloth around the connector and carefully loosen connector.**

- Procedures before opening high pressure fuel injection system --> **Before Opening High-Pressure Fuel Injection System**.

To prevent personal injury and damage to the injection and ignition system, observe the following:

- The ignition must be switched off before connecting or disconnecting injection and ignition system wiring or tester cables.
- Only clean engine with ignition switched off.
- If electrical connectors were disconnected, faults are saved in ECM:

- Connect Vehicle Diagnosis, Testing and Information System VAS 5051B.
- Start "Guided Functions" operating mode.
- Generate readiness code in ECM.

CAUTION: Risk of destroying electrical components when battery is disconnected.

- **Observe measures when disconnecting battery.**
- **Only disconnect battery with ignition switched off.**

- Disconnect battery --> **27 - STARTER, GENERATOR, CRUISE CONTROL** .

Note the following when working on the cooling system:

CAUTION: Risk of scalding due to hot steam and hot coolant.

- **When the engine is warm the cooling system is under pressure.**
- **To reduce pressure, cover coolant reservoir cap with cloth and carefully open.**

If it is necessary to use testing and measuring devices on road tests, observe the following:

CAUTION: Distraction and improperly secured test equipment can lead to accidents.

Risk of passenger airbag deploying in an accident.

- **Operating testing and measuring equipment while driving creates a distraction.**
- **There is an increased risk of injury due to unsecured testing and measuring equipment.**
- **Always secure testers on the rear seat with a strap and have a second person on the rear seat operate them.**

Before Opening High-Pressure Fuel Injection System

Before Opening High-Pressure Fuel Injection System

- The fuel injection system is separated into a high-pressure section (max. approximately 120 bar) and a low-pressure section (approximately 6 bar).
- Before opening high pressure area, fuel pressure must be reduced to a residual pressure of approximately 6 bar. The procedure for this is as follows.

Special tools, testers and auxiliary items required

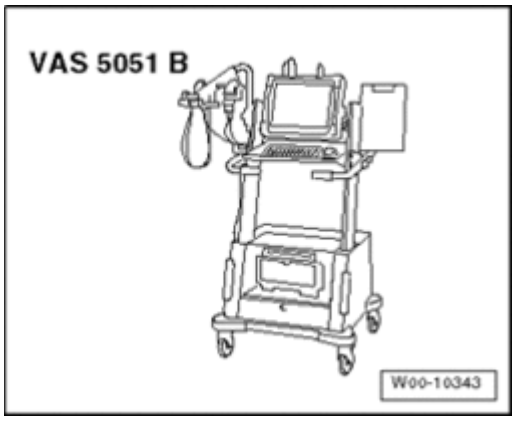

Fig. 3: Identifying Vehicle Diagnosis, Testing And Information System VAS 5051B
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Vehicle diagnostic, testing, and information system VAS 5051 (VAS 5051 B version shown as example

only)

Procedure

Proceed as follows:

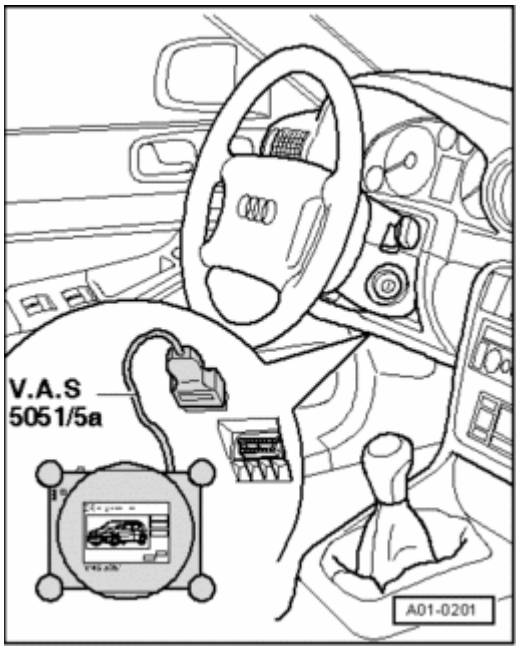

Fig. 4: Connecting Data Link Connector (DLC)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect vehicle diagnosis, testing and information system VAS 5051B while the ignition is switched off.

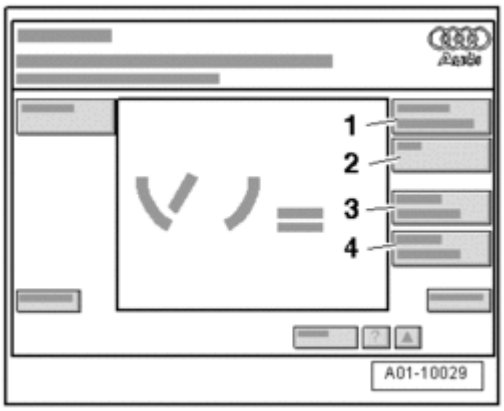

Fig. 5: Display On VAS 5051B - Vehicle Self-Diagnosis Button
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Display on VAS 5051B :

- Press Vehicle Self-Diagnosis button - **1** - in selection.

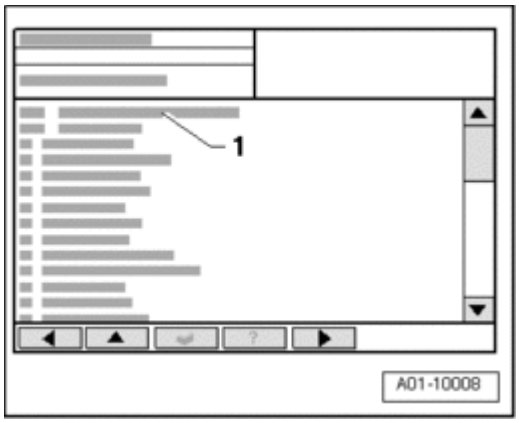

Fig. 6: Display On VAS 5051 - "01 - Engine Electronics"
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Display on VAS 5051B :

- In selection - **1** - , press "01 - Engine electronics" vehicle system and continue by pressing button.

Fig. 7: Display On VAS 5051 - "006 - Basic Setting"
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Display on VAS 5051B :

- In selection - **1** - , press diagnostic function "006 - Basic setting" and continue by pressing the button.

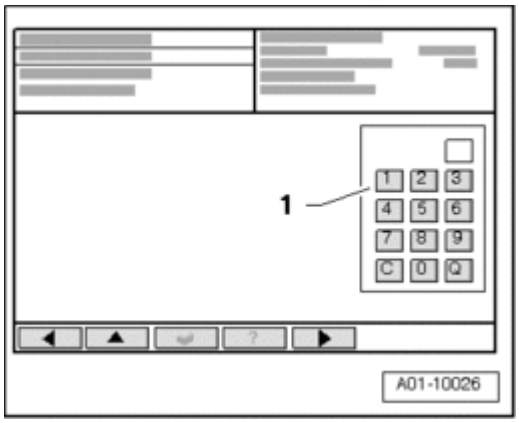

Fig. 8: Display On VAS 5051 - "Display Group 140"
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Display on VAS 5051B :

- In button field - **1** - , press 1 4 0 buttons for "Display group 140" and confirm entry by pressing the Q button.

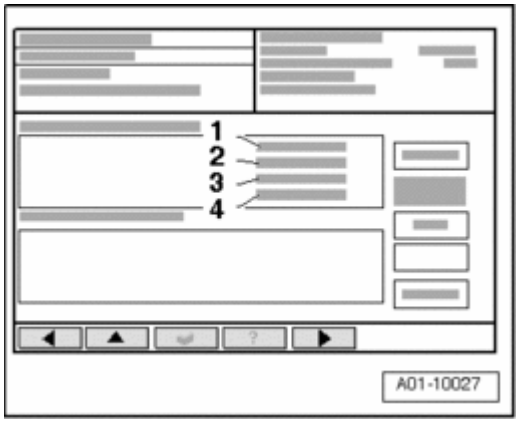

Fig. 9: Display On VAS 5051 - (Read-Out For Fuel Pressure In Fuel Rail)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Display on VAS 5051B :

- Check display for fuel pressure in fuel rail in display field - **3** -.

Example:

3 - 40.63 bar

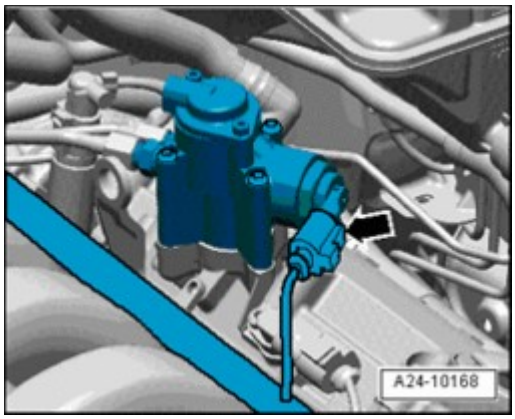

Fig. 10: Disconnecting Electrical Connector At Fuel Metering Valve 2 N402 On Left High Pressure Pump
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connector - **arrow** - at Fuel Metering Valve 2 N402 on left high pressure pump.

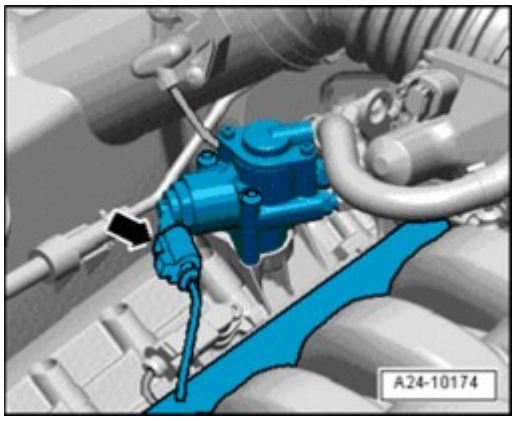

Fig. 11: Disconnecting Electrical Connector At Fuel Metering Valve 2 N290 On Right High Pressure Pump
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connector - **arrow** - at Fuel Metering Valve 2 N290 on right high pressure pump.

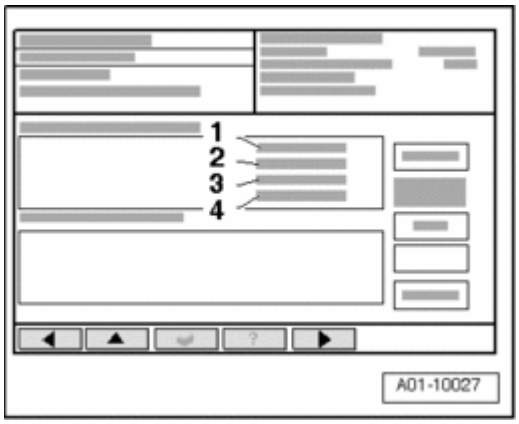

Fig. 12: Display On VAS 5051 - (Read-Out For Fuel Pressure In Fuel Rail)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Display on VAS 5051B :

- Check indication in display field - **3** - :

- Fuel pressure in fuel rail must sink to approximately 6 bar.

- Switch off ignition.

The fuel rail will continue to be filled with fuel, but it will no longer be under high pressure.

Now components or lines can be opened.

- Lay clean cloths around connectors and catch escaping fuel.

Final procedures

- Reconnect electrical harness connectors.
- Start "Guided Functions" operating mode.
- Generate readiness code in ECM.

Clean Working Conditions

Clean Working Conditions

Even a little contamination can lead to faults. Pay careful attention to the following rules for clean working conditions when working on the fuel supply and injection system:

- Before loosening, connections and surrounding areas must be cleaned thoroughly with engine or brake cleaner, and then cleaned area must be dried completely.
- Plug open lines and connections immediately with appropriate protective caps.
- Place parts that have been removed on a clean surface and cover them. Use lint-free cloths.
- Only install clean components: Only unpack replacement parts immediately prior to installation. Do not use parts that have been stored unpacked (e.g. in tool boxes etc.).

- When the system is open: Do not work with compressed air. Do not move vehicle unless absolutely necessary.
- Protect disconnected electrical connectors from dirt and moisture and only connect if dry.

Contact Corrosion

Contact Corrosion

Contact corrosion can occur if incorrect fasteners (bolts, nuts, washers, etc.) are used.

For this reason, only install connecting elements that are treated with a special coating.

Also, rubber or plastic parts and adhesive consist of non-conductive materials.

If there are doubts about the suitability of parts, generally use new parts .

NOTE:

- **Only original replacement parts are recommended, they are checked and compatible with aluminum.**
- **Audi accessories are recommended.**
- **Damage due to contact corrosion is not covered by warranty.**

Lines, Routing and Securing

Lines, Routing and Securing

To prevent mistakes and ensure the original installation location is kept, mark the hydraulic lines, vacuum lines or electrical lines before removing them. If necessary, draw sketches or take pictures.

10 - ENGINE - ASSEMBLY

ENGINE, REMOVING AND INSTALLING

Engine, Removing and Installing

--> **Engine, Removing**

--> **Engine and Transmission, Separating**

--> **Engine, Securing to Assembly Stand**

--> **Engine, Installing**

Engine, Removing

Engine, Removing

NOTE:

- **With lock carrier installed, engine is removed downward with transmission and subframe.**
- **Drained coolant must be stored in a clean container for disposal or reuse.**
- **During installation, reinstall all heat insulation sleeves and heat shields at the same locations.**
- **All cable ties opened or cut during engine removal must be reinstalled at the same locations during installation.**

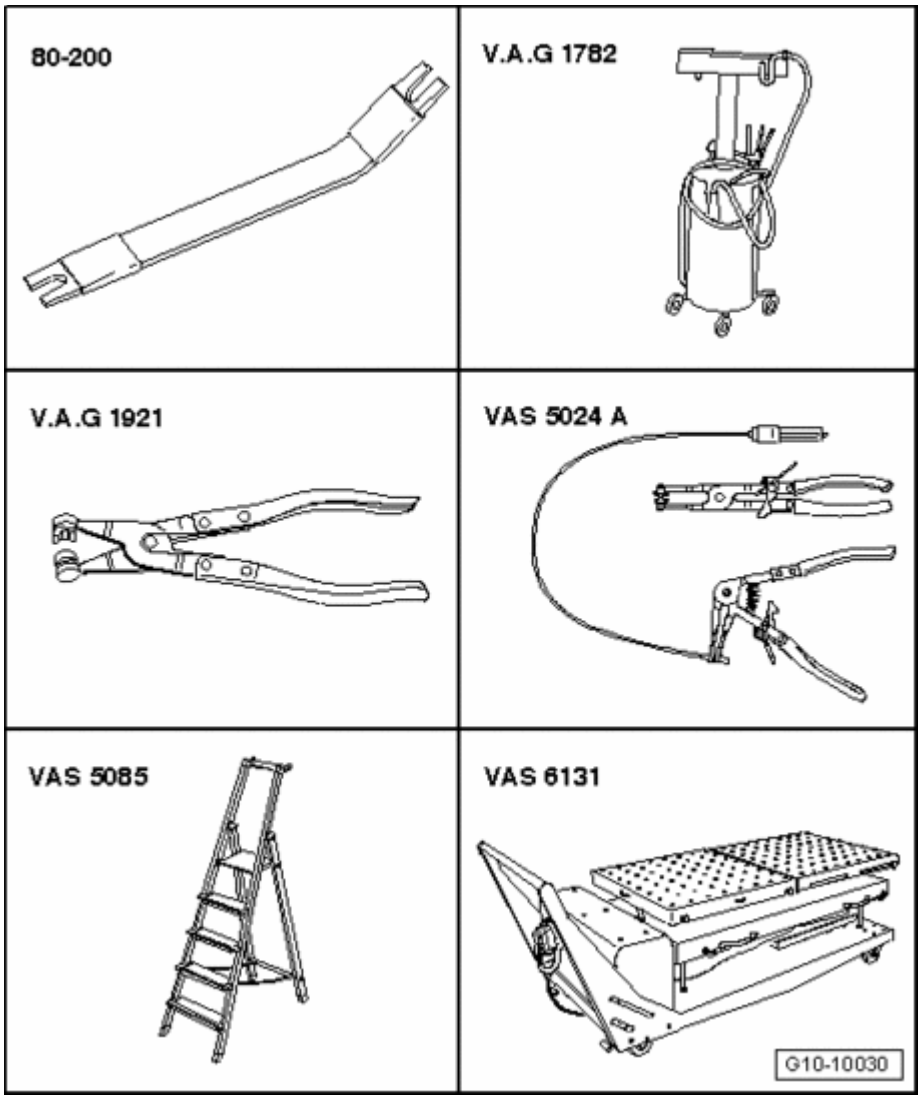

Fig. 13: Identifying Special Tools - Engine, Removing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Pry Lever - Rmv Outside Mirror 80-200
- Old oil collecting and extracting device V.A.G 1782
- Hose clamp pliers V.A.G 1921
- Hose clip pliers VAS 6340 (formerly: VAS 5024 A)
- Step ladder VAS 5085
- Scissor lift table VAS 6131 with support set VAS 6131/10 and adapters VAS 6131/10-12 (qty. 2)

Special tools, testers and auxiliary items required

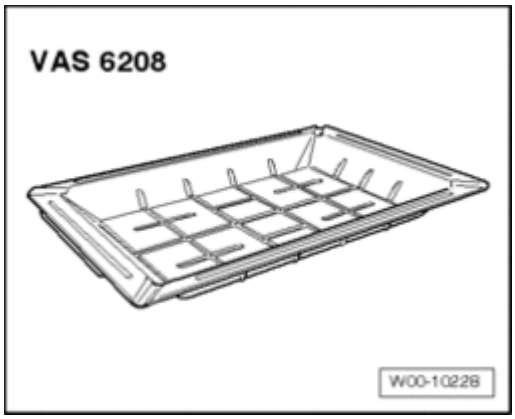

Fig. 14: Drip Tray For Workshop Crane VAS 6208
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Drip tray for workshop crane VAS 6208

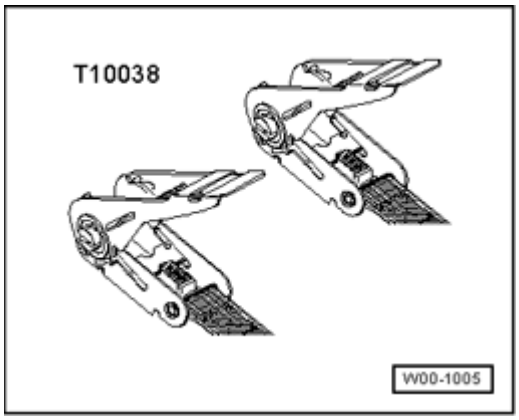

Fig. 15: Tensioning Strap T10038
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tensioning Strap T10038

NOTE:

- **If the engine should be separated from transmission after removal, another Adapter VAS 6131/10-12 (qty. 2) set is needed.**

Procedure

CAUTION: Before removing engine, secure vehicle against tipping over. For this the luggage compartment must be empty.

CAUTION: Observe safety precautions when disconnecting the battery --> 27 - STARTER, GENERATOR, CRUISE CONTROL .

NOTE:

- **So that the front wheels can still be turned with the battery disconnected, the battery must only be disconnected with ignition key inserted.**
- **In order for the driveshaft to be able to rotate for removal, the electronic parking brake must be released before disconnecting battery.**

- Remove luggage compartment floor trim.
- Open battery retaining strap if present.

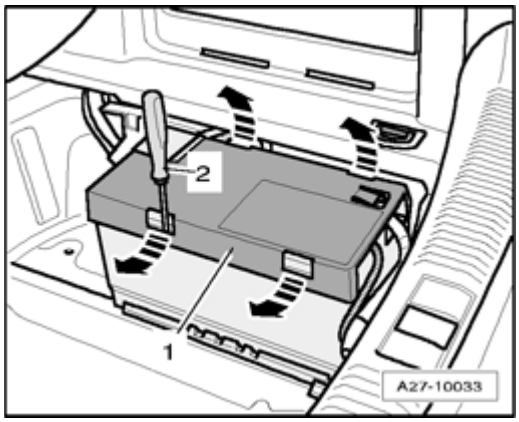

Fig. 16: Releasing Retaining Clips With A Screwdriver And Removing Battery Ground Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Release retaining clips - **arrows** - with a screwdriver - **2** - and remove cover - **1** -.

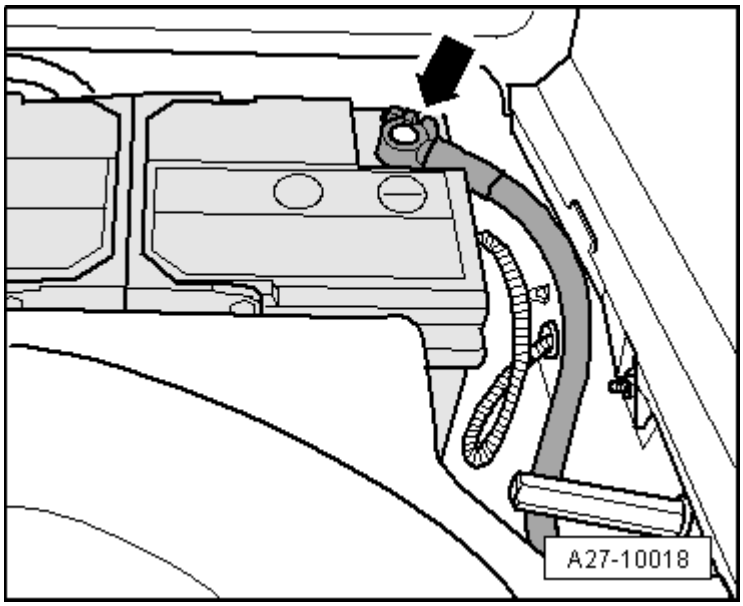

Fig. 17: Disconnecting Ground (GND) Strap At Battery Ground (GND) Terminal
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- With ignition switched off, disconnect Battery Ground (GND) wire - **arrow** -.
- Discharge refrigerant circuit --> Refrigerant R134a - Servicing.

- Extract hydraulic oil for power-steering from reservoir using old oil collecting and extracting device V.A.G 1782.

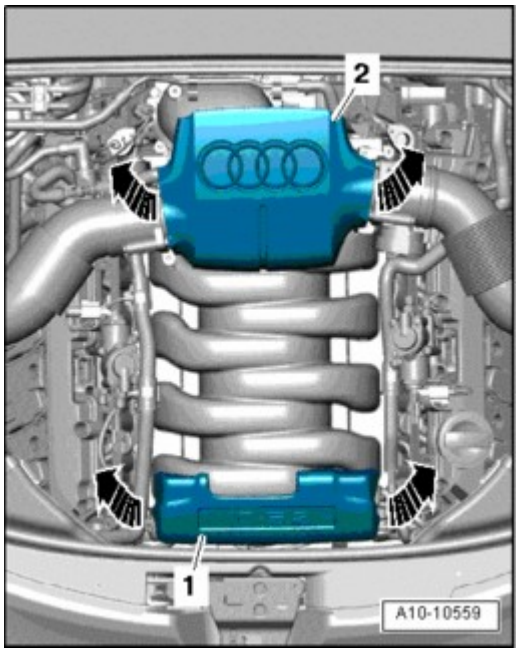

Fig. 18: Removing Rear Engine Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove front engine cover - **1** - and rear - **2** - - **arrows** -.

CAUTION: Cover cap of expansion tank with rag and open carefully, as hot steam i.e. hot coolant may escape when opening.

- Open cap of coolant expansion tank.
- Remove both front wheels.

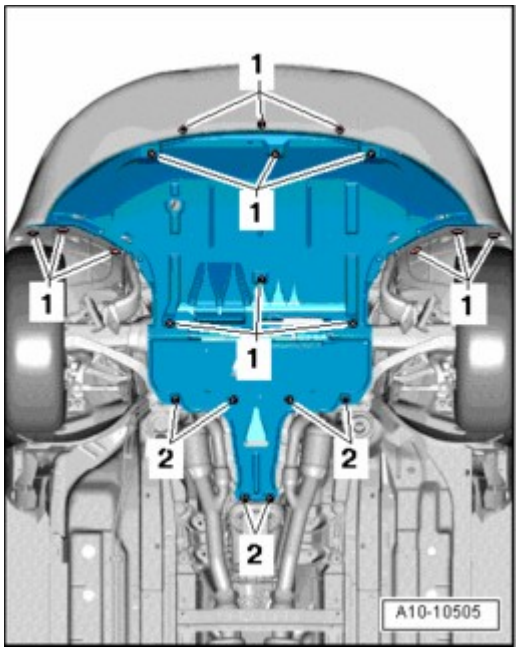

Fig. 19: Identifying Noise Insulation Quick-Release Fasteners
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen quick-release fasteners - **1** - and - **2** - and remove noise insulation.
- Place drip tray for workshop crane VAS 6208 under engine.

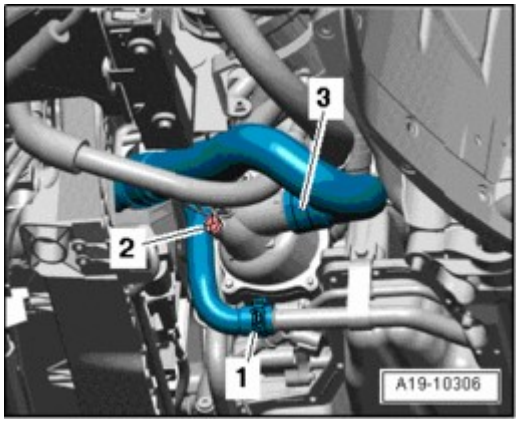

Fig. 20: Removing Drain Plug At Coolant Thermostat Housing & Coolant Hoses
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove drain plug - **2** - at coolant thermostat housing and drain coolant.
- Remove coolant hoses - **1** - and - **3** -.

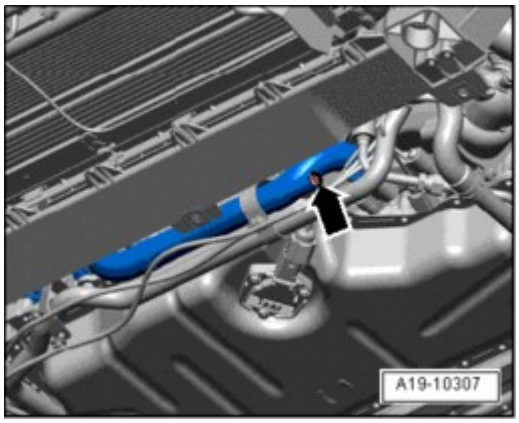

Fig. 21: Removing Drain Plug At Front Coolant Pipe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove drain plug - **arrow** - at front coolant pipe and drain coolant.

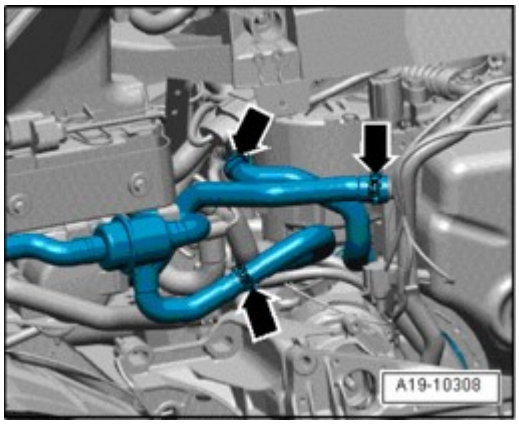

Fig. 22: Disconnecting Coolant Hoses
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect coolant hoses at positions indicated by - **arrows** -.
- Drain remaining coolant.

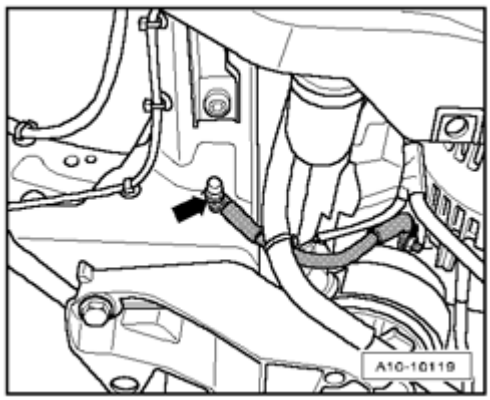

Fig. 23: Removing Ground (GND) Strap From Right Longitudinal Member

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect Ground (GND) cable - **arrow** - from right longitudinal member.

NOTE:

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

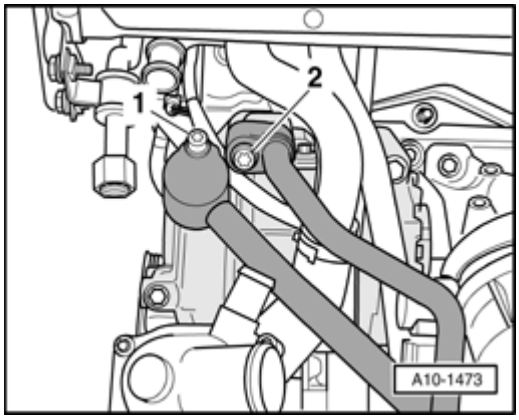

Fig. 24: Removing Bolts & Right Refrigerant Line From A/C Compressor
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **1** - and - **2** -.
- Disconnect refrigerant lines from A/C compressor.
- Seal open connections on A/C compressor using clean plugs.

NOTE:

- **Place a rag under separating point to catch escaping hydraulic fluid.**

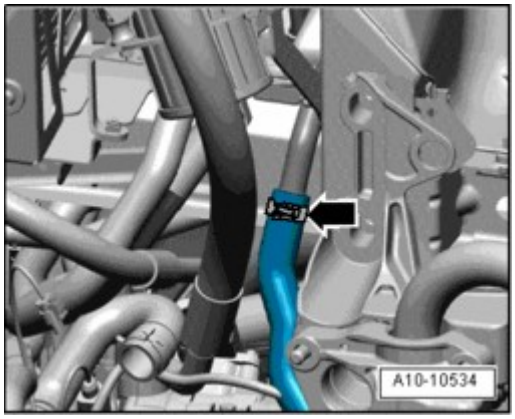

Fig. 25: Removing Hydraulic Hose From Line On Left Longmember
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove hydraulic hose - **arrow** - from line on left longmember.

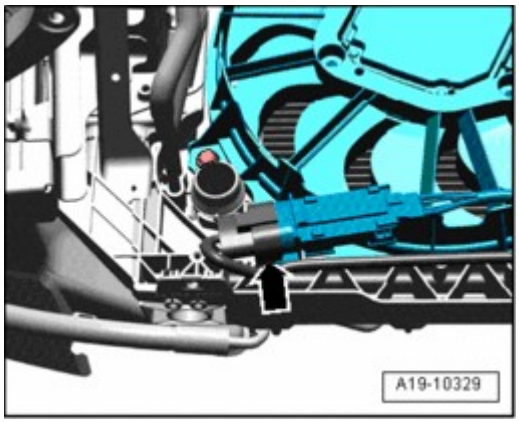

Fig. 26: Disengaging Electrical Connector From Bracket At Left Of Lock Carrier
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disengage electrical connector - **arrow** - from bracket at left of lock carrier.

NOTE:

- **Electrical connector is not disconnected.**

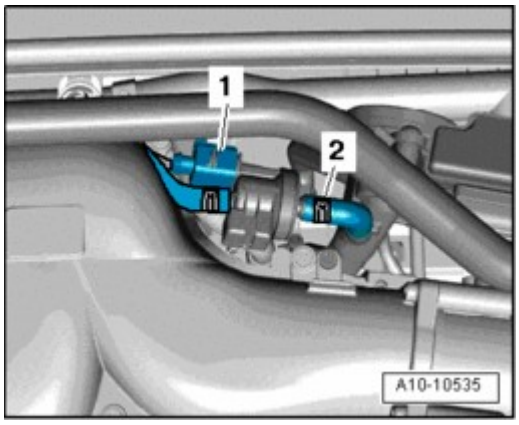

Fig. 27: Disconnecting Electrical Connector On Evaporative Emission (EVAP) Canister Purge Regulator Valve N80 And Removing Vacuum Hose
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connector - **1** - on Evaporative Emission (EVAP) Canister Purge Regulator Valve N80 and remove vacuum hose - **2** -.
- Remove Evaporative Emission (EVAP) Canister Purge Regulator Valve N80 from bracket and lay aside with hose connected.

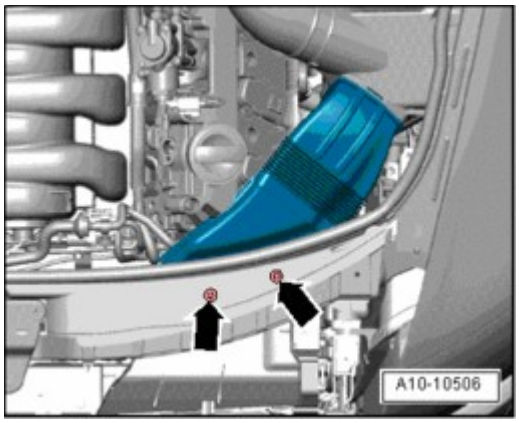

Fig. 28: Removing Bolts And Left Air Duct
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** - and remove left air duct.

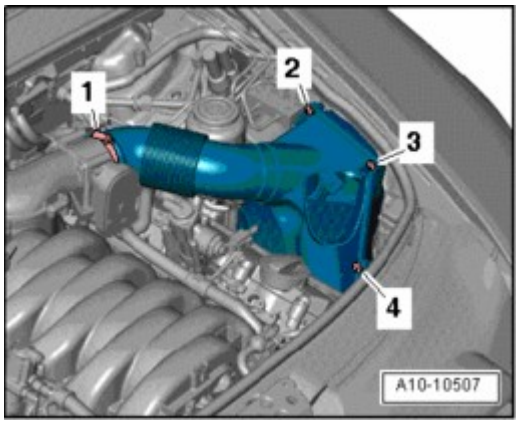

Fig. 29: Identifying Hose Clamps And Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen hose clamp - **1** - and remove screws - **2, 3, 4** -.
- Remove upper part of left air filter housing.

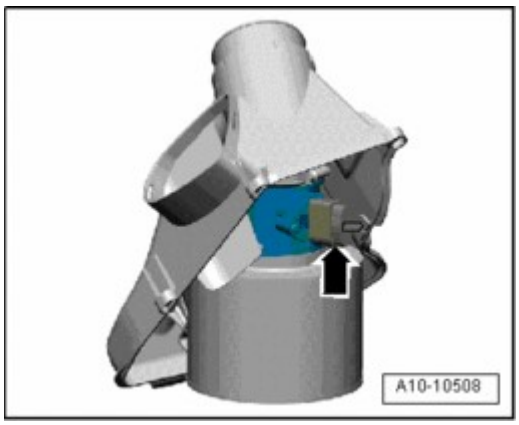

Fig. 30: Identifying Electrical Connector On Mass Air Flow Sensor

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connector - **arrow** - on Mass Air Flow (MAF) Sensor 2 G246.

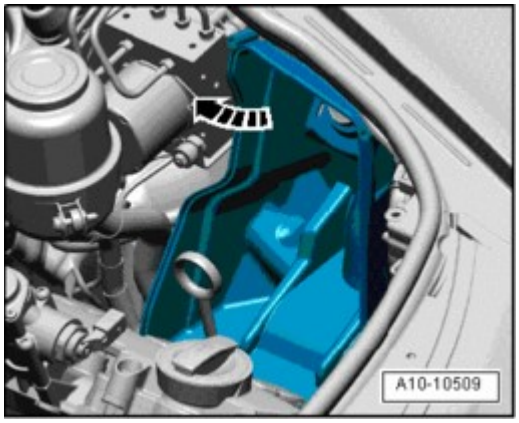

Fig. 31: Removing Lower Part Of Air Filter Housing From Side Connection
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove lower part of air filter housing from side connection.
- Tilt upper part of air filter housing up and out - **arrow** -.

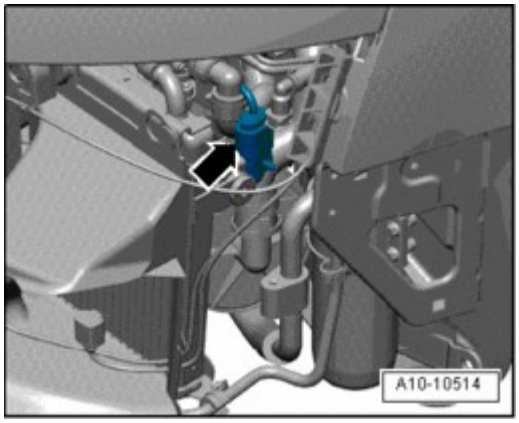

Fig. 32: Disconnecting Secondary Air Injection Electrical Connector
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect secondary air injection electrical connector - **arrow** - below headlamp.
- Free up electrical wiring.

NOTE:

- **To improve clarity, the bumper cover is shown removed.**

- Remove hood seal from lock carrier and from fender edges.

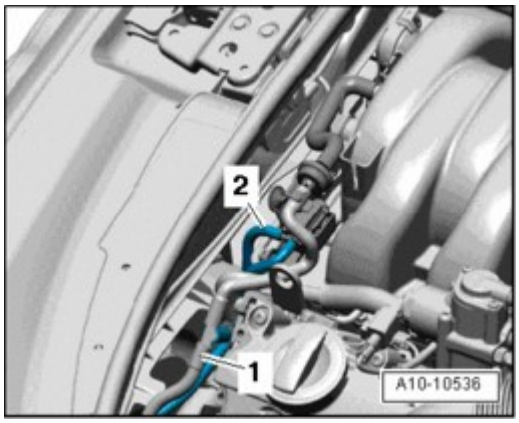

Fig. 33: Disconnecting Vacuum Hoses And Free Them Up
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect vacuum hoses - **1** - and - **2** - and free them up.

NOTE:

- **Place a rag under separating point to catch escaping hydraulic fluid.**

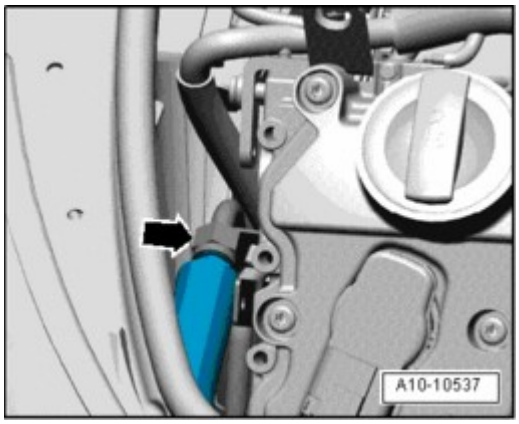

Fig. 34: Disconnecting Power Steering Hydraulic Pressure Line At Left Front On Engine
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect power steering hydraulic pressure line - **arrow** - at left front on engine.

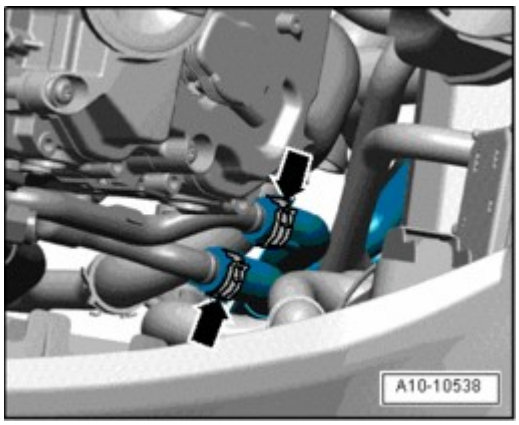

Fig. 35: Disconnect Air Guide Hoses To Secondary Air Injection Combi-Valves
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect air guide hoses - **arrows** - to secondary air injection combi-valves.

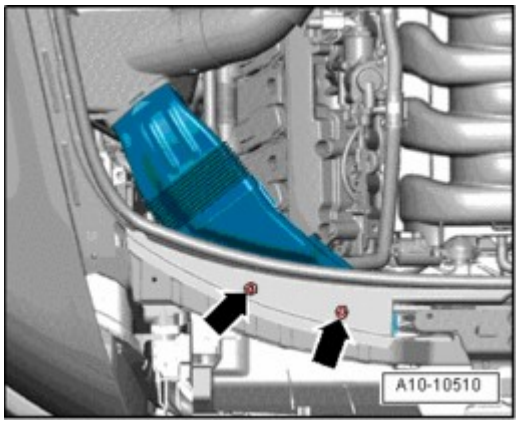

Fig. 36: Identifying Vacuum Hoses And Bolts For Right Air Guide
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** - and remove right air duct.

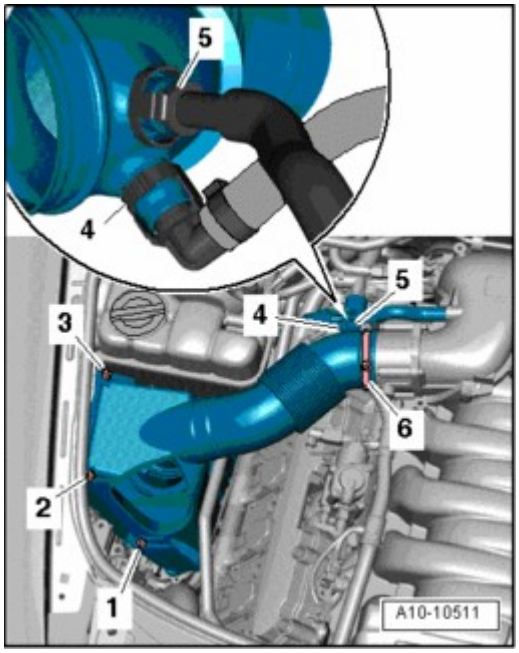

Fig. 37: Identifying Hose Clamps And Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect vacuum hose - **5** - from air guide hose.

CAUTION: Hose connectors - 4 - must not be opened. Lay aside right upper part of air filter housing with connected crankcase ventilation hose.

- Loosen hose clamp - **6** - and remove screws - **1,2, 3** -.
- Remove upper part of right air filter housing.

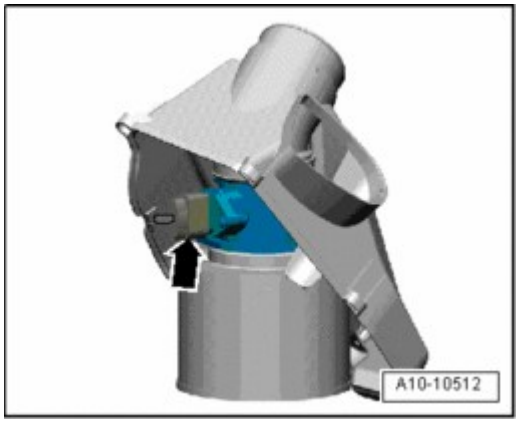

Fig. 38: Identifying Electrical Connector On Mass Air Flow Sensor
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connector - **arrow** - on Mass Air Flow (MAF) Sensor G70.
- Remove lower part of air filter housing from side connection.

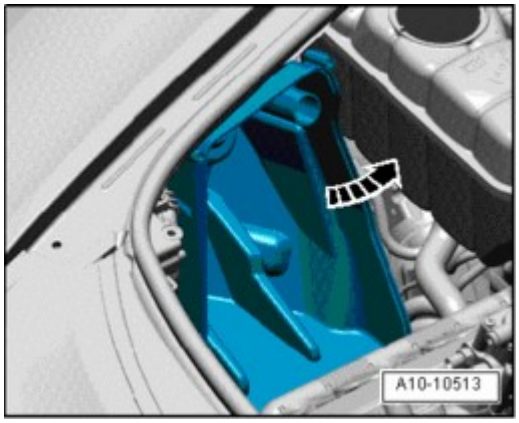

Fig. 39: Tilting Upper Part Of Air Filter Housing Up/Out
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tilt upper part of air filter housing up and out - **arrow** -.

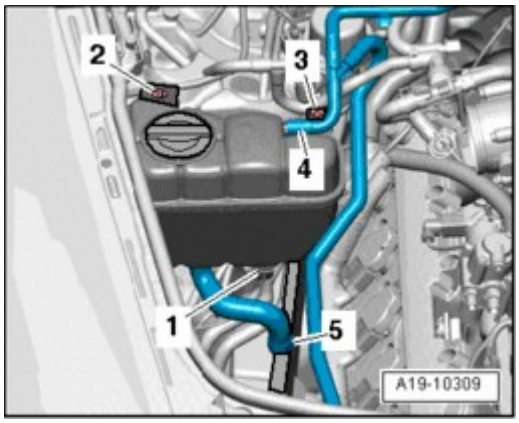

Fig. 40: Identifying Bolts And Coolant Hoses
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove coolant hoses - **4** - and - **5** - from coolant reservoir and coolant pipe.
- Disconnect electrical connector - **1** - on Engine Coolant Level (ECL) Warning Switch F66 at bottom of coolant expansion tank.
- Remove bolts - **2** - and - **3** - and remove coolant reservoir.

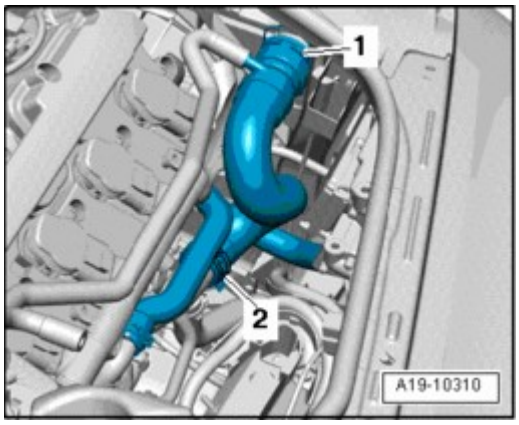

Fig. 41: Removing Coolant Hose From Radiator And Right Coolant Pipe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove coolant hose - **1** - from radiator and right coolant pipe - **2** -.
- Lay coolant hose on engine.

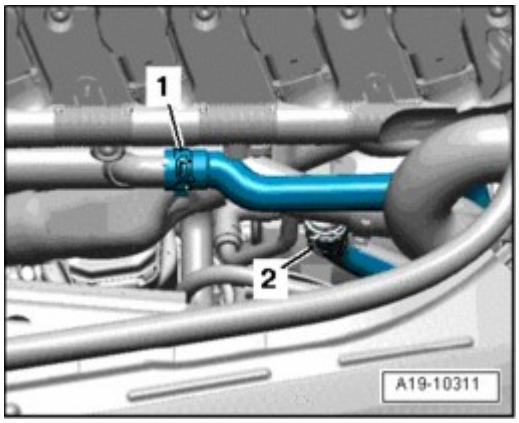

Fig. 42: Removing Coolant Hoses From Right Coolant Pipe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove coolant hoses - **1** - and - **2** - from right coolant pipe.

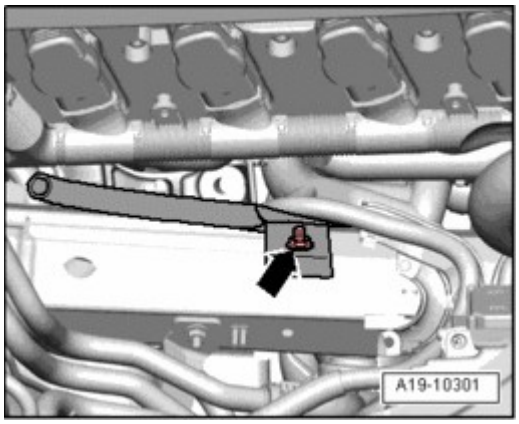

Fig. 43: Removing Nut And Coolant Pipe From Right Longmember
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove nut - **arrow** - and remove coolant pipe from right longmember.

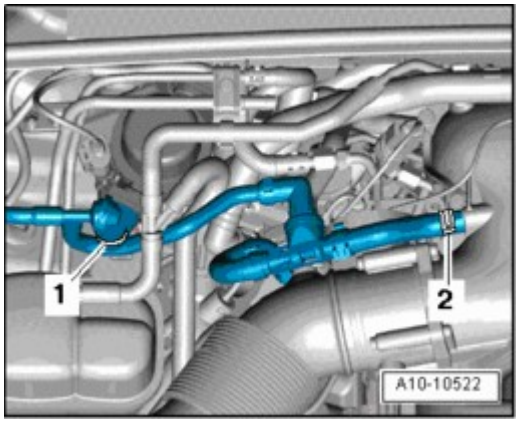

Fig. 44: Removing Vacuum Hoses
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove vacuum hoses - **1** - and - **2** -.

CAUTION: Fuel system is under pressure! Before opening system, place clean rags around the connection. Then release pressure by carefully loosening the connection.

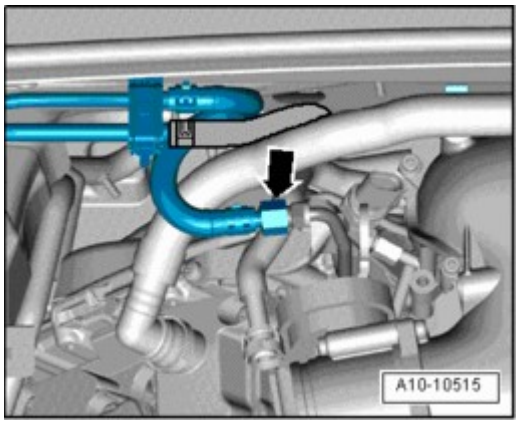

Fig. 45: Disconnecting Fuel Supply Line On Distribution Piece
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect fuel supply line - **arrow** - on distribution piece.

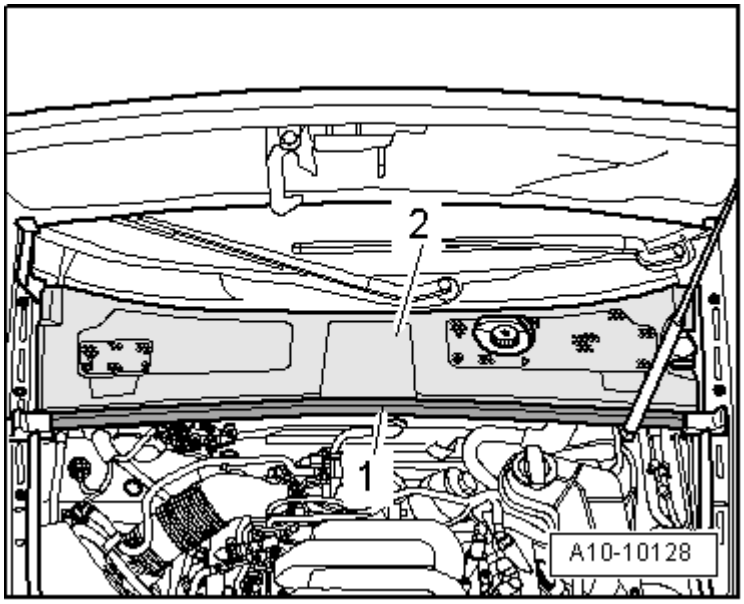

Fig. 46: Removing Rubber Seal For Plenum Chamber Cover & Plenum Chamber Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove rubber seal - **1** - and remove plenum chamber cover - **2** -.

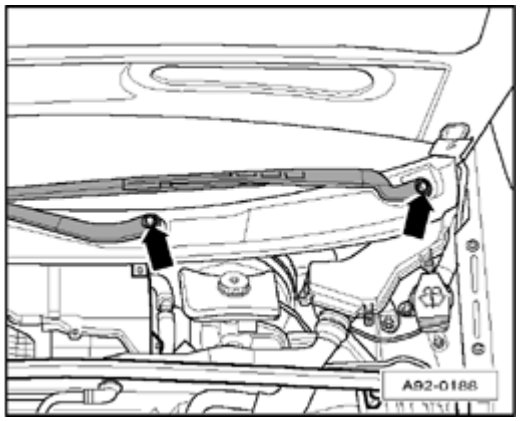

Fig. 47: Identifying Wiper Arm Nuts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pry out cover caps on windshield wiper arms with a screwdriver and loosen nuts - **arrows** - a few turns.
- Loosen wiper arms by tilting slightly from windshield wiper axle.
- Remove nuts completely and remove wiper arms.

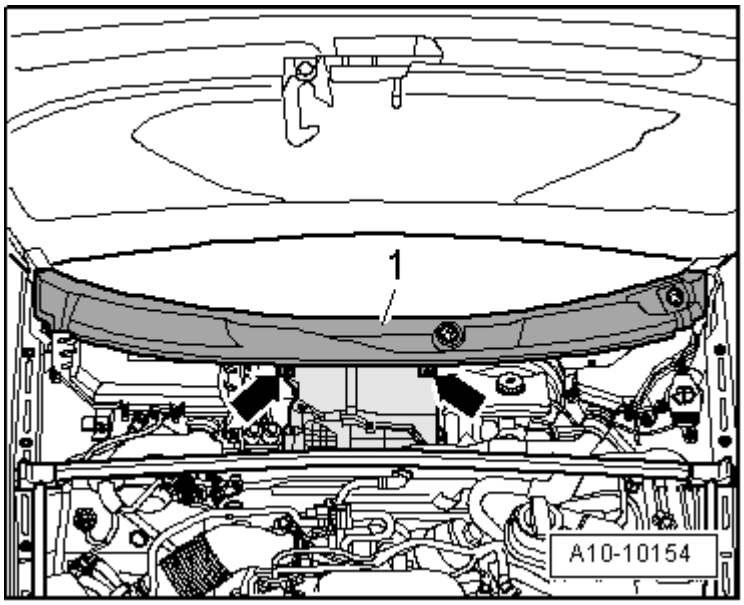

Fig. 48: Removing Bolts For Cowl Grill
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** - and remove cowl grille - **1** - from windshield.

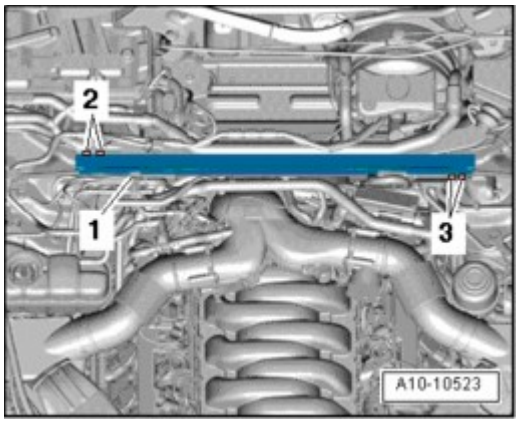

Fig. 49: Removing Bracket From Suspension Strut Transverse Beam & Bolts And Suspension Strut Transverse Beam
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bracket - **1** - from suspension strut transverse beam.
- Remove bolts - **2** - and - **3** - and remove suspension strut transverse beam.

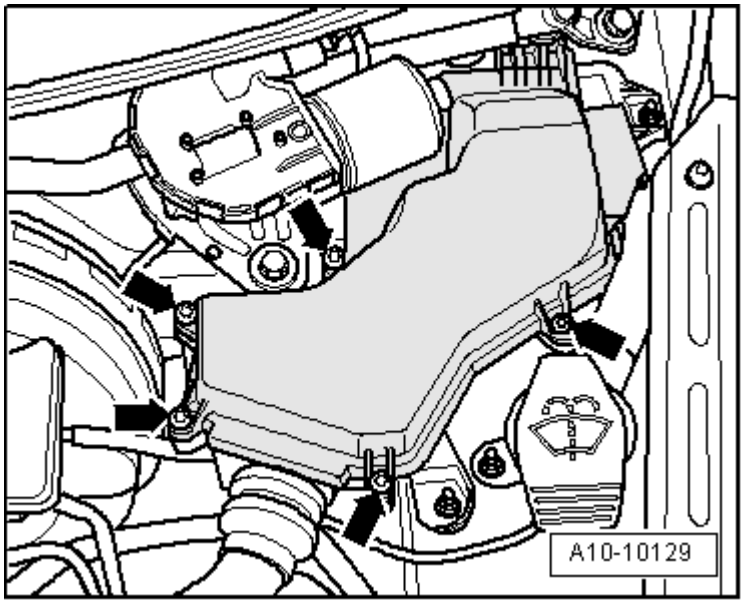

Fig. 50: Removing Bolts And Cover Form E-Box At Left In Engine Compartment
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** - and remove cover form E-box at left in engine compartment.

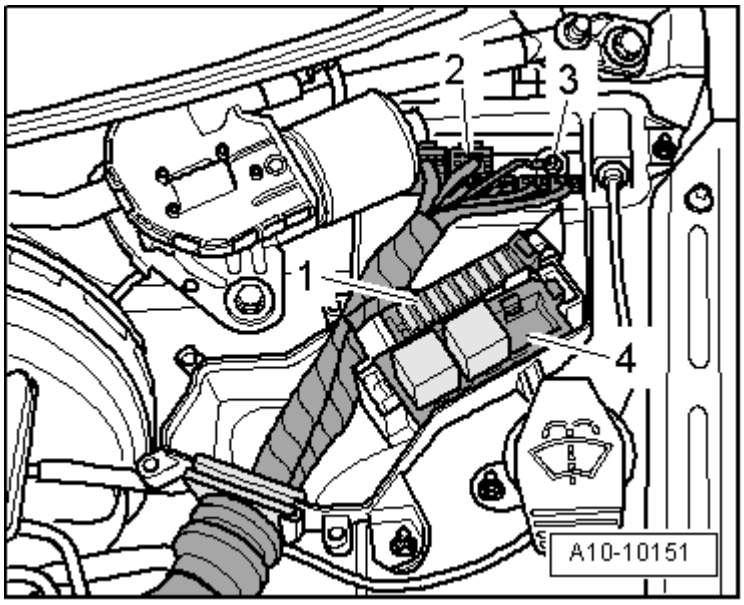

Fig. 51: Identifying Fuse Holder, 3-Socket Relay Carrier, Electrical Wire Connection & Electrical Connections
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Release retaining tabs and pull fuse holder - **1** - and 3-socket relay carrier - **4** - upward and off.
- Remove electrical wire connection - **3** -.
- Disconnect all electrical connections - **2** - at rear on connector strip.
- Disengage and free up engine wiring harness at E-Box.

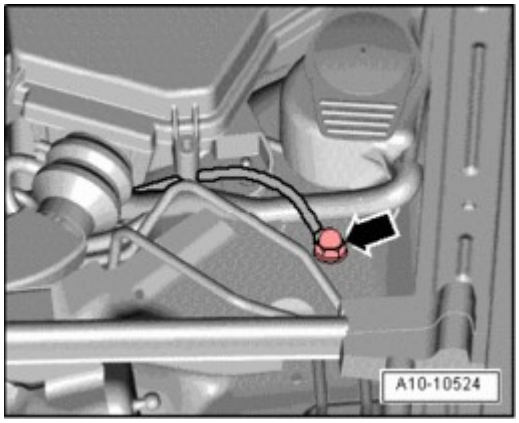

Fig. 52: Removing Ground (Gnd) Cable At Left In Plenum Chamber
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove Ground (GND) cable - **arrow** - at left in plenum chamber.

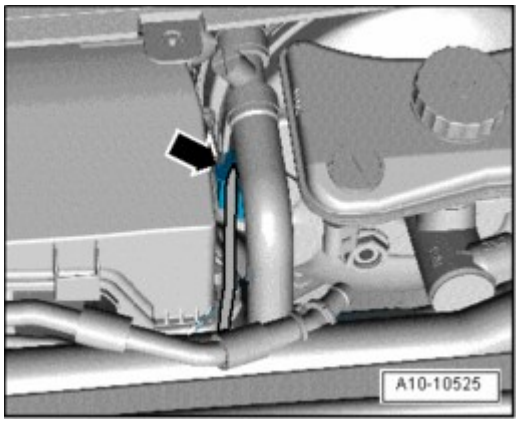

Fig. 53: Disconnecting Electrical Harness Connector At Brake Booster Pressure Sensor G294
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical harness connector - **arrow** - at Brake Booster Pressure Sensor G294.

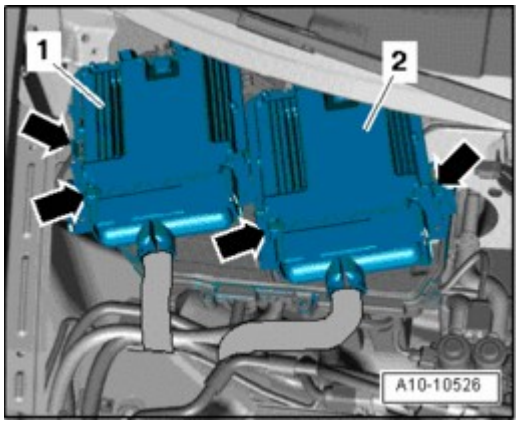

Fig. 54: Releasing Retaining Clips And Removing ECM
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Release retaining clips - **arrows** - and remove ECM - **1** - and - **2** -.

NOTE:

- **The ECMs remain connected to the wiring harness.**

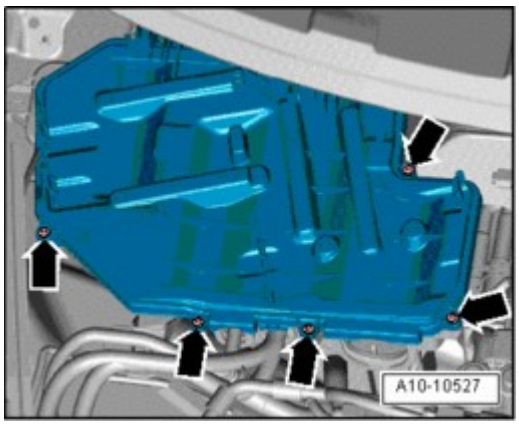

Fig. 55: Removing Bolts And Cover For E-Box At Right In Engine Compartment
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** - and remove cover for E-box at right in engine compartment.

CAUTION: The heater pump valve unit (at left in front of the E-box) becomes very hot during operation and could cause burns.

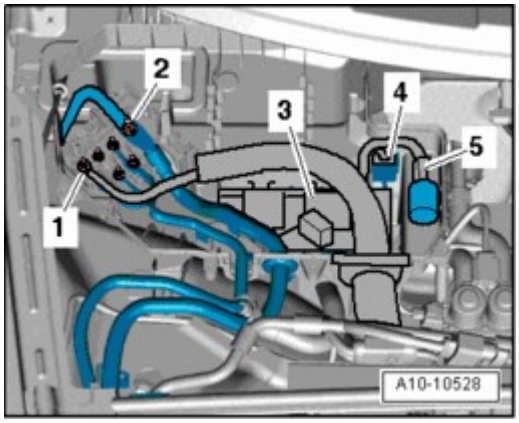

Fig. 56: Identifying Suppressor, Electrical Harness Connector, And Main Fuse Carrier
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unclip suppression capacitor - **5** - from bracket in E-box.
- Disconnect electrical connection - **4** - at rear on connector strip.
- Remove electrical wiring connections - **1** - and - **2** -.
- Unclip relay carrier - **3** - from bracket in E-box.

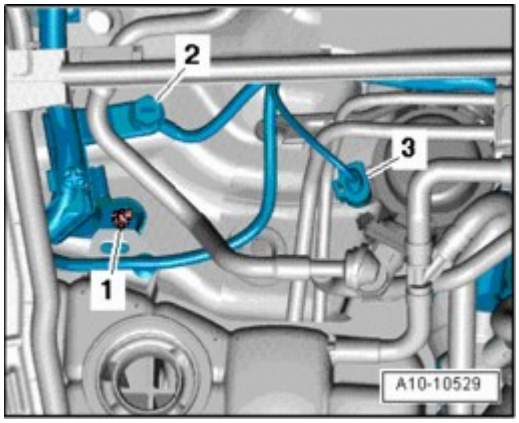

Fig. 57: Removing Bolts & Disconnecting Electrical Connector On Brake System Vacuum Pump V192
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **1** - and - **2** -.
- Disconnect electrical connector - **3** - on Brake System Vacuum Pump V192.

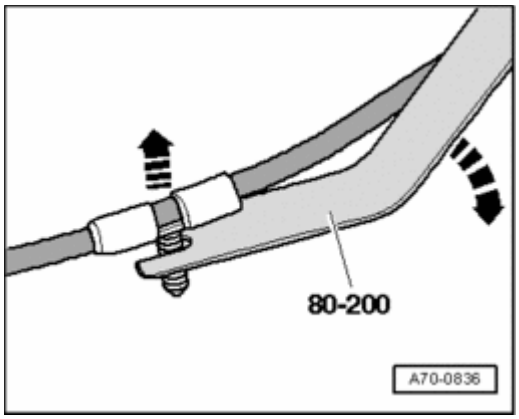

Fig. 58: Free Electrical Wiring Up To Generator Using Pry Lever - Rmv Outside Mirror 80-200
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Free electrical wiring up to generator using Pry Lever - Rmv Outside Mirror 80-200.

NOTE:

- **If necessary, use silicon-free spray lubricant to facilitate removal of wiring clips.**

- Set wiring harnesses on engine and secure Engine Control Modules (ECM) against falling down.
- Have a second technician press brake pedal.

CAUTION: To loosen collar bolt for drive axle, the wheel bearing must not be under load (vehicle must not be standing on its wheels).

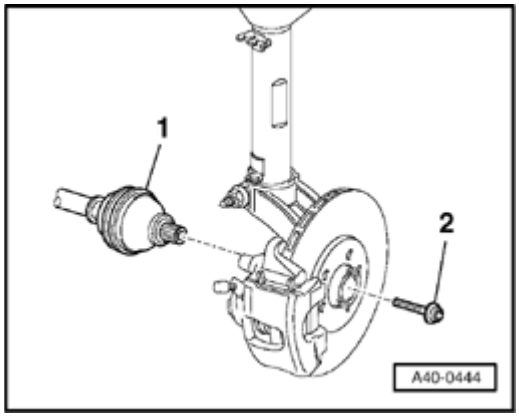

Fig. 59: Removing Collar Bolt At Left/Right Drive Axles
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove collar bolt - **2** - at left and right drive axles - **1** -.

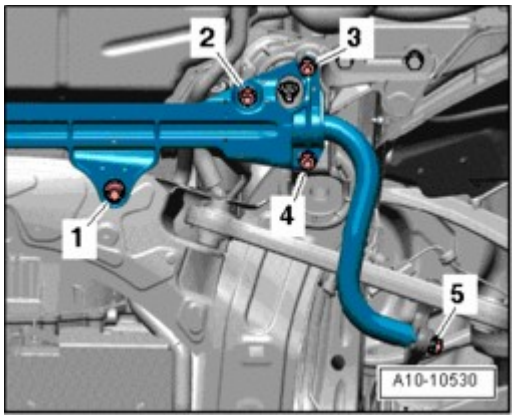

Fig. 60: Removing Stabilizer Bar Left/Right Bolts And Nuts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove left and right bolts and nuts - **1 through 5** -.
- Remove stabilizer bar with cross beam.

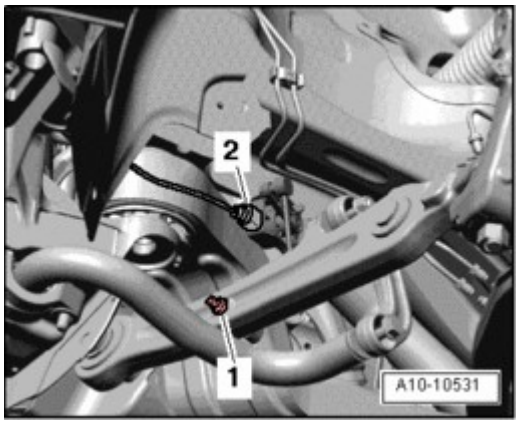

Fig. 61: Disconnecting Electrical Harness Connector At Level Control System Sensor & Connecting Link From Control Arm
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical harness connector - **2** - at Level Control System Sensor.
- Disconnect connecting link - **1** - from control arm.

CAUTION: Wheel bearing housing must be supported to prevent upper control arm joints from being damaged.

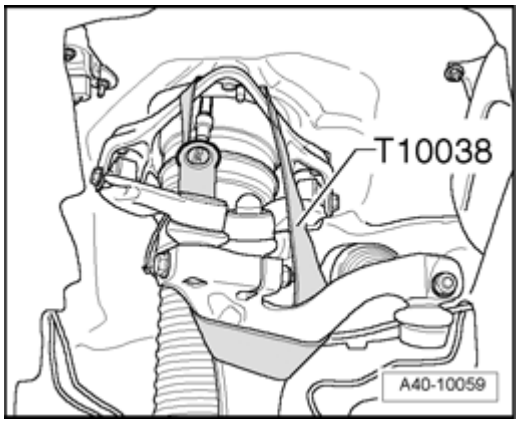

Fig. 62: Tying Up Wheel Bearing Housing With Tension Strap T10038
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tie up wheel bearing housing with Tension Strap T10038 as shown in illustration.

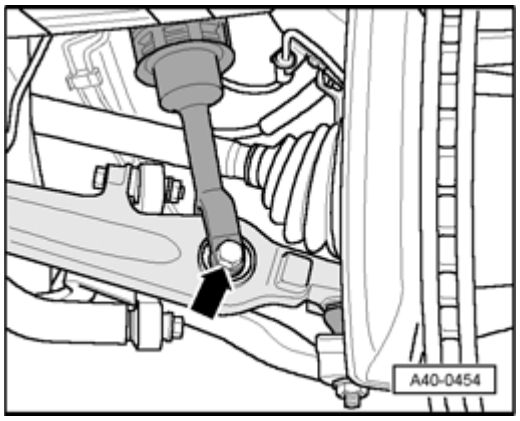

Fig. 63: Removing Bolt And Suspension Strut From Control Arm
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove suspension strut from control arm - **arrow** -.

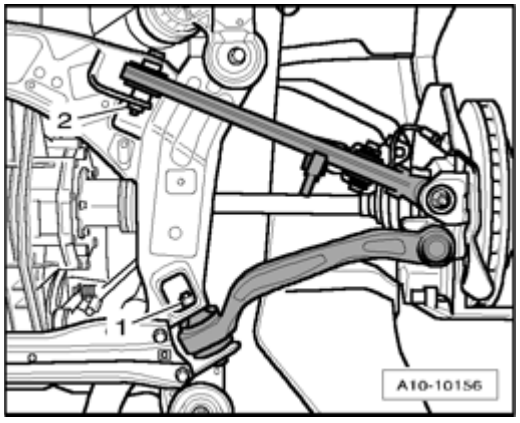

Fig. 64: Removing Guide Control Arm And Control Arm On Subframe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove guide control arm - **1** - and control arm - **2** - from subframe.

CAUTION: Guide control arm and control arm must not hang free. Tie up both control arms on wheel bearing housing - arrows - as shown in illustration.

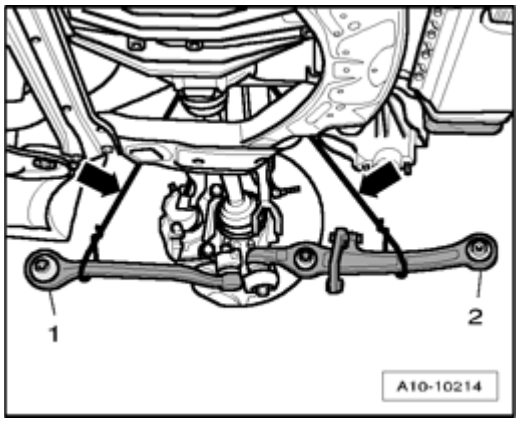

Fig. 65: Swinging Guide Control Arm And Control Arm Outward
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Swing guide control arm - **1** - and control arm - **2** - outward.
- Repeat work procedure on opposite side of the vehicle.
- Remove drive axle from transmission flanged shaft.

CAUTION: Do not damage brake hose!

- Swing wheel bearing housing outward and remove drive axle.
- Repeat work procedure on opposite side of the vehicle.

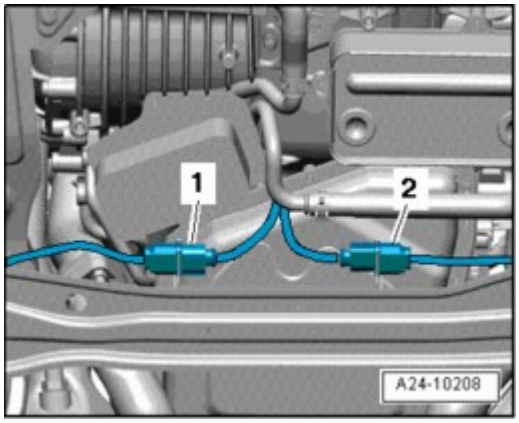

Fig. 66: Removing Electrical Connectors For Heated Oxygen Sensor (HO2S) G39 And For Heated Oxygen Sensor (HO2S) 3 G285 From Bracket
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove electrical connectors - **1** - for Heated Oxygen Sensor (HO2S) G39 and - **2** - for Heated Oxygen Sensor (HO2S) 3 G285 from bracket.

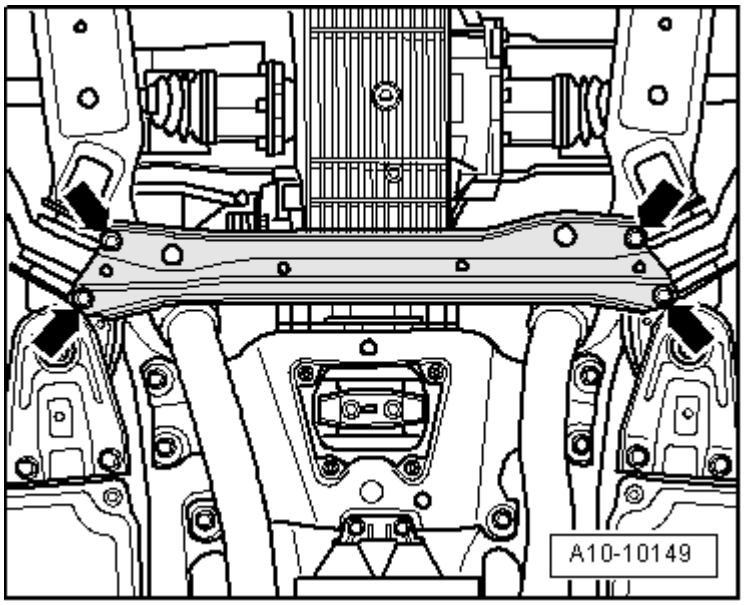

Fig. 67: Removing Subframe Transverse Beam
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove subframe transverse beam - **arrows** -.

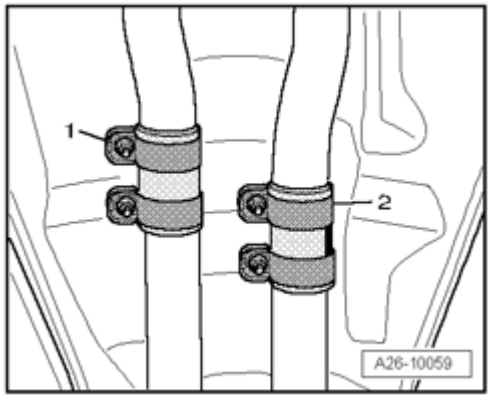

Fig. 68: Loosening Clamping Sleeves
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen clamping sleeves - **1** - and - **2** - and slide them back.

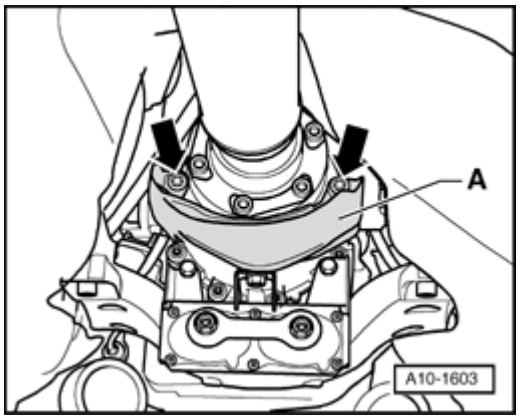

Fig. 69: Removing/Installing Heat Shield For Driveshaft
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove heat shield - **A** - for driveshaft - **arrows** -.
- Remove bolts on transmission/driveshaft connection.
- Slide driveshaft back to rear final drive; constant velocity joints can move axially.

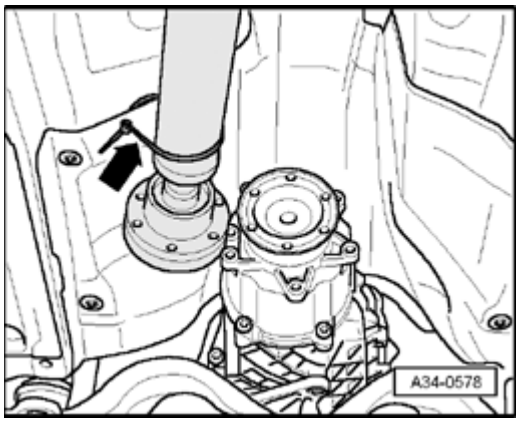

Fig. 70: Drive Shaft Tied To Side, Onto Heat Shield
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tie driveshaft up and to the side against heat shield - **arrow** -.

Prepare scissor lift platform:

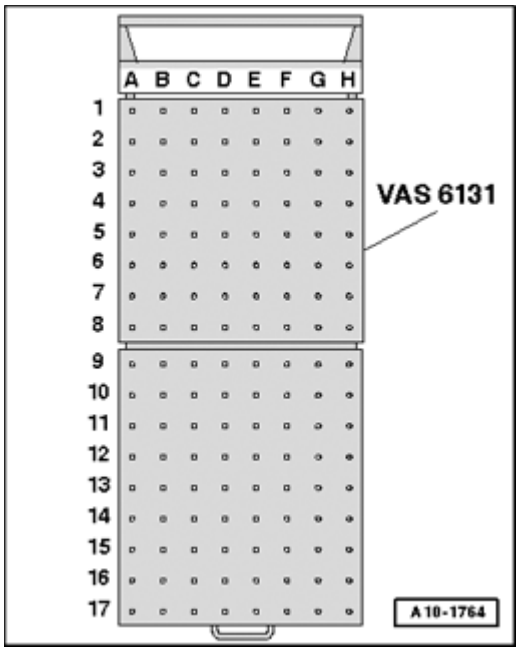

Fig. 71: Identifying Scissor Lift Platform VAS 6131
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Equip scissor lift platform VAS 6131 with support set for Audi VAS 6131/10 as follows:

Platform coordinates	Parts from Support Set VAS 6131/10			
B3	/10-1	/10-4	/10-5	/10-11
G3	/10-1	/10-4	/10-5	/10-11
A11	/10-1	/10-2	/10-5	/10-8
H11	/10-1	/10-2	/10-5	/10-8
F10	/10-1	/10-3	/10-5	/10-13
D11	/10-1	/10-3	/10-5	/10-12
D16	/10-1	/10-2	/10-5	/10-12

- Screw support elements first tightly by hand on scissor lift platform.
- Place scissor lift platform VAS 6131 in horizontal position.

- Note bubble level (sight glass) on support platform.

- Drive scissor lift platform VAS 6131 under engine/transmission subassembly.

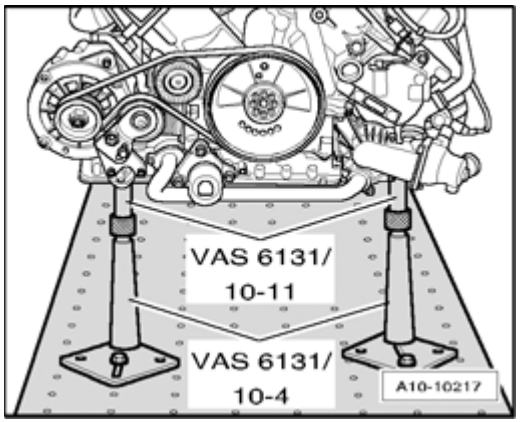

Fig. 72: Positioning Support Elements From VAS 6131/10 At Front On Engine
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position support elements from VAS 6131/10 at front on engine as shown in illustration.

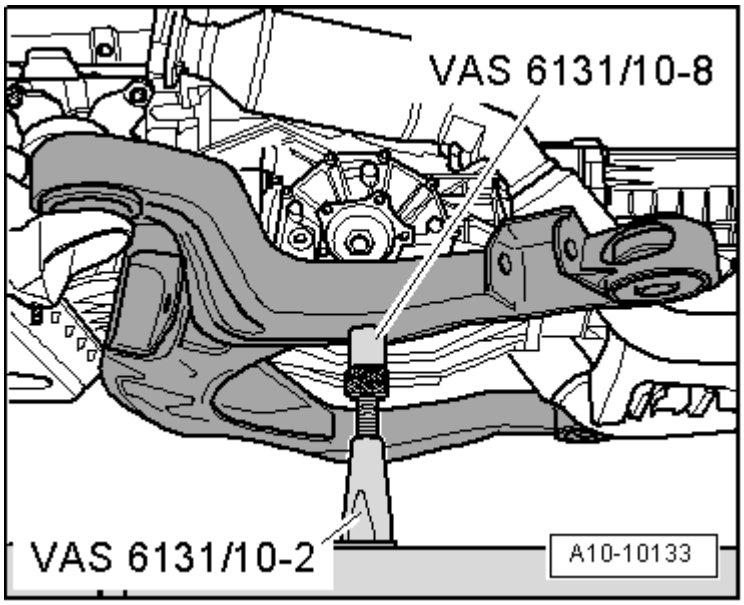

Fig. 73: Positioning Support Elements From VAS 6131/10 At Left/Right On Subframe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position support elements from VAS 6131/10 at left and right on subframe as shown in illustration.

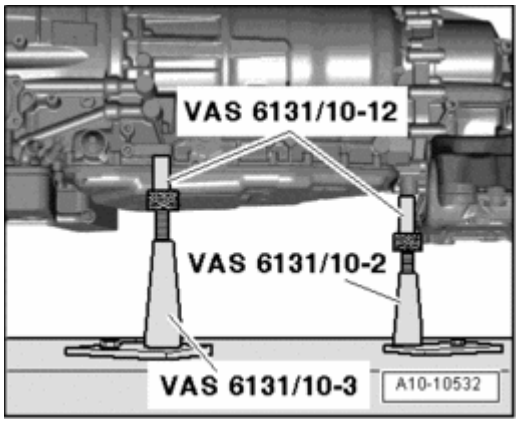

Fig. 74: Positioning Support Elements From VAS 6131/10 At Left Rear On Engine/Transmission
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position support elements from VAS 6131/10 at left rear on engine/transmission as shown in illustration.

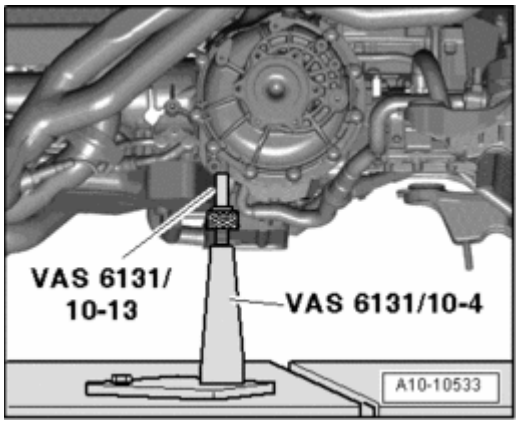

Fig. 75: Positioning Support Elements From VAS 6131/10 At Right On Transmission
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position support elements from VAS 6131/10 at right on transmission as shown in illustration.
- Twist all spindles of support elements upward far enough until all support pins make contact at support points.
- Tighten base plates for support elements to 20 Nm on scissor lift platform VAS 6131.

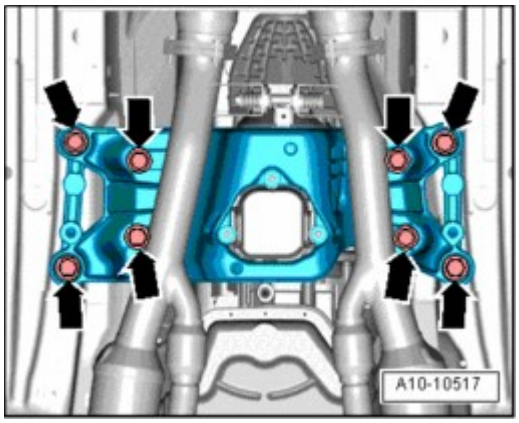

Fig. 76: Removing/Installing Bolts On Tunnel Cross Member
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** - on tunnel cross member.

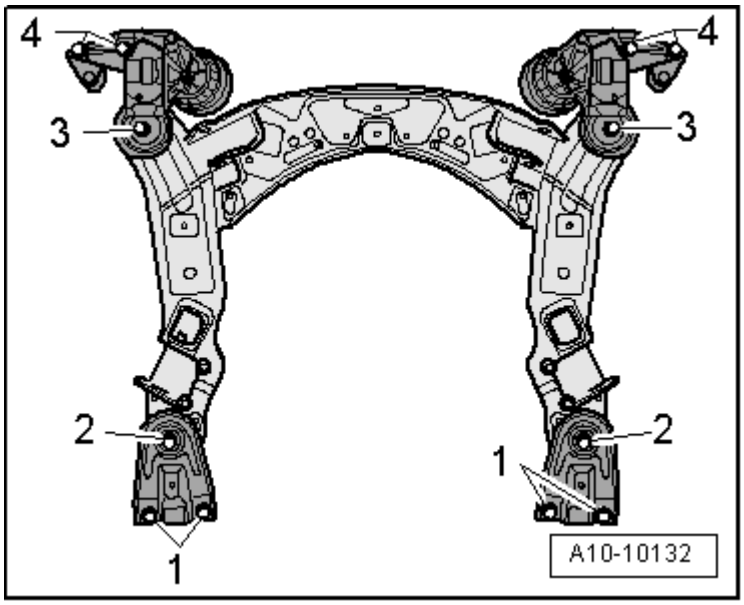

Fig. 77: Engine Mount Plate Bolts Removal/Installing Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **1** -.
- Mark installation position of subframe and of both engine mount consoles to longmembers using a felt-tip marker.
- Remove bolts - **2, 3, 4** - in diagonal sequence and in stages.

NOTE:

- **Verify that all hoses and lines between engine, transmission, subframe and body have been disconnected.**
- **While lowering, carefully guide engine/transmission subassembly with subframe out of engine compartment in order to prevent damage.**

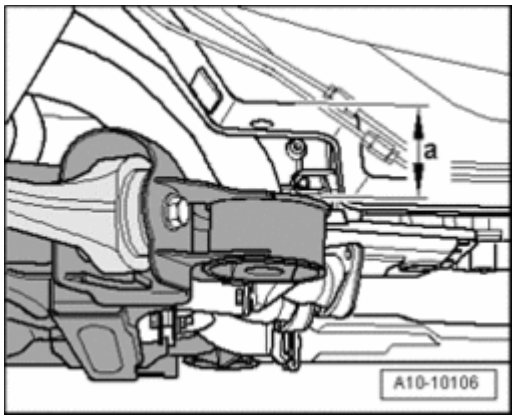

Fig. 78: Lowering Engine/Transmission Assembly Using Scissor Lift Platform VAS 6131 Only Approx. By Dimension
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- First lower engine/transmission assembly using scissor lift platform VAS 6131 only approx. by dimension - **a** -.

- Dimension - **a** - = max. 100 mm.

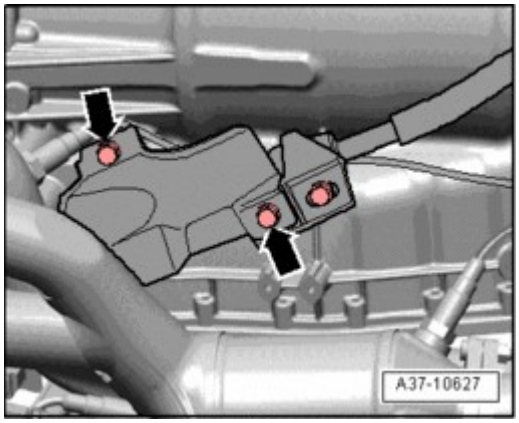

Fig. 79: Removing Bolts & Selector Lever Cable Heat Shield
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** - and remove selector lever cable heat shield.

NOTE:

- **Mark the installation position of bracket for selector lever cable using a felt-tip marker.**

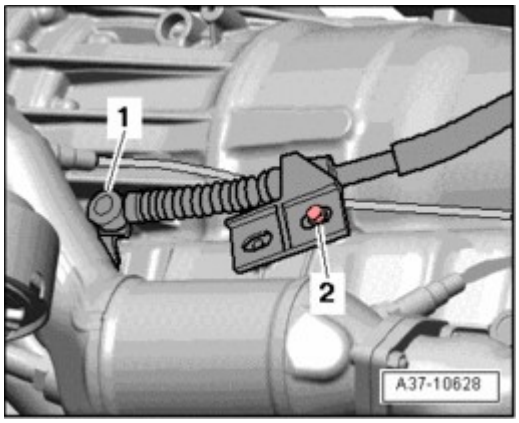

Fig. 80: Identifying Ball Socket & Mounting Bracket
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press ball socket - **1** - of selector lever cable from selector shaft lever.
- Remove mounting bracket - **2** - from transmission.
- Move selector lever cable clear.
- Lower engine/transmission subassembly downward.

- Push scissor lift platform VAS 6131 with engine/transmission subassembly under vehicle.

Engine and Transmission, Separating

Engine and Transmission, Separating

Special tools, testers and auxiliary items required

- Support Element VAS 6131/10-12 (qty. 2)

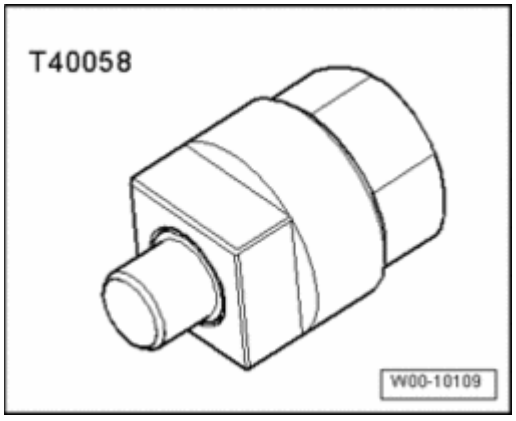

Fig. 81: Adapter T40058
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Adapter T40058

Procedure

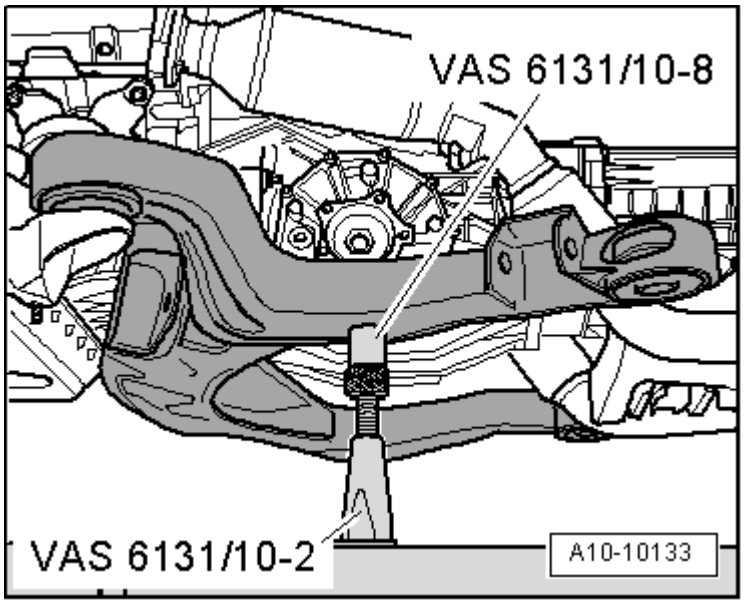

Fig. 82: Positioning Support Elements From VAS 6131/10 At Left/Right On Subframe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Engine/transmission unit removed and attached to scissor lift platform VAS 6131.

  - Twist spindles of support elements at left and right at subframe completely downward.
  - Remove both base plates of the subframe support elements from Scissor Lift Table VAS 6131.
  - Remove subframe to side.

NOTE:

- **The support points for front of engine and transmission remain unchanged.**

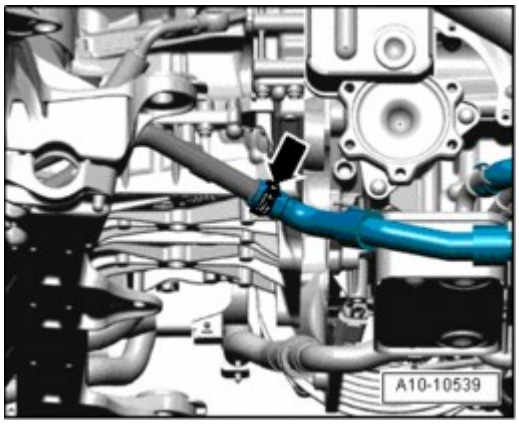

Fig. 83: Removing Coolant Hose From Coolant Pipe At Left Of Engine
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove coolant hose from coolant pipe at left of engine - **arrow** -.

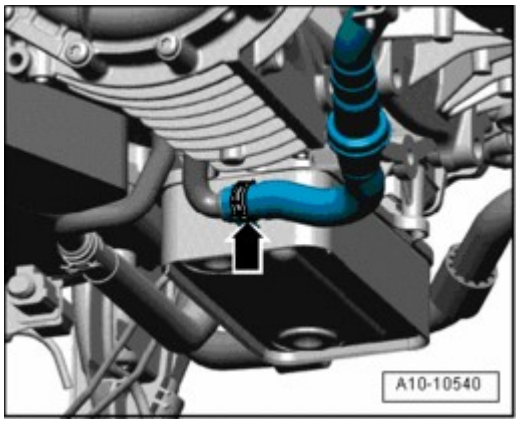

Fig. 84: Removing Coolant Hose From ATF Cooler On Bottom Of Transmission
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove coolant hose from ATF cooler on bottom of transmission - **arrow** -.

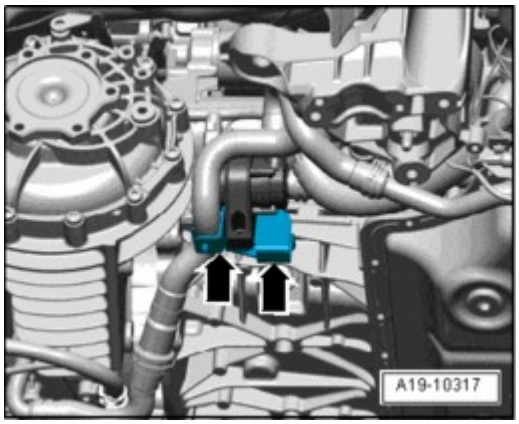

Fig. 85: Removing After-Run Coolant Pump V51
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove After-Run Coolant Pump V51 - **arrows** -.

NOTE:

- **Coolant hoses and electrical connector remain attached.**

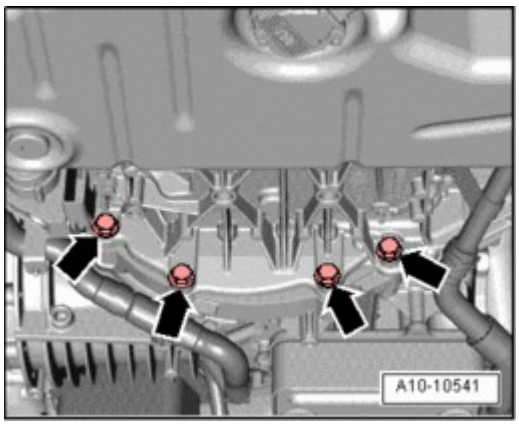

Fig. 86: Removing Bottom Engine/Transmission Connecting Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bottom engine/transmission connecting bolts - **arrows** -.

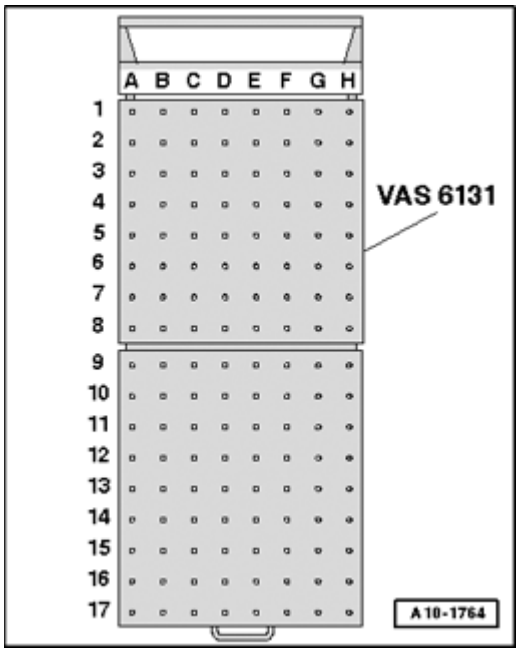

Fig. 87: Identifying Scissor Lift Platform VAS 6131
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Equip Scissor Lift Table VAS 6131 with Support Set VAS 6131/10 as well as 3 Support Elements VAS 6131/10-12 as follows:

Platform coordinates	**Parts from Support Set VAS 6131/10**			
B3 1)	/10-1	/10-4	/10-5	/10-11
G3 1)	/10-1	/10-4	/10-5	/10-11
C7	/10-1	/10-4	/10-5	/10-12
F7	/10-1	/10-4	/10-5	/10-12
F10 1)	/10-1	/10-3	/10-5	/10-13
D11 1)	/10-1	/10-3	/10-5	/10-12
D16 1)	/10-1	/10-2	/10-5	/10-12
1) The support elements remain unchanged.				

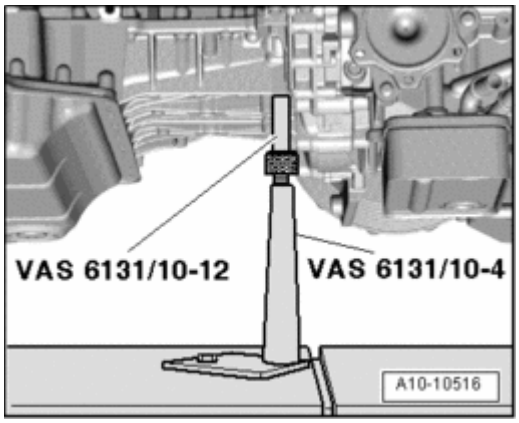

Fig. 88: Positioning/Removing Support Elements From VAS 6131/10 At Left On Engine
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position support elements from VAS 6131/10 at left on engine as shown in illustration.

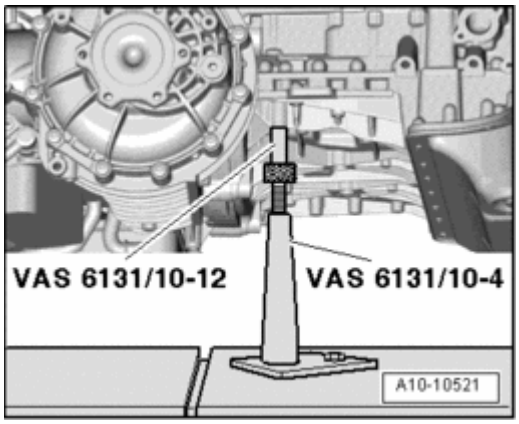

Fig. 89: Positioning/Removing Support Elements From VAS 6131/10 At Right On Engine
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position support elements from VAS 6131/10 at right on engine as shown in illustration.
- Twist spindles of attachments upward far enough until all support pins make contact at support points.
- Tighten base plates for support elements to 20 Nm on scissor lift platform VAS 6131.

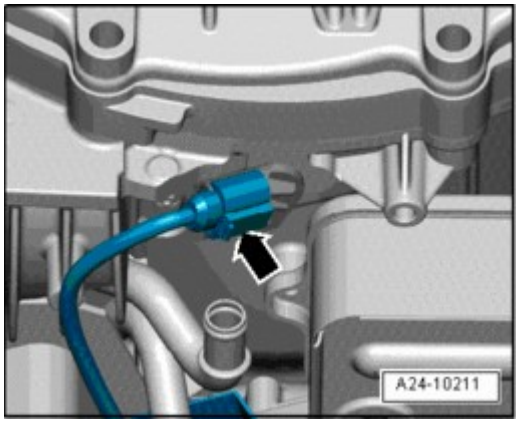

Fig. 90: Disconnecting Electrical Connector On Engine Speed (RPM) Sensor G28
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connector - **arrow** - on Engine Speed (RPM) Sensor G28.

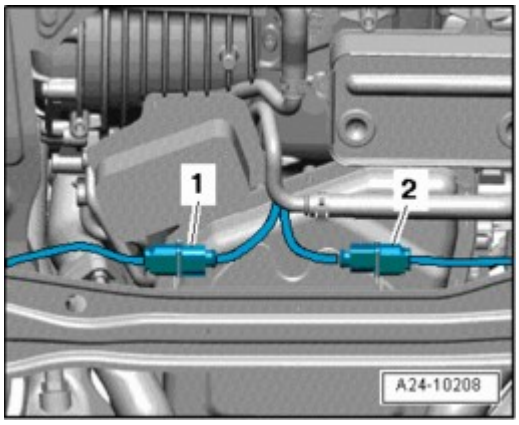

Fig. 91: Removing Electrical Connectors For Heated Oxygen Sensor (HO2S) G39 And For Heated Oxygen Sensor (HO2S) 3 G285 From Bracket
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connectors - **1** - for Heated Oxygen Sensor (HO2S) G39 and - **2** - for Heated Oxygen Sensor (HO2S) 3 G285.

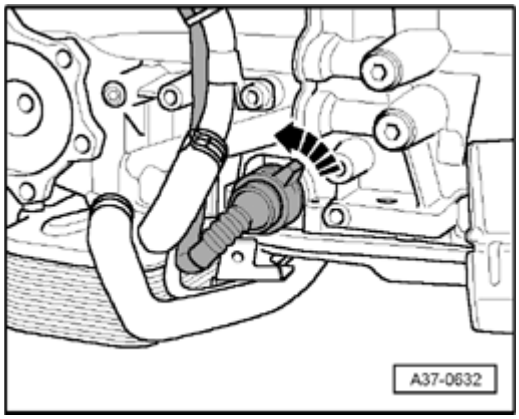

Fig. 92: Disconnecting Electrical Connector At Left On Transmission By Turning Twist Lock Counterclockwise
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connector at left on transmission by turning twist lock counterclockwise - **arrow** -.
- Free up electrical wiring.

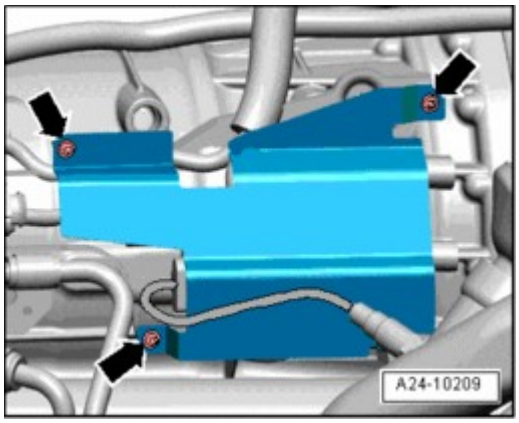

Fig. 93: Removing Right Oxygen Sensor Connection Heat Shield From Transmission
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove right oxygen sensor connection heat shield from transmission - **arrows** -.

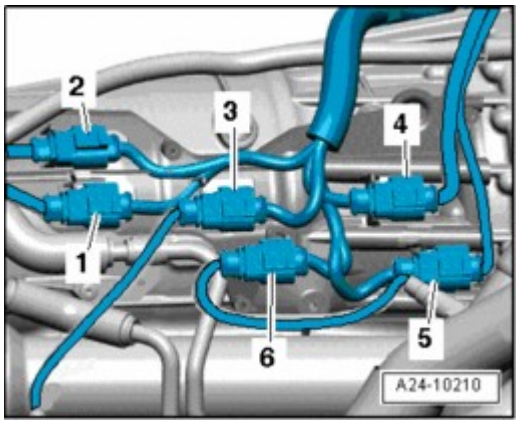

Fig. 94: Removing Oxygen Sensor Electrical Connectors From Bracket On Transmission
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove oxygen sensor electrical connectors - **1 through 6** - from bracket on transmission.
- Disconnect electrical harness connectors.

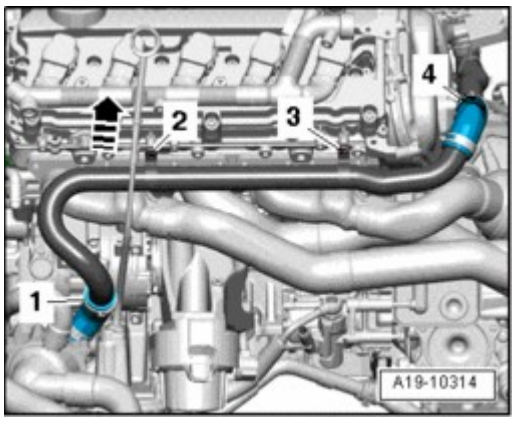

Fig. 95: Removing Bolts, Oil Dipstick Guide Tube Upward & Loosening Hose Clamps And Removing

Left Coolant Pipe From Coolant Hoses
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **2** - and - **3** - and remove oil dipstick guide tube upward - **arrow** -.
- Loosen hose clamps - **1** - and - **4** - and remove left coolant pipe from coolant hoses.

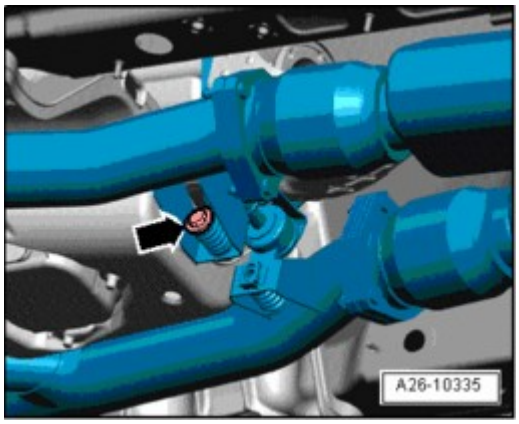

Fig. 96: Removing Bolt At Left Exhaust Tract Strap
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolt - **arrow** - at left exhaust tract strap.

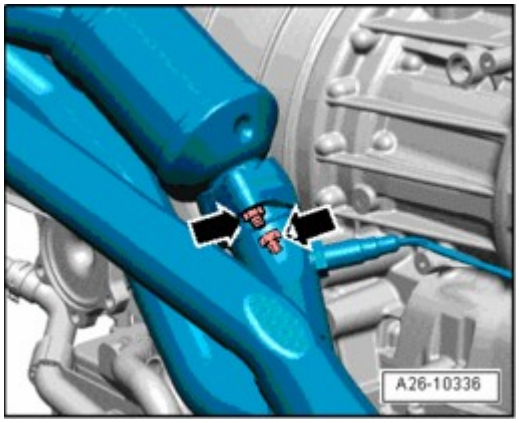

Fig. 97: Removing Nuts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove nuts - **arrows** -.

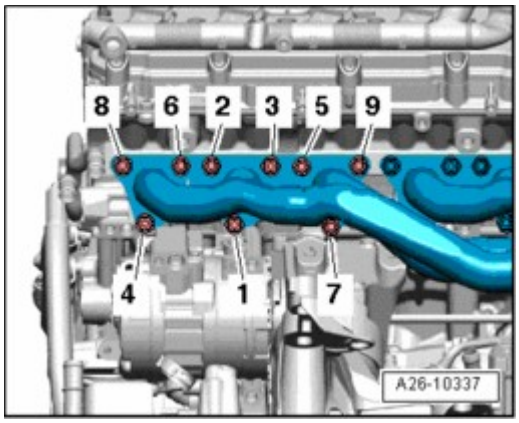

Fig. 98: Removing/Installing Nuts In Sequence And Left Front Exhaust Manifold With Catalytic Converter
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove nuts in - **9 to 1** - sequence and remove left front exhaust manifold with catalytic converter.

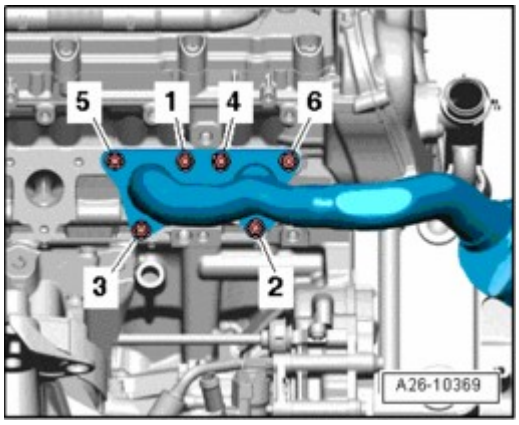

Fig. 99: Removing Nuts In Sequence And Left Rear Exhaust Manifold With Catalytic Converter
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove nuts - **6 to 1** - in sequence and remove left rear exhaust manifold with catalytic converter.

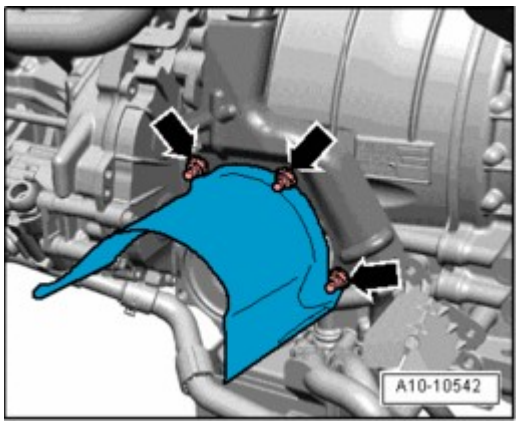

Fig. 100: Removing Left Drive Axle Heat Shield From Transmission

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove left drive axle heat shield from transmission - **arrows** -.

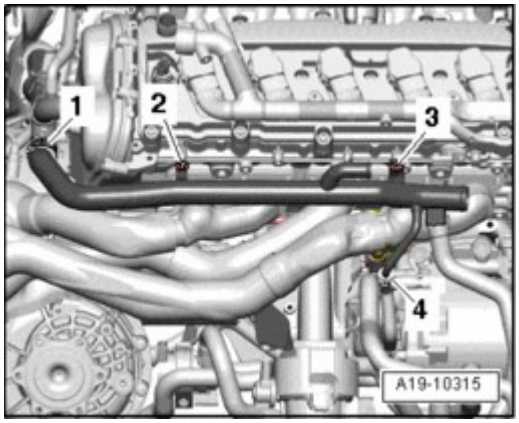

Fig. 101: Removing Bolts, Loosening Hose Clamps And Removing Right Coolant Pipe From Coolant Hoses
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **2** - and - **3** -.
- Loosen hose clamps - **1** - and - **4** - and remove right coolant pipe from coolant hoses.

Fig. 102: Removing Bolt At Right Exhaust Tract Strap
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolt - **arrow** - at right exhaust tract strap.

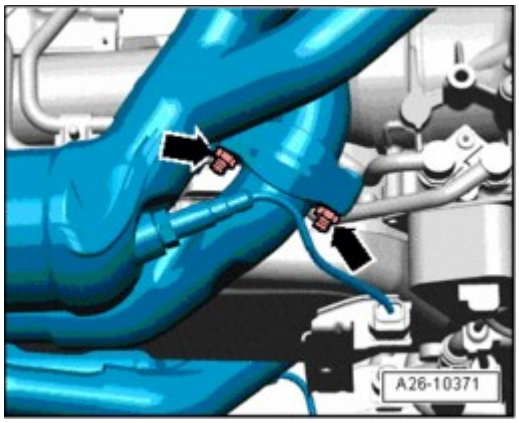

Fig. 103: Removing Nuts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove nuts - **arrows** -.

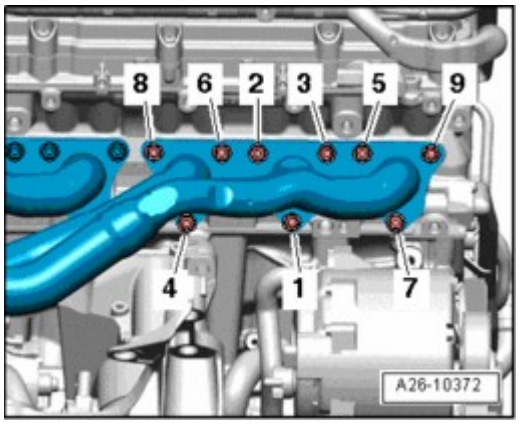

Fig. 104: Removing Nuts In Sequence And Right Front Exhaust Manifold With Catalytic Converter
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove nuts - **9 to 1** - in sequence and remove right front exhaust manifold with catalytic converter.

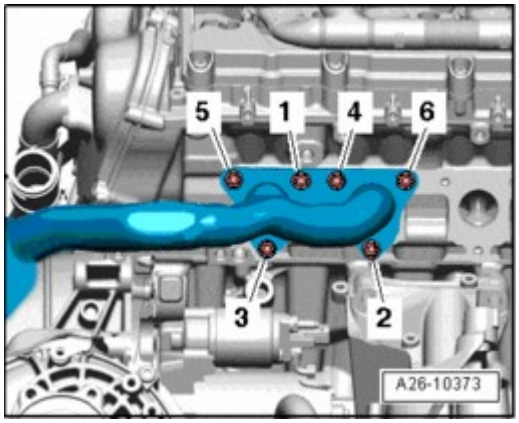

Fig. 105: Removing Nuts In Sequence And Right Rear Exhaust Manifold With Catalytic Converter
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove nuts - **6 to 1** - in sequence and remove right rear exhaust manifold with catalytic converter.

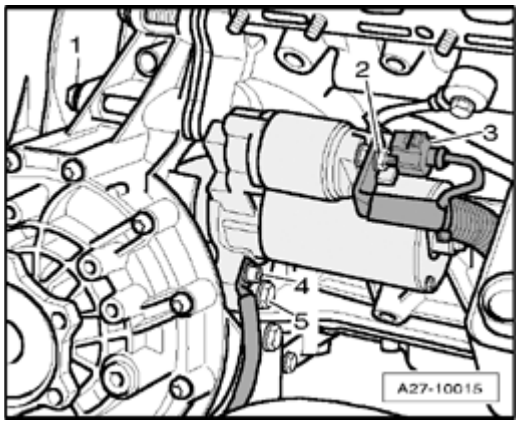

Fig. 106: Identifying Ground Wire, Electrical Wires, Bolts, And Starter
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove Ground (GND) cable - **4** - from starter.
- Disconnect electrical wires - **2** - and - **3** - from starter.
- Remove bolts - **1** - and - **5** - and remove starter.

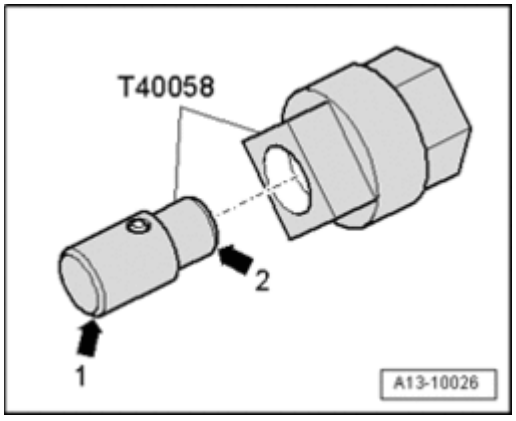

Fig. 107: Inserting Guide Pin Of Adapter T40058 So Small Diameter Points To Engine
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert guide pin of adapter T40058 so that small diameter - **arrow 2** - points to engine. Large diameter - **arrow 1** - points to socket.

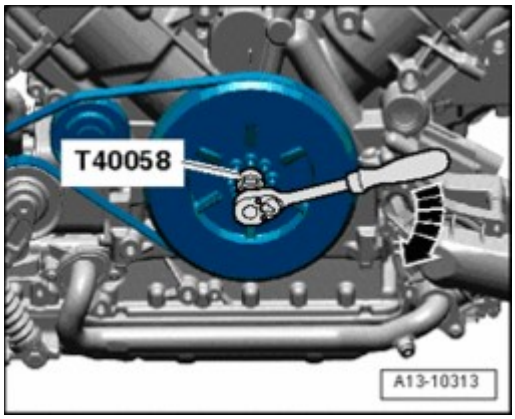

Fig. 108: Using Socket T40058 To Rotate Crankshaft To TDC
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- To loosen torque converter bolts, counterhold crankshaft using adapter T40058.

NOTE:

- **Disregard - arrow -.**

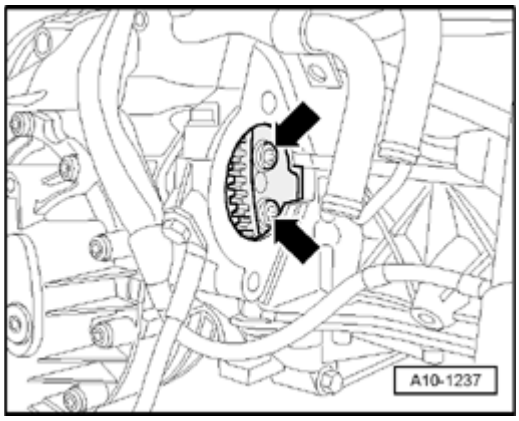

Fig. 109: Removing Torque Converter Bolts In Opening On Removed Starter
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove 6 torque converter bolts - **arrows** - in opening on removed starter (turn crankshaft $^{1}/_{3}$ rotation in each case).

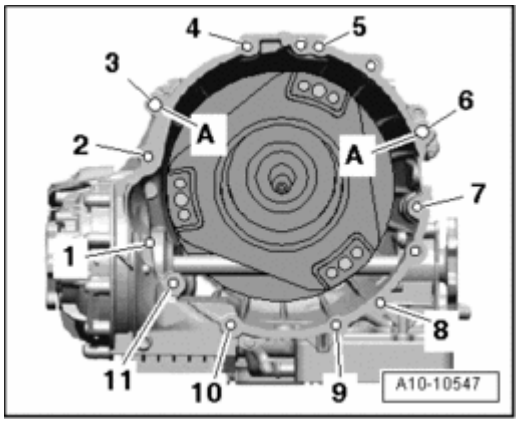

Fig. 110: Removing Engine/Transmission Connecting Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove engine/transmission connecting bolts - **3 to 7** -.

NOTE:

- **Ignore - A -.**

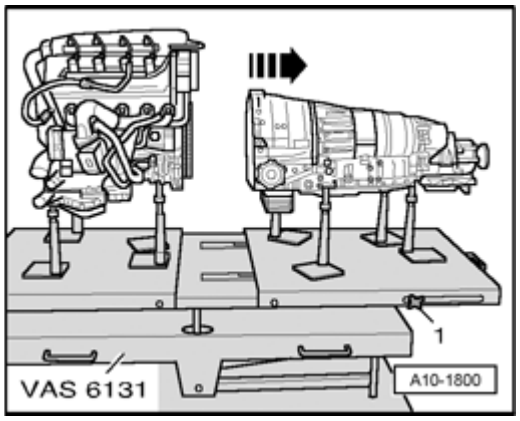

Fig. 111: Loosening Clamping Bolts On Side Of Scissor Lift Table VAS 6131 And Pulling Rear Table Section With Transmission Rearward
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen side clamping screws - **1** - on scissor lift platform VAS 6131 and pull rear platform top with transmission toward rear - **arrow** - , simultaneously push torque converter through opening of drive plate while doing this.

Engine, Securing to Assembly Stand

Engine, Securing to Assembly Stand

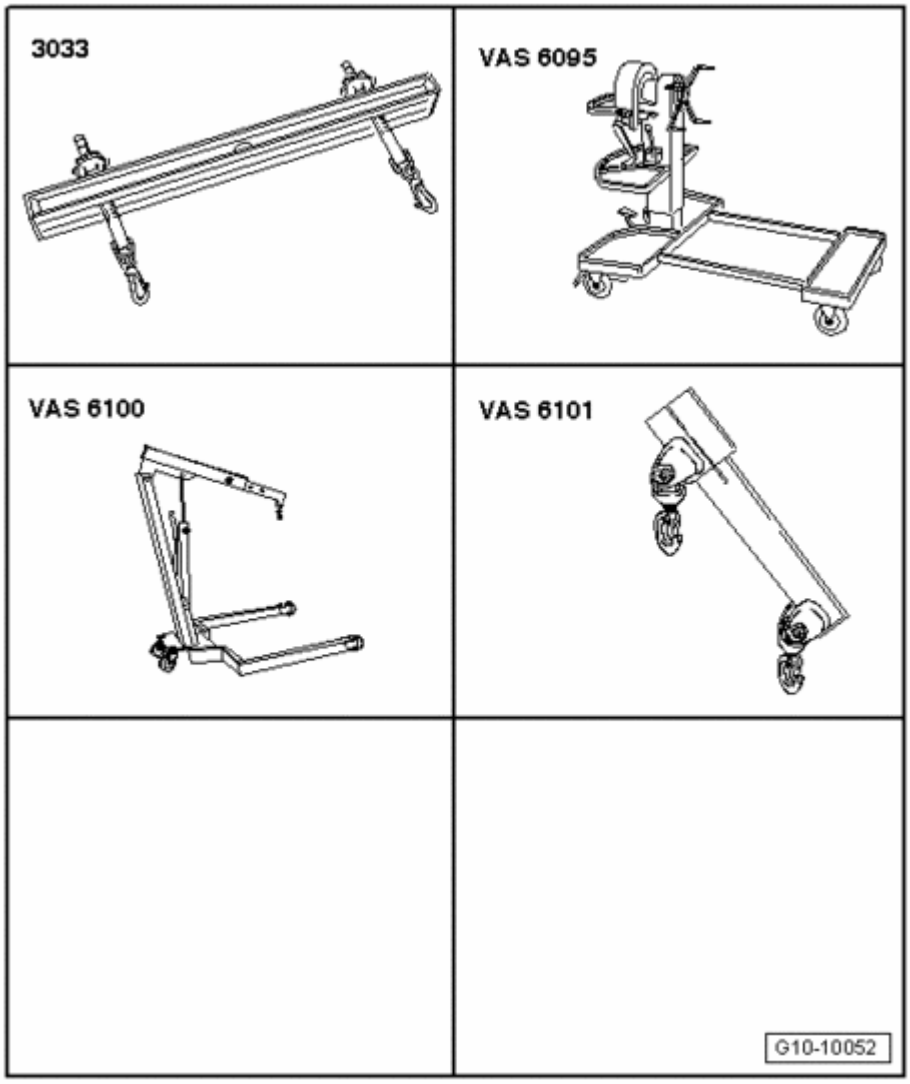

Fig. 112: Identifying Special Tools - Engine, Securing To Assembly Stand
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Lifting tackle 3033
- Engine and Transmission Holder VAS 6095 with Bracket VAS 6095/1-7
- Shop crane VAS 6100
- Lift arm extension for workshop crane VAS 6101

Procedure

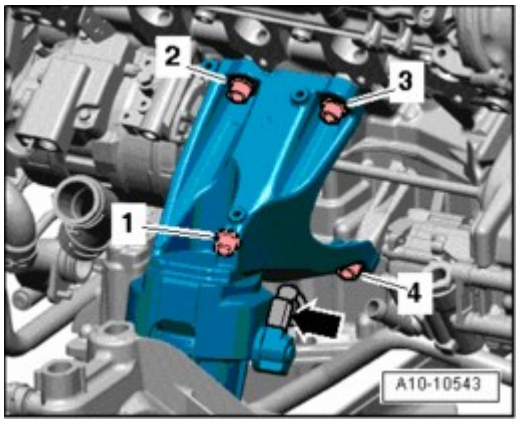

Fig. 113: Disconnecting Electrical Harness Connector At Left Engine Mount & Removing Bolts And Engine Support From Engine Mount
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical harness connector - **arrow** - at left engine mount.
- Remove bolts - **1 to 4** - and remove engine support from engine mount.

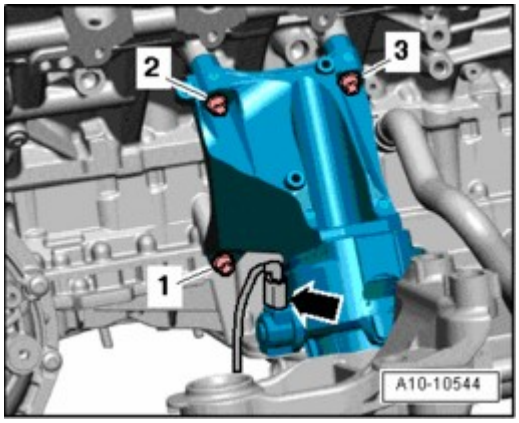

Fig. 114: Identifying Electrical Harness Connector And Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical harness connector - **arrow** - at right engine mount.
- Remove bolts - **1, 2, 3** - and remove engine support from engine mount.

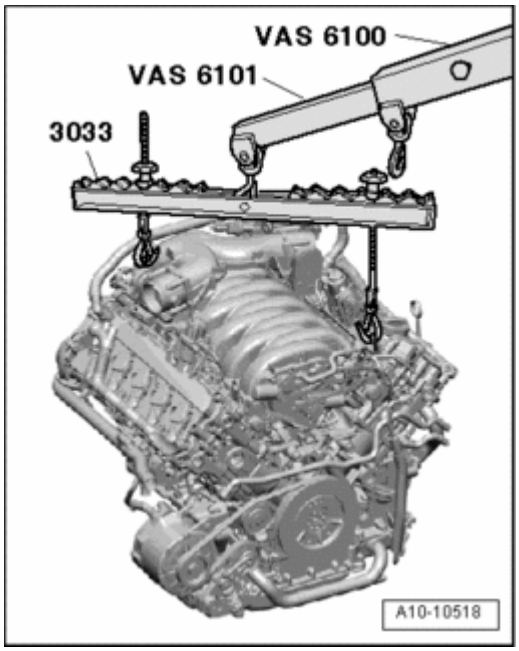

Fig. 115: Engaging Lifting Tackle 3033 On Engine Lifting Eyes And On Shop Crane VAS 6100 With Lift Arm Ext./Workshop Hoist VAS 6101
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Engage Lifting Tackle 3033 on engine lifting eyes and on Shop Crane VAS 6100 with Lift Arm Ext./Workshop Hoist VAS 6101 as shown in the illustration.
- Lift engine from support elements of scissor lift platform VAS 6131.

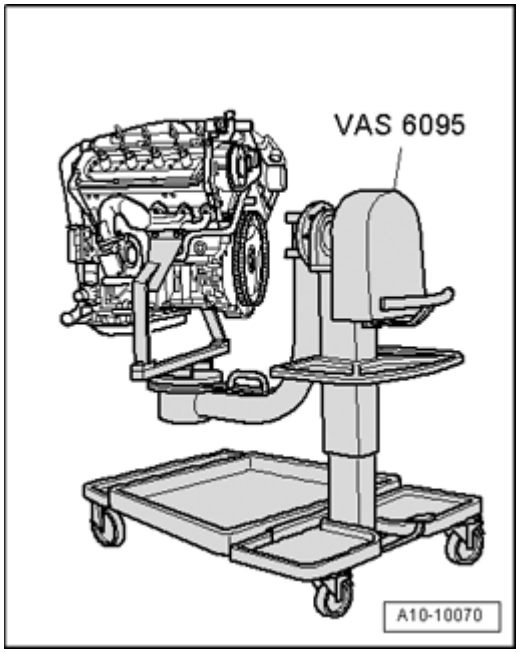

Fig. 116: Securing Engine On The Engine And Transmission Holder VAS 6095 Using Bracket VAS 6095/1-7 Tightened To 40 Nm
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Secure engine on the engine and transmission holder VAS 6095 using bracket VAS 6095/1-7 tightened to 40 Nm as shown in the illustration.

Engine, Installing

Engine, Installing

NOTE:

- **During assembly, replace self-locking nuts and bolts.**
- **Always replace bolts that are tightened to torque as well as sealing rings, gaskets and O-rings.**
- **Secure all hose connections using hose clamps appropriate for the model type .**
- **During installation, reinstall all heat insulation sleeves and heat shields at the same locations.**
- **During installation, all cable ties must be reinstalled at the same location.**

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

Bushing for torque converter

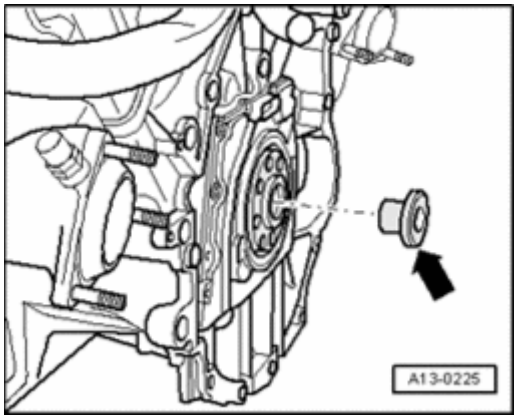

Fig. 117: Torque Converter Centering Bushing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- On a vehicle with automatic transmission, check whether bearing bushing - **arrow** - is inserted at rear of crankshaft. Drive in bushing if necessary.

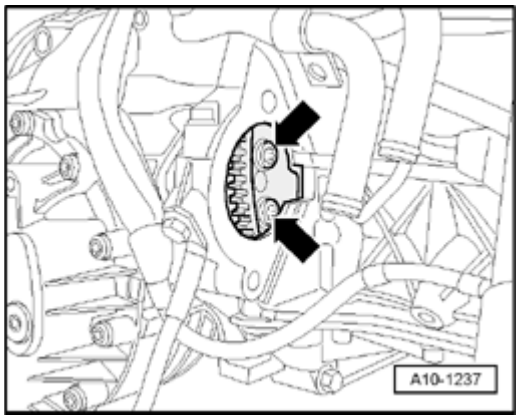

Fig. 118: Removing Torque Converter Bolts In Opening On Removed Starter
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Before guiding engine and transmission together, rotate torque converter and drive plate so that holes or threaded holes are same height as opening on removed starter - **arrows** -.
- To secure torque converter to drive plate, use new original ribbed bolts .
- Bolt transmission to engine.

NOTE:

- **Torque specifications only apply to lightly greased, oiled, phosphated or blackened nuts and bolts.**
- **Additional lubricants, such as engine or transmission oil are permissible, although lubricants containing graphite are not.**
- **Do not use any degreased parts.**
- **Tolerance for torque specifications 15%.**

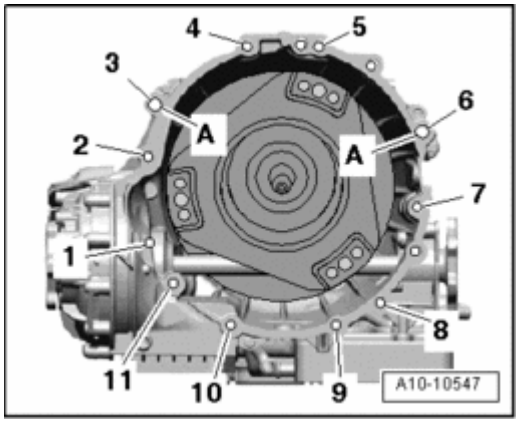

Fig. 119: Removing Engine/Transmission Connecting Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Engine/transmission, fastening

Pos.	Bolt	Nm
1	M10x40	45

2	M10x135 1)	65
3	M12x105	65
4, 5	M12x100	65
6, 8, 9, 10, 11	M12x75	65
7	M12x155	65
A	Alignment sleeves for centering	
1) Bolt class 10.9.		

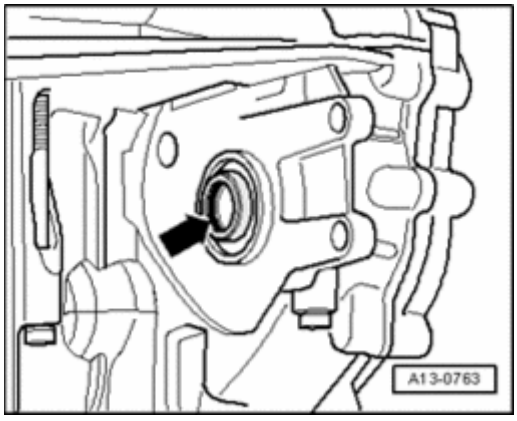

Fig. 120: Checking Whether O-Ring Is Inserted In Power Steering Pump Input Shaft
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Before installing an exchanged engine, check whether O-ring - **arrow** - is inserted in power steering pump input shaft.
- Install starter --> **27 - STARTER, GENERATOR, CRUISE CONTROL** .
- Install left exhaust system tract --> **Left Exhaust System Tract, Removing and Installing**.
- Install right exhaust system tract --> **Right Exhaust System Tract, Removing and Installing**.

- Install left coolant pipe --> **Left Coolant Pipe, Removing and Installing**.
- Install right coolant pipe --> **Right Coolant Pipe, Removing and Installing**.
- Always clean threaded bores in transmission flanged shaft for crankshaft of locking fluid residue using a tap before installation.

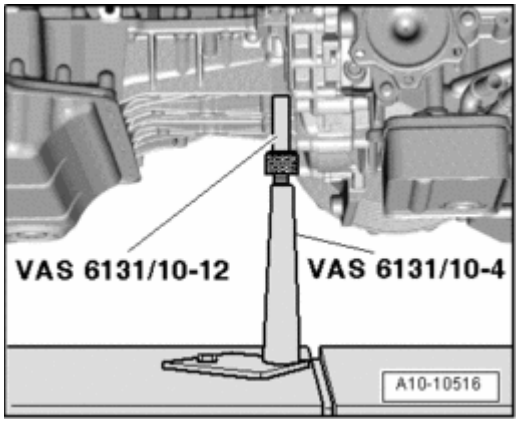

Fig. 121: Positioning/Removing Support Elements From VAS 6131/10 At Left On Engine
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Turn spindle of left support element on engine/transmission assembly downward.
- Remove left support element base plate from Scissor Lift Table VAS 6131.
- Turn spindle of right support element on engine/transmission assembly downward.

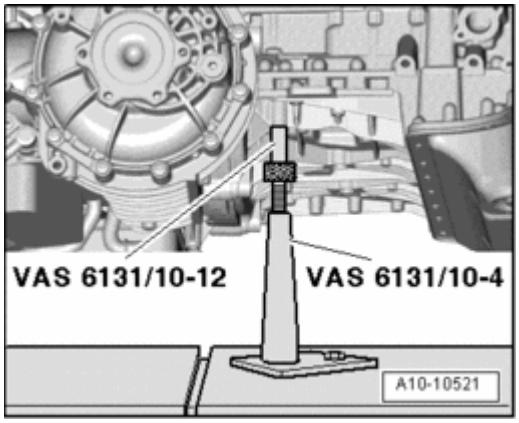

Fig. 122: Positioning/Removing Support Elements From VAS 6131/10 At Right On Engine
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove right support element base plate from Scissor Lift Table VAS 6131.

NOTE:

- **The support points for front of engine and transmission remain unchanged.**

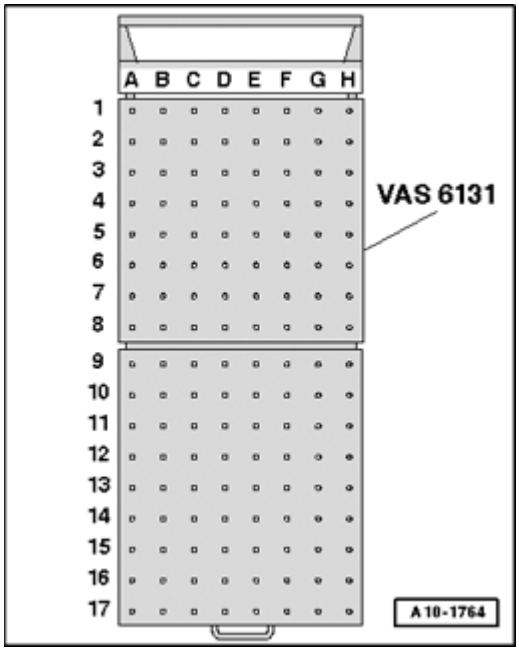

Fig. 123: Identifying Scissor Lift Platform VAS 6131
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Equip scissor lift platform VAS 6131 with support set for Audi VAS 6131/10 as follows:

Platform coordinates	Parts from Support Set VAS 6131/10			
B3 1)	/10-1	/10-4	/10-5	/10-11
G3 1)	/10-1	/10-4	/10-5	/10-11
A11	/10-1	/10-2 2)	/10-5 2)	/10-8 2)
H11	/10-1	/10-2 2)	/10-5 2)	/10-8 2)
F10 1)	/10-1	/10-3	/10-5	/10-13
D11 1)	/10-1	/10-3	/10-5	/10-12
D16 1)	/10-1	/10-2	/10-5	/10-12
1) The support elements remain unchanged. 2) Only install support elements after installing subframe.				

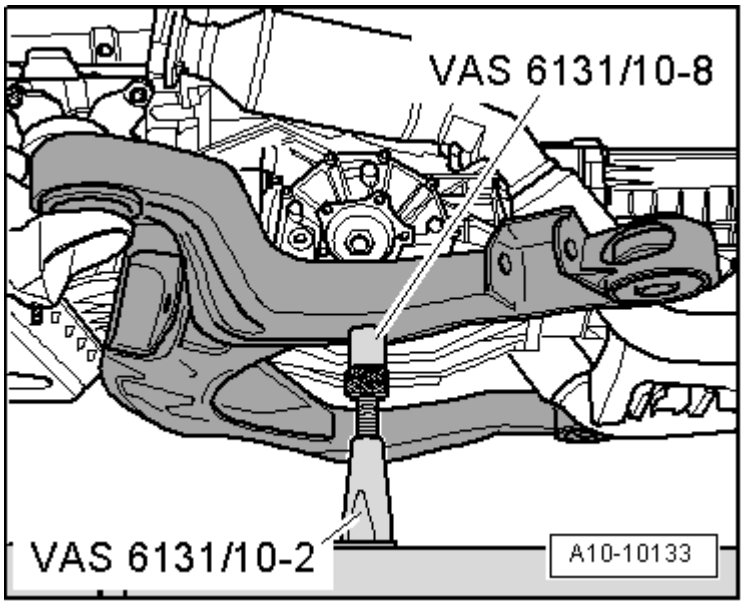

Fig. 124: Positioning Support Elements From VAS 6131/10 At Left/Right On Subframe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position subframe on both attachments VAS 6131/10-8.
- Twist spindles of support elements upward on both sides.
- Tighten base plates for support elements to 20 Nm on scissor lift platform VAS 6131.
- Using Scissor Lift Platform VAS 6131 , slowly guide engine/transmission unit with subframe into body from below.

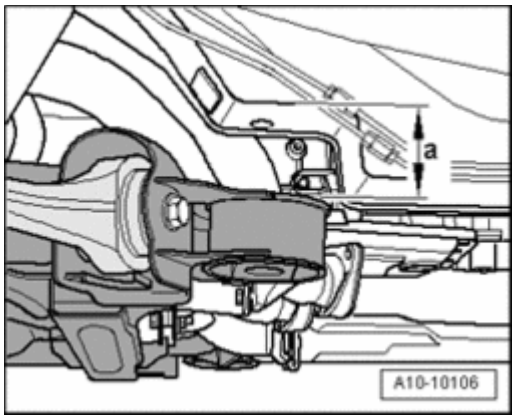

Fig. 125: Lowering Engine/Transmission Assembly Using Scissor Lift Platform VAS 6131 Only Approx. By Dimension
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Lift engine/transmission subassembly using scissor lift platform VAS 6131 until dimension - **a** - is reached.

- Dimension - **a** - = max. 100 mm.

- Install selector lever cable and check adjustment if necessary -->
  - **37 - AUTOMATIC TRANSMISSION - CONTROLS, HOUSING** for 6 SPD. AUTOMATIC TRANSMISSION 09E ALL WHEEL DRIVE
  - **37 CONTROLS, HOUSING** for AUTOMATIC TRANSMISSION 09L, ALL WHEEL DRIVE

  .
- Raise engine/transmission assembly with subframe further using Scissor Lift Table VAS 6131.

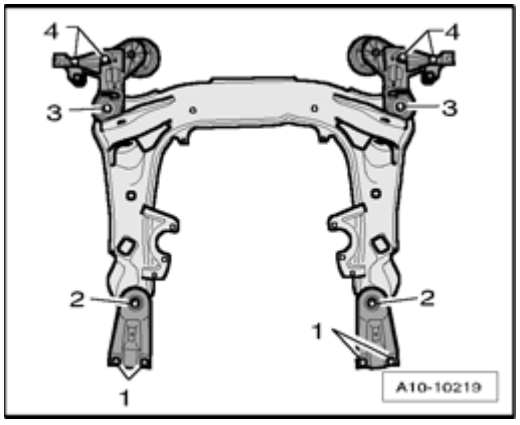

Fig. 126: Removing/Installing Bolts In Diagonal Sequence And In Stages
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Align subframe and engine mount consoles according to markings applied on longmembers during removal.
- Tighten subframe and engine bearing plate bolts only to specified torque, do not tighten further (only tighten bolts after axle alignment).

1. 55 Nm
2. 110 Nm
3. 110 Nm
4. 75 Nm

CAUTION: Vehicle must not be driven in this condition.

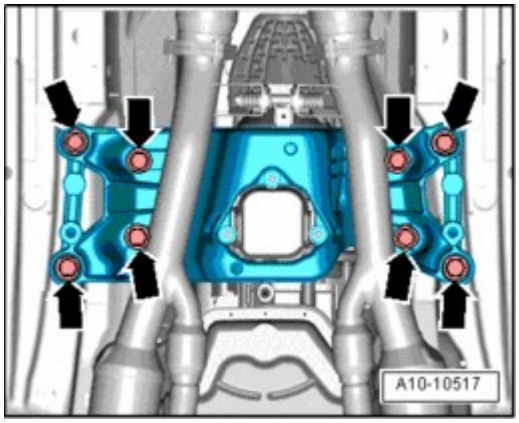

Fig. 127: Removing/Installing Bolts On Tunnel Cross Member
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tighten bolts - **arrows** - at tunnel cross member.

The rest of the installation is in reverse order of removal, note the following:

- Install drive axles --> **40 - FRONT SUSPENSION** .
- Install guide control arm, control arm, stabilizer bar, connecting link, suspension strut and subframe crossmember --> **40 - FRONT SUSPENSION**
- Install driveshaft --> **39 FINAL DRIVE, REAR DIFFERENTIAL** .
- Align exhaust system --> **Exhaust System, Installing**.
- Install refrigerant lines --> **87 - AIR CONDITIONING** .
- Install left and right air filter housing --> **24 - MULTIPORT FUEL INJECTION (MFI)** .
- Electrical connections and routing --> Electrical Wiring Diagrams, Troubleshooting and Component Locations , tightening torques --> **97 - WIRES** .
- Observe safety precautions after connecting battery --> **27 - STARTER, GENERATOR, CRUISE CONTROL** .

CAUTION: Do not use a battery charger for starting assistance! There is the risk that the vehicle control modules could be damaged.

- Install suspension strut cross member --> **40 - FRONT SUSPENSION** .

- Mount wiper arms and adjust --> **92 - WINDSHIELD WIPER AND WASHER SYSTEM** .
- Add engine oil and check oil level --> **Oil Level, Checking**.
- Before starting engine for the first time, fill power steering vacuum reservoir with hydraulic oil --> **48 - STEERING** .

NOTE:

- **Power-steering pump must not run dry.**

- Fill with coolant --> **Cooling System, Draining and Filling** .

NOTE:

- **Only reuse drained coolant if cylinder head or engine block was not replaced.**
- **Dirty coolant must not be re-used.**

- Fill refrigerant circuit --> Refrigerant R134a - Servicing.
- Align subframe and both engine mount consoles --> **40 - FRONT SUSPENSION** .
- Perform axle alignment --> **44 - WHEELS, TIRES, WHEEL ALIGNMENT** .

CAUTION: After axle alignment, tighten subframe bolts to final torque.

Tightening Specifications

NOTE:

- **Torque specifications only apply to lightly greased, oiled, phosphated or blackened nuts and bolts.**
- **Additional lubricants, such as engine or transmission oil are permissible, although lubricants containing graphite are not.**
- **Do not use any degreased parts.**
- **Tolerance for torque specifications 15%.**

Component		Nm
Bolts/nuts	M6	9
	M8	20
	M10	40
	M12	65
Exceptions:		
Drive plate to torque converter		85 1)
Clamp B+ to starter		16
Engine support to cylinder block		40
Heat shield for drive axle to transmission		23
Engine mount console to longitudinal member		75

Tunnel cross member to body	50
Fuel supply line to distribution piece	25
1) Replace bolts.	

13 - ENGINE - CRANKSHAFT, CYLINDER BLOCK

BELT PULLEY SIDE, SERVICING

Belt Pulley Side, Servicing

--> **Ribbed Belt Drive, Component Overview**

--> **Ribbed Belt, Removing and Installing**

--> **Vibration Damper, Removing and Installing**

--> **Crankshaft Seal, Ribbed Belt Side, Replacing**

Ribbed Belt Drive, Component Overview

Ribbed Belt Drive, Component Overview

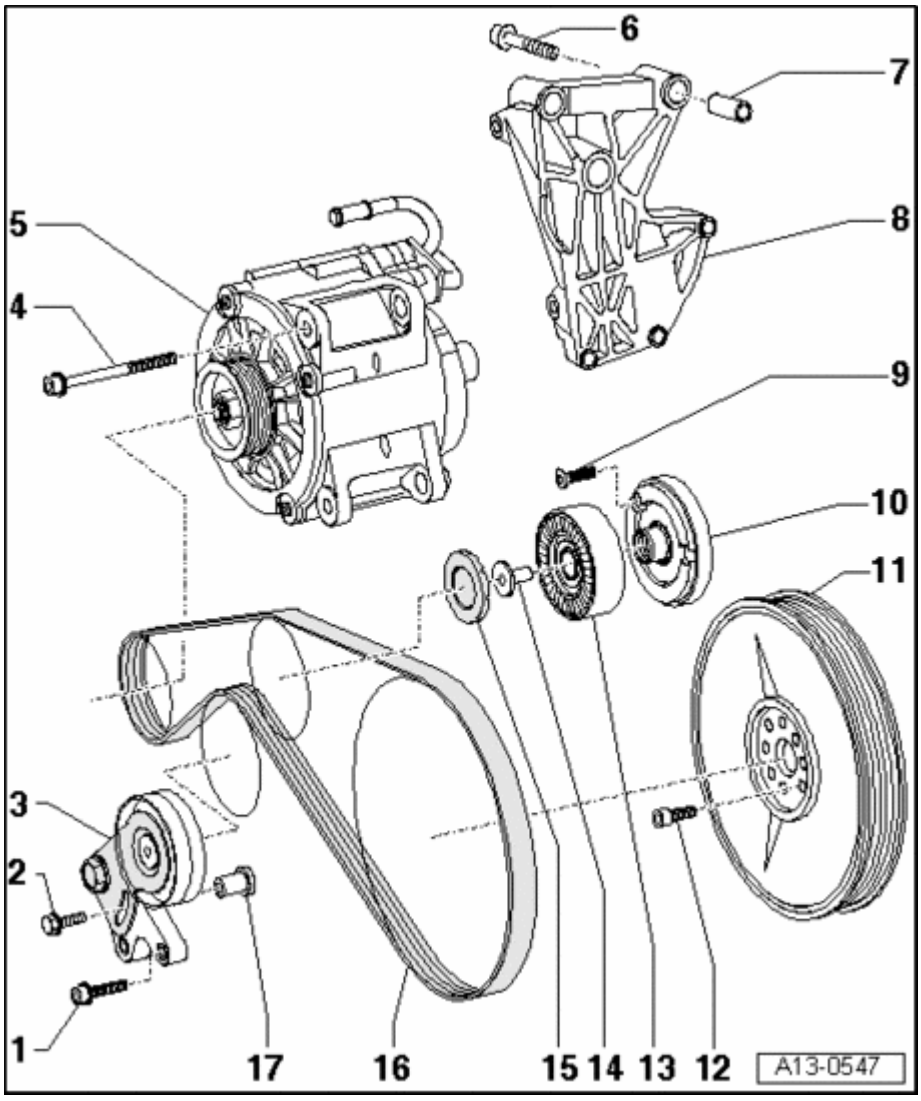

Fig. 128: Ribbed Belt Drive, Component Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 22 Nm

2 - 22 Nm

3 - Tensioning device for ribbed belt

4 - 22 Nm

5 - Generator

- Removing and installing --> **27 - STARTER, GENERATOR, CRUISE CONTROL**

6 - M8, 22 Nm; M10, 46 Nm

7 - Alignment bushing

- For generator bracket
- 2 pieces

8 - Generator bracket

9 - 10 Nm

10 - Idler roller holder

11 - Vibration damper

- Removing and installing --> **Vibration Damper, Removing and Installing**

12 - Bolt

- Replace
- Only use original equipment bolts, Bolt class 12.9
- Insert bolts that are not self-locking with locking compound; Locking compound .
- Tightening order --> **Vibration Damper, Removing and Installing**

13 - Idler roller for ribbed belt

14 - 22 Nm

15 - Cover cap

16 - Ribbed belt

- Check for wear
- Do not kink
- Before removing, mark direction of rotation using chalk or felt-tip marker. A reversed in turning direction can cause damage to the ribbed belt under operating conditions.
- Removing and installing --> **Ribbed Belt, Removing and Installing**

- When installing ribbed belt, make sure it is seated correctly on the pulleys

17 - Threaded bushing

Ribbed Belt, Removing and Installing

Ribbed Belt, Removing and Installing

Special tools, testers and auxiliary items required

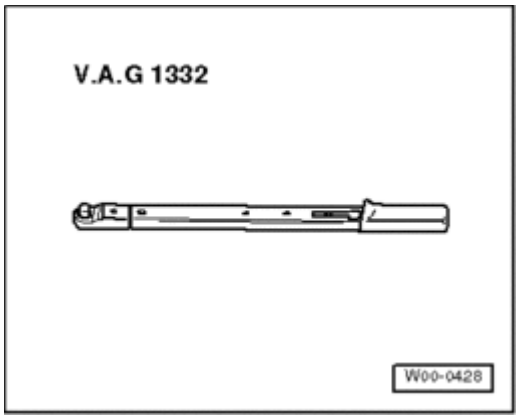

Fig. 129: Torque Wrench V.A.G. 1332
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Torque wrench V.A.G 1332

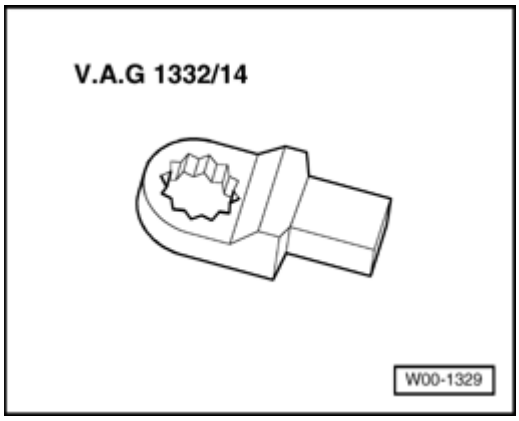

Fig. 130: Socket AF 16 mm V.A.G 1332/14
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Socket AF 16 mm V.A.G 1332/14

Removing

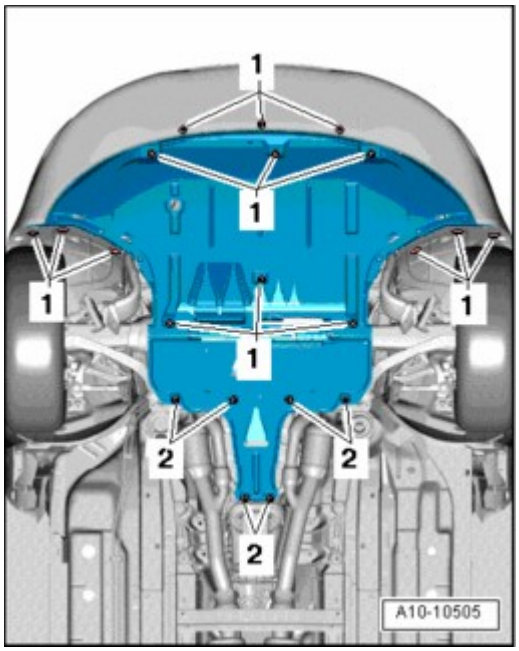

Fig. 131: Identifying Noise Insulation Quick-Release Fasteners
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen quick-release fasteners - **1** - and remove front noise insulation.

NOTE:

- **Before removing ribbed belt, mark the turning direction on it with chalk or a felt tip pen. A reversed turning direction can cause damage to the ribbed belt under operating conditions.**

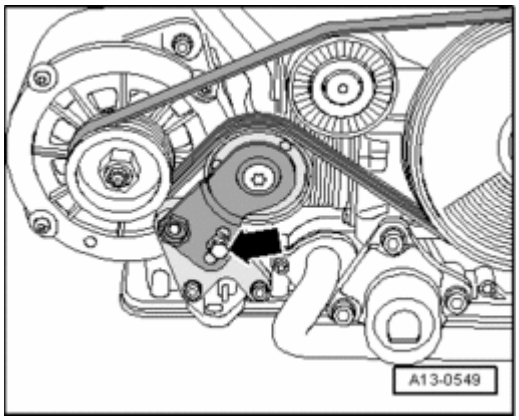

Fig. 132: Loosening Tensioning Bolt And Ribbed Belt
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen tensioning bolt - **arrow** - and remove ribbed belt.

Installing

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

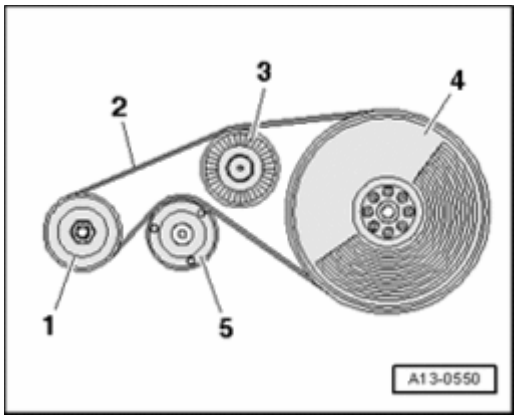

Fig. 133: Placing Ribbed Belt Over Belt Pulley In Specified Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place ribbed belt over belt pulley in specified sequence.

1. Generator
2. Ribbed belt
3. Idler roller
4. Vibration damper
5. Tensioning roller

NOTE:

- **When installing the ribbed belt, make sure it is seated correctly on the pulleys.**

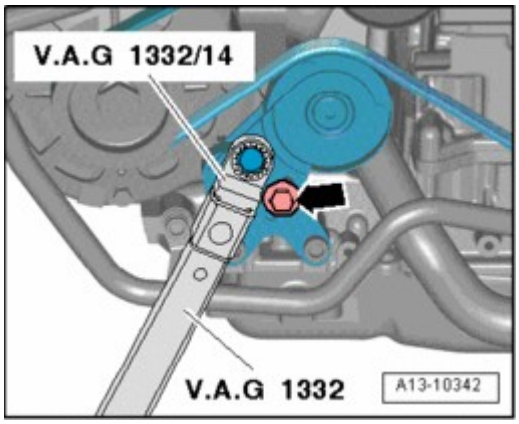

Fig. 134: Positioning Torque Wrench With Socket AF 16 mm V.A.G 1332/14 On Tensioning Roller Hex Head And Tension Ribbed Belt To 70 Nm
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position torque wrench with Socket AF 16 mm V.A.G 1332/14 on tensioning roller hex head and tension ribbed belt to 70 Nm.
- At the same time, tighten tensioning bolt - **arrow** - to 25 Nm.
- Start engine and check running belt.

Vibration Damper, Removing and Installing

Vibration Damper, Removing and Installing

Removing

- Drain coolant --> **Cooling System, Draining and Filling**.
- Remove radiator --> **Radiator, Removing and Installing**.

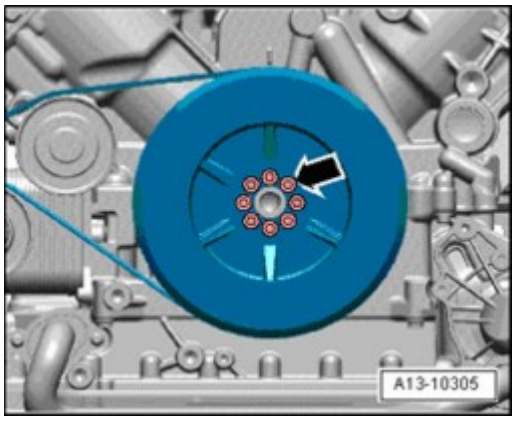

Fig. 135: Loosening Mounting Bolts On Vibration Damper
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen 8 bolts - **arrow** - on vibration damper several turns by counterholding on generator belt pulley central nut with open end wrench.

NOTE:

- **Before removing ribbed belt, mark the turning direction on it with chalk or a felt tip pen. A reversed turning direction can cause damage to the ribbed belt under operating conditions.**

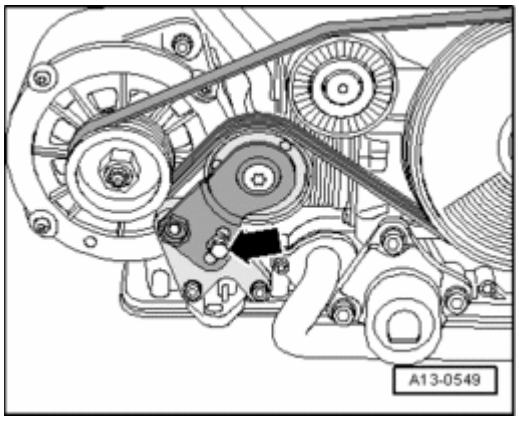

Fig. 136: Loosening Tensioning Bolt And Ribbed Belt
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen tensioning bolt - **arrow** - and remove ribbed belt.

- Remove vibration damper.

Installing

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

NOTE:

- **Replace the vibration damper bolts with new original bolts .**
- **Insert bolts that are not self-locking with locking compound; Locking compound .**
- **The vibration damper can only be installed in one position - note the alignment bushing.**

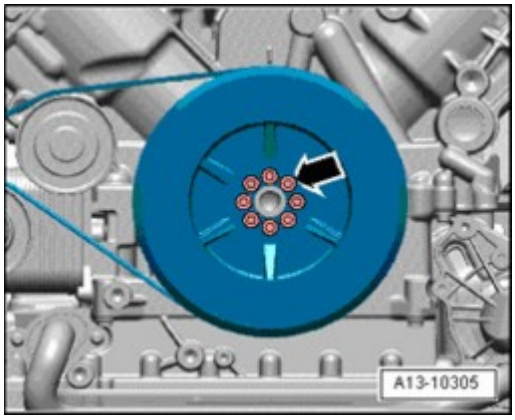

Fig. 137: Loosening Mounting Bolts On Vibration Damper
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tighten vibration damper bolts - **arrow** - diagonally in 3 stages.
- Using torque wrench, tighten to 15 Nm.
- Using torque wrench, tighten to 22 Nm.
- With Torx key, 90 ($^{1}/_{4}$ turn) additional turn.
- Install ribbed belt --> **Ribbed Belt, Removing and Installing**.
- Install radiator --> **Radiator, Removing and Installing**.
- Fill with coolant --> **Cooling System, Draining and Filling** .

Crankshaft Seal, Ribbed Belt Side, Replacing

Crankshaft Seal, Ribbed Belt Side, Replacing

Special tools, testers and auxiliary items required

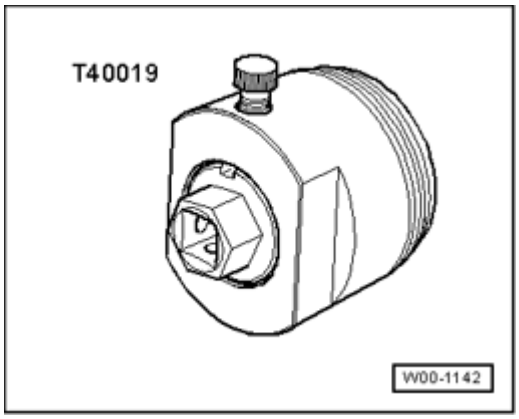

Fig. 138: Seal Remover T40019
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Seal remover T40019

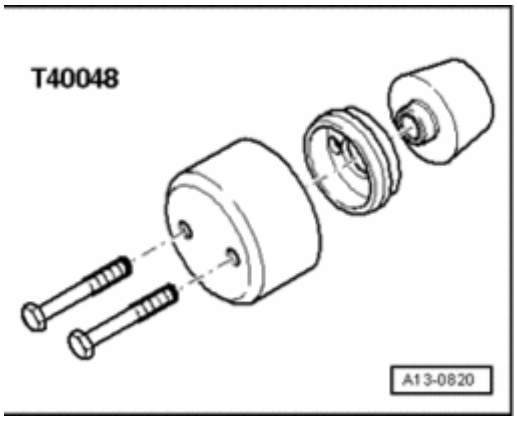

Fig. 139: Assembly Tool T40048
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Assembly tool T40048

Procedure

- Drain coolant --> **Cooling System, Draining and Filling**.
- Remove radiator --> **Radiator, Removing and Installing**.
- Remove vibration damper --> **Vibration Damper, Removing and Installing**.

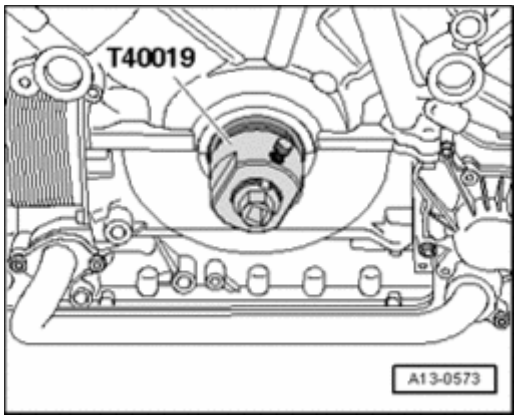

Fig. 140: Installing Oil Seal Extractor T40019
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position inner part of Oil Seal Extractor T40019 flush with outer part and secure inner part with knurled thumb screw.
- Lubricate threaded head of seal remover, place against seal, and with strong force screw into seal as far as possible.
- Loosen knurled screw and turn inner portion against crankshaft until oil seal is pulled out.
- Clamp seal extractor at mounting points in a vise.
- Remove seal using pliers.
- Clean operating and sealing surfaces.

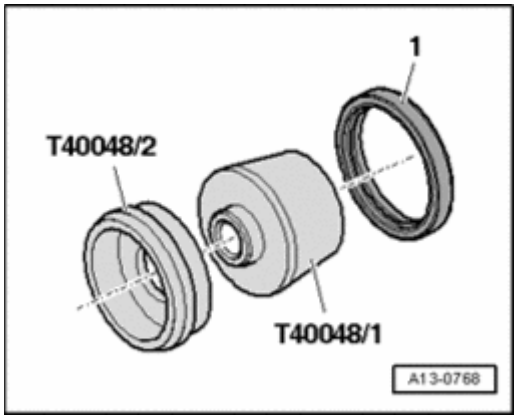

Fig. 141: Inserting Assembly Device T40048/1 Onto Pull Sleeve T40048/2 And Sliding Seal Onto Pull Sleeve
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert assembly device T40048/1 onto pull sleeve T40048/2 and slide seal - **1** - onto pull sleeve.
- Remove assembly device.

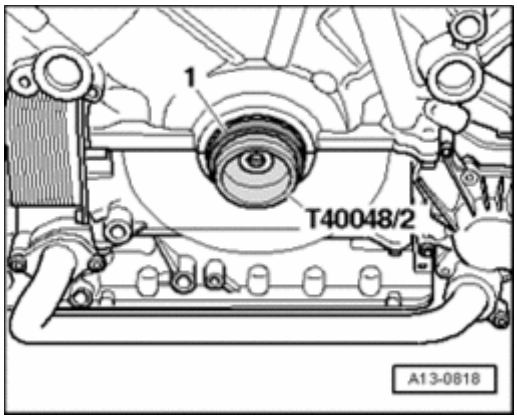

Fig. 142: Placing Pull Sleeve T40048/2 On Crankshaft And Sliding Seal Into Sealing Surface On Engine
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place pull sleeve T40048/2 on crankshaft and slide seal - **1** - into sealing surface on engine.

NOTE:

- **Pull sleeve remains on crankshaft for pressing in.**

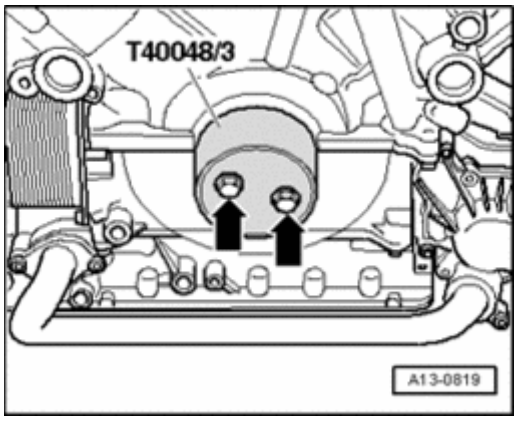

Fig. 143: Positioning Pressure Sleeve T40048/3 With Bolts On Crankshaft
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position Pressure Sleeve T40048/3 with 2 bolts M8x55 mm - **arrows** - on crankshaft.
- Install bolts by hand.
- Tighten bolts each $^{1}/_{2}$ turn by alternating sides to press in seal until it reaches stop.

The rest of installation is in reverse order of removal, note the following:

- Install vibration damper --> **Vibration Damper, Removing and Installing**.
- Install ribbed belt --> **Ribbed Belt, Removing and Installing**.
- Install radiator --> **Radiator, Removing and Installing**.
- Fill with coolant --> **Cooling System, Draining and Filling** .

TIMING CHAIN SIDE, SERVICING

Timing Chain Side, Servicing

--> **Drive Plate, Component Overview**

--> **Drive Plate, Removing and Installing**

--> **Crankshaft Seal, Timing Chain Side, Replacing**

--> **Timing Chain Covers, Component Overview**

--> **Timing Chain Covers, Removing and Installing**

--> **Lower Timing Chain Cover, Removing and Installing**

--> **Camshaft Timing Chain, Component Overview**

--> **Camshaft Timing Chains, Removing from Camshafts**

--> **Camshaft Timing Chain, Removing and Installing**

--> **Timing Mechanism Drive Chain, Component Overview**

--> **Timing Mechanism Drive Chain, Removing and Installing**

--> **Power Take-Off Drive Chain, Oil Pump and Balance Shaft, Component Overview**

--> **Power Take-Off, Oil Pump and Balancing Shaft Drive Chain, Removing and Installing**

--> **Power Take-Off, Component Overview**

--> **Power Take-Off Seals, Replacing**

--> **Spur Gear Unit, Removing and Installing**

--> **Balancing Shaft, Component Overview**

--> **Balancing Shaft, Removing and Installing**

Drive Plate, Component Overview

Drive Plate, Component Overview

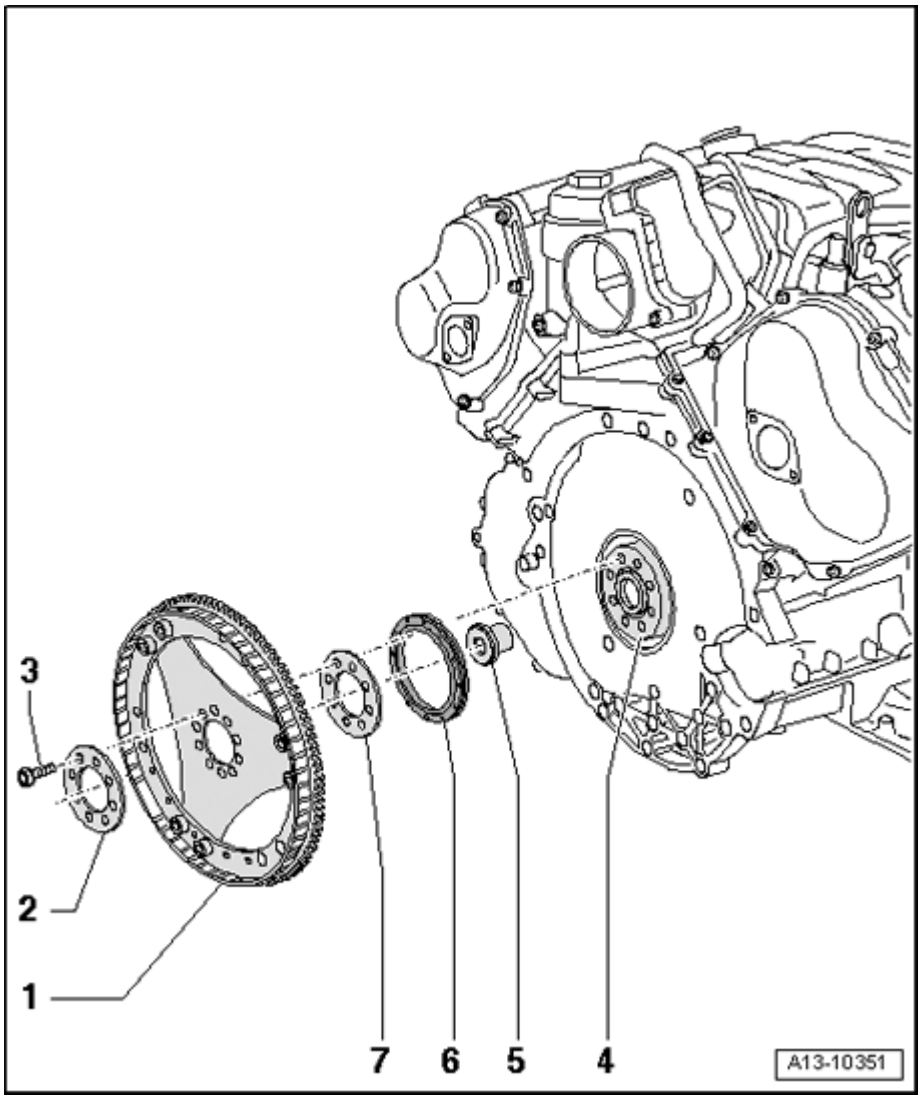

Fig. 144: Drive Plate, Component Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Drive plate

- Removing and installing --> **Drive Plate, Removing and Installing**
- Mark for re-installation

2 - Washer

- 3.4 mm thick
- Mark for re-installation

3 - 60 Nm plus an additional 90 ($^{1}/_{4}$ turn)

- Replace

4 - Crankshaft

5 - Centering bushing

- For torque converter
- Check availability

6 - Crankshaft seal, timing chain side

- Replacing --> **Crankshaft Seal, Timing Chain Side, Replacing**.

7 - Spacer washer

- 1.5 mm thick
- Mark for re-installation

Drive Plate, Removing and Installing

Drive Plate, Removing and Installing

Special tools, testers and auxiliary items required

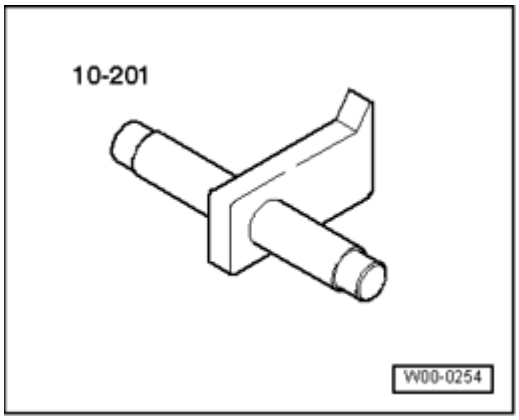

Fig. 145: Counter-Holder Tool 10-201
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Counter-holder tool 10-201

Removing

- Remove engine --> **Engine, Removing**.
- Separate engine and transmission --> **Engine and Transmission, Separating**.
- Leave engine on Scissor Lift Table VAS 6131 or secure engine to assembly stand --> **Engine, Securing to Assembly Stand**.

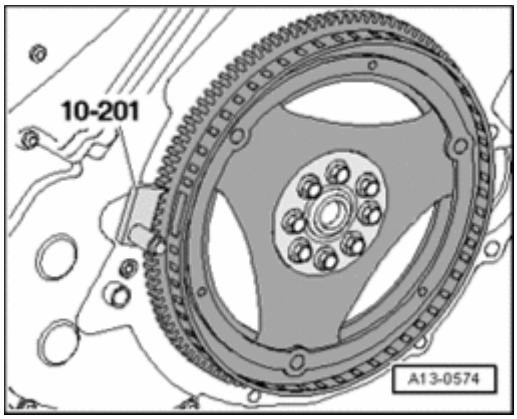

Fig. 146: Inserting Counter Hold Tool 10-201 To Loosen Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert counterhold tool 10-201 to loosen bolts.
- Mark installation position on drive plate to crankshaft using a felt-tip marker.
- Remove drive plate.
- Remove spacer washer behind.

Installing

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

- Install drive plate with spacer washer.
- Use new bolts when securing.
- Turn over counterhold tool 10-201 to tighten bolts.
- Install engine --> **Engine, Installing**.

Torque specifications

Component	Nm
Drive plate to crankshaft	60 + 90° 1)2)
1) Replace bolts. 2) 90° corresponds to a quarter turn.	

Crankshaft Seal, Timing Chain Side, Replacing

Crankshaft Seal, Timing Chain Side, Replacing

Special tools, testers and auxiliary items required

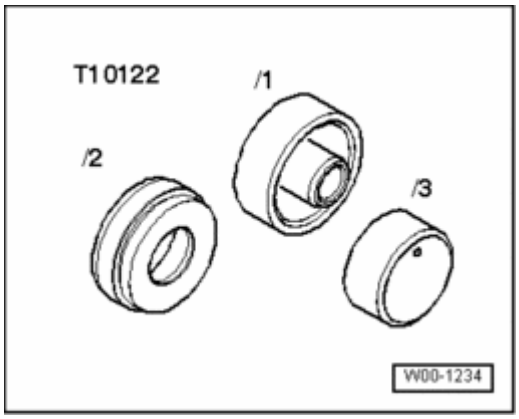

Fig. 147: Pulling Fixture T10122
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pulling fixture T10122

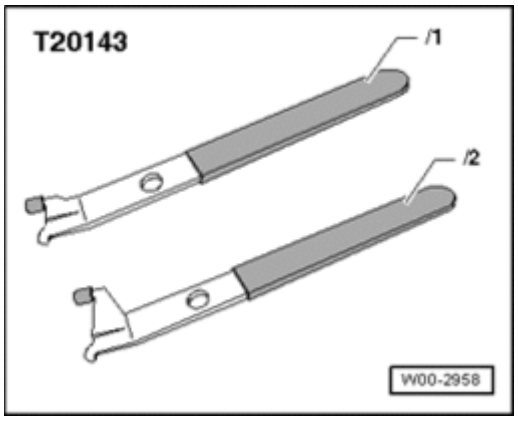

Fig. 148: Identifying Extractor Hook T20143
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Extractor hook T20143

Procedure

- Remove engine --> **Engine, Removing**.
- Separate engine and transmission --> **Engine and Transmission, Separating**.
- Leave engine on Scissor Lift Table VAS 6131 or secure engine to assembly stand --> **Engine, Securing to Assembly Stand**.
- Remove drive plate --> **Drive Plate, Removing and Installing**.

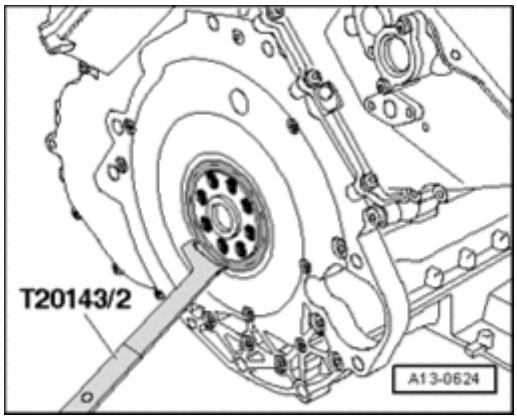

Fig. 149: Prying Out Sealing Ring Using Pulling Hook T20143/2
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pry out sealing ring using Pulling Hook T20143/2.
- Clean operating and sealing surfaces.

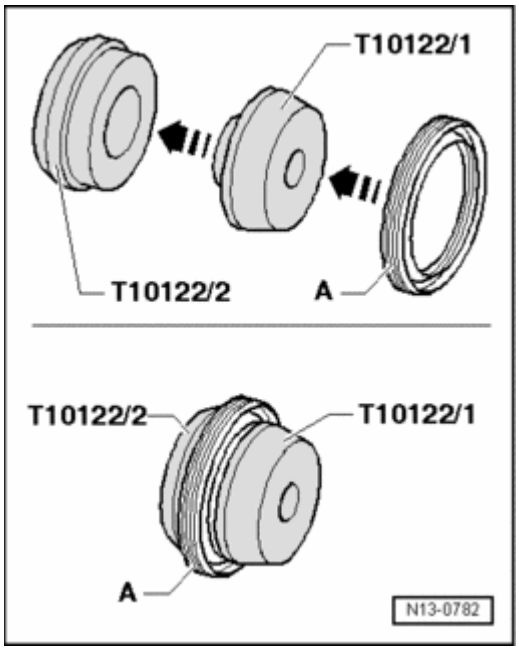

Fig. 150: Identifying Seal, Sleeve T10122/1 And Assembly Tool T10122/2
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert assembly device T10122/1 onto pull sleeve T10122/2 and slide seal - **A** - onto pull sleeve.
- Remove assembly device.

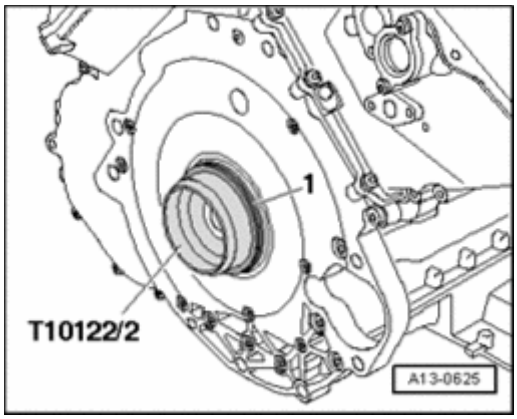

Fig. 151: Installing Pull Sleeve T10122/2 With Sealing Ring Onto Crankshaft
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install pull sleeve T10122/2 with sealing ring - **1** - onto crankshaft.

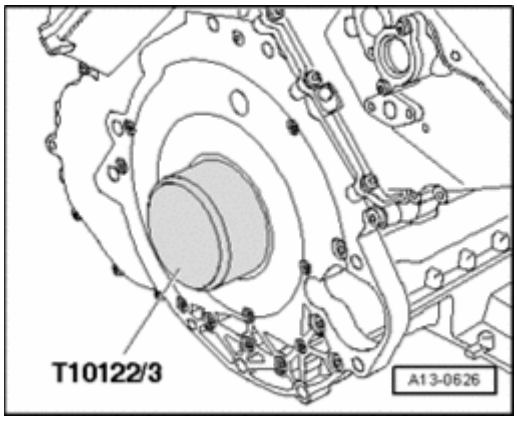

Fig. 152: Pressing In Sealing Ring All Around Evenly And Flush Using Pressure Sleeve T10122/3
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press seal evenly and flush all around using T10122/3.

The rest of installation is in reverse order of removal, note the following:

- Install drive plate --> **Drive Plate, Removing and Installing**.
- Install engine --> **Engine, Installing**.

Timing Chain Covers, Component Overview

Timing Chain Covers, Component Overview

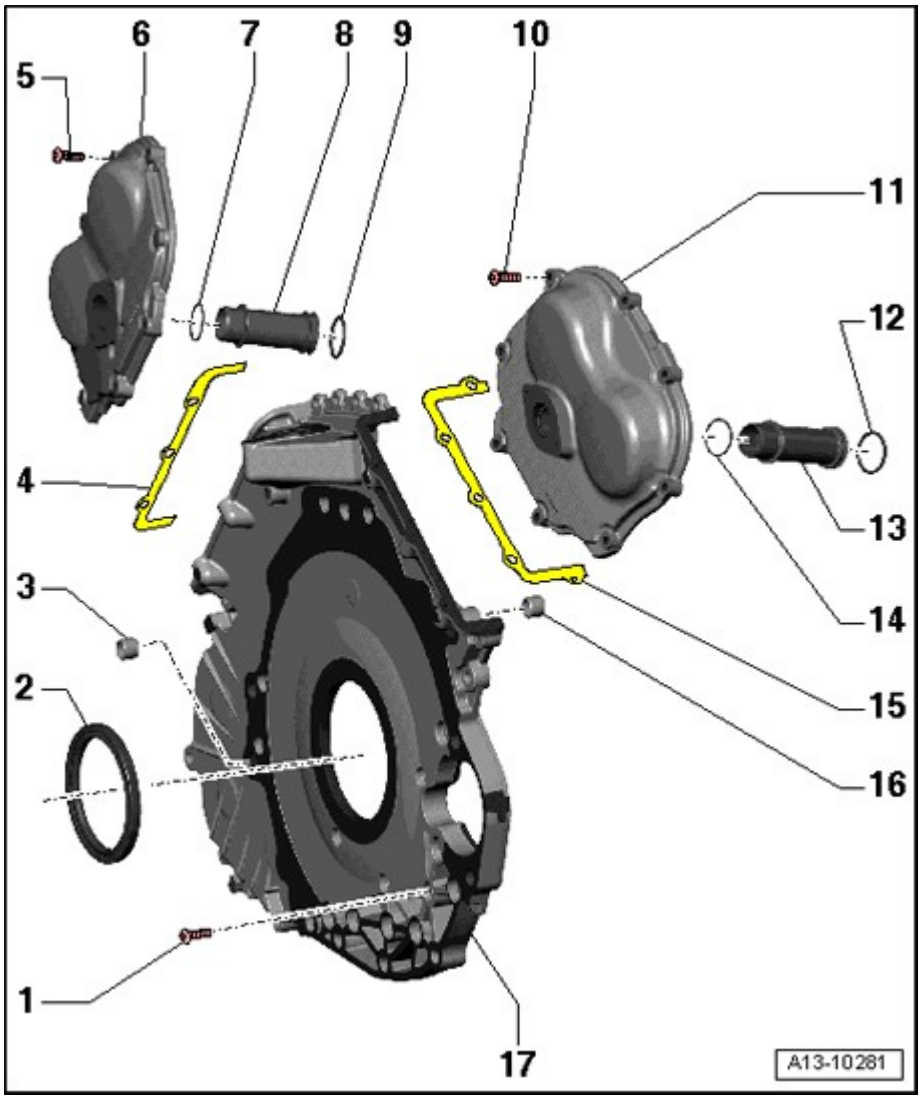

Fig. 153: Timing Chain Covers, Component Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Bolt

- M6 - 8 Nm plus an additional 90 ($^{1}/_{4}$ turn); replace
- M8 - 22 Nm
- Note tightening sequence --> **Fig. 176**

2 - Crankshaft seal, timing chain side

- Replacing --> **Crankshaft Seal, Timing Chain Side, Replacing**.

3 - Alignment bushing

- 2 pieces

4 - Left cylinder head gasket

5 - 9 Nm

- Observe sequence when tightening: Left --> **Fig. 163** ; right --> **Fig. 165**

6 - Left timing chain cover

- Removing and installing --> **Timing Chain Covers, Removing and Installing**

7 - O-ring

- Replace

8 - Left coolant intermediate pipe

- Drive out with suitable drift

9 - O-ring

- Replace

10 - 9 Nm

- Note tightening sequence --> **Fig. 165**

11 - Right timing chain cover

- Removing and installing --> **Timing Chain Covers, Removing and Installing**

12 - O-ring

- Replace

13 - Right coolant intermediate pipe

- Drive out with suitable drift

14 - O-ring

- Replace

15 - Right cylinder head gasket

16 - Alignment bushing

- 2 pieces

17 - Lower timing chain cover

- Removing and installing --> **Lower Timing Chain Cover, Removing and Installing**

Timing Chain Covers, Removing and Installing

Timing Chain Covers, Removing and Installing

Special tools, testers and auxiliary items required

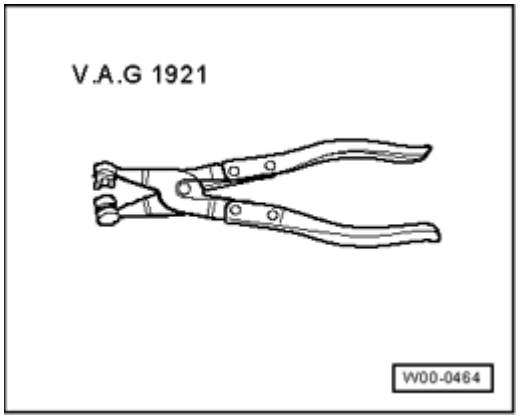

Fig. 154: Hose Clip Pliers V.A.G 1921
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Hose clamp pliers V.A.G 1921
- Hand drill with plastic brush attachment
- Protective glasses
- Sealant

Removing

NOTE:

- **During installation, reinstall all heat insulation sleeves and heat shields at the same locations.**
- **All cable ties opened or cut during engine removal must be reinstalled at the same locations during installation.**

- Remove engine --> **Engine, Removing**.
- Leave engine with transmission installed on scissor lift platform VAS 6131.

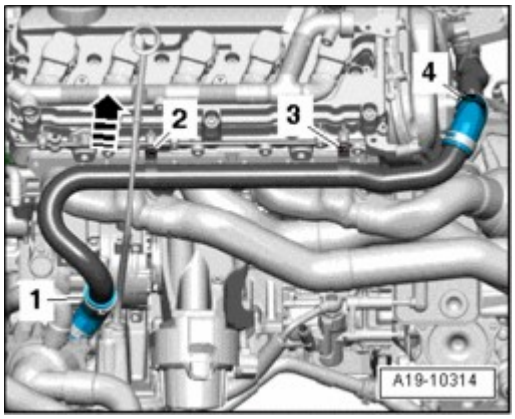

Fig. 155: Removing Bolts, Oil Dipstick Guide Tube Upward & Loosening Hose Clamps And Removing Left Coolant Pipe From Coolant Hoses
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **2** - and - **3** - and remove oil dipstick guide tube upward - **arrow** -.
- Loosen hose clamps - **1** - and - **4** - and remove left coolant pipe from coolant hoses.

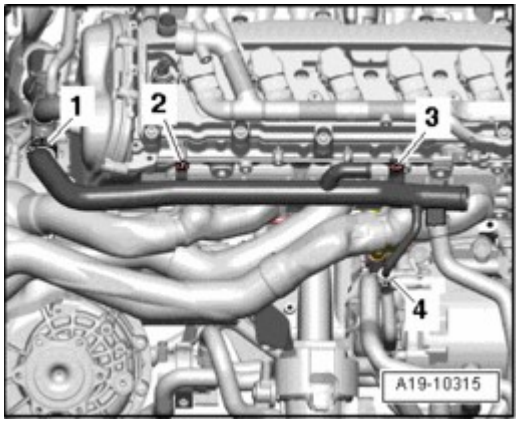

Fig. 156: Removing Bolts, Loosening Hose Clamps And Removing Right Coolant Pipe From Coolant Hoses
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **2** - and - **3** -.
- Loosen hose clamps - **1** - and - **4** - and remove right coolant pipe from coolant hoses.

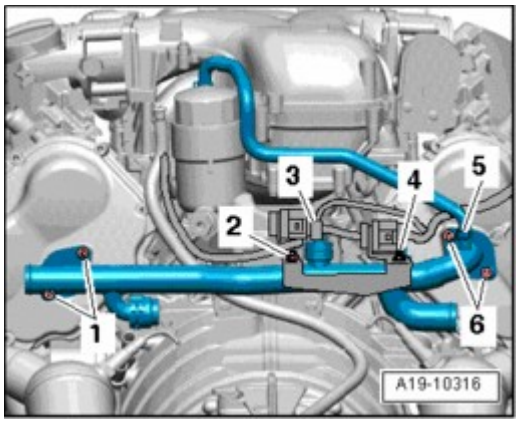

Fig. 157: Identifying Nuts, Bolts, Electrical Connector On Engine Coolant Temperature (ECT) Sensor G62 & Coolant Hose
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove nuts - **2** - and - **4** - and remove connector bracket from rear coolant pipe.
- Free up engine wiring harness on rear coolant pipe.
- Disconnect electrical connector - **3** - on Engine Coolant Temperature (ECT) Sensor G62.
- Remove coolant hose - **5** - from rear coolant pipe.

- Remove bolts - **1** - and - **6** - and remove rear coolant pipe.

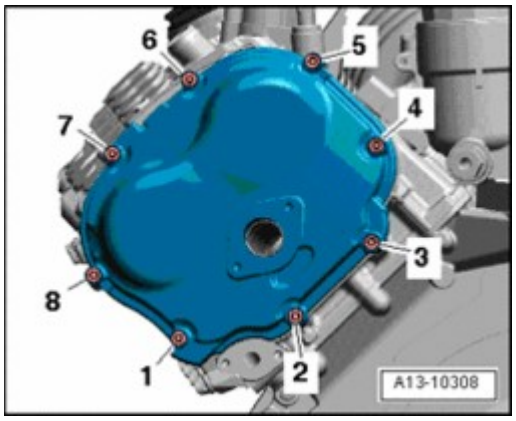

Fig. 158: Identifying Left Timing Chain Cover And Tighten/Removing Bolts Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **1 to 8** - and remove left timing chain cover.

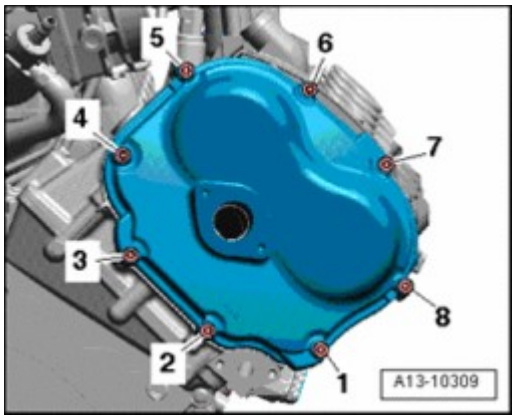

Fig. 159: Identifying Right Timing Chain Cover And Tighten/Removing Bolts Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **1 to 8** - and remove right timing chain cover.

Installing

NOTE:

- **Replace O-rings.**
- **Secure all hose connections using hose clamps appropriate for the model .**
- **During installation, reinstall all heat insulation sleeves and heat shields at the same locations.**
- **During installation, all cable ties must be reinstalled at the same location.**

CAUTION: Wear safety glasses.

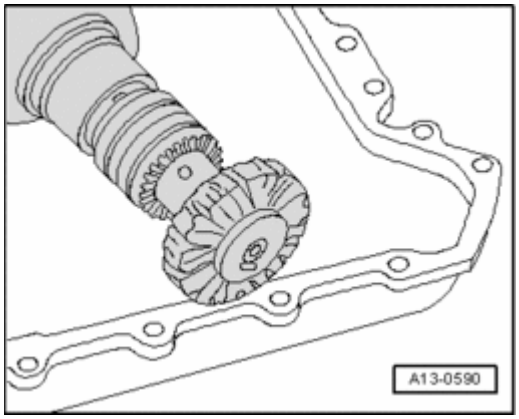

Fig. 160: Using Rotating Plastic Brush To Remove Any Sealant Residue From Sealing Flange, Cylinder Block And Upper Part Of Oil Pan
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove sealant residue on timing chain covers and cylinder head, e.g. with a rotating plastic brush.

CAUTION: Make sure that no sealant residue enters the engine.

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

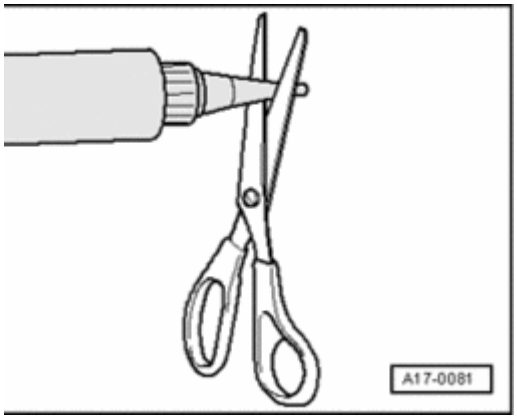

Fig. 161: Cutting Tube Nozzle At Front Marking
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Cut off nozzle on tube of sealant at front mark (dia. of nozzle approx. 2 mm).

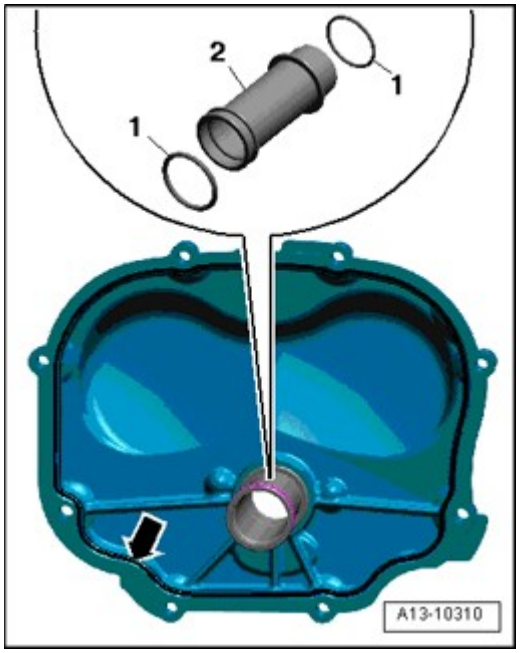

Fig. 162: Driving Left Coolant Intermediate Pipe Out Of Left Timing Chain Cover With Suitable Drift
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Drive left coolant intermediate pipe - **2** - out of left timing chain cover with a suitable drift.
- Replace O-rings - **1** - at coolant intermediate pipe - **2** -.
- Insert coolant intermediate pipe in left timing chain cover.

- Apply sealant bead - **arrow** - on clean sealing surfaces of left timing chain cover, as shown in illustration.
- Thickness of sealant bead: 2.5 mm.

NOTE:

- **Covers for timing chain must be installed within 5 minutes after applying sealant.**

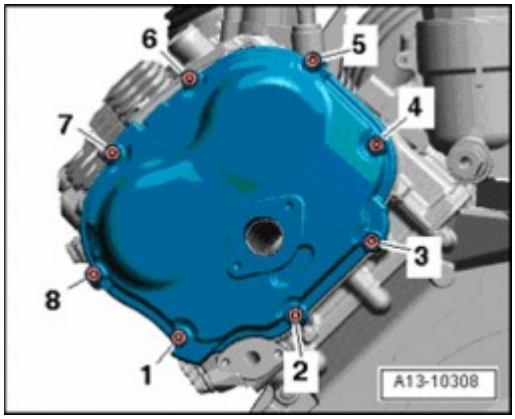

Fig. 163: Identifying Left Timing Chain Cover And Tighten/Removing Bolts Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position left timing chain cover and tighten bolts in sequence - **1 to 8** -.

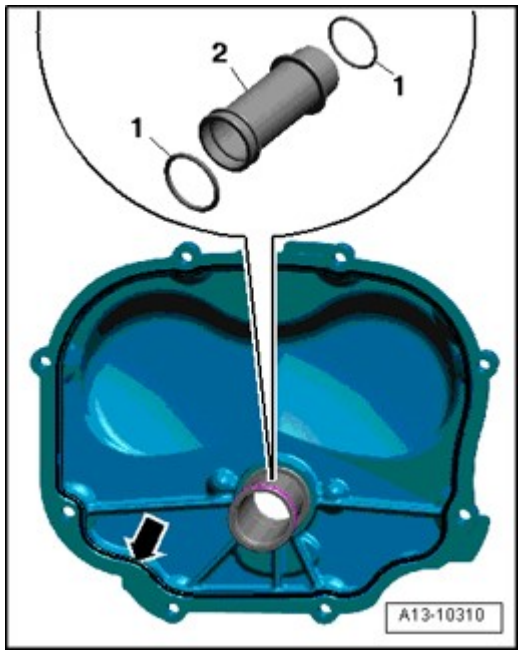

Fig. 164: Driving Left Coolant Intermediate Pipe Out Of Left Timing Chain Cover With Suitable Drift
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Drive right coolant intermediate pipe - **2** - out of right timing chain cover with a suitable drift.

- Replace O-rings - **1** - at coolant intermediate pipe - **2** -.
- Insert coolant intermediate pipe in right timing chain cover.
- Apply sealant bead - **arrows** - on clean sealing surfaces of right timing chain cover, as shown in illustration.

- Thickness of sealant bead: 2.5 mm.

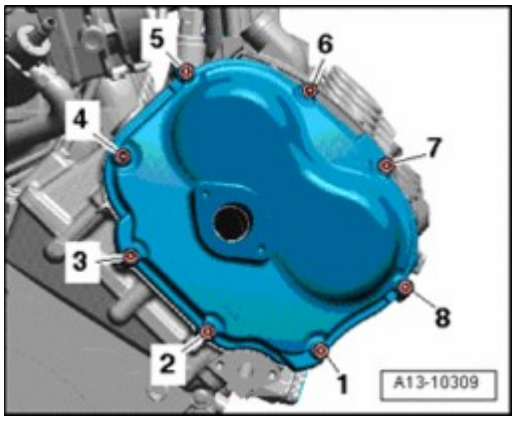

Fig. 165: Identifying Right Timing Chain Cover And Tighten/Removing Bolts Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position right timing chain cover and tighten bolts in sequence - **1 to 8** -.

The rest of installation is in reverse order of removal, note the following:

- Install rear coolant pipe --> **Rear Coolant Line, Removing and Installing**.
- Install left coolant pipe --> **Left Coolant Pipe, Removing and Installing**.
- Install right coolant pipe --> **Right Coolant Pipe, Removing and Installing**.
- Install engine --> **Engine, Installing**.

Torque specifications

Component	Nm
Left and right timing chain covers on engine	9

Lower Timing Chain Cover, Removing and Installing

Lower Timing Chain Cover, Removing and Installing

Special tools, testers and auxiliary items required

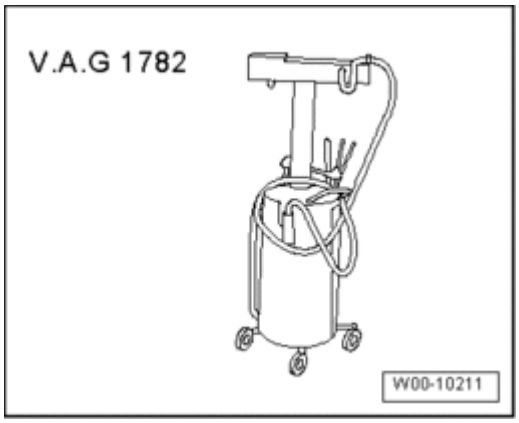

Fig. 166: Identifying Old Oil Collecting And Extracting Device V.A.G 1782
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Old oil collecting and extracting device V.A.G 1782
- Hand drill with plastic brush attachment
- Protective glasses
- Sealant

Removing

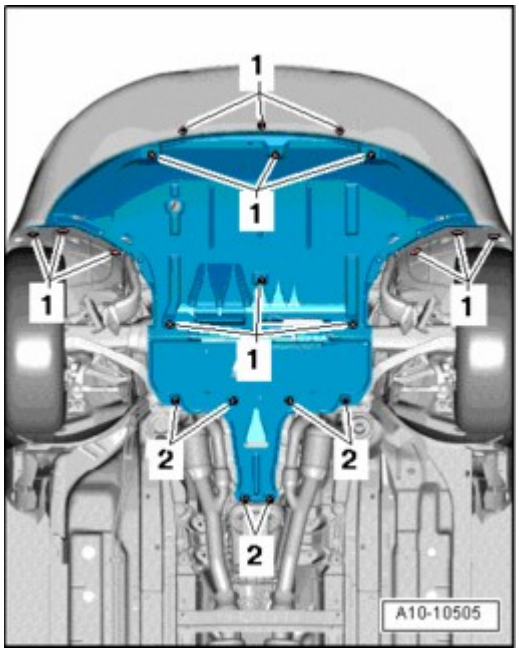

Fig. 167: Identifying Noise Insulation Quick-Release Fasteners
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen quick-release fasteners - **1** - and - **2** - and remove noise insulation.
- Place old oil collecting and extracting device V.A.G 1782 under engine and drain engine oil.
- Remove engine --> **Engine, Removing**.

- Separate engine and transmission --> **Engine and Transmission, Separating**.
- Leave engine on Scissor Lift Table VAS 6131 or secure engine to assembly stand --> **Engine, Securing to Assembly Stand**.
- Remove drive plate --> **Drive Plate, Removing and Installing**.
- Remove left and right timing chain covers --> **Timing Chain Covers, Removing and Installing**.
- Remove intake manifold --> **24 - MULTIPORT FUEL INJECTION (MFI)** .
- Remove oil filter housing --> **Oil Filter Housing, Removing and Installing**.

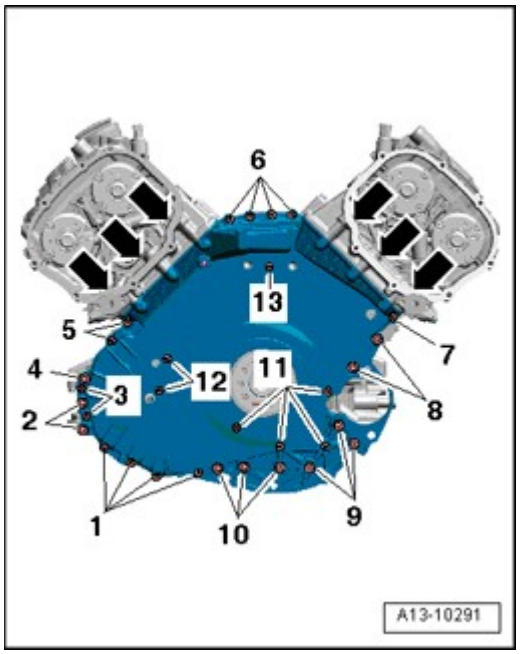

Fig. 168: Removing/Installing Bolts And Lower Timing Chain Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** -.
- Remove bolts - **1 to 13** - and remove lower timing chain cover.
- Press crankshaft seal timing chain side out of lower timing chain cover.

Installing

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

- Pull alignment bushing out of top right of cylinder block.

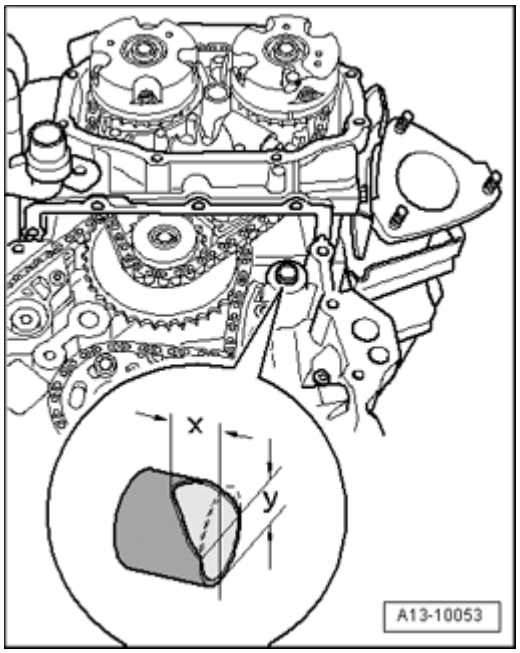

Fig. 169: Chamfer Alignment Bushing With File
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Chamfer alignment bushing with a file, as shown in the illustration.

- Dimension - **x** - = 6.5 mm.
- Dimension - **y** - = 8 mm.

- Install alignment bushing into cylinder block so that the chamfered side faces upward.

NOTE:

- **The chamfer simplifies installation of the lower timing chain cover with cylinder head installed.**

CAUTION: Wear safety glasses.

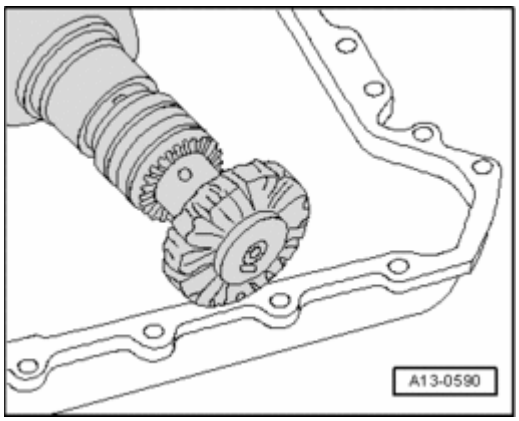

Fig. 170: Using Rotating Plastic Brush To Remove Any Sealant Residue From Sealing Flange, Cylinder Block And Upper Part Of Oil Pan
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove sealant residue in timing chain cover and cylinder block, e.g. with a rotating plastic brush.

CAUTION: Make sure that no sealant residue enters the engine.

- Clean sealing surfaces so they are completely free of any oil or grease.

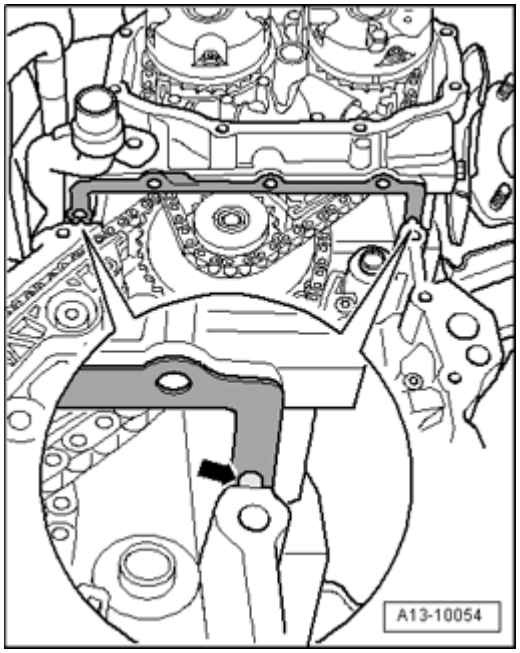

Fig. 171: Cleaning Old Sealant From Holes In Cylinder Head Gaskets
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Clean old sealant from holes - **arrow** - in cylinder head gaskets.

NOTE:

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

CAUTION: Cylinder head gasket must not be kinked. A kinked cylinder head gasket must be replaced.

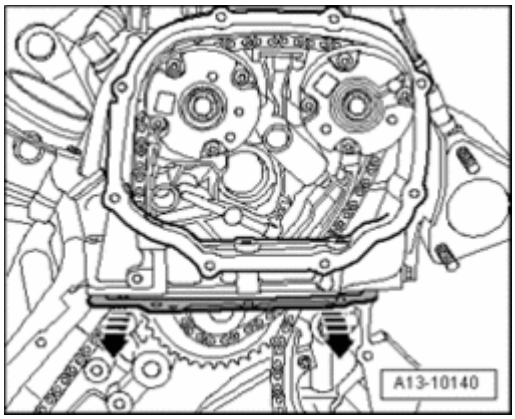

Fig. 172: Bending Ends Of Cylinder Head Gaskets Very Slightly Downward Until Upper Sealing Surface Of Gasket And Cylinder Head Can Be Cleaned
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Bend the ends of the cylinder head gaskets very slightly downward - **arrows** - until upper sealing surface of the gasket and cylinder head can be cleaned.
- Clean both cylinder head gaskets, top and bottom, so they are completely free of any oil or grease.

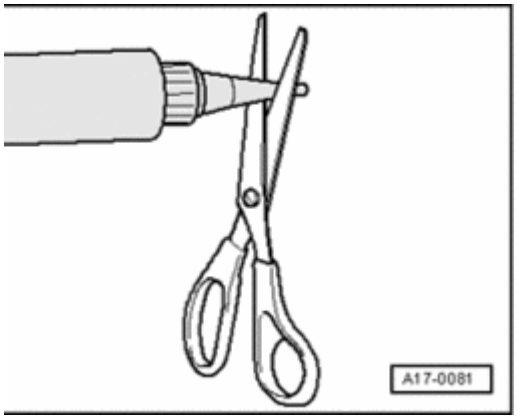

Fig. 173: Cutting Tube Nozzle At Front Marking
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Cut off nozzle on tube of sealant at the front mark (dia. of nozzle approx. 2 mm).

CAUTION: Cylinder head gasket must not be kinked. A kinked cylinder head gasket must be replaced.

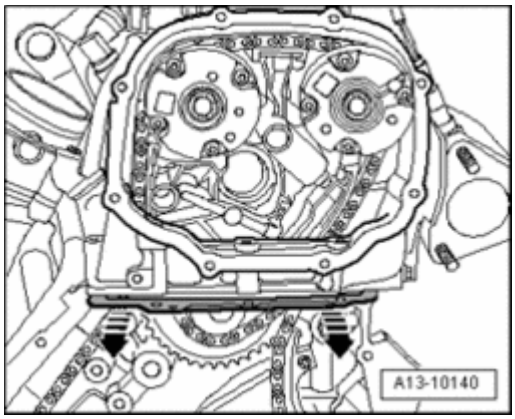

Fig. 174: Bending Ends Of Cylinder Head Gaskets Very Slightly Downward Until Upper Sealing Surface Of Gasket And Cylinder Head Can Be Cleaned
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Coat the sealing surfaces of the cylinder head gaskets, top and bottom, with a thin layer of sealant, slightly bending the cylinder head gaskets downward again - **arrows** - to do this.
- To coat surface between the cylinder head and gasket, use a flat object, e.g. a feeler gauge.

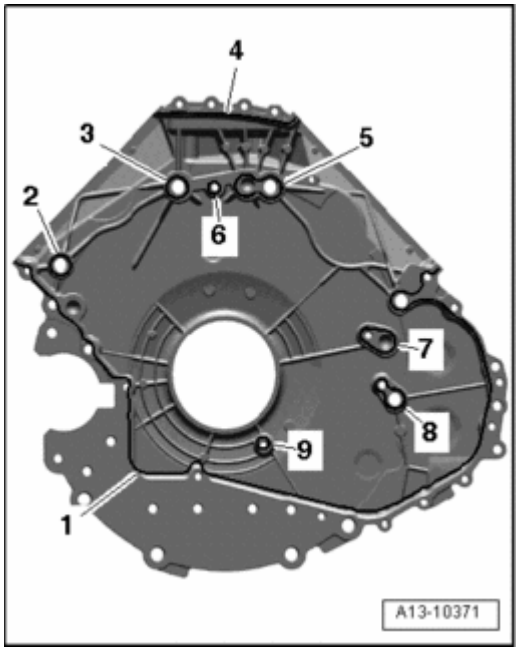

Fig. 175: Applying Sealant Beads On Clean Sealing Surfaces Of Lower Timing Chain Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Apply sealant beads - **1 to 9** - on clean sealing surfaces of lower timing chain cover, as shown in illustration.

- Thickness of sealant beads: 2.5 mm.

NOTE:

- **Timing chain cover must be installed within 5 minutes of applying sealant.**

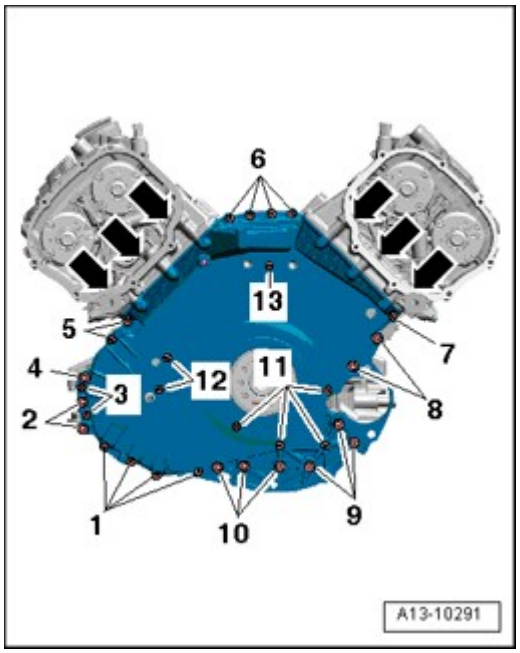

Fig. 176: Removing/Installing Bolts And Lower Timing Chain Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Set lower timing chain cover in place, guiding cover at an angle from below onto cylinder block sealing surface and cylinder head.
- When installing, make sure that the cylinder head gaskets do not become damaged. A damaged gasket must be replaced.
- Tighten bolts in 5 stages as follows:

Tighten the bolts arrows to 5 Nm using a torque wrench. Tighten bolts 1 to 13 in diagonal sequence to 8 Nm with torque wrench. Tighten bolts arrows to 9 Nm with torque wrench. Tighten bolts 1, 3, 5, 6, 7, 11, 12, 13 an additional 90° (1/4 turn) in a diagonal sequence using a rigid wrench. Tighten bolts 2, 4, 8, 9, 10 to 22 Nm with torque wrench.

The rest of installation is in reverse order of removal, note the following:

- Install crankshaft seal, timing chain side --> **Crankshaft Seal, Timing Chain Side, Replacing**.
- Install oil filter housing --> **Oil Filter Housing, Removing and Installing**.
- Install intake manifold --> **24 - MULTIPORT FUEL INJECTION (MFI)** .
- Install left and right timing chain covers --> **Timing Chain Covers, Removing and Installing** .
- Install drive plate --> **Drive Plate, Removing and Installing**.
- Install engine --> **Engine, Installing**.
- Add engine oil and check oil level --> **Oil Level, Checking**.

Torque specifications

Component	Nm

Lower timing chain cover to	Cylinder head		9
Cylinder block	M6	8 + 90° 1)2)	
		M8	22
1) Replace bolts. 2) 90° corresponds to a quarter turn.			

Camshaft Timing Chain, Component Overview

Camshaft Timing Chain, Component Overview

Left camshaft timing chain

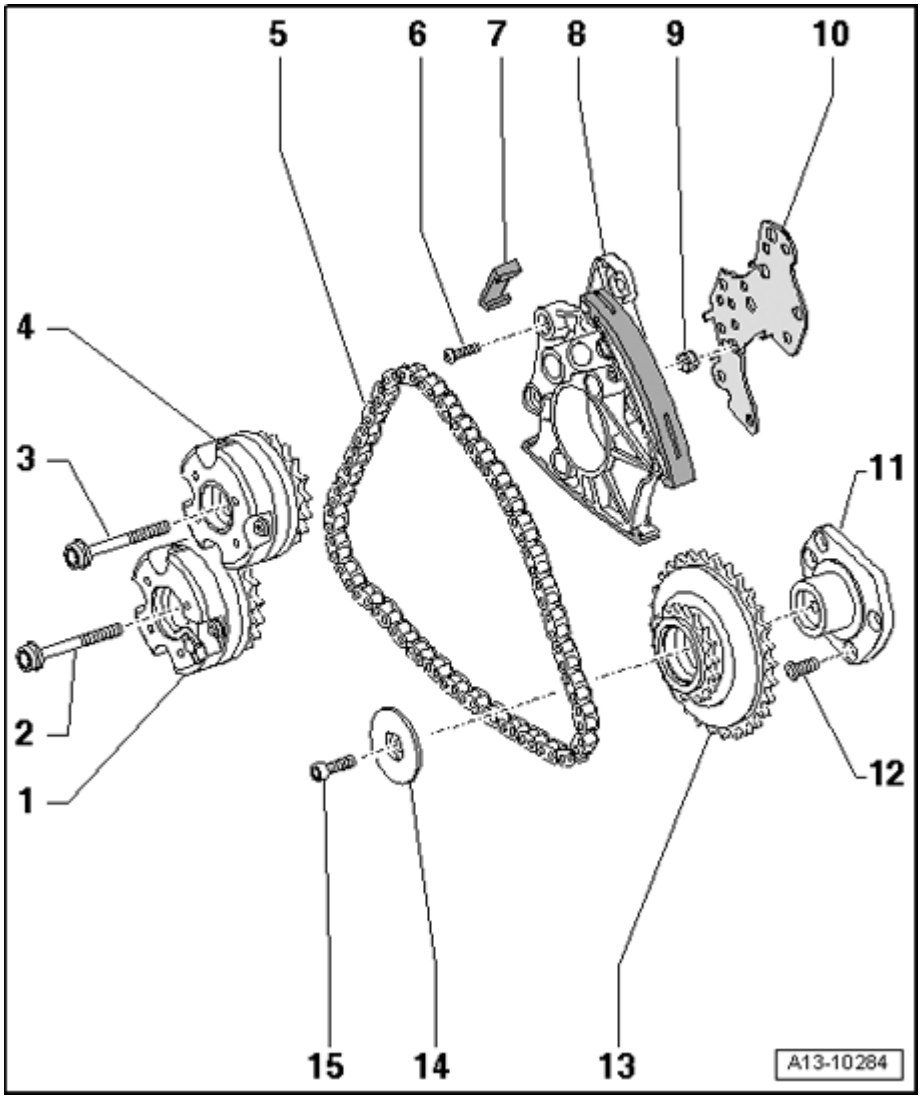

Fig. 177: Camshaft Timing Chain, Assembly Overview (Left Camshaft Timing Chain)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Camshaft adjuster for exhaust camshaft

- Identification "Exhaust"
- Removing and installing --> **Camshaft Timing Chain, Removing and Installing**

2 - Camshaft bolt

- Replace
- Initial tightening specifications: 60 Nm
- Final tightening specifications: 80 Nm plus an additional 90 ($^{1}/_{4}$ turn)

3 - Camshaft bolt

- Replace
- Initial tightening specifications: 60 Nm
- Final tightening specifications: 80 Nm plus an additional 90 ($^{1}/_{4}$ turn)

4 - Camshaft adjuster for intake camshaft

- Identification "Intake"
- Removing and installing --> **Camshaft Timing Chain, Removing and Installing**

5 - Left camshaft timing chain

- Before removing, mark direction of rotation with paint. Reversing rotation direction of a used chain can destroy it
- Removing and installing --> **Camshaft Timing Chain, Removing and Installing**

6 - 5 Nm plus an additional 90 ($^{1}/_{4}$ turn)

- Replace

7 - Guide piece

8 - Chain tensioner for left camshaft timing chain

- Removing and installing --> **Camshaft Timing Chain, Removing and Installing**

9 - Oil strainer

- Set into chain tensioner
- Observe locating tabs on circumference

10 - Gasket

- Replace
- Clipped onto chain tensioner

11 - Mounting bracket for drive sprocket

12 - 9 Nm

13 - Drive sprocket for left camshaft timing chain

14 - Thrust washer for drive sprocket

15 - 22 Nm

Right camshaft timing chain

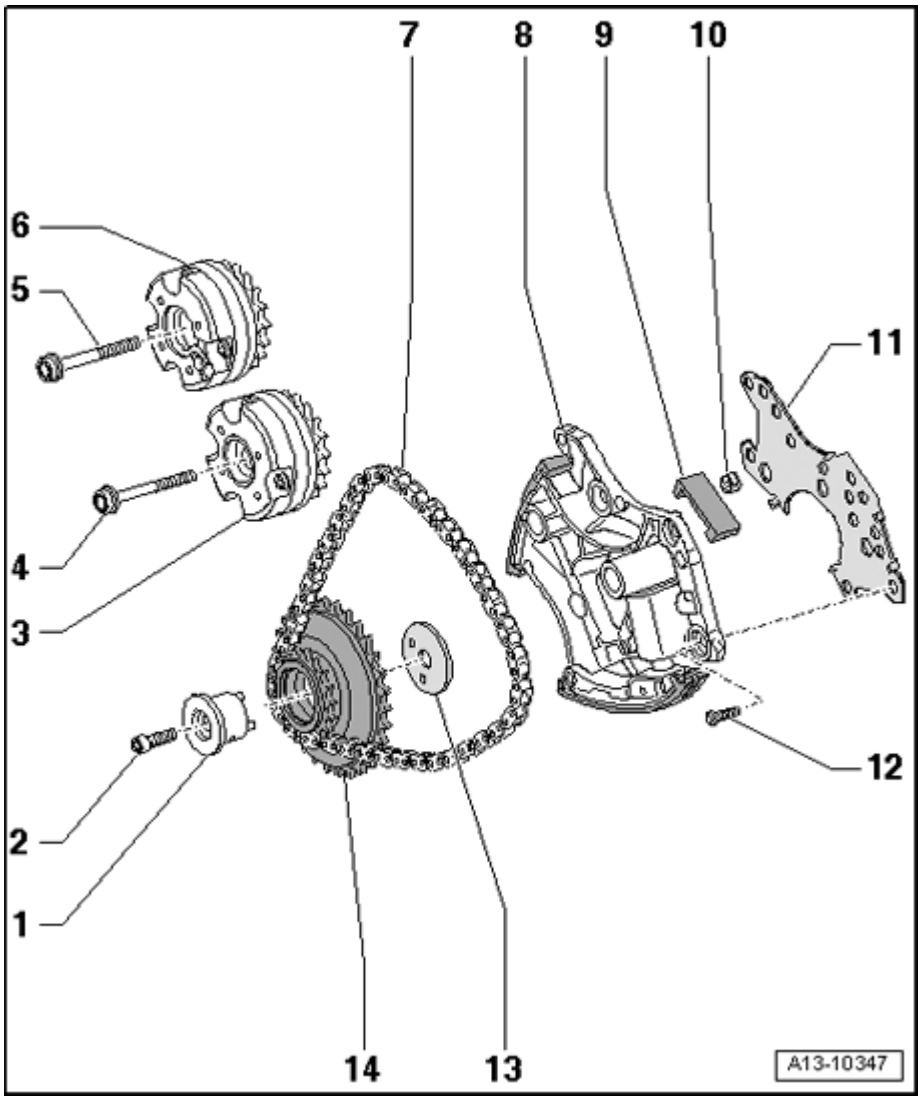

Fig. 178: Camshaft Timing Chain, Assembly Overview (Right Camshaft Timing Chain)

Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Mounting bracket for drive sprocket

- For right camshaft timing chain
- Asymmetrical version
- Installed location --> **Location of the mounting pins for the camshaft timing chain drive sprocket**

2 - 42 Nm

3 - Camshaft adjuster for exhaust camshaft

- Identification "Exhaust"
- Removing and installing --> **Camshaft Timing Chain, Removing and Installing**

4 - Camshaft bolt

- Replace
- Initial tightening specifications: 60 Nm
- Final tightening specifications: 80 Nm plus an additional 90 ($^{1}/_{4}$ turn)

5 - Camshaft bolt

- Replace
- Initial tightening specifications: 60 Nm
- Final tightening specifications: 80 Nm plus an additional 90 ($^{1}/_{4}$ turn)

6 - Camshaft adjuster for intake camshaft

- Identification "Intake"
- Removing and installing --> **Camshaft Timing Chain, Removing and Installing**

7 - Right camshaft timing chain

- Before removing, mark direction of rotation with paint. Reversing rotation direction of a used chain can destroy it
- Removing and installing --> **Camshaft Timing Chain, Removing and Installing**

8 - Chain tensioner for right camshaft timing chain

- Removing and installing --> **Camshaft Timing Chain, Removing and Installing**

9 - Guide piece

10 - Oil strainer

- Set into chain tensioner
- Installed position: Observe locating tabs on circumference

11 - Gasket

- Replace
- Clipped onto chain tensioner

12 - 5 Nm plus an additional 90 ($^{1}/_{4}$ turn)

- Replace

13 - Thrust washer for drive sprocket

14 - Drive sprocket for right camshaft timing chain

Location of the mounting pins for the camshaft timing chain drive sprocket

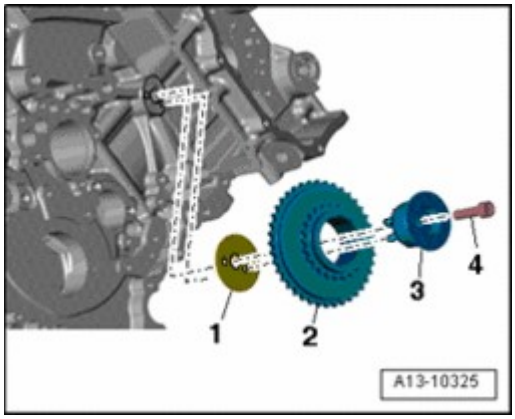

Fig. 179: Location Of The Mounting Pins For The Camshaft Timing Chain Drive Sprocket
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Alignment bushings in right camshaft timing chain drive sprocket mounting pins - **3** - must engage in holes in thrust washer - **1** - and cylinder block.

2 - Drive sprocket for right camshaft timing chain

4 - Bolt, 42 Nm

Camshaft Timing Chains, Removing from Camshafts

Camshaft Timing Chains, Removing from Camshafts

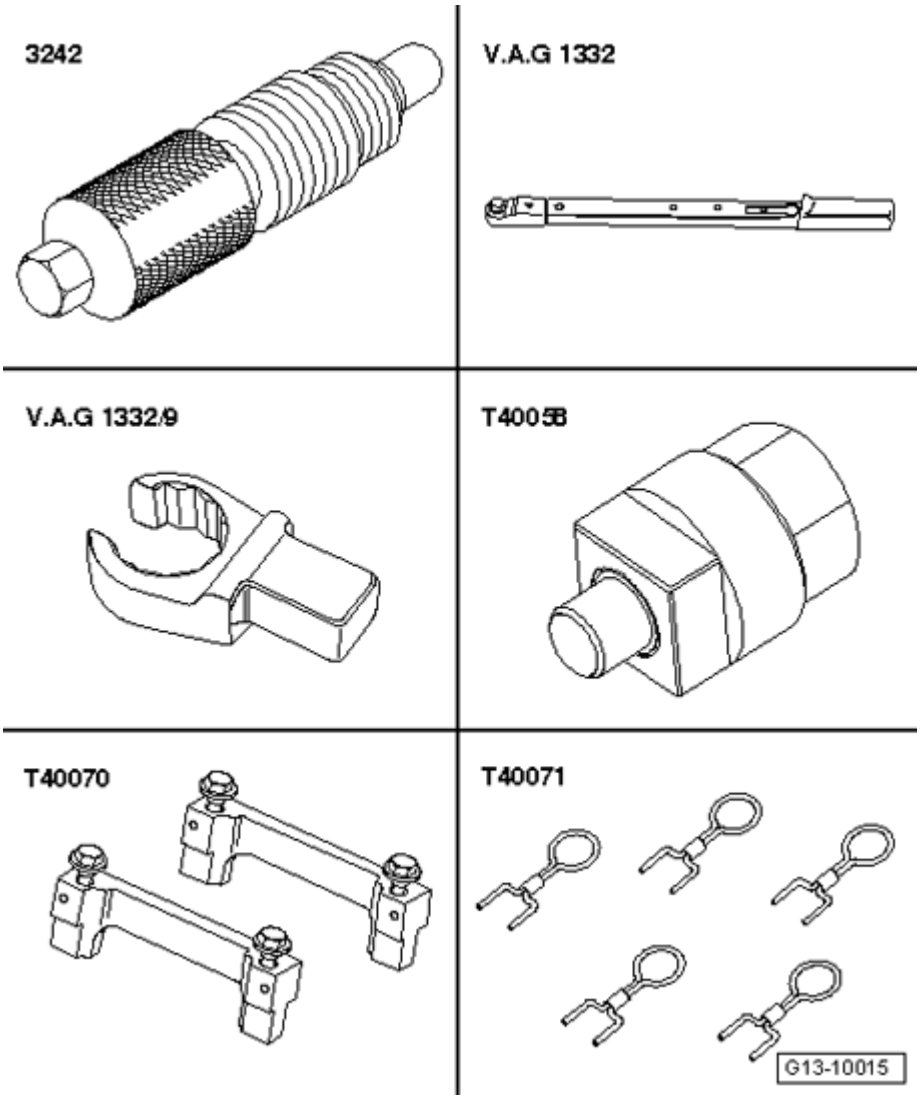

Fig. 180: Identifying Special Tools - Camshaft Timing Chains, Removing From Camshafts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Locking pin 3242
- Torque wrench V.A.G 1332
- Assembly tool V.A.G 1332/9
- Adapter T40058
- Camshaft locator T40070 (2x)
- Securing pin T40071 (2x)

Special tools, testers and auxiliary items required

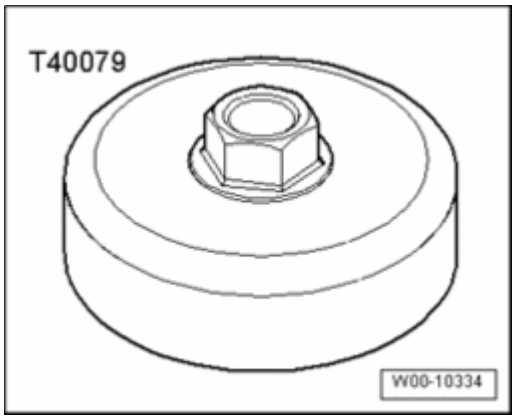

Fig. 181: Adapter T40079
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Adapter T40079

Removing

NOTE:

- **According to the following description, the timing chains for camshafts remain on engine.**

- Remove engine --> **Engine, Removing**.
- Leave engine with transmission installed on the scissor lift platform VAS 6131.
- Remove cylinder head cover: Left --> **Left Cylinder Head Cover, Removing and Installing** , right --> **Right Cylinder Head Cover, Removing and Installing**.
- Remove left and right timing chain covers --> **Timing Chain Covers, Removing and Installing**.

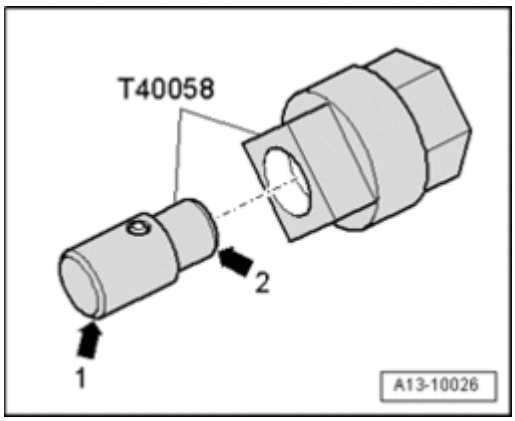

Fig. 182: Inserting Guide Pin Of Adapter T40058 So Small Diameter Points To Engine
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert guide pin of adapter T40058 so that small diameter - **arrow 2** - points to engine. Large diameter - **arrow 1** - points to socket.

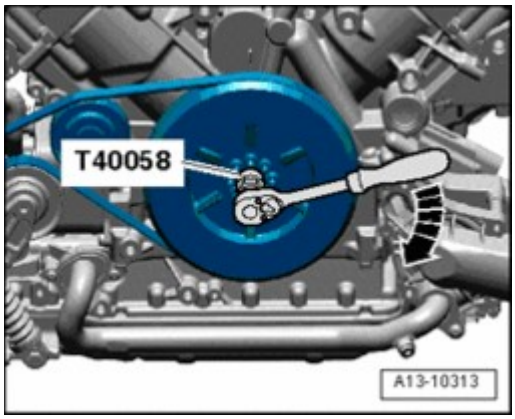

Fig. 183: Using Socket T40058 To Rotate Crankshaft To TDC
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Using Socket T40058 , rotate crankshaft in direction of engine rotation - **arrow** - to "TDC".

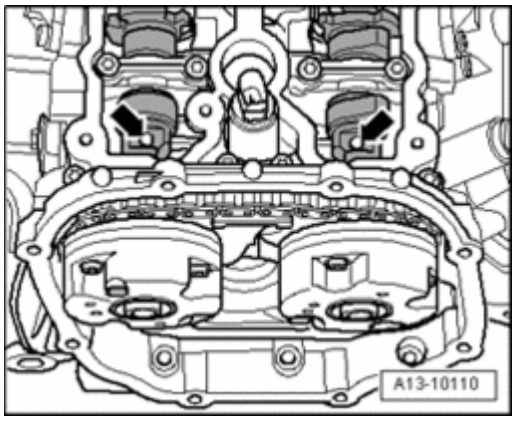

Fig. 184: Identifying Threaded Holes In Camshafts Must Face Upward
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- The threaded holes - **arrows** - in camshafts must face upward.

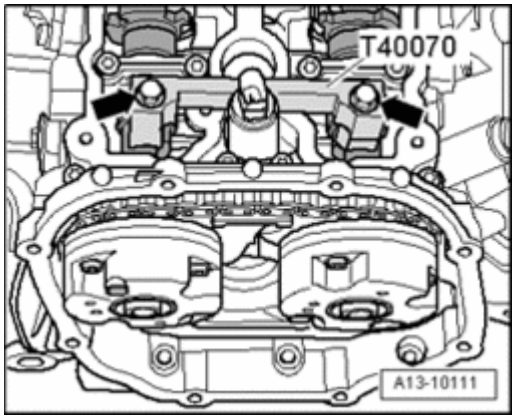

Fig. 185: Mounting Camshaft Locating Tool T40070 To Both Cylinder Heads And Tightening Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Mount camshaft locating tool T40070 to both cylinder heads and tighten bolts - **arrows** - to 25 Nm.

- The camshaft locating tool T40070 is correctly positioned when holes for the cylinder head bolts remain free.

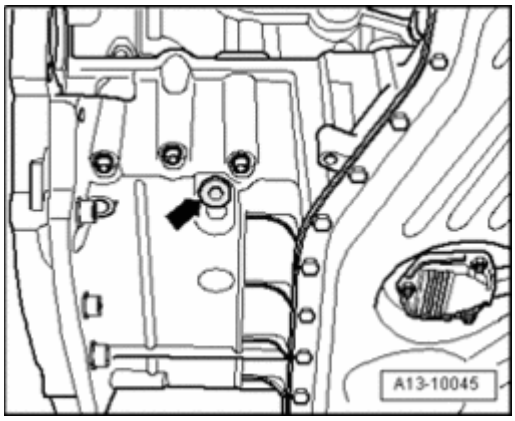

Fig. 186: Removing Locking Bolt From Upper Part Of Oil Pan
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove locking bolt - **arrow** - from upper part of oil pan.

CAUTION: Do not turn the crankshaft - 1 - while touching the "TDC" hole with your finger. You could be injured.

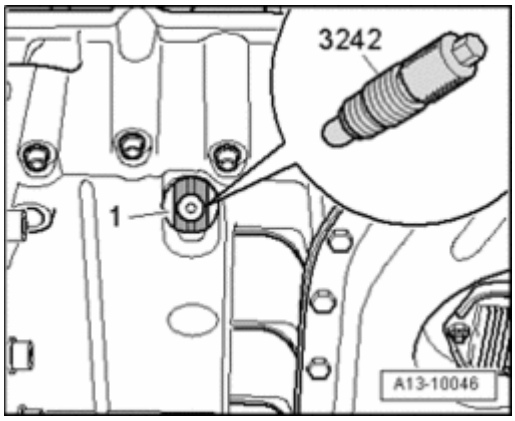

Fig. 187: Installing/Removing Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install the crankshaft holder 3242 in the hole and tighten to 20 Nm. If necessary, rotate the crankshaft back and forth slightly to completely center the holder.

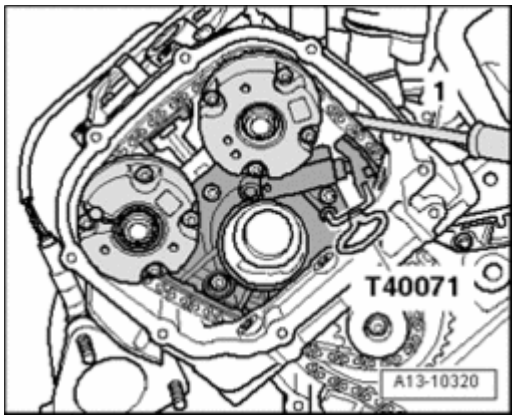

Fig. 188: Pressing Left Camshaft Timing Chain Tensioner Glide Track Inward With Screwdriver As Far As Stop And Securing Chain Tensioner With Locking Pin T40071
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press left camshaft timing chain tensioner glide track inward with a screwdriver - **1** - as far as stop and secure chain tensioner with Locking Pin T40071.

NOTE:

- **The toothed belt tensioner is lubricated with oil and should only be compressed slowly by applying constant pressure.**

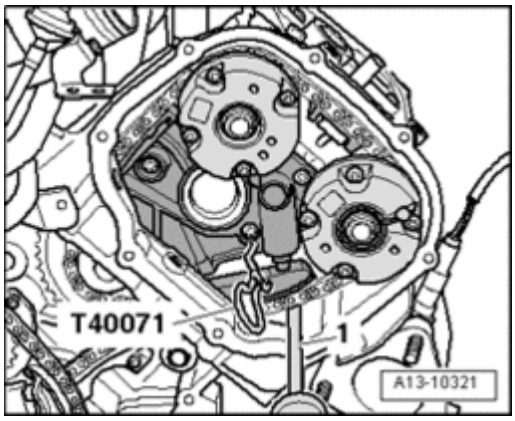

Fig. 189: Pressing Right Camshaft Timing Chain Tensioner Glide Track Inward With Screwdriver As Far As Stop And Securing Chain Tensioner With Locking Pin T40071
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press right camshaft timing chain tensioner glide track inward with a screwdriver - **1** - as far as stop and secure chain tensioner with Locking Pin T40071.

NOTE:

- **The toothed belt tensioner is lubricated with oil and should only be compressed slowly by applying constant pressure.**

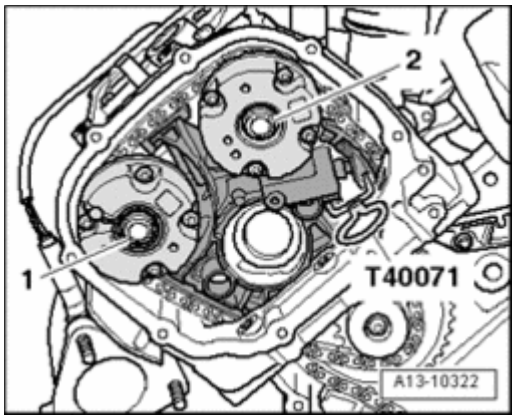

Fig. 190: Identifying Bolts On Left Cylinder Head And Removing Both Camshaft Adjusters
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- For re-installation, identify installation location of camshaft adjuster with paint.
- Remove bolts - **1** - and - **2** - on left cylinder head and remove both camshaft adjusters.

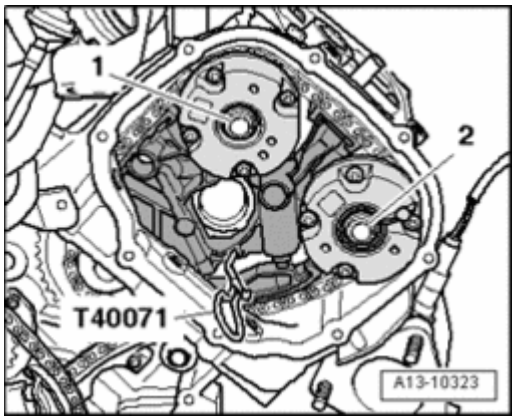

Fig. 191: Identifying Bolts On Right Cylinder Head And Removing Both Camshaft Adjusters
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- For re-installation, identify installation location of camshaft adjuster with paint.
- Remove bolts - **1** - and - **2** - on right cylinder head and remove both camshaft adjusters.

Installing

NOTE:

- **Replace bolts which have been tightened to torque.**

CAUTION: When turning camshaft crankshaft must not be at "TDC" for any cylinder. Valves and/or pistons may be damaged.

- Drive chain for timing mechanism installed --> **Timing Mechanism Drive Chain, Removing and Installing**.

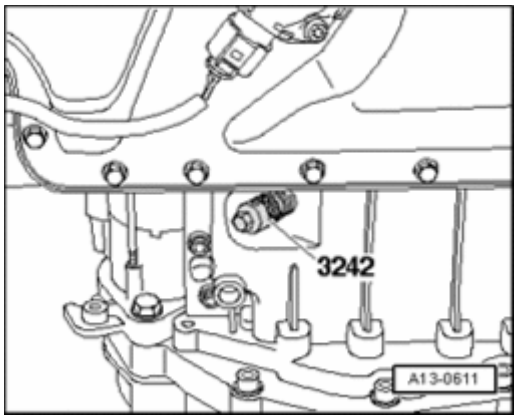

Fig. 192: Securing Crankshaft In TDC Position Using Crankshaft Holder 3242
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Secure crankshaft in "TDC" position using Crankshaft Holder 3242.

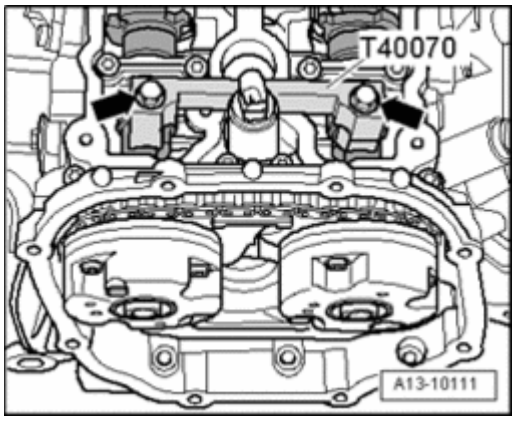

Fig. 193: Mounting Camshaft Locating Tool T40070 To Both Cylinder Heads And Tightening Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Camshaft Clamp T40070 mounted on both cylinder heads and fastened to 25 Nm - **arrows** -.

NOTE:

- **Reinstall left camshaft adjuster according to the mark applied during removal.**

  - Replace camshaft bolts.

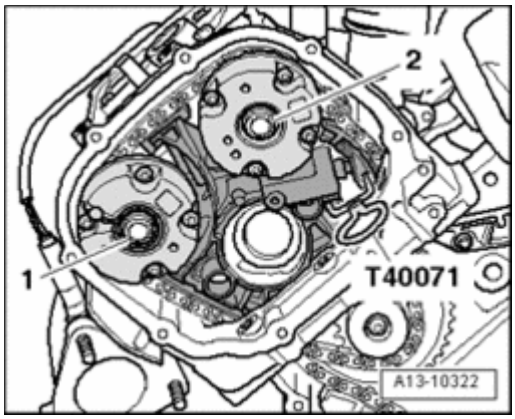

Fig. 194: Identifying Bolts On Left Cylinder Head And Removing Both Camshaft Adjusters
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place camshaft timing chain onto drive sprocket and onto camshaft adjusters and loosely thread in bolts - **1** - and - **2** -.

- Both camshaft adjusters must be able to still be rotated on camshaft and must not tip.

- Remove Locking Pin T40071.

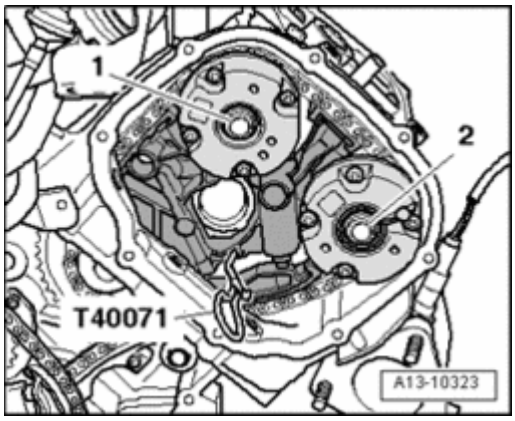

Fig. 195: Identifying Bolts On Right Cylinder Head And Removing Both Camshaft Adjusters
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE:

- **Reinstall right camshaft adjuster according to the mark applied during removal.**

- Replace camshaft bolts.
- Place camshaft timing chain onto drive sprocket and onto camshaft adjusters and loosely thread in bolts - **1** - and - **2** -.

- Both camshaft adjusters must be able to still be rotated on camshaft and must not tip.

- Remove Locking Pin T40071.

NOTE:

- **A 2nd technician is needed for further work.**

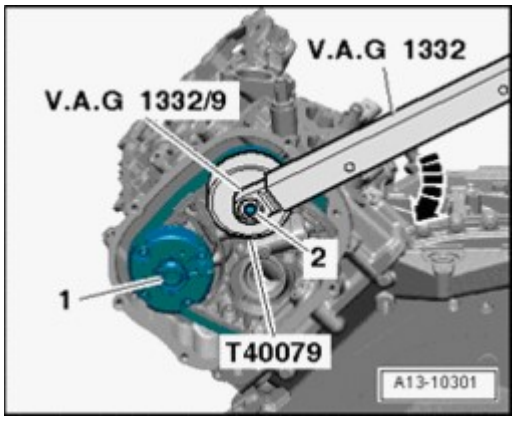

Fig. 196: Positioning Adapter T40079 On Intake Camshaft Adjuster At Left Cylinder Head
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position Adapter T40079 on intake camshaft adjuster at left cylinder head.
- Position Torque Wrench V.A.G 1332 with Open Ring Spanner Insert V.A.G 1332/9 on Adapter T40079.
- Pre-tension camshaft adjuster to 40 Nm in direction of - **arrow** - and maintain tension.
- Tighten bolts - **1** - on exhaust camshaft simultaneously to initial torque.

- Torque specification: 60 Nm.

- Continue holding pretension on exhaust camshaft and pre-torque bolt - **2** - on exhaust camshaft.

- Torque specification: 60 Nm.

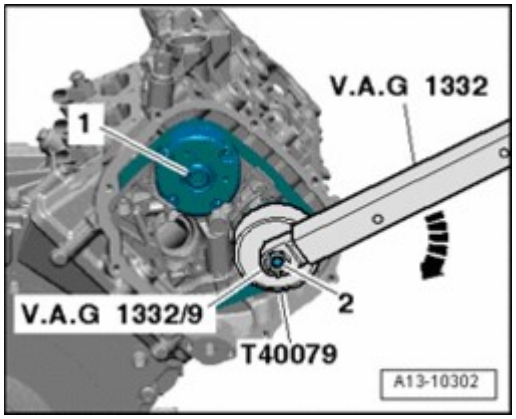

Fig. 197: Positioning Adapter T40079 On Exhaust Camshaft Adjuster At Right Cylinder Head
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position Adapter T40079 on exhaust camshaft adjuster at right cylinder head.
- Position Torque Wrench V.A.G 1332 with Open Ring Spanner Insert V.A.G 1332/9 on Adapter T40079.
- Pre-tension camshaft adjuster to 40 Nm in direction of - **arrow** - and maintain tension.

- Tighten bolts - **1** - on intake camshaft simultaneously to initial torque.
- Tightening Specifications: 60 Nm.
- Continue holding pretension on exhaust camshaft and pre-torque bolt - **2** - on exhaust camshaft.
- Tightening Specifications: 60 Nm.
- Remove Adapter T40079.

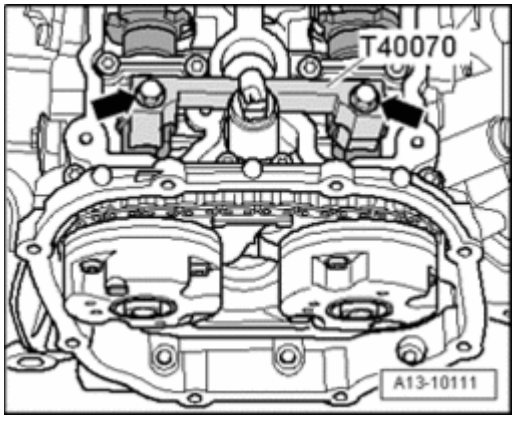

Fig. 198: Mounting Camshaft Locating Tool T40070 To Both Cylinder Heads And Tightening Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove Camshaft Clamp T40070 on both cylinder heads - **arrows** -.

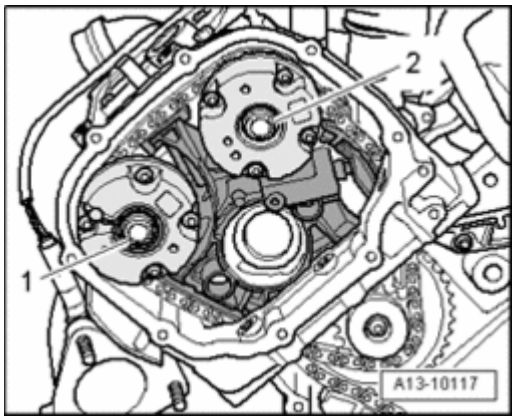

Fig. 199: Removing/Installing Camshaft Adjuster Screws On Left Cylinder Head
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- First tighten camshaft bolt - **1** - and then camshaft bolt - **2** - on left cylinder head to final torque.
- Tightening Specifications: 80 Nm plus an additional 90 ($^{1}/_{4}$ turn).

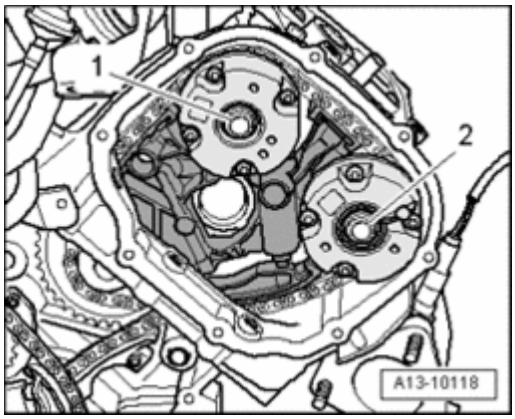

Fig. 200: Removing/Installing Camshaft Adjuster Screws On Right Cylinder Head
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- First tighten camshaft bolt - **1** - and then camshaft bolt - **2** - on right cylinder head to final torque.

- Tightening Specifications: 80 Nm plus an additional 90 ($^{1}/_{4}$ turn).

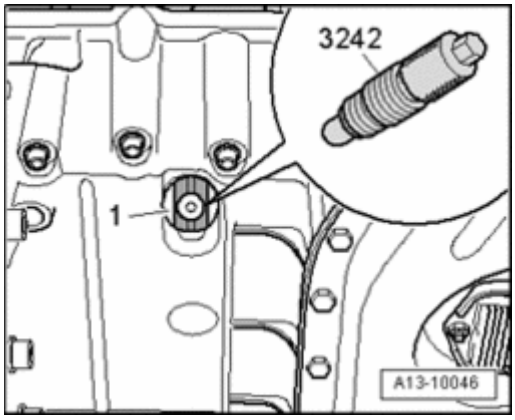

Fig. 201: Installing/Removing Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove crankshaft holder 3242.

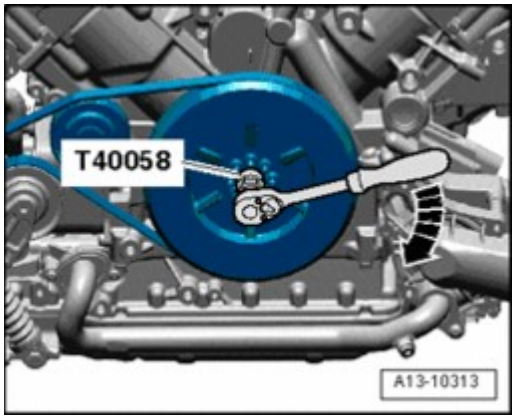

Fig. 202: Using Socket T40058 To Rotate Crankshaft To TDC
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Using Socket T40058 turn crankshaft two complete rotations in direction of engine rotation - **arrow** - until crankshaft stands at "TDC" again.

NOTE:

- **If rotated unintentionally beyond "TDC" , turn back crankshaft again approx. 30 and set to "TDC" again.**

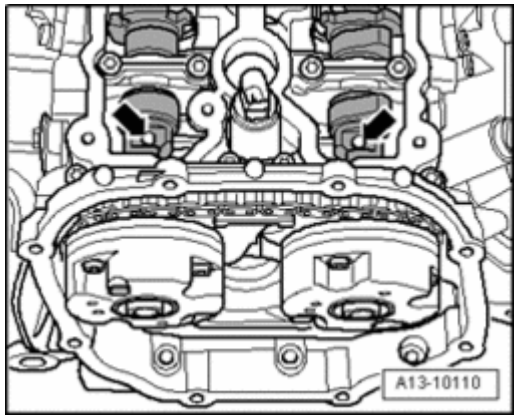

Fig. 203: Identifying Threaded Holes In Camshafts Must Face Upward
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- **The threaded holes - arrows - in camshafts must face upward.**

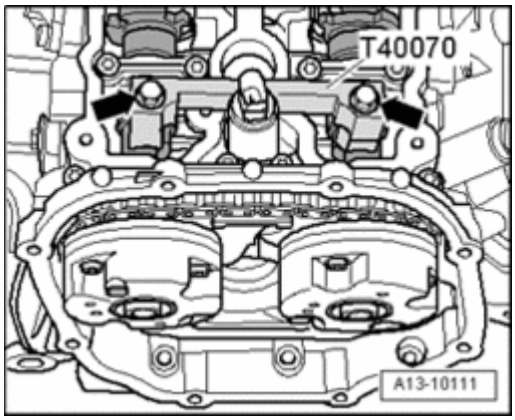

Fig. 204: Mounting Camshaft Locating Tool T40070 To Both Cylinder Heads And Tightening Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Mount camshaft locating tools T40070 to both cylinder heads and tighten bolts - **arrows** - to 25 Nm.

- The camshaft locating tool T40070 is correctly positioned when the holes for the cylinder head bolts remain free.

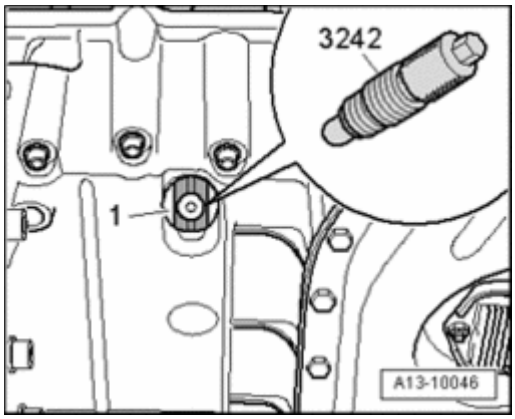

Fig. 205: Installing/Removing Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install Crankshaft Holder 3242 in bore or groove and tighten to 20 Nm.
- The crankshaft holder 3242 must engage in the locating hole or groove on the crankshaft - **1** -. Repeat adjustment if it does not.
- Remove camshaft locating tools on both cylinder heads.
- Remove crankshaft holder 3242.
- Install "TDC" mark sealing plug with new seal in upper part of oil pan.

The rest of installation is in reverse order of removal, note the following:

- Install left and right timing chain covers --> **Timing Chain Covers, Removing and Installing** .
- Install cylinder head cover: Left --> **Left Cylinder Head Cover, Removing and Installing** , right --> **Right Cylinder Head Cover, Removing and Installing**.
- Install engine --> **Engine, Installing**.

Tightening Specifications

Component	Nm
Camshaft bolts	80 + 90° 1)2)3)
Sealing plug in upper section of oil pan	35 4)
1) Replace bolts. 2) 90° corresponds to a quarter turn. 3) Tighten in 2 stages. 4) Install with new gasket.	

Camshaft Timing Chain, Removing and Installing

Camshaft Timing Chain, Removing and Installing

Special tools, testers and auxiliary items required

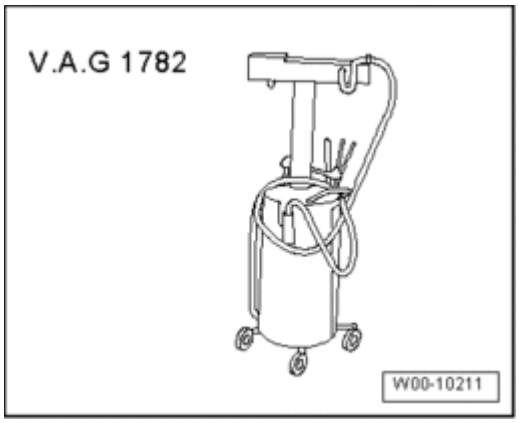

Fig. 206: Identifying Old Oil Collecting And Extracting Device V.A.G 1782
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Old oil collecting and extracting device V.A.G 1782

Removing

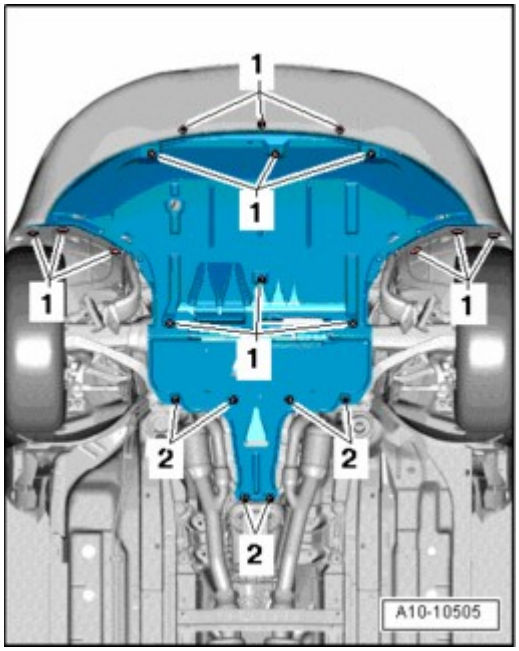

Fig. 207: Identifying Noise Insulation Quick-Release Fasteners
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen quick-release fasteners - **1** - and - **2** - and remove noise insulation.
- Place old oil collecting and extracting device V.A.G 1782 under engine and drain engine oil.
- Remove engine --> **Engine, Removing**.
- Separate engine and transmission --> **Engine and Transmission, Separating**.
- Leave engine on Scissor Lift Table VAS 6131 or secure engine to assembly stand --> **Engine, Securing to Assembly Stand**.

- Remove drive plate --> **Drive Plate, Removing and Installing**.
- Remove cylinder head cover: Left --> **Left Cylinder Head Cover, Removing and Installing** , right --> **Right Cylinder Head Cover, Removing and Installing**.
- Remove left and right timing chain covers --> **Timing Chain Covers, Removing and Installing**.

- Remove intake manifold --> **24 - MULTIPORT FUEL INJECTION (MFI)** .
- Remove oil filter housing --> **Oil Filter Housing, Removing and Installing**.
- Remove lower timing chain cover --> **Lower Timing Chain Cover, Removing and Installing**.
- Remove camshaft timing chains from camshafts --> **Camshaft Timing Chains, Removing from Camshafts**.

- Mark running direction of left camshaft timing chain with paint.

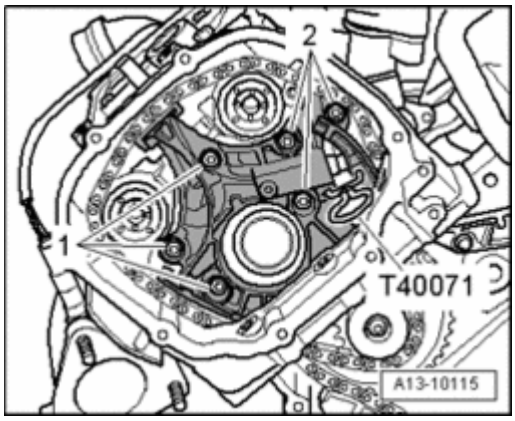

Fig. 208: Tightening/Removing Bolts & Replacing Camshaft Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **1** - and - **2** - and remove left chain tensioner and left camshaft timing chain.
- Mark running direction of right camshaft timing chain with paint.

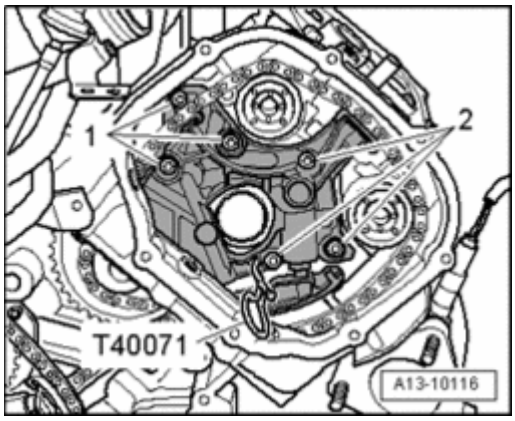

Fig. 209: Tightening Bolts & Replacing Camshaft Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **1** - and - **2** - and remove right chain tensioner and right camshaft timing chain.

Installing

NOTE:

- **If the tensioning element is to be removed from the chain tensioner, observe the installed position: Hole in housing floor faces toward chain tensioner, piston faces toward tensioning rail.**
- **Replace bolts which have been tightened to torque.**

CAUTION: When turning camshaft, crankshaft must not be at "TDC" for any cylinder. Valves and/or pistons may be damaged.

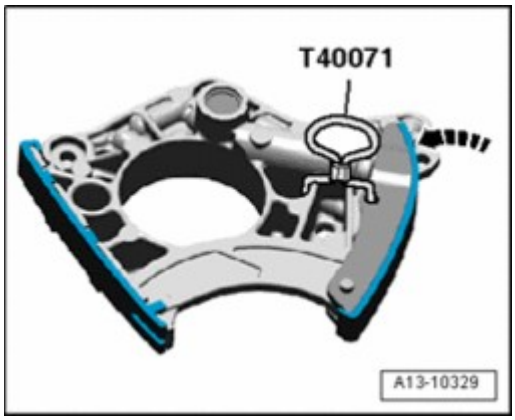

Fig. 210: Pressing Left/Right Camshaft Timing Chain Guide Rail Inward And Securing Chain Tensioner With Locking Pin T40071
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press left and right camshaft timing chain guide rail inward - **arrow** - as far as stop and secure chain tensioner with Locking Pin T40071.

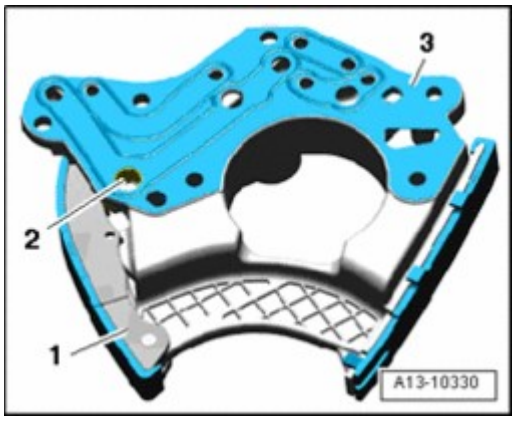

Fig. 211: Identifying Chain Tensioner Oil Screen, Gasket & Chain Tensioner
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Clean oil strainer - **2** - in both chain tensioners if necessary.
- Place a new gasket - **3** - onto rear of the chain tensioner - **1** -.

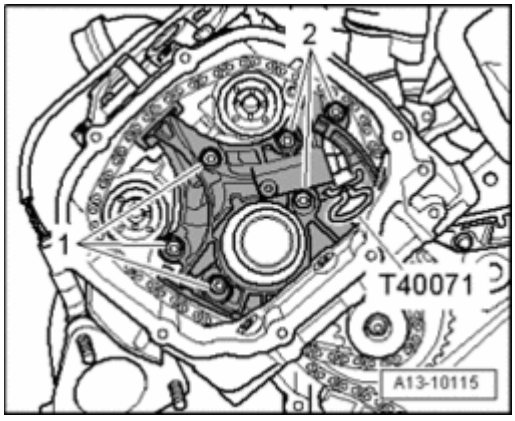

Fig. 212: Tightening/Removing Bolts & Replacing Camshaft Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert chain tensioner in left cylinder head and position camshaft timing chain according to mark applied during removal, as shown in illustration.
- Tighten bolts - **1** - and - **2** -.

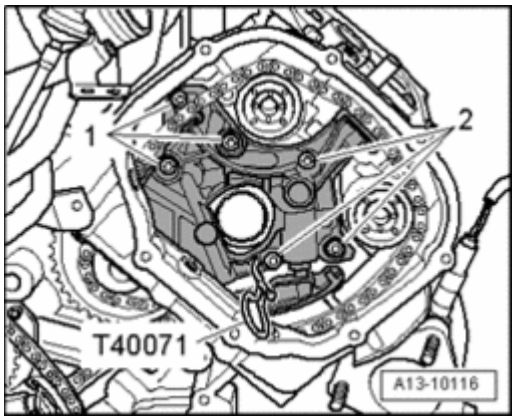

Fig. 213: Tightening Bolts & Replacing Camshaft Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert chain tensioner in right cylinder head and position camshaft timing chain according to mark applied during removal, as shown in illustration.
- Tighten bolts - **1** - and - **2** -.

Further installation is in reverse order of removal, note the following:

- Position camshaft timing chains on camshafts --> **Camshaft Timing Chain, Removing and Installing** .
- Install lower timing chain cover --> **Lower Timing Chain Cover, Removing and Installing**.
- Install crankshaft seal, timing chain side --> **Crankshaft Seal, Timing Chain Side, Replacing**.

- Install oil filter housing --> **Oil Filter Housing, Removing and Installing**.
- Install intake manifold --> **24 - MULTIPORT FUEL INJECTION (MFI)** .
- Install left and right timing chain covers --> **Timing Chain Covers, Removing and Installing** .
- Install cylinder head cover: Left --> **Left Cylinder Head Cover, Removing and Installing** , right --> **Right Cylinder Head Cover, Removing and Installing**.
- Install drive plate --> **Drive Plate, Removing and Installing**.
- Install engine --> **Engine, Installing**.
- Add engine oil and check oil level --> **Oil Level, Checking**.

Tightening specifications

Component	Nm
Chain tensioner to cylinder head	5 + 90° 1)2)
1) Replace bolts. 2) 90° corresponds to a quarter turn.	

Timing Mechanism Drive Chain, Component Overview

Timing Mechanism Drive Chain, Component Overview

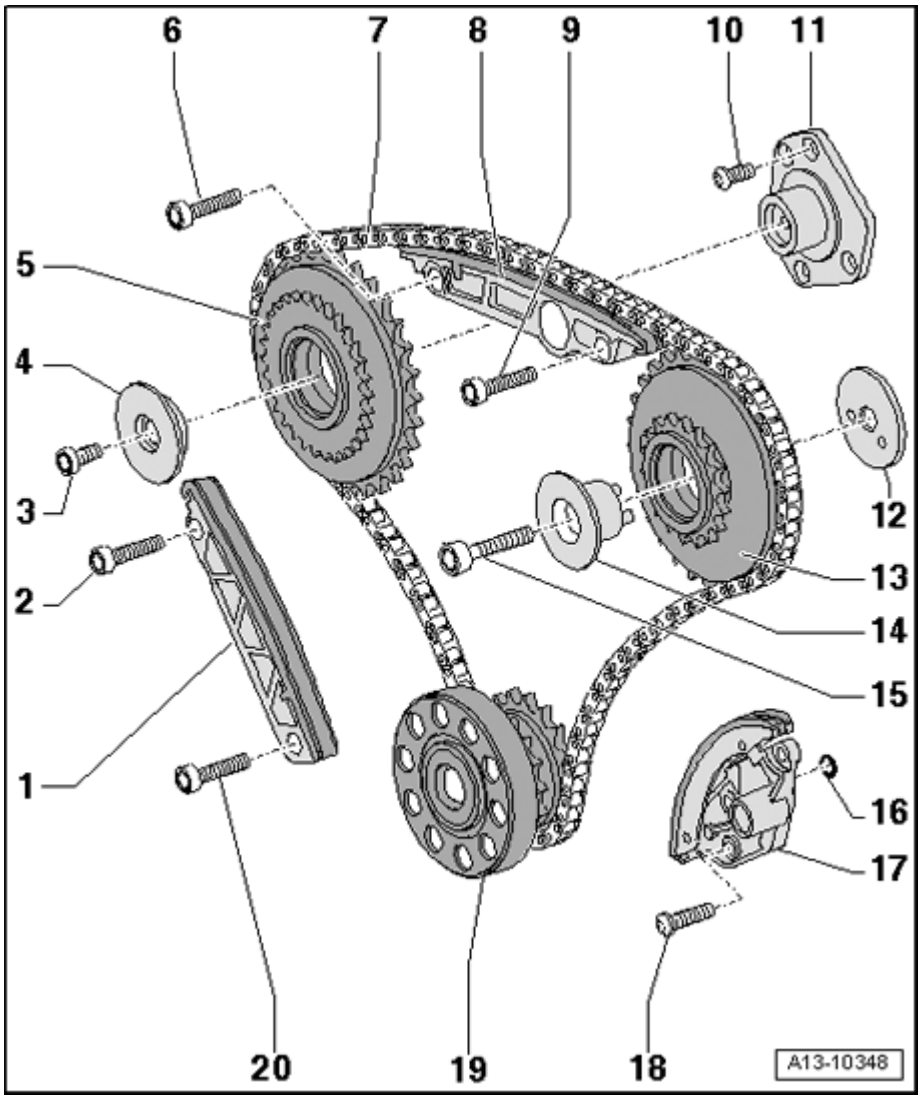

Fig. 214: Timing Mechanism Drive Chain, Component Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Guide rail

2 - 10 Nm plus an additional 90 ($^{1}/_{4}$ turn)

- Replace

3 - 24 Nm

4 - Thrust washer for drive sprocket

5 - Drive sprocket for left timing chain

6 - 10 Nm plus an additional 90 ($^{1}/_{4}$ turn)

- Replace

7 - Timing Mechanism Drive Chain

- Before removing, mark direction of rotation with paint. Reversing rotation direction of a used chain can destroy it.
- Removing and installing --> **Timing Mechanism Drive Chain, Removing and Installing**

8 - Guide rail

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

- Replace

10 - 9 Nm

11 - Mounting bracket for drive sprocket

- For right camshaft timing chain
- Asymmetrical version
- Installed location --> **Location of the mounting pins for camshaft timing chain drive sprocket**

12 - Thrust washer

13 - Drive sprocket for right timing chain

14 - Pivot pin for drive sprocket

15 - 42 Nm

16 - O-ring

- Replace

17 - Chain tensioner

18 - 5 Nm plus an additional 90 ($^{1}/_{4}$ turn)

- Replace

19 - Crankshaft

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

- Replace

Location of the mounting pins for camshaft timing chain drive sprocket

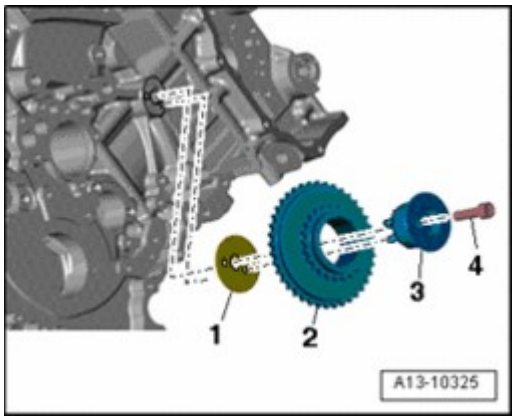

Fig. 215: Location Of The Mounting Pins For Camshaft Timing Chain Drive Sprocket
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Alignment bushings in right camshaft timing chain drive sprocket mounting pins - **3** - must engage in holes in thrust washer - **1** - and cylinder block.

2 - Drive sprocket for right camshaft timing chain

4 - Bolt, 42 Nm

Timing Mechanism Drive Chain, Removing and Installing

Timing Mechanism Drive Chain, Removing and Installing

Special tools, testers and auxiliary items required

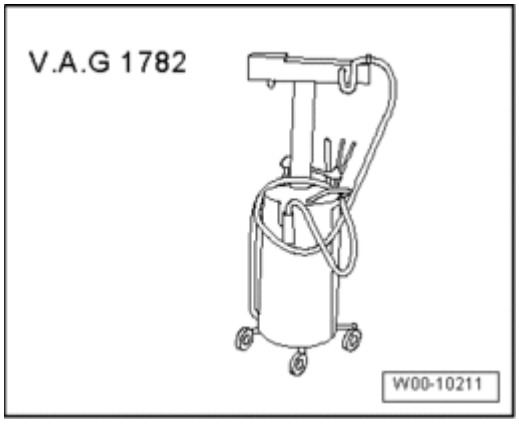

Fig. 216: Identifying Old Oil Collecting And Extracting Device V.A.G 1782
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Old oil collecting and extracting device V.A.G 1782

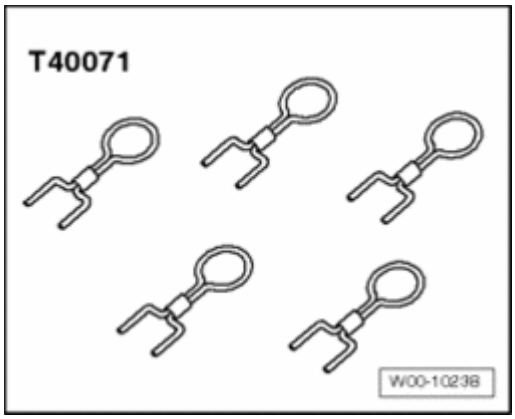

Fig. 217: Securing Pin T40071
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Securing pin T40071

Removing

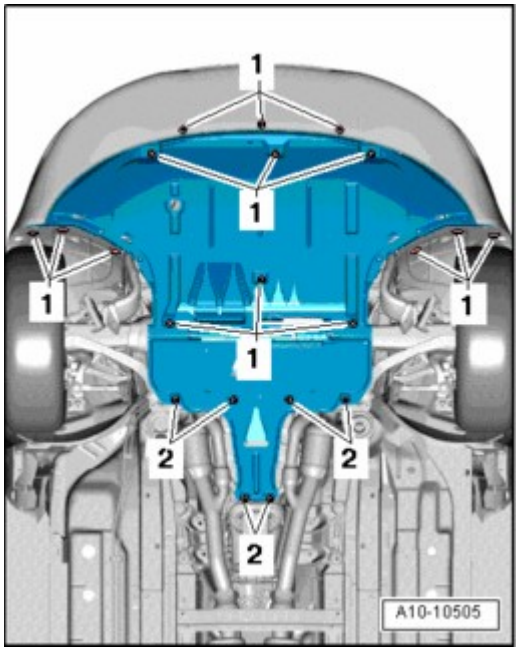

Fig. 218: Identifying Noise Insulation Quick-Release Fasteners
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen quick-release fasteners - **1** - and - **2** - and remove noise insulation.
- Place old oil collecting and extracting device V.A.G 1782 under engine and drain engine oil.
- Remove engine --> **Engine, Removing**.
- Separate engine and transmission --> **Engine and Transmission, Separating**.
- Leave engine on Scissor Lift Table VAS 6131 or secure engine to assembly stand --> **Engine, Securing to Assembly Stand**.

- Remove drive plate --> **Drive Plate, Removing and Installing**.
- Remove cylinder head cover: Left --> **Left Cylinder Head Cover, Removing and Installing** , right --> **Right Cylinder Head Cover, Removing and Installing**.
- Remove left and right timing chain covers --> **Timing Chain Covers, Removing and Installing**.

- Remove intake manifold --> **24 - MULTIPORT FUEL INJECTION (MFI)** .
- Remove oil filter housing --> **Oil Filter Housing, Removing and Installing**.
- Remove lower timing chain cover --> **Lower Timing Chain Cover, Removing and Installing**.
- Remove camshaft timing chains --> **Camshaft Timing Chain, Removing and Installing**.

- Remove oil pump drive chain and balance shaft --> **Power Take-Off, Oil Pump and Balancing Shaft Drive Chain, Removing and Installing**.

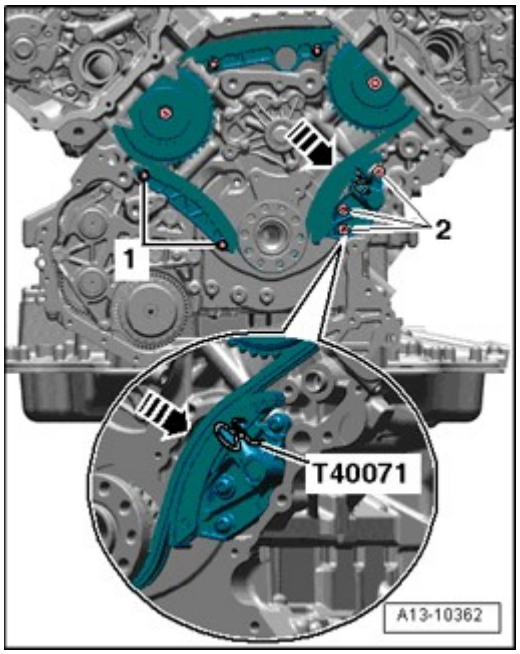

Fig. 219: Pushing Drive Chain Tensioner Guide Rail And Securing Chain Tensioner Using Locking Pin T40071
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Push drive chain tensioner guide rail in direction of - **arrow** - and secure chain tensioner using Locking Pin T40071.
- Mark drive chain running direction with paint.
- Remove bolts - **1** - and remove guide rail.
- Remove bolts - **2 to 4** - and remove chain tensioner.

- Remove timing mechanism drive chain.

Installing

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

NOTE:

- **Replace bolts which have been tightened to torque.**

- Route timing mechanism drive chain according to marks applied to drive chain sprockets during removal.
- Install guide rail and tighten bolts - **1** -.
- Install chain tensioner and tighten bolts - **2** -.
- Press drive chain tensioner guide rail in direction of - **arrow** - and remove Locking Pin T40071 from chain tensioner.

- Install oil pump drive chain and balance shaft --> **Power Take-Off, Oil Pump and Balancing Shaft Drive Chain, Removing and Installing**.
- Install camshaft timing chains --> **Camshaft Timing Chain, Removing and Installing** .
- Install lower timing chain cover --> **Lower Timing Chain Cover, Removing and Installing**.
- Install crankshaft seal, timing chain side --> **Crankshaft Seal, Timing Chain Side, Replacing**.

- Install oil filter housing --> **Oil Filter Housing, Removing and Installing**.
- Install intake manifold --> **24 - MULTIPORT FUEL INJECTION (MFI)** .
- Install left and right timing chain covers --> **Timing Chain Covers, Removing and Installing** .
- Install cylinder head cover: Left --> **Left Cylinder Head Cover, Removing and Installing** , right --> **Right Cylinder Head Cover, Removing and Installing**.

- Install drive plate --> **Drive Plate, Removing and Installing**.
- Install engine --> **Engine, Installing**.
- Add engine oil and check oil level --> **Oil Level, Checking**.

Torque specifications

Component	Nm
Guide track to cylinder block	10 Nm +90° 1) 2)
Chain tensioner on cylinder block	5 Nm +90° 1) 2)
1) Replace bolts. 2) 90° corresponds to a quarter turn.	

Power Take-Off Drive Chain, Oil Pump and Balance Shaft, Component Overview

Power Take-Off Drive Chain, Oil Pump and Balance Shaft, Component Overview

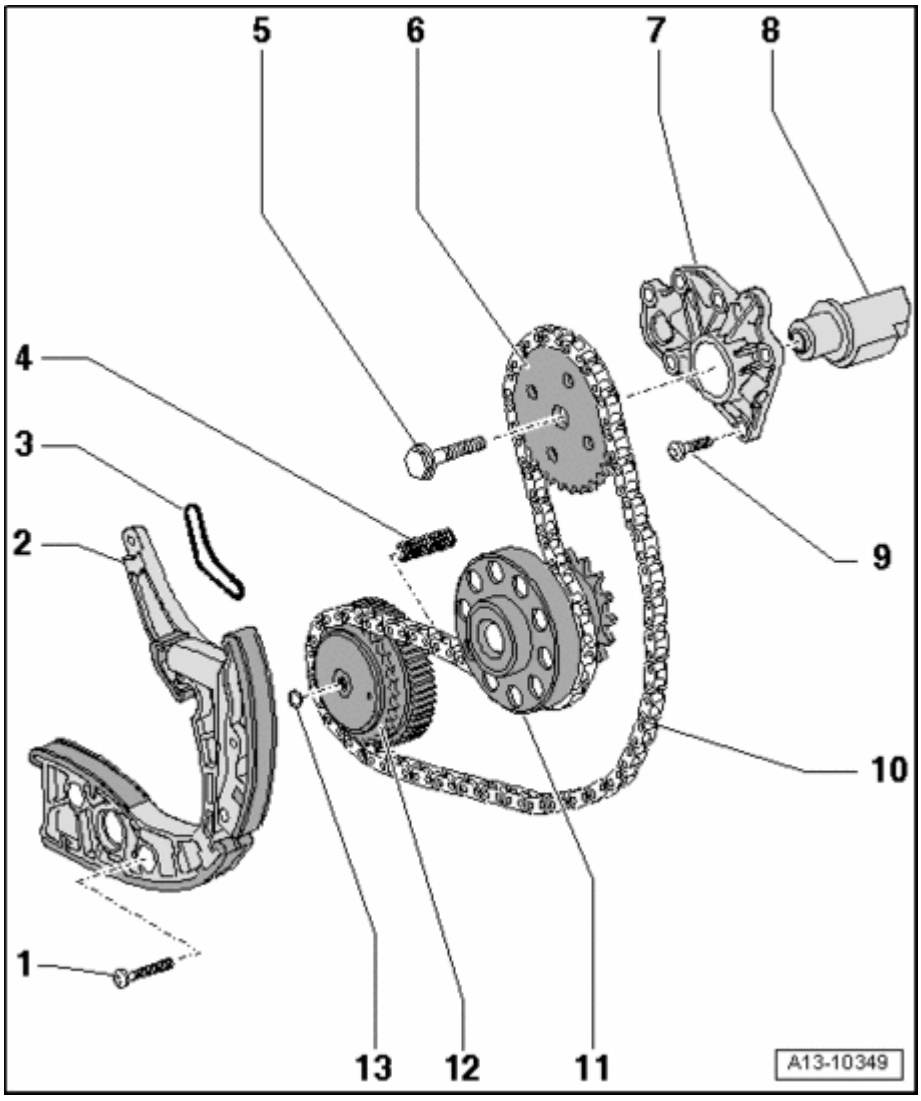

Fig. 220: Power Take-Off Drive Chain, Oil Pump And Balance Shaft, Component Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 9 Nm

2 - Chain tensioner

- With glide track

3 - Gasket

- Replace

4 - Spring

5 - 42 Nm

6 - Chain sprocket for balance shaft

7 - Bearing cap

8 - Differential shaft

- Removing and installing --> **Balancing Shaft, Removing and Installing**

9 - 9 Nm

10 - Drive chain for power take-off, oil pump and balance shaft

- Before removing, mark direction of rotation with paint. Reversing rotation direction of a used chain can destroy it.
- Removing and installing --> **Power Take-Off, Oil Pump and Balancing Shaft Drive Chain, Removing and Installing**

11 - Crankshaft

12 - Drive chain for power take-off and oil pump

13 - Circlip

Power Take-Off, Oil Pump and Balancing Shaft Drive Chain, Removing and Installing

Power Take-Off, Oil Pump and Balancing Shaft Drive Chain, Removing and Installing

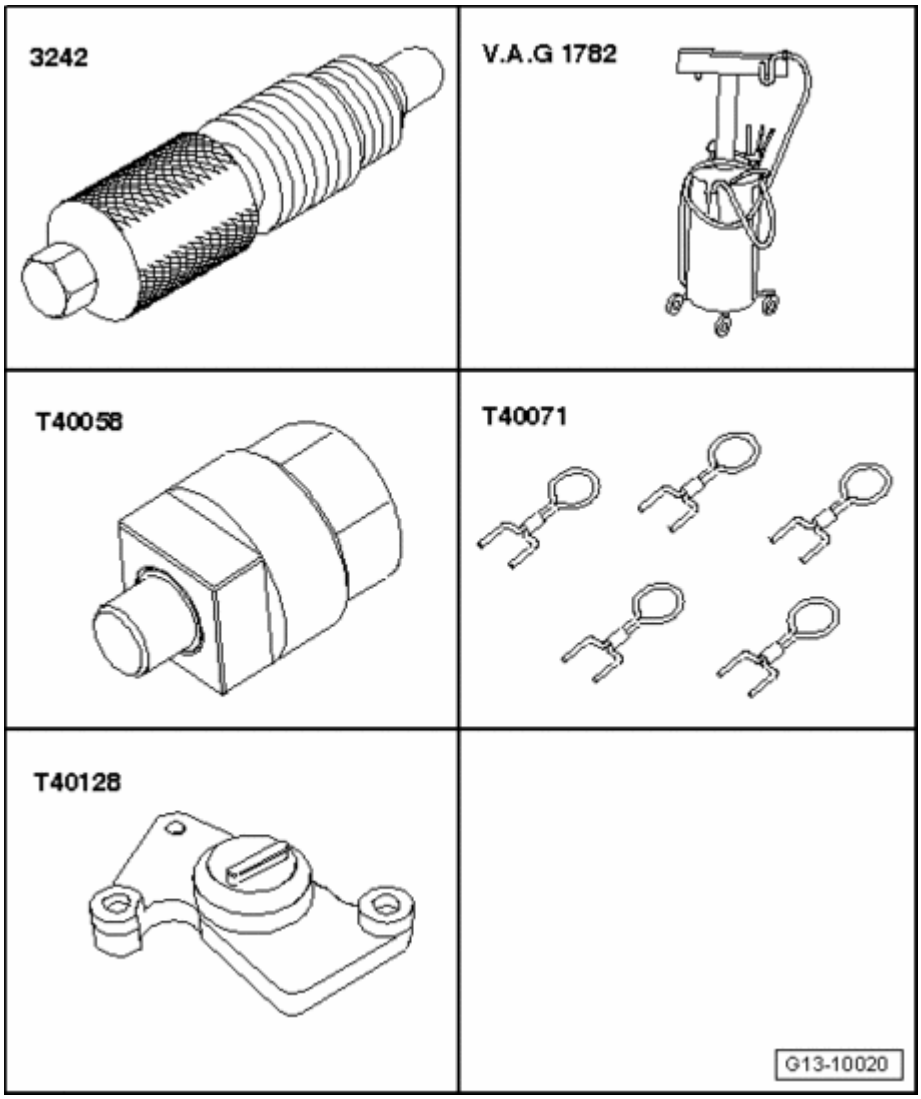

Fig. 221: Identifying Special Tools - Power Take-Off, Oil Pump And Balancing Shaft Drive Chain, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Locking pin 3242
- Old oil collecting and extracting device V.A.G 1782
- Adapter T40058
- Securing pin T40071
- Setting gauge T40128

Removing

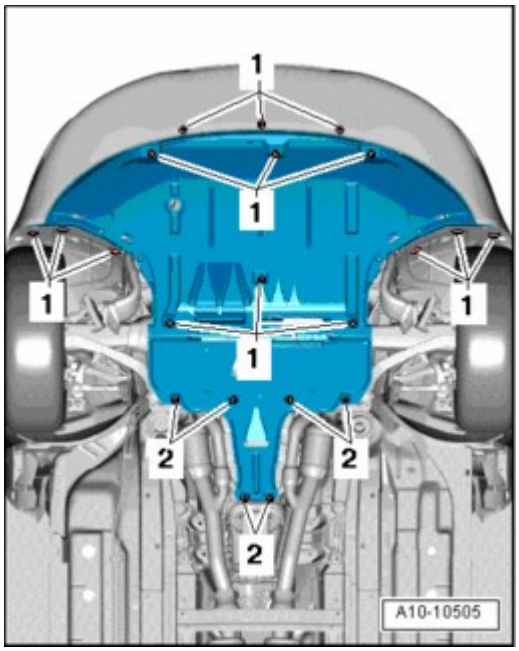

Fig. 222: Identifying Noise Insulation Quick-Release Fasteners
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen quick-release fasteners - **1** - and - **2** - and remove noise insulation.
- Place old oil collecting and extracting device V.A.G 1782 under engine and drain engine oil.
- Remove engine --> **Engine, Removing**.
- Separate engine and transmission --> **Engine and Transmission, Separating**.

- Leave engine on Scissor Lift Table VAS 6131 or secure engine to assembly stand --> **Engine, Securing to Assembly Stand**.

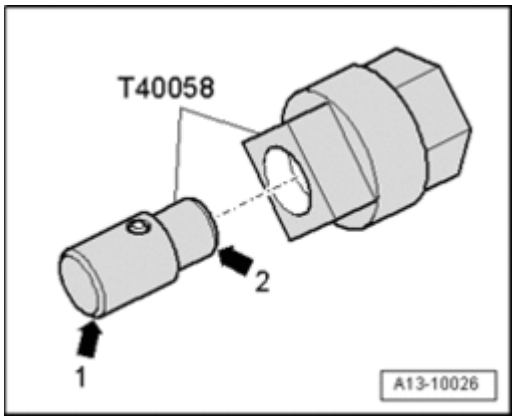

Fig. 223: Inserting Guide Pin Of Adapter T40058 So Small Diameter Points To Engine
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert guide pin of adapter T40058 so that small diameter - **arrow 2** - points to engine. Large diameter - **arrow 1** - points to socket.

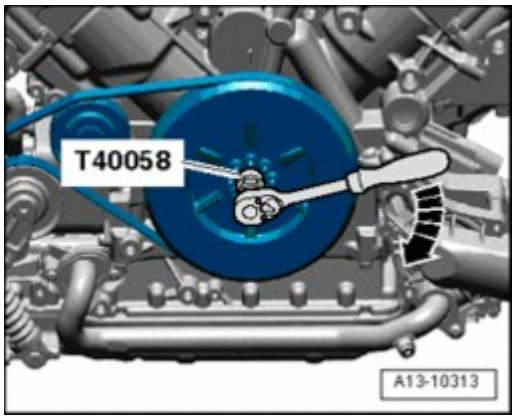

Fig. 224: Using Socket T40058 To Rotate Crankshaft To TDC
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Using Socket T40058 , rotate crankshaft in direction of engine rotation - **arrow** - to "TDC".

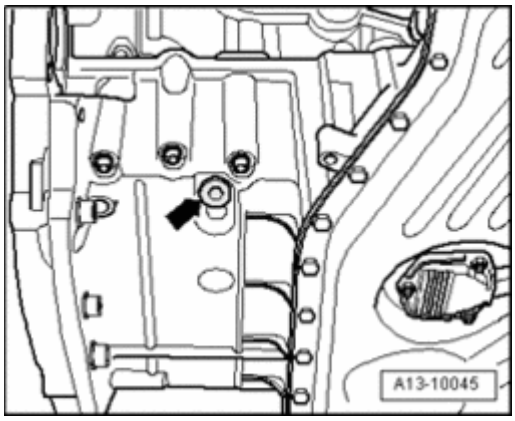

Fig. 225: Removing Locking Bolt From Upper Part Of Oil Pan
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove locking bolt - **arrow** - from upper part of oil pan.

CAUTION: Do not turn the crankshaft - 1 - while touching the "TDC" hole with your finger. You could be injured.

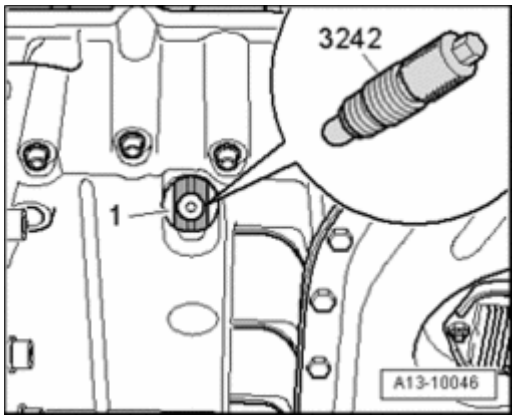

Fig. 226: Installing/Removing Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install crankshaft holder 3242 into hole to 20 Nm. If necessary rotate crankshaft very slightly back and forth to completely center the holder.
- Remove vibration damper --> **Vibration Damper, Removing and Installing**.
- Remove drive plate --> **Drive Plate, Removing and Installing**.
- Remove left and right timing chain covers --> **Timing Chain Covers, Removing and Installing**.

- Remove intake manifold --> **24 - MULTIPORT FUEL INJECTION (MFI)** .
- Remove oil filter housing --> **Oil Filter Housing, Removing and Installing**.
- Remove lower timing chain cover --> **Lower Timing Chain Cover, Removing and Installing**.

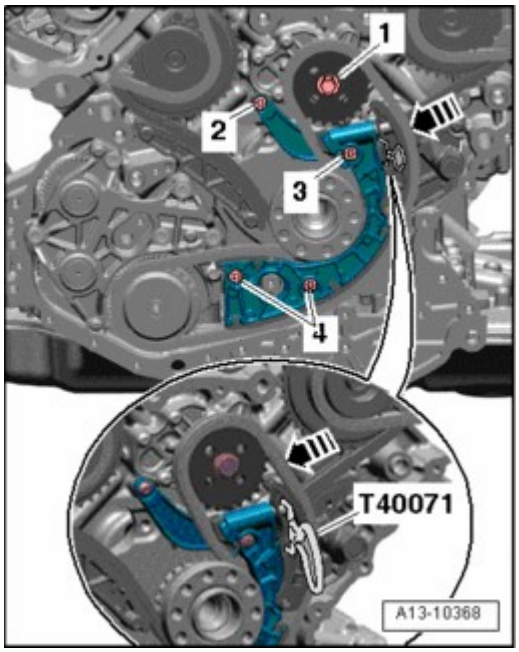

Fig. 227: Pressing Tensioning Rail, Securing Chain Tensioner With Locking Pin T40071, Removing Bolts, Balance Shaft Chain Sprocket & Chain Tensioner
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Mark running direction of power take-off chain with paint.
- Press tensioning rail in direction of - **arrow** - and secure chain tensioner with Locking Pin T40071.
- Remove bolt - **1** - and remove balance shaft chain sprocket.
- Remove bolts - **2 to 4** - and remove chain tensioner.

- Remove drive chain for power take-off, oil pump and balance shaft.

Installing

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

NOTE:

- **Replace gaskets, seal and O-rings.**

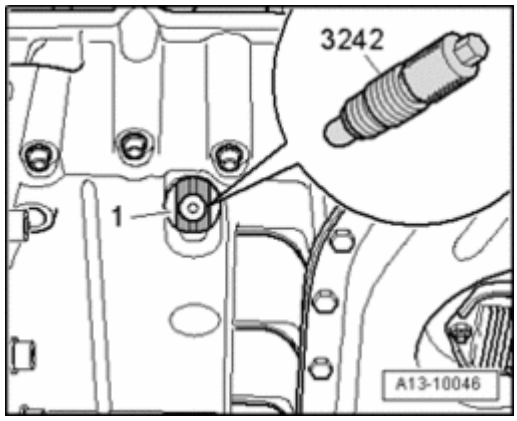

Fig. 228: Installing/Removing Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- **Secure crankshaft - 1 - in "TDC" position using crankshaft holder 3242.**

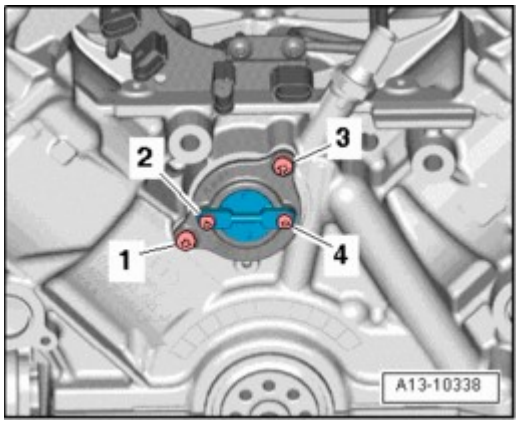

Fig. 229: Removing Bolts & Balance Shaft Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **2** - and - **4** -.

- Remove balance shaft cover.
- Remove bolts - **1** - and - **3** -.

NOTE:

- **Balance shaft front bearing cap remains installed.**

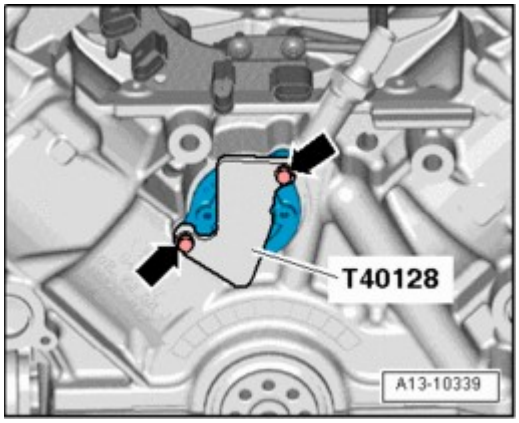

Fig. 230: Positioning Setting Gauge T40128 On Balance Shaft Front Bearing Cap
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position Setting Gauge T40128 on balance shaft front bearing cap.
- Rib on Setting Gauge T40128 must engage in groove on balance shaft.
- Fasten Setting Gauge T40128 to cylinder block with 2 M6x30 bolts - **arrows** -.

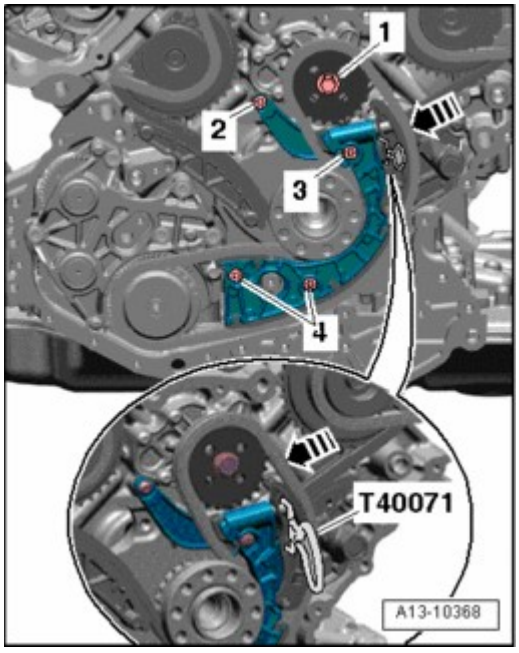

Fig. 231: Pressing Tensioning Rail, Securing Chain Tensioner With Locking Pin T40071, Removing Bolts, Balance Shaft Chain Sprocket & Chain Tensioner
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Route drive chain for power-take off, oil pump and balance shaft according to marks made during removal.
- Install chain tensioner and tighten bolts - **2 through 4** -.
- Place drive chain on balance shaft chain sprocket and tighten bolt - **1** -.
- Remove Setting Gauge T40128.

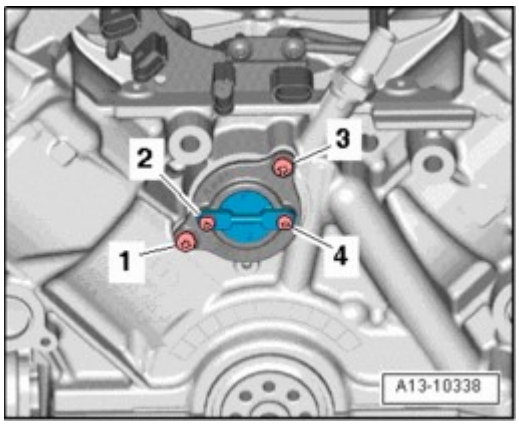

Fig. 232: Removing Bolts & Balance Shaft Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tighten bolts - **1** - and - **3** -.
- Replace balance shaft cover O-ring.
- Tighten bolts - **2** - and - **4** - on balance shaft cover.

Further installation is in reverse order of removal, note the following:

- Install lower timing chain cover --> **Lower Timing Chain Cover, Removing and Installing**.
- Install crankshaft seal, timing chain side --> **Crankshaft Seal, Timing Chain Side, Replacing**.
- Install oil filter housing --> **Oil Filter Housing, Removing and Installing**.
- Install intake manifold --> **24 - MULTIPORT FUEL INJECTION (MFI)** .

- Install left and right timing chain covers --> **Timing Chain Covers, Removing and Installing** .
- Install drive plate --> **Drive Plate, Removing and Installing**.
- Install vibration damper --> **Vibration Damper, Removing and Installing**.
- Install engine --> **Engine, Installing**.

- Add engine oil and check oil level --> **Oil Level, Checking**.

Torque specifications

Component	Nm
Chain tensioner on cylinder block	9
Chain sprocket to balance shaft	42

Balance shaft front bearing cap to cylinder block	9
Balance shaft cover to balance shaft front bearing cap	5
Sealing plug in upper section of oil pan	35 1)
1) Replace seal.	

Power Take-Off, Component Overview

Power Take-Off, Component Overview

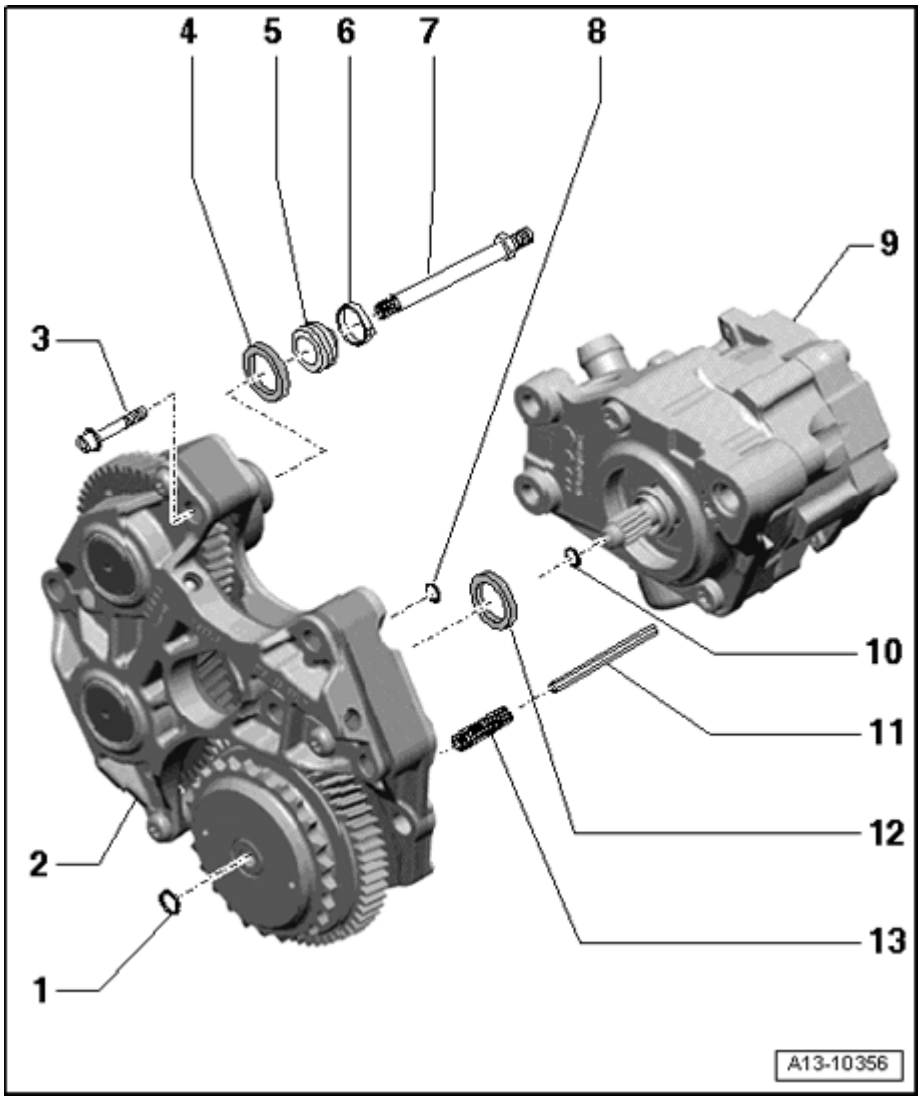

Fig. 233: Power Take-Off, Component Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Circlip

2 - Spur gear unit

- Cannot be replaced separately
- Removing and installing --> **Spur Gear Unit, Removing and Installing**

3 - 22 Nm

4 - Sealing ring for A/C compressor drive

- Replacing --> **Power Take-Off Seals, Replacing**.

5 - Dust seal cap for A/C compressor drive

6 - Clamp

7 - Drive shaft for A/C compressor

- Tighten to 60 Nm

8 - O-ring

- Replace

9 - Power-steering pump

10 - O-ring

- Replace

11 - Drive shaft for oil pump

12 - Sealing ring for power-steering pump drive

- Replacing --> **Power Take-Off Seals, Replacing**.

13 - Spring

Power Take-Off Seals, Replacing

Power Take-Off Seals, Replacing

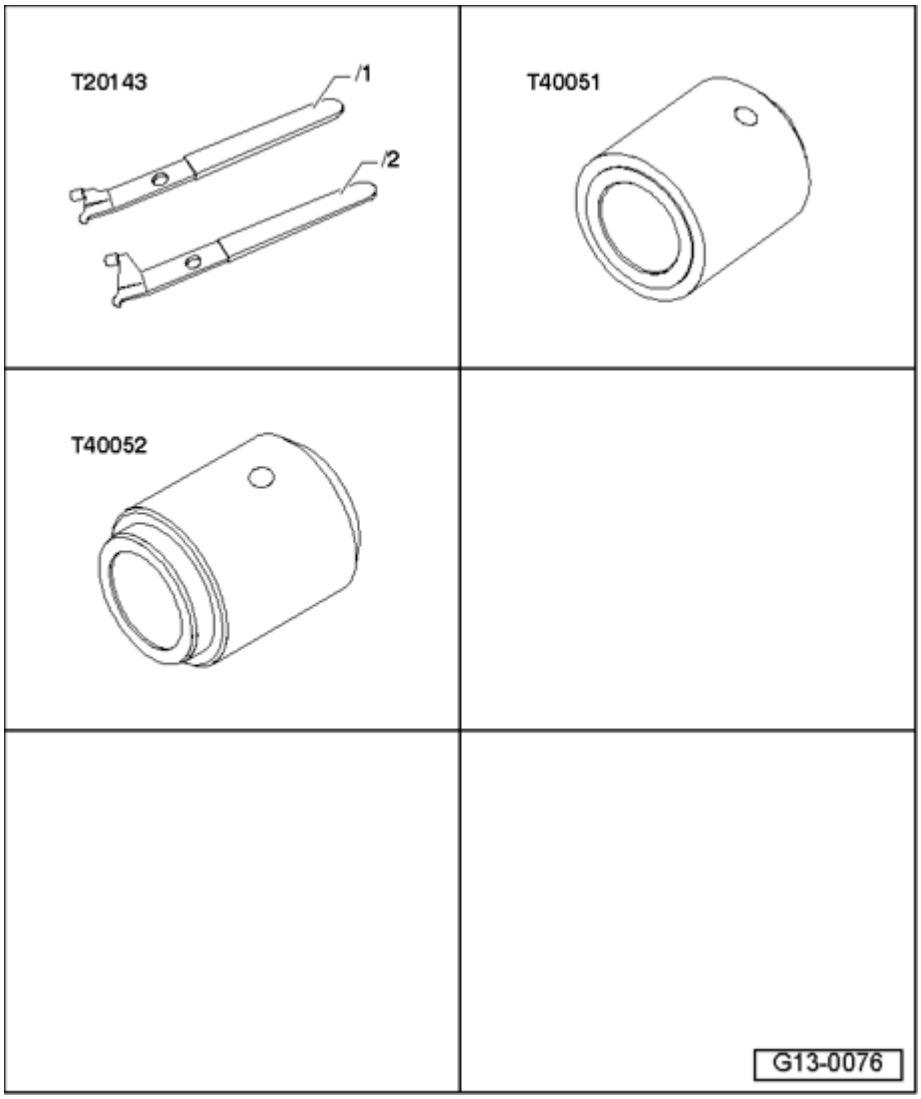

Fig. 234: Identifying Special Tools - Power Take-Off Seals, Replacing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Extractor hook T20143/1
- Pressure piece T40051
- Pressure piece T40052

Procedure

- Remove engine --> **Engine, Removing**.
- Remove air conditioning compressor --> **87 - AIR CONDITIONING** .
- Remove power steering pump --> **48 - STEERING** .

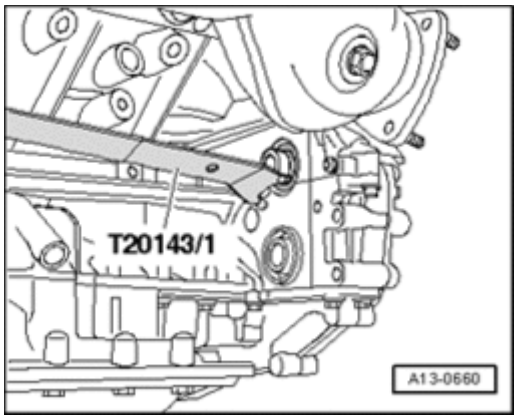

Fig. 235: Prying Out Sealing Ring For A/C Compressor Drive Using Pulling Hook T20143/1
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pry out sealing ring for A/C compressor drive using pulling hook T20143/1.

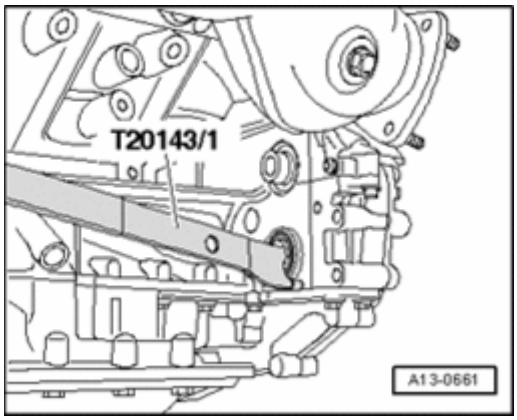

Fig. 236: Prying Out Power-Steering Pump Drive Seal Using Pulling Hook T20143/1
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pry out power-steering pump drive seal using pulling hook T20143/1.

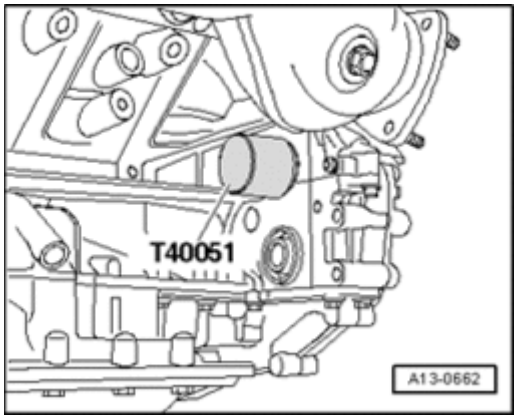

Fig. 237: Driving In Sealing Ring For A/C Compressor Drive Using Thrust Piece T40051
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Drive in sealing ring for A/C compressor drive using thrust piece T40051.

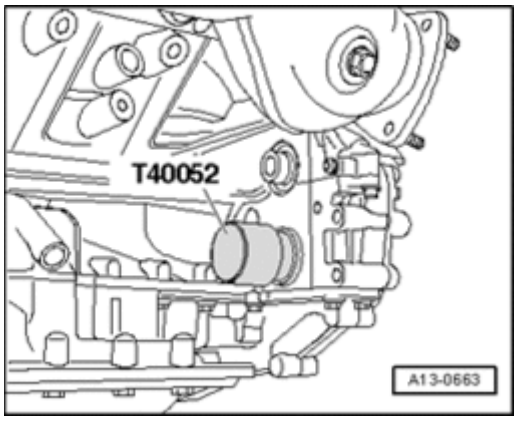

Fig. 238: Driving In Sealing Ring For Power-Steering Pump Drive Using Thrust Piece T40052
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Drive in sealing ring for power-steering pump drive using thrust piece T40052.

The rest of installation is in reverse order of removal, note the following:

- Install power steering pump --> **48 - STEERING** .
- Install A/C compressor --> **87 - AIR CONDITIONING** .

Spur Gear Unit, Removing and Installing

Spur Gear Unit, Removing and Installing

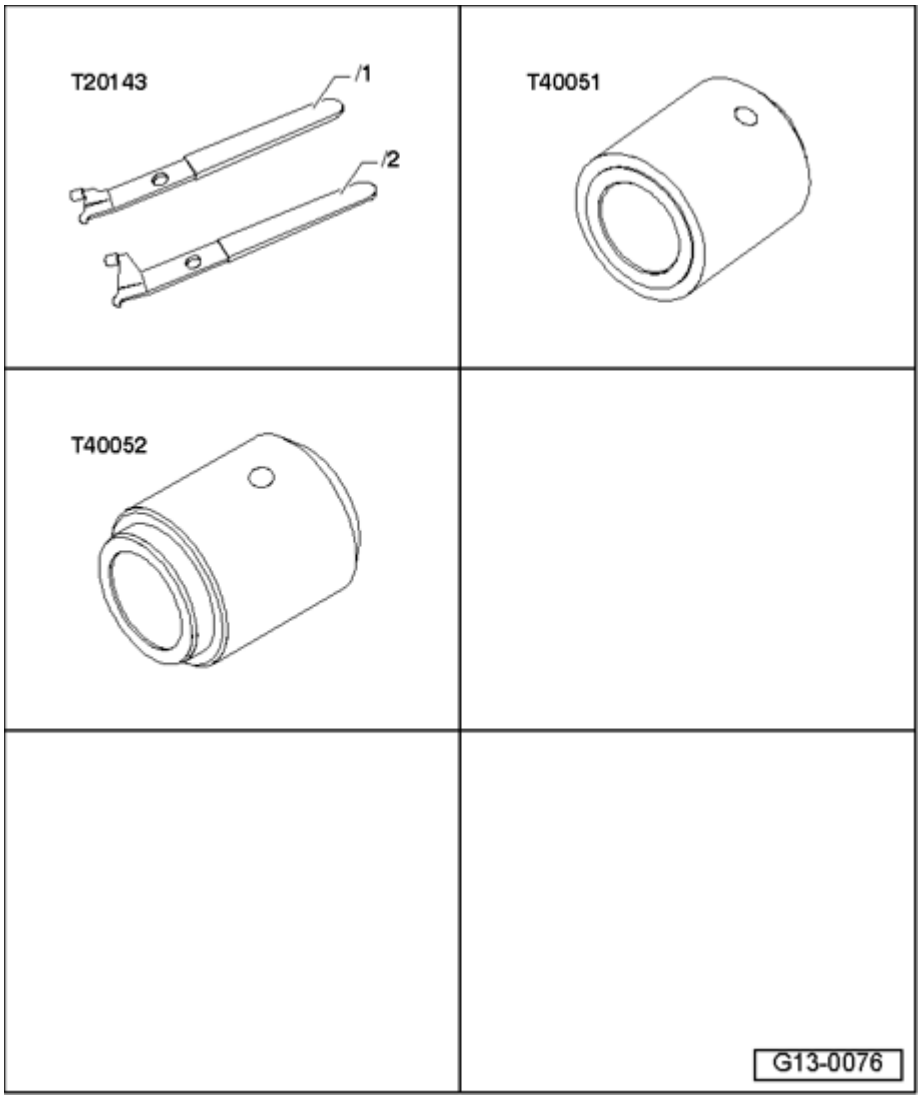

Fig. 239: Identifying Special Tools - Spur Gear Unit, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Extractor hook T20143/1
- Pressure piece T40051
- Pressure piece T40052

Special tools, testers and auxiliary items required

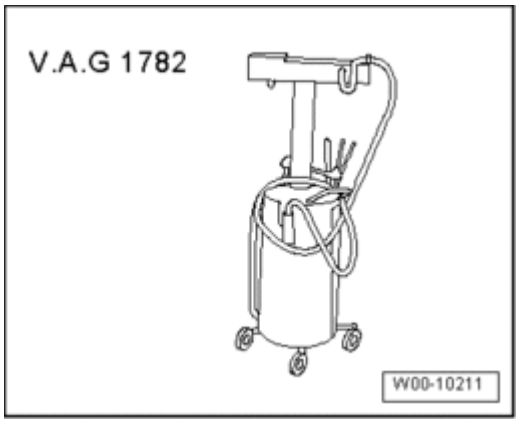

Fig. 240: Identifying Old Oil Collecting And Extracting Device V.A.G 1782
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Old oil collecting and extracting device V.A.G 1782
- Sealant

Removing

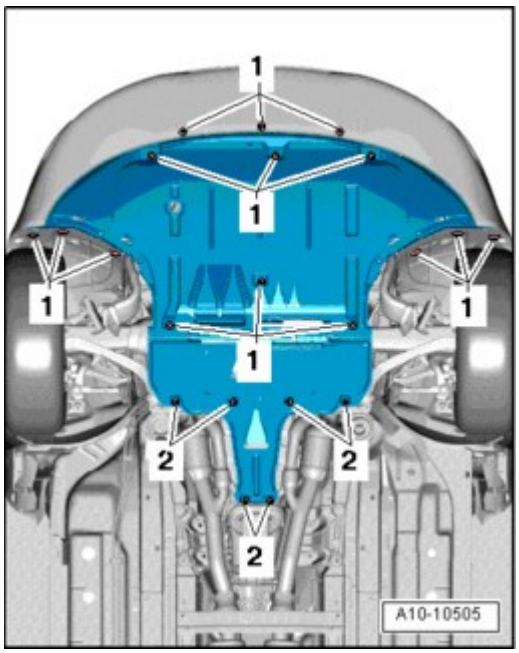

Fig. 241: Identifying Noise Insulation Quick-Release Fasteners
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen quick-release fasteners - **1** - and - **2** - and remove noise insulation.
- Place old oil collecting and extracting device V.A.G 1782 under engine and drain engine oil.
- Remove engine --> **Engine, Removing**.
- Separate engine and transmission --> **Engine and Transmission, Separating**.

- Leave engine on Scissor Lift Table VAS 6131 or secure engine to assembly stand --> **Engine, Securing**

to Assembly Stand.

- Remove drive plate --> **Drive Plate, Removing and Installing**.
- Remove left and right timing chain covers --> **Timing Chain Covers, Removing and Installing**.
- Remove intake manifold --> **24 - MULTIPORT FUEL INJECTION (MFI)** .

- Remove oil filter housing --> **Oil Filter Housing, Removing and Installing**.
- Remove lower timing chain cover --> **Lower Timing Chain Cover, Removing and Installing**.
- Remove power-steering pump from cylinder block.

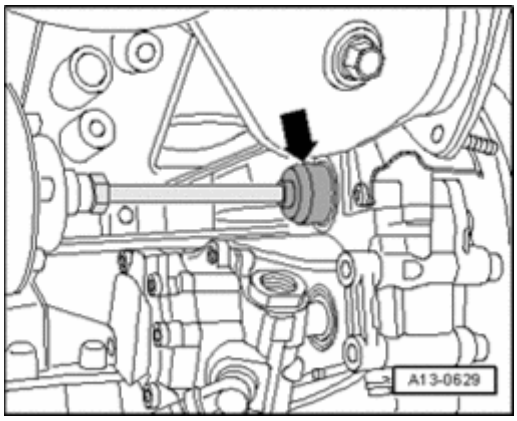

Fig. 242: Removing Hose Clamp At A/C Compressor Dust Cap
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove hose clamp at A/C compressor dust cap - **arrow** -.
- Remove power take-off drive chain --> **Power Take-Off, Oil Pump and Balancing Shaft Drive Chain, Removing and Installing**.

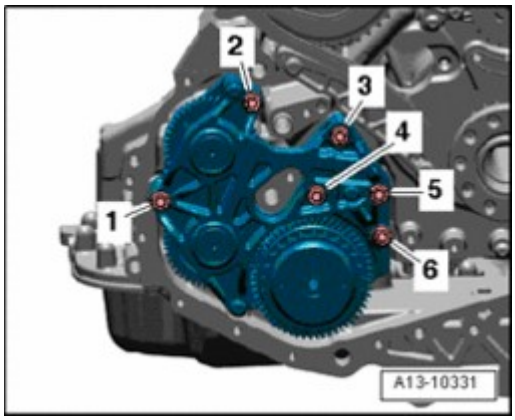

Fig. 243: Removing Bolts & Spur Gear Unit
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **1 to 6** -.
- Remove spur gear unit.

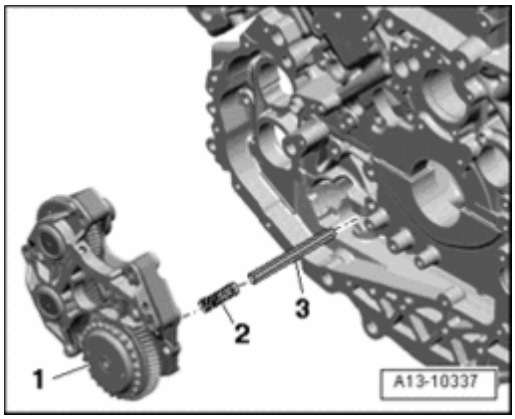

Fig. 244: Removing/Installing Compression Spring Between Spur Gear Unit And Oil Pump Input Shaft
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove compression spring - **2** - between spur gear unit - **1** - and oil pump input shaft - **3** -.

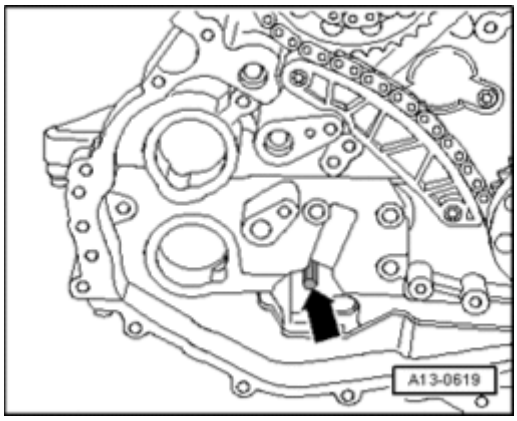

Fig. 245: Removing Drive Shaft For Oil Pump
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove drive shaft - **arrow** - for oil pump.

Installing

NOTE:

- **Replace seals and O-rings.**

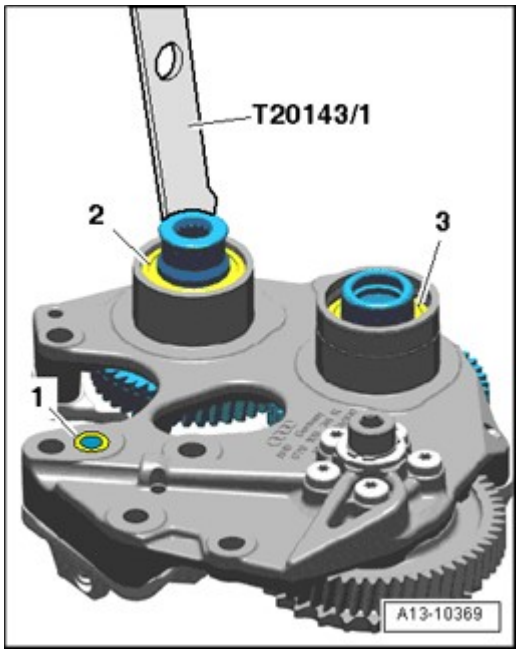

Fig. 246: Removing A/C Compressor Drive Seal And Power Steering Pump Drive Seal Using Pulling Hook T20143/1
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove A/C compressor drive seal - **2** - and power steering pump drive seal - **3** - using Pulling Hook T20143/1.
- Remove O-ring - **1** -.
- Remove sealant residue on front bearing cap and on cylinder block.
- Clean sealing surfaces, they must be free of oil and grease.

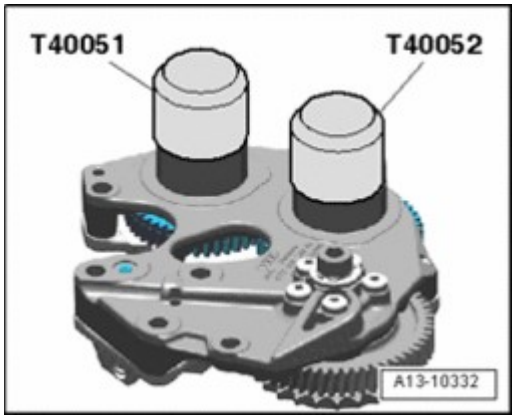

Fig. 247: Driving In Sealing Ring For A/C Compressor Drive Using Thrust Piece T40051 & Sealing Ring For Power-Steering Pump Drive Using Thrust Piece T40052
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Drive in sealing ring for A/C compressor drive using thrust piece T40051.
- Drive in sealing ring for power-steering pump drive using thrust piece T40052.

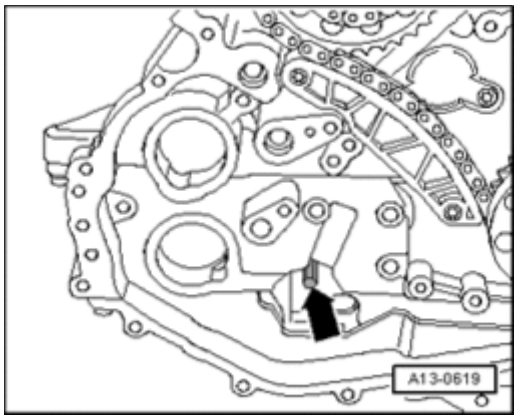

Fig. 248: Removing Drive Shaft For Oil Pump
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert drive shaft - **arrow** - for oil pump into guide on oil pump.

NOTE:

- **To guarantee that the drive shaft engages correctly in oil pump, insert drive shaft only into oil pump, do not install together with front bearing cap.**

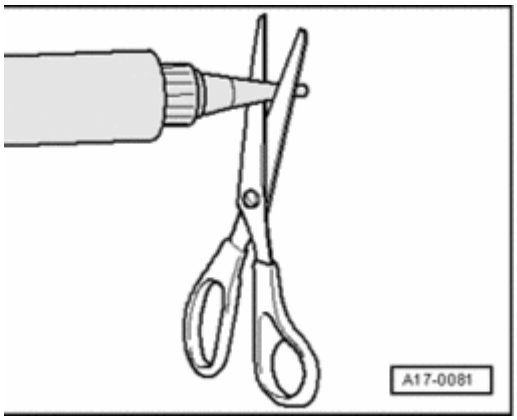

Fig. 249: Cutting Tube Nozzle At Front Marking
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Cut off nozzle on tube of sealant at front mark (dia. of nozzle approx. 1.5 mm).

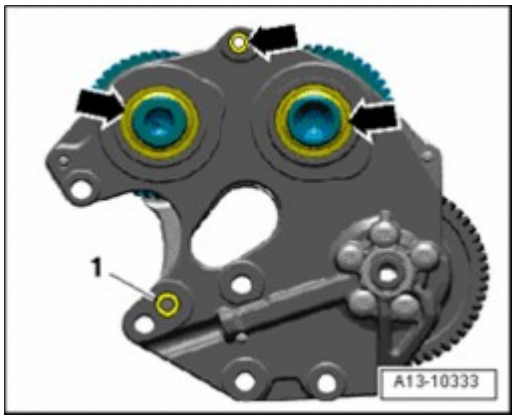

Fig. 250: Applying Sealant Beads To Clean Sealing Surfaces Of Spur Gear Unit
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Apply sealant beads - **arrows** - on clean sealing surfaces of front bearing cap as shown in illustration.
- Thickness of sealant beads: 2.0 mm.
- Position O-ring - **1** - and secure it with some grease.

NOTE:

- **The bearing cap must be installed within 5 minutes after application of sealant.**

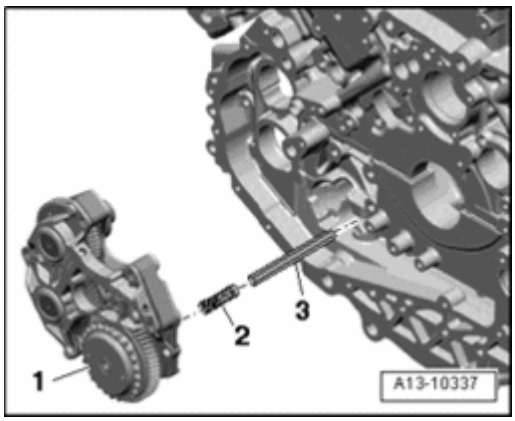

Fig. 251: Removing/Installing Compression Spring Between Spur Gear Unit And Oil Pump Input Shaft
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position compress spring - **2** - for input shaft - **3** - in spur gear unit - **1** -.

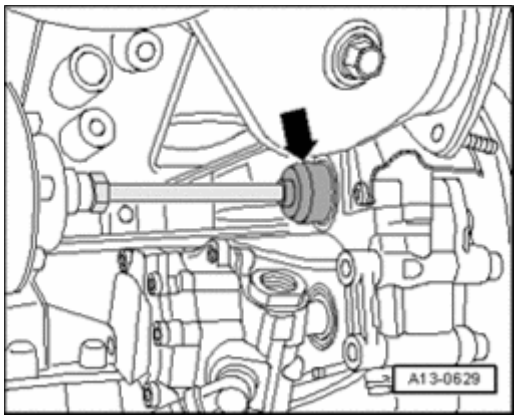

Fig. 252: Sliding Dust Seal Cap Onto Shaft End Of A/C Compressor Drive Spur Gear
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Slide dust seal cap - **arrow** - with hose clamp already installed onto shaft end of A/C compressor drive spur gear.

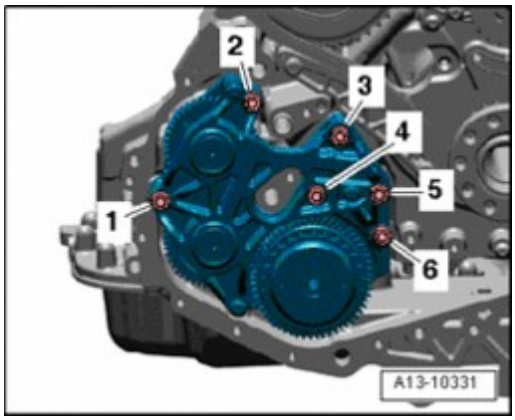

Fig. 253: Positioning Spur Gear Unit And Tighten Bolts In Diagonal Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position spur gear unit and tighten bolts - **1 to 6** - in a diagonal sequence in stages.
- Install oil pump drive chain and balance shaft --> **Power Take-Off, Oil Pump and Balancing Shaft Drive Chain, Removing and Installing**.
- Slide power steering pump with new O-ring onto spur gear for power-steering pump drive.

The rest of installation is in reverse order of removal, note the following:

- Install lower timing chain cover --> **Lower Timing Chain Cover, Removing and Installing**.
- Install crankshaft seal, timing chain side --> **Crankshaft Seal, Timing Chain Side, Replacing**.
- Install oil filter housing --> **Oil Filter Housing, Removing and Installing**.
- Install intake manifold --> **24 - MULTIPORT FUEL INJECTION (MFI)** .

- Install left and right timing chain covers --> **Timing Chain Covers, Removing and Installing** .
- Install drive plate --> **Drive Plate, Removing and Installing**.

- Install engine --> **Engine, Installing**.
- Add engine oil and check oil level --> **Oil Level, Checking**.

Torque specifications

Component	Nm
Spur gear unit to cylinder block	22

Balancing Shaft, Component Overview

Balancing Shaft, Component Overview

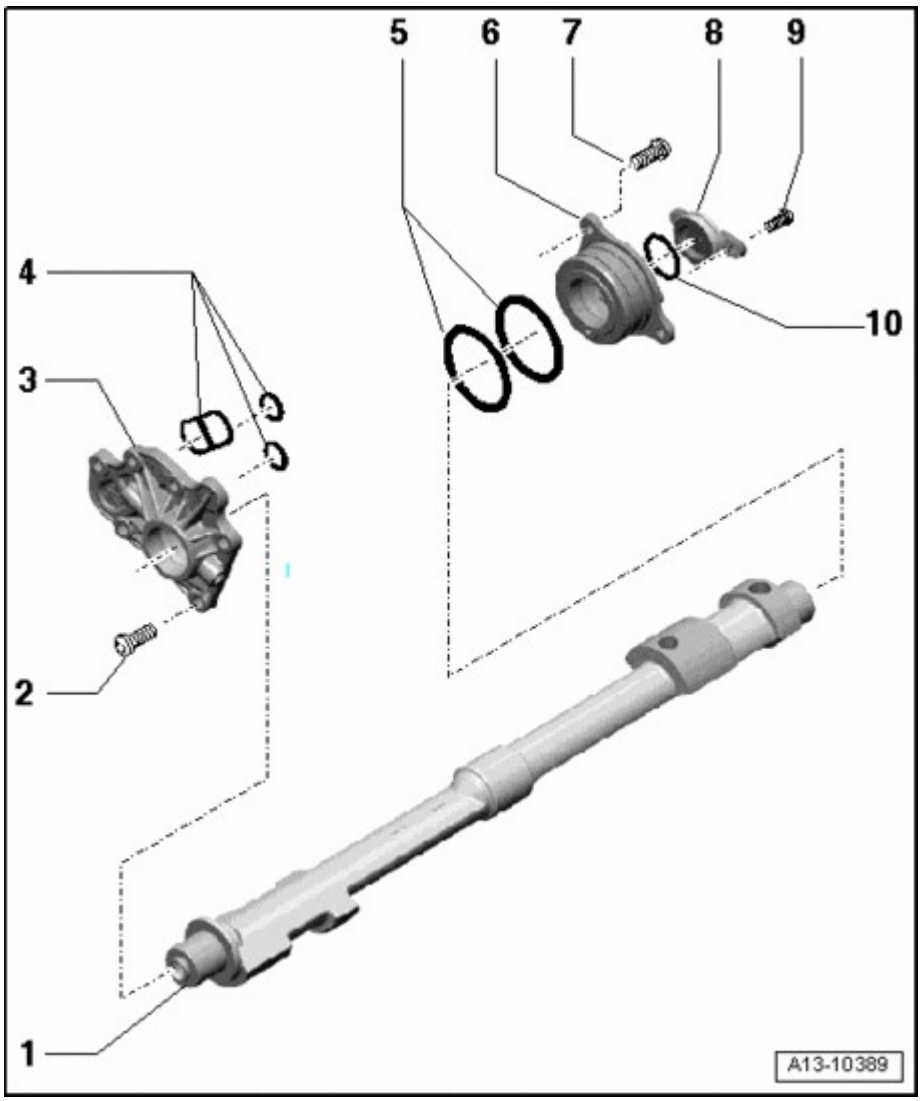

Fig. 254: Balancing Shaft, Component Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Differential shaft

- Removing and installing --> **Balancing Shaft, Removing and Installing**

2 - 9 Nm

3 - Rear bearing cap

- For balance shaft

4 - Seals

- For balance shaft rear bearing cap
- Replace

5 - O-rings

- Replace

6 - Front bearing cap

- For balance shaft

7 - 9 Nm

8 - Cover

- For balance shaft

9 - 5 Nm

10 - O-ring

- Replace

Balancing Shaft, Removing and Installing

Balancing Shaft, Removing and Installing

Removing

- Remove oil pump drive chain and balance shaft --> **Power Take-Off, Oil Pump and Balancing Shaft Drive Chain, Removing and Installing**.

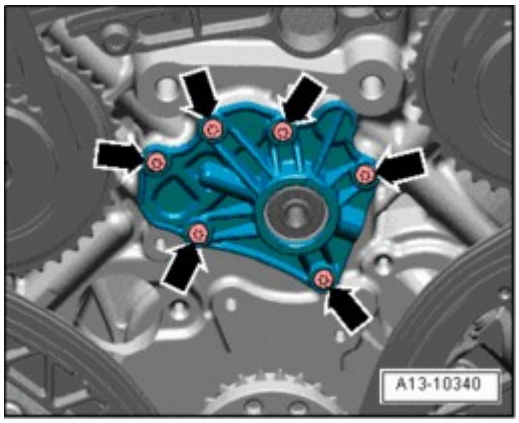

Fig. 255: Tightening Balance Shaft Rear Bearing Cap
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** -.
- Remove balance shaft rear bearing cap.

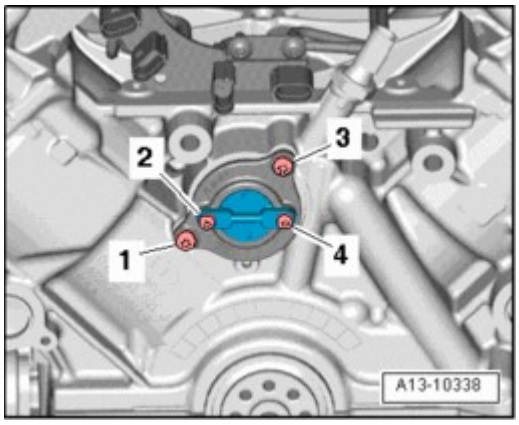

Fig. 256: Removing Bolts & Balance Shaft Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **2** - and - **4** -.
- Remove balance shaft cover.
- Remove bolts - **1** - and - **3** -.
- Remove balance shaft front bearing cap.

- Carefully remove balance shaft from cylinder block.

CAUTION: Ensure piston spray nozzles are not damaged when balance shaft is removed.

Installing

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

NOTE:

- **Replace gaskets and O-rings.**

- Carefully insert balance shaft in cylinder block.

CAUTION: Ensure piston spray nozzles are not damaged when balance shaft is inserted.

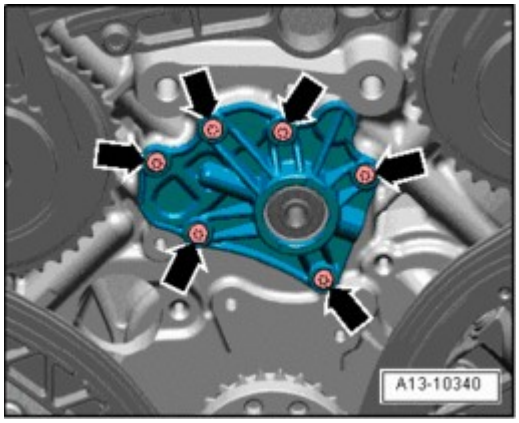

Fig. 257: Tightening Balance Shaft Rear Bearing Cap
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tighten balance shaft rear bearing cap - **arrows** -.
- Insert balance shaft in rear bearing cap.

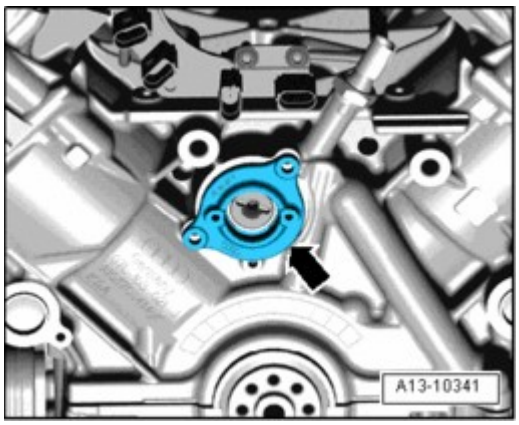

Fig. 258: Inserting Balance Shaft Front Bearing Cap
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert balance shaft front bearing cap - **arrow** -.

NOTE:

- **The bolts for the balance shaft front bearing cap are installed later after the balance shaft is adjusted.**
- **Balance shaft, adjusting --> Power Take-Off, Oil Pump and Balancing Shaft**

Drive Chain, Removing and Installing.

- Install oil pump drive chain and balance shaft --> **Power Take-Off, Oil Pump and Balancing Shaft Drive Chain, Removing and Installing**.

Tightening specifications

Component	Nm
Balance shaft rear bearing cap to cylinder block	9

CRANKSHAFT

Crankshaft

--> **Crankshaft, Component Overview**

--> **Main Bearing Shells, New Crankshafts, Allocating**

--> **Main Bearing Shears, Used and Reworked Crankshafts, Allocating**

--> **Crankshaft Dimensions**

--> **Axial Clearance, Measuring**

--> **Radial Clearance, Measuring**

Crankshaft, Component Overview

Crankshaft, Component Overview

NOTE:

- **For performing work, secure engine using Bracket VAS 6095/1-7 to Engine and Transmission Holder VAS 6095 --> Engine, Securing to Assembly Stand.**

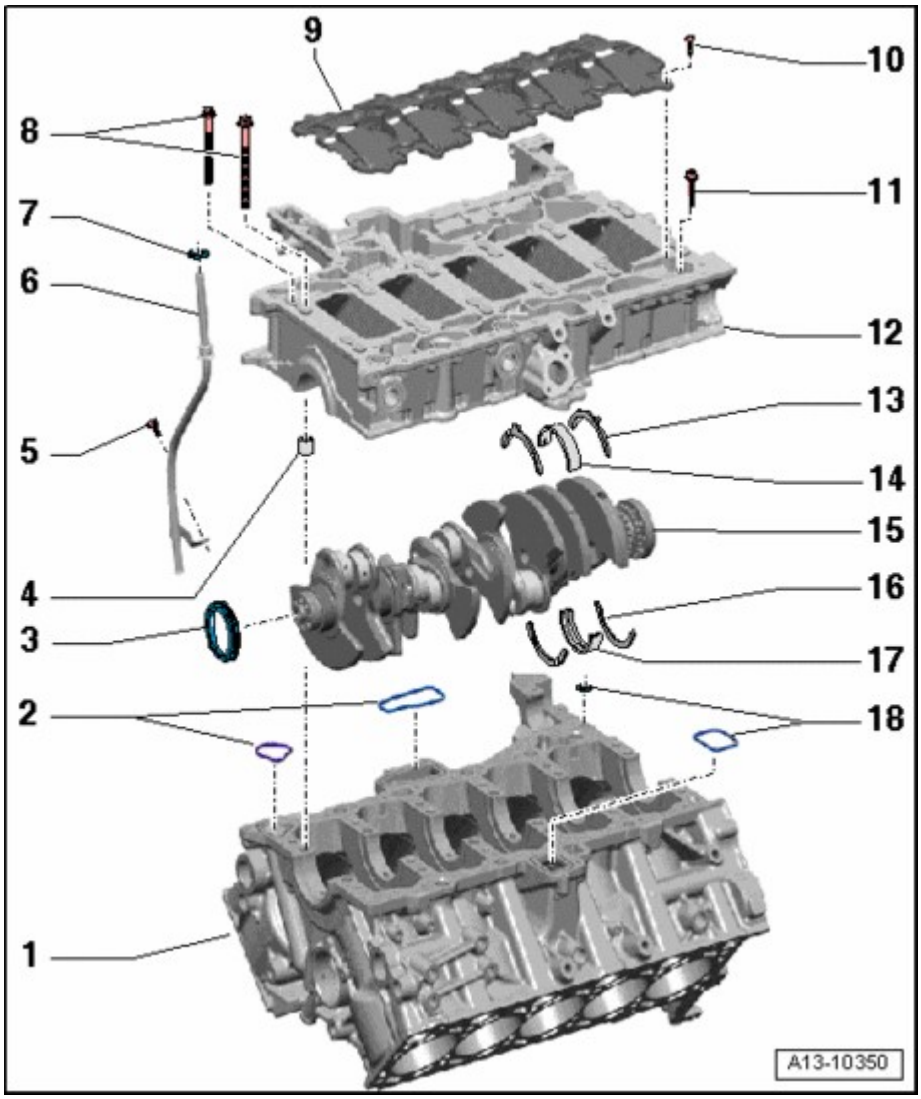

Fig. 259: Crankshaft, Component Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Cylinder block

- Paired to - **12** -
- Sealant applied on cylinder block (for guide frame) --> **Guide frame sealant application on cylinder block**

2 - Seals

- Replace

3 - Crankshaft seal, ribbed belt side

- Replacing --> **Crankshaft Seal, Ribbed Belt Side, Replacing**.

4 - Alignment bushing

- 3 pieces
- Insert into guide frame
- Installed location --> **Guide frame sealant application on cylinder block**

5 - 9 Nm

6 - Guide tube for oil dipstick

7 - O-ring

- Replace

8 - Bolts

- For guide frame
- Replace
- Various bolt sizes
- Tightening order --> **Installing guide frame**

9 - Baffle plate

10 - 9 Nm

- Tightening order --> **Baffle plate tightening plate**

11 - Bolt

- For sealing surfaces of cylinder block/guide frame
- Different bolt lengths
- Tightening specifications and tightening sequence --> **Installing guide frame**

12 - Bearing bracket

- Paired to - **item 1** -
- Sealant applied on cylinder block (for guide frame) --> **Guide frame sealant application on cylinder block**
- Tightening order --> **Installing guide frame**

13 - Thrust washer

- Only at 4th crankshaft bearing
- Lubricating grooves face outward

- Note locating point in guide frame
- Measuring crankshaft axial clearance --> **Axial Clearance, Measuring**

14 - Bearing shell

- For guide frame without lubricating groove
- Do not interchange used bearings (mark)
- Insert new bearing shells for guide frame with proper color marking

  - New crankshafts --> **Main Bearing Shells, New Crankshafts, Allocating**
  - Used and reworked crankshafts --> **Main Bearing Shears, Used and Reworked Crankshafts, Allocating**

15 - Crankshaft

- Measuring axial play --> **Axial Clearance, Measuring**
- Radial clearance, measuring --> **Radial Clearance, Measuring**
- Do not turn crankshaft when measuring radial play
- Crankshaft dimensions --> **Crankshaft Dimensions**

16 - Thrust washer

- Only at 4th crankshaft bearing
- Lubricating grooves face outward
- Measuring crankshaft axial clearance --> **Axial Clearance, Measuring**

17 - Bearing shell

- For cylinder block with oil groove
- Do not interchange used bearings (mark)
- Insert new bearing shells for cylinder block with proper color marking: With new crankshafts --> **Main Bearing Shells, New Crankshafts, Allocating** , with used and reworked crankshafts --> **Main Bearing Shears, Used and Reworked Crankshafts, Allocating**

18 - Seals

- Replace

Baffle plate tightening plate

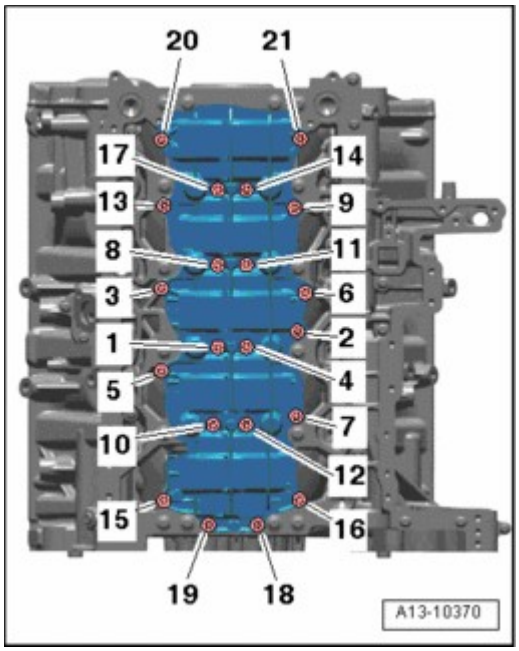

Fig. 260: Baffle Plate Tightening Plate
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Then tighten bolts in sequence - **1 to 21** -.

Guide frame sealant application on cylinder block

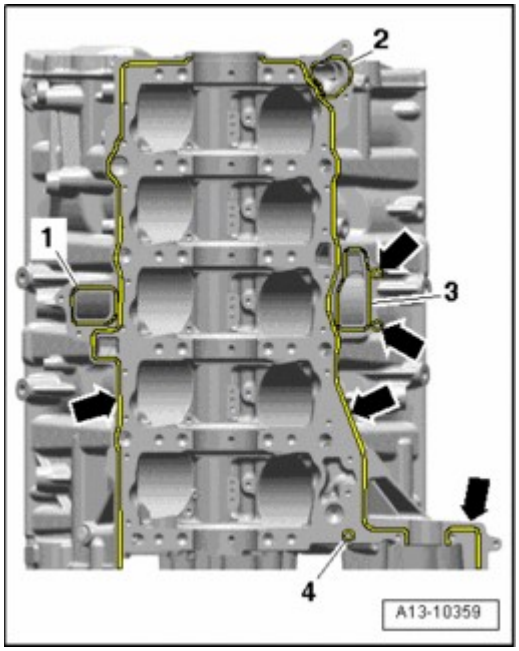

Fig. 261: Guide Frame Sealant Application On Cylinder Block
Courtesy of VOLKSWAGEN UNITED STATES, INC.

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

- Apply sealant beads - **arrows** - on clean sealing surfaces of guide frame as shown in illustration.
- Thickness of sealant beads: 2.0 mm.
- Install seals - **1 to 4** -.

Installation position of alignment bushings

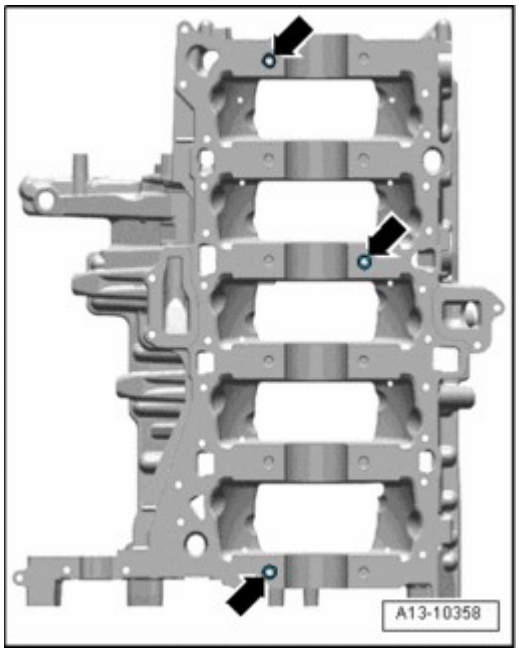

Fig. 262: Installation Position Of Alignment Bushings
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Check whether alignment bushings - **arrows** - are inserted at locations in guide frame as shown in the illustration.

Installing guide frame

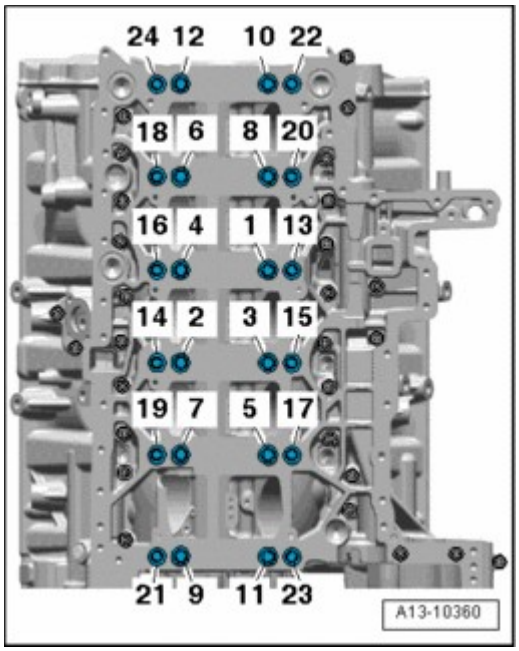

Fig. 263: Installing Guide Frame
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Replace bolts - **1 to 24** -.
- Tighten bolts for guide frame as follows:
- Tighten bolts - **1 to 12** - to 30 Nm using a torque wrench.
- Tighten bolts - **13 to 24** - to 20 Nm using a torque wrench.
- Tighten bolts - **1 to 12** - to 50 Nm using a torque wrench.
- Tighten bolts - **13 to 24** - to 30 Nm using a torque wrench.
- Tighten bolts - **1 to 12** - 90 ($^1/_4$ turn) using a rigid wrench.
- Tighten bolts - **13 to 24** - 90 ($^1/_4$ turn) using a rigid wrench.
- Tighten cylinder block/guide frame bolts - **dark shaded** - in a diagonal sequence to 9 Nm.

Main Bearing Shells, New Crankshafts, Allocating

Main Bearing Shells, New Crankshafts, Allocating

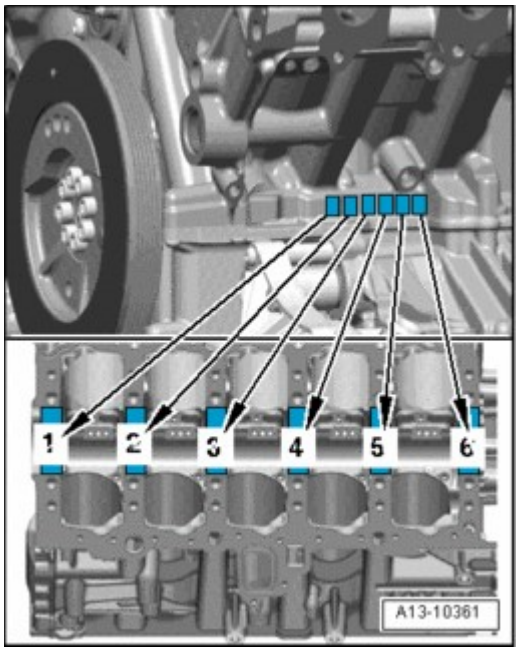

Fig. 264: Allocation Of Crankshaft Bearing Shells For Cylinder Block
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Allocation of crankshaft bearing shells for cylinder block

- Bearing shells with correct thickness are allocated to cylinder block in factory. Colored dots on sides of bearing shells serve for identifying bearing shell thickness.
- Allocation of bearing shells to cylinder block is marked by one letter each at left front on cylinder block (can be read from outside) as shown in the illustration.

Letter on cylinder block		Color of bearing
R	=	Red
G	=	Yellow
B	=	Blue

NOTE:

- **In addition, the letters are also stamped on the guide frame.**

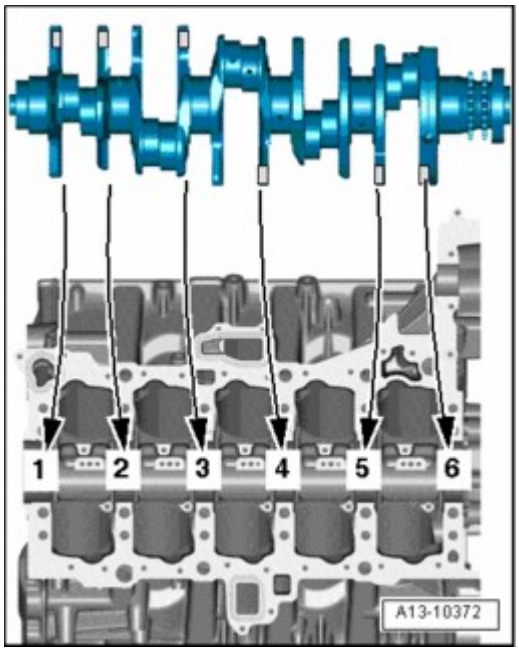

Fig. 265: Allocation Of Crankshaft Bearing Shells For Guide Frame - Version I
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Allocation of crankshaft bearing shells for guide frame - Version I

- Bearing shells with correct thickness are allocated to the guide frame in the factory. Colored dots on sides of bearing shells serve for identifying bearing shell thickness.
- Allocation of bearing shells to guide frame is marked by one colored dot each on crankshaft counterweight as shown in the illustration.

Colored dot on crankshaft	Color of bearing
Red	Red
Yellow	Yellow
Blue	Blue

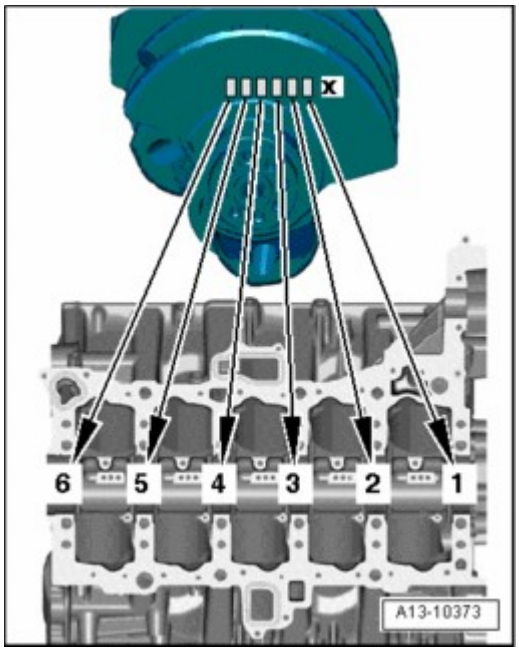

Fig. 266: Allocation Of Crankshaft Bearing Shells For Guide Frame - Version II
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Allocation of crankshaft bearing shells for guide frame - Version II

- Bearing shells with the correct thickness are allocated to the guide frame in the factory. Colored dots on sides of bearing shells serve for identifying bearing shell thickness.
- Allocation of bearing shells to guide frame is marked by one colored dot each on front crankshaft counterweight as shown in the illustration. The "X" marks the end of the letter series and stand next to color identification for bearing 1, belt pulley side.

Letter on crankshaft		Color of bearing
R	=	Red
G	=	Yellow
B	=	Blue

Main Bearing Shears, Used and Reworked Crankshafts, Allocating

Main Bearing Shears, Used and Reworked Crankshafts, Allocating

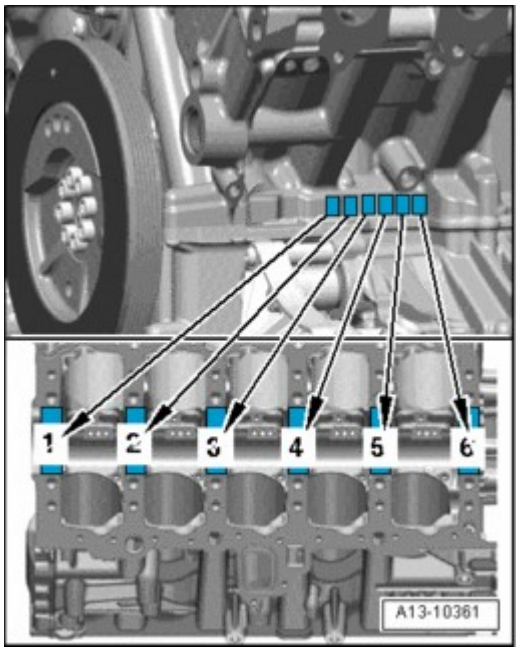

Fig. 267: Allocation Of Crankshaft Bearing Shells For Cylinder Block
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Allocation of crankshaft bearing shells for cylinder block

- Bearing shells are allocated to cylinder block corresponding to color markings stamped into cylinder block.
- For used and reworked crankshafts, the main crankshaft journals must be measured in order to allocate the matching bearing shells.
- Basic dimension of main crankshaft journals = dia. 65.00 mm.
- Repair stage of main crankshaft journals = dia. 64.75 mm.

- Thicker, over-sized bearing shells are available for reworked crankshafts. These have the same color markings as the original-size bearing shells.

Letter on cylinder block		Color of bearing
R	=	Red
G	=	Yellow
B	=	Blue

Allocation of crankshaft bearing shells for guide frame

- For used and reworked crankshafts, the main crankshaft journals must be measured in order to allocate the matching bearing shells.
- Any other markings on the crankshaft are invalid when reworking crankshafts.
- Allocate bearing shells to determined diameter of main crankshaft journals according to the following table.

Main crankshaft journals diameter	Color identification of bearing shells for guide frame		
Dimensions in mm	**Red**	**Yellow**	**Blue**
Basic dimension 65.000	64.978 to 64.972	64.972 to 64.965	64.965 to 64.958
Repair stage 64.750 1)	64.728 to 64.722	64.722 to 64.715	64.715 to 64.708
1) The same color marking is valid for thicker over-sized bearing for reworked crankshafts as for new crankshafts despite the greater bearing thickness.			

Crankshaft Dimensions

Crankshaft Dimensions

Reconditioning dimension in mm	Crankshaft journal diameter		Connecting rod journal diameter	
Basic dimension	65.000	0.022 0.042	54.000	0.022 0.042
Repair stage	64.750	0.022 0.042	53.750	0.022 0.042

Axial Clearance, Measuring

Axial Clearance, Measuring

Special tools, testers and auxiliary items required

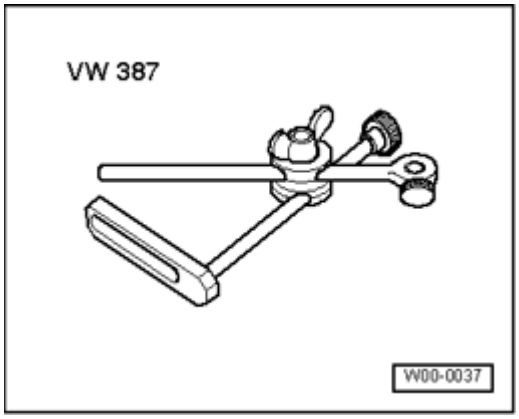

Fig. 268: Dial Gauge Holder VW 387
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Dial gauge holder VW 387

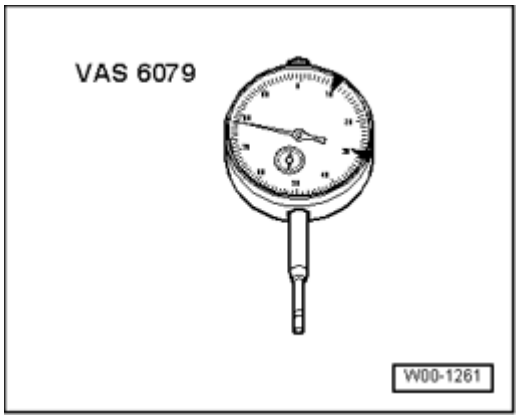

Fig. 269: Dial Gauge VAS 6079
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Dial gauge VAS 6079

Procedure

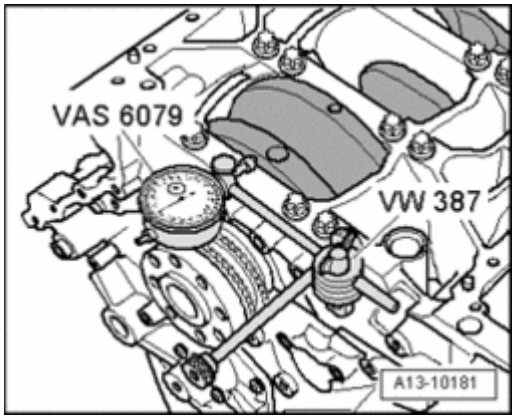

Fig. 270: Securing Dial Gauge VAS 6079 With Dial Gauge Holder VW 387 To Cylinder Block
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Secure Dial Gauge VAS 6079 with Dial Gauge Holder VW 387 to cylinder block as shown in illustration.
- Position dial gauge against crankshaft counterweight.
- Press crankshaft by hand against gauge and set gauge to "0".
- Press crankshaft off gauge and read value.

- Axial clearance: 0.090 to 0.158 mm.

Radial Clearance, Measuring

Radial Clearance, Measuring

Special tools, testers and auxiliary items required

- Plastigage

Procedure

NOTE:

- **Do not interchange used bearings**
- **Bearing shells that are worn down to the nickel layer must be replaced.**

- Remove guide frame and clean journals.
- Place Plastigage over entire width of bearing journal or into bearing shells.

- Plastigage must rest in center of bearing shell.

- Install guide frame and tighten to 30 Nm. Do not turn crankshaft.
- Remove guide frame again.
- Compare width of Plastigage with measuring scale.

Radial clearance:

- New: 0.017 to 0.044 mm.
- Wear limit: 0.08 mm.

PISTON AND CONNECTING ROD

Piston and Connecting Rod

--> **Piston and Connecting Rod, Component Overview**

--> **Piston and Cylinder Dimensions**

--> **Connecting Rod, Measuring Radial Clearance**

Piston and Connecting Rod, Component Overview

Piston and Connecting Rod, Component Overview

NOTE:

- **Oil injector jet for piston cooling --> Oil spray jet for piston cooling**

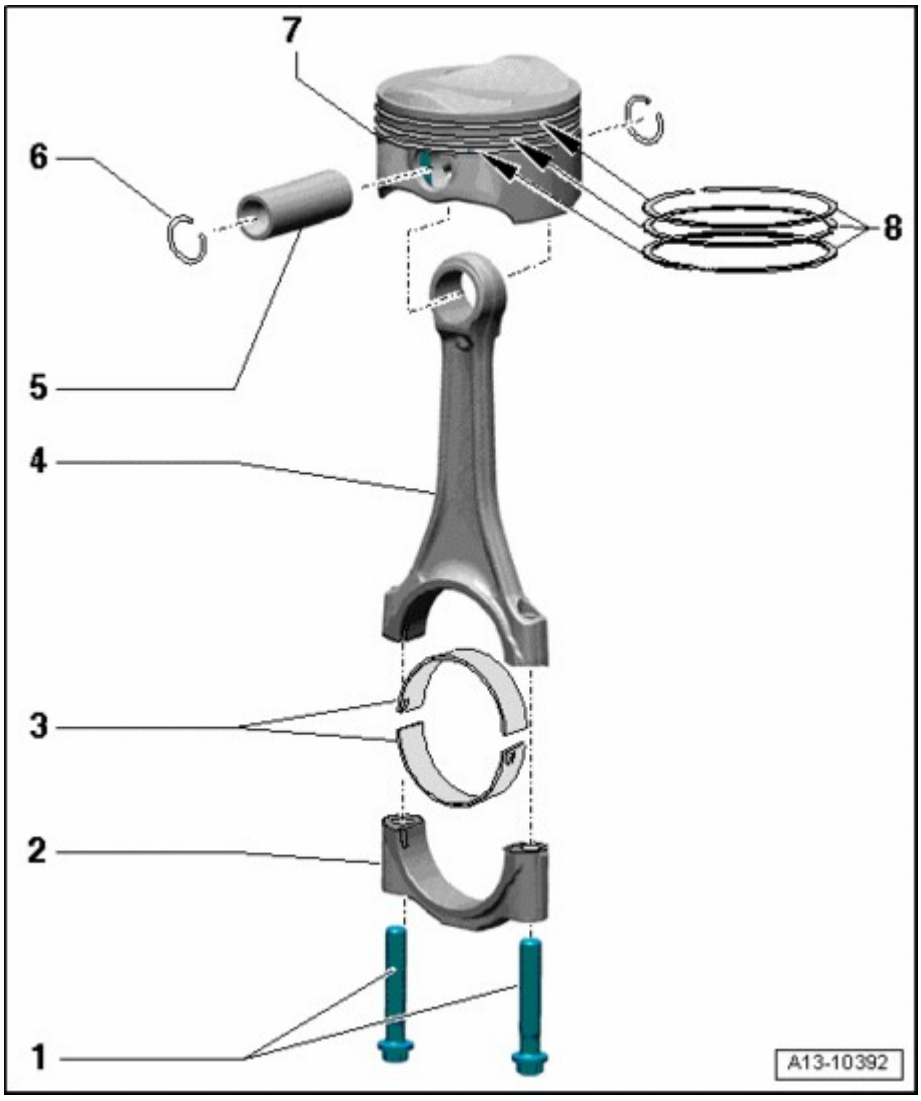

Fig. 271: Piston And Connecting Rod, Component Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Connecting rod bolt - 50 Nm plus an additional 90 ($^{1}/_{4}$ turn)

- Replace
- Lubricate threads and contact surface
- Tighten to 50 Nm to measure radial play, do not turn further

2 - Connecting rod bearing cap

- Do not interchange
- Mark affiliation to cylinder with paint --> **Mark connecting rod**
- Installation position of connecting rod pairs --> **Connecting rod, installed location**

3 - Bearing shells

- Check that retaining tabs are secured
- Do not interchange used bearing shells (mark, but not on the running surface)
- Radial clearance, measuring --> **Connecting Rod, Measuring Radial Clearance**
- To measure radial play, tighten bolts - **1** - to 60 Nm but no further
- Over-sized bearings are available for reworked crankshaft connecting rod journals

4 - Connecting rod

- Only replace as set
- Mark affiliation to cylinder with paint --> **Mark connecting rod**
- Installation position of connecting rod pairs --> **Connecting rod, installed location**
- Axial play for each new connecting rod pair: 0.20 to 0.38 mm
- Radial clearance, measuring --> **Connecting Rod, Measuring Radial Clearance**

5 - Piston pin

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

6 - Circlip

7 - Piston

- Installation position of pistons --> **Piston installation position**
- Piston and cylinder dimension, piston allocation to cylinder bore --> **Piston and Cylinder Dimensions**
- Checking --> **Checking piston**
- Install with piston ring compressor
- Measuring cylinder bore --> **Measuring cylinder bore**

8 - Piston rings

- Offset gaps by 120
- Use piston ring pliers for removal and installation
- "TOP" marking or inscribed side must point to piston head
- Gap, measuring --> **Piston ring end gap, measuring**
- Measuring side clearance --> **Measuring piston ring side clearance**

Piston ring end gap, measuring

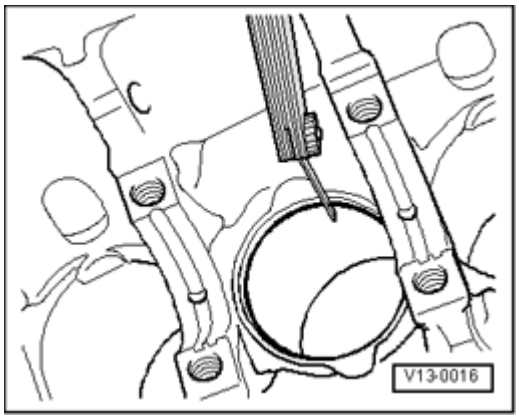

Fig. 272: Piston Ring End Gap, Measuring
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Slide piston ring down from above at a right angle to cylinder wall until it is approximately 15 mm from bottom edge of cylinder.
- When sliding in, use a piston without piston rings.

Piston ring dimensions in mm	New	Wear limit
1st Compression ring	0.20 to 0.35	0.80
2nd Compression ring	0.20 to 0.40	0.80
Oil scraping ring	0.20 to 0.40	1)
1) Not determined yet.		

Measuring piston ring side clearance

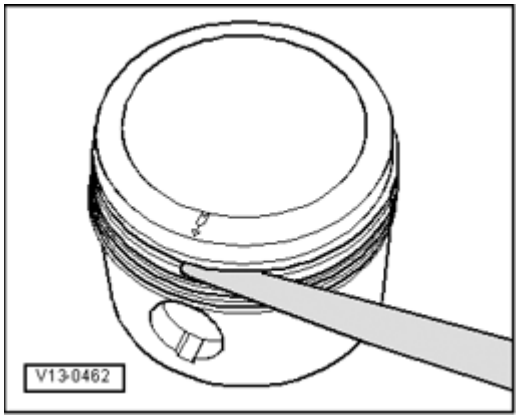

Fig. 273: Measuring Piston Ring Side Clearance
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Clean ring groove of piston before checking.

Piston ring dimensions in mm	New	Wear limit
1st Compression ring	0.035 to 0.085	0.200
2nd Compression ring	0.005 to 0.045	0.200

Oil scraping ring	0.01 to 0.05	0.15

Checking piston

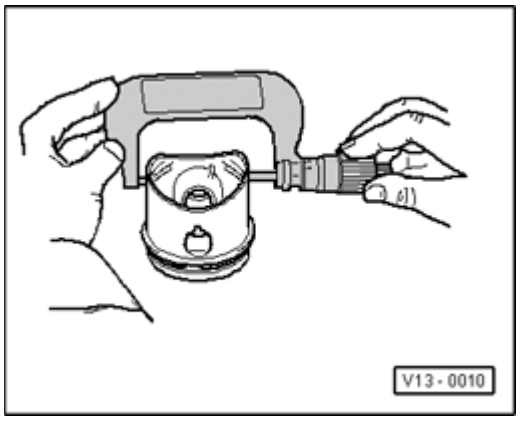

Fig. 274: Checking Piston
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Measure approximately 15 mm from the lower edge, at a 90 angle to piston pin axis using an external micrometer 75 to 100 mm.

- Maximum deviation from nominal dimension: 0.03 mm.

Nominal dimension --> **Piston and Cylinder Dimensions**.

Measuring cylinder bore

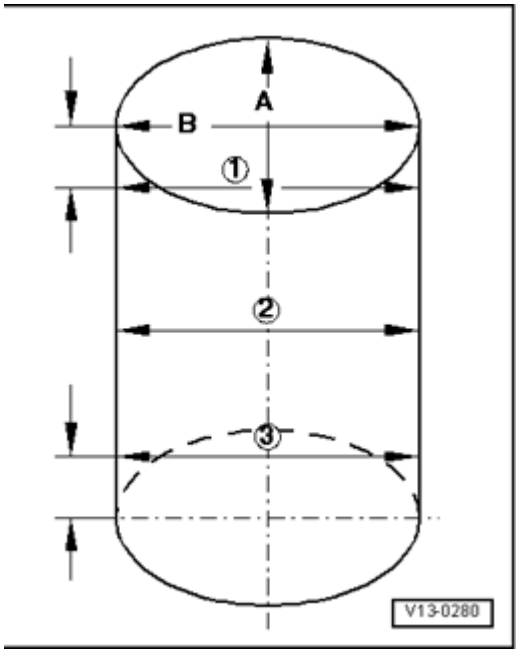

Fig. 275: Measuring Cylinder Bore
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Using an internal dial gauge 50 to 100 mm, measure at 3 points in diagonal sequence horizontally - **A** - and vertically - **B** -.

- Maximum deviation from nominal dimension: 0.08 mm.

Nominal dimension --> **Piston and Cylinder Dimensions**.

Piston installation position

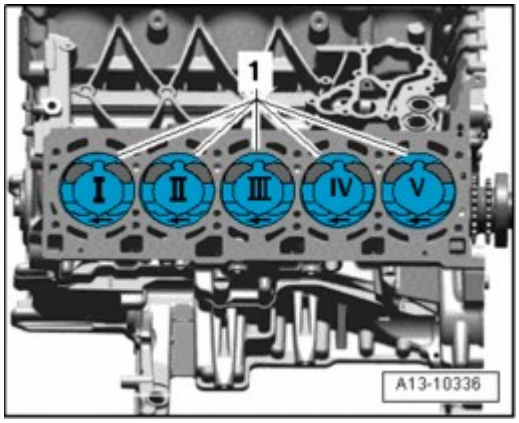

Fig. 276: Piston Installation Position
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Identify allocation to cylinder with paint on piston crown.

NOTE:

- **Do not use a center punch or scribe, since the piston head coating will be damaged.**

Installed location:

- Arrows on piston heads point to belt pulley side.
- Large valve recesses - **1** - point toward center of engine.

Mark connecting rod

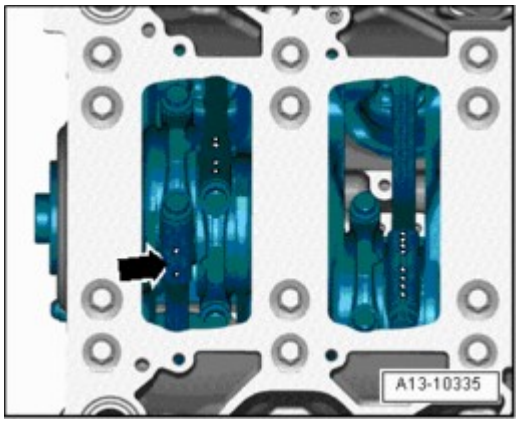

Fig. 277: Mark Connecting Rod
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE:

- **Only replace connecting rod as a set.**
- **Do not interchange connecting rod bearings.**

- Before removing, mark allocation of connecting rod and connecting rod bearing caps to each other and to cylinder with paint - **arrow** -.

Connecting rod, installed location

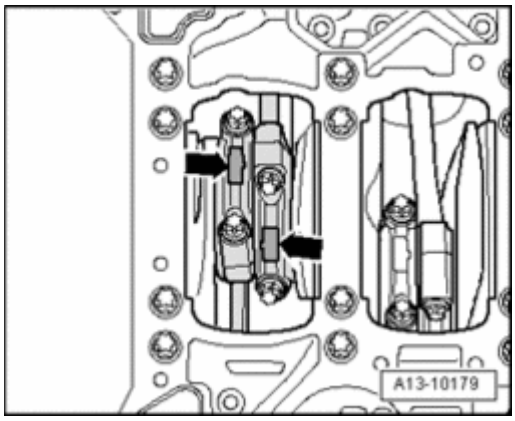

Fig. 278: Connecting Rod, Installed Location
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Molded tabs - **arrows** - at the beveled surfaces of the connecting rod pairs 1 and 2, 3 and 4, 5 and 6, 7 and 8 as well as 9 and 10 must point toward each other.

Oil spray jet for piston cooling

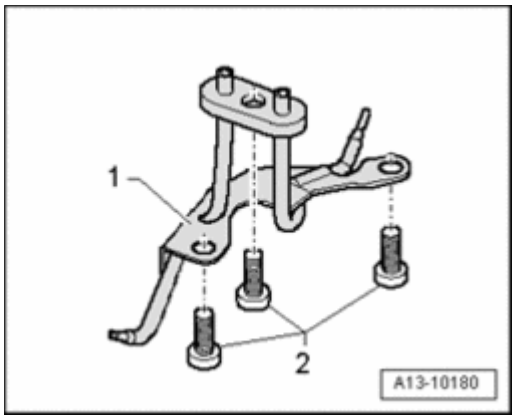

Fig. 279: Oil Spray Jet For Piston Cooling
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1. Oil spray jet
2. Bolts, 9 Nm. Insert with locking compound; Locking compound

CAUTION:
- **Do not bend piston spray nozzles.**
- **Bent piston spray nozzles must be replaced.**

Piston and Cylinder Dimensions

Piston and Cylinder Dimensions

Matching pistons are allocated to the different manufacturing stages of the cylinder block.

Cylinder bore diameter mm	Piston diameter mm
84.510 ± 0.005	84.490 1)
84.610 ± 0.005	84.590 1)
1) Measurement with coating (thickness = 0.01 mm). The coating wears off.	

Connecting Rod, Measuring Radial Clearance

Connecting Rod, Measuring Radial Clearance

Special tools, testers and auxiliary items required

- Plastigage

Procedure

- Remove connecting rod bearing caps.
- Clean bearing caps and journals
- Place Plastigage over entire width of bearing journal or into bearing shells.
- Install connecting rod bearing cap and tighten to 60 Nm. Do not turn crankshaft.

- Remove connecting rod bearing caps again.
- Compare width of Plastigage with measuring scale.

Radial clearance:

- New: 0.020 to 0.069 mm.
- Wear limit: 0.120 mm.

- Replace bolts for connecting rod bearings.

15 - ENGINE - CYLINDER HEAD, VALVETRAIN

CYLINDER HEAD

Cylinder Head

--> **Cylinder Head, Component Overview**

--> **Left Cylinder Head Cover, Removing and Installing**

--> **Right Cylinder Head Cover, Removing and Installing**

--> **Cylinder Head, Removing and Installing**

--> **Compression, Checking**

Cylinder Head, Component Overview

Cylinder Head, Component Overview

NOTE:

- **Cylinder head for cylinder bank 2 (left) is shown in illustration.**

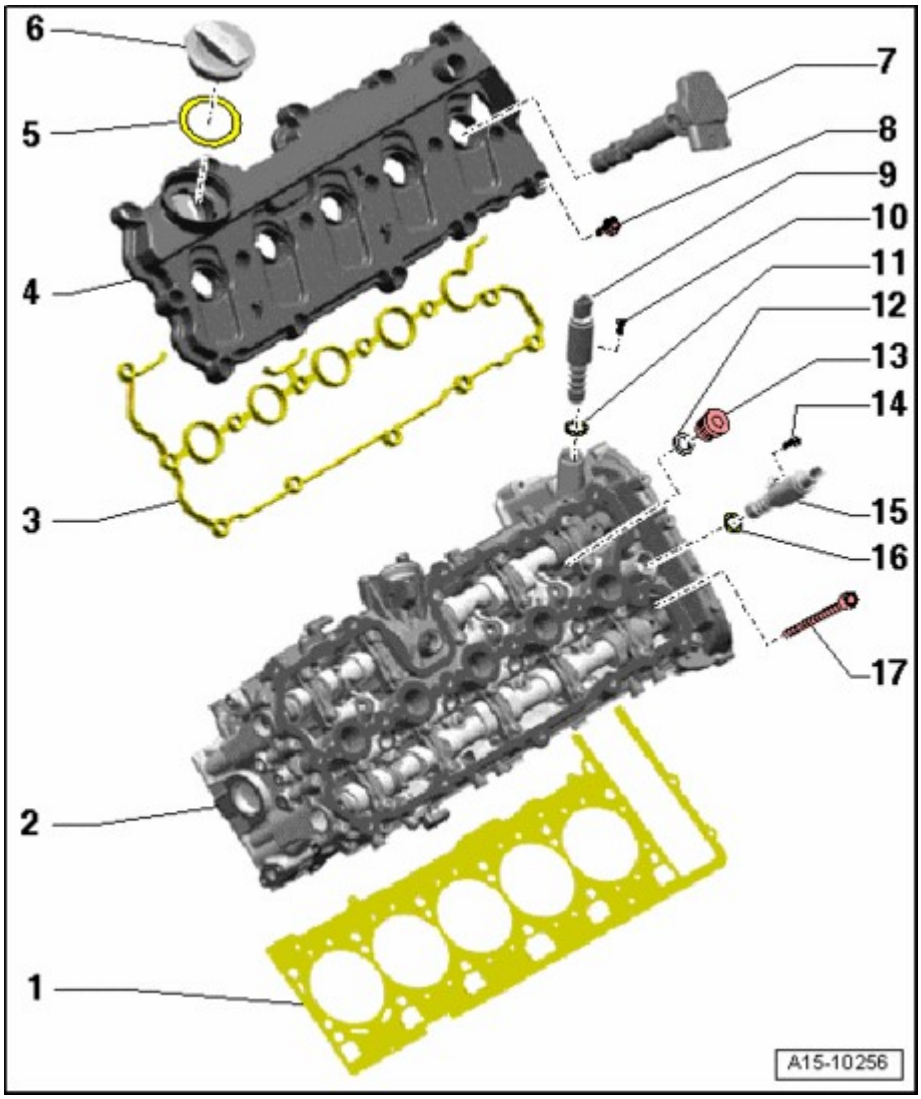

Fig. 280: Cylinder Head, Component Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Cylinder head gasket

- Replacing --> **Cylinder Head, Removing and Installing**.
- Installed location: Part Number, points to cylinder head
- After replacing, change coolant and engine oil

2 - Cylinder head

- Removing and installing --> **Cylinder Head, Removing and Installing**
- Check for distortion --> **Checking cylinder head for distortion**
- Reworking dimension --> **Checking cylinder head for distortion**
- After replacing, change coolant and engine oil

3 - Cylinder head cover gasket

- Replace if damaged or leaking

4 - Cylinder head cover

- Removing and installing: Left --> **Left Cylinder Head Cover, Removing and Installing** , right --> **Right Cylinder Head Cover, Removing and Installing**

5 - Gasket

- For cap
- Replace if damaged or leaking

6 - Cap

7 - Ignition coil

- Remove with Ignition Coil Puller T40039

8 - Special bolt - 9 Nm

- Replace if seal is damaged
- Note tightening sequence --> **Fig. 291**

9 - Camshaft Adjustment Valve 2 N208

10 - 2.4 Nm

11 - O-ring

- Replace

12 - Seal

- Replace

13 - Locking bolt - 35 Nm

14 - 2.4 Nm

15 - Camshaft Adjustment Valve 2 (exhaust) N319

16 - O-ring

- Replace

17 - Cylinder head bolt

- Replace
- Observe sequence for loosening --> **Fig. 309**
- Note tightening sequence --> **Fig. 313**

Checking cylinder head for distortion

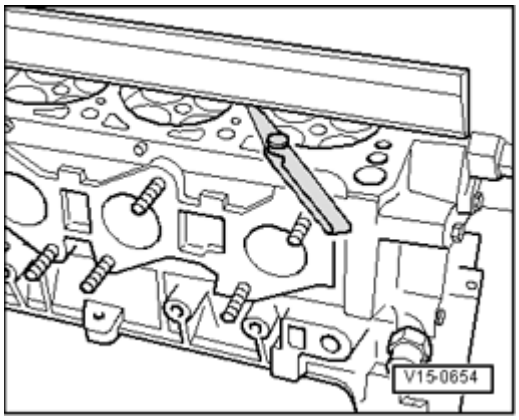

Fig. 281: Checking Cylinder Head For Distortion
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Check cylinder head at multiple points for distortion, using straight edge and feeler gauges.

- Max. permissible distortion: 0.1 mm.

Reworking dimension, cylinder head

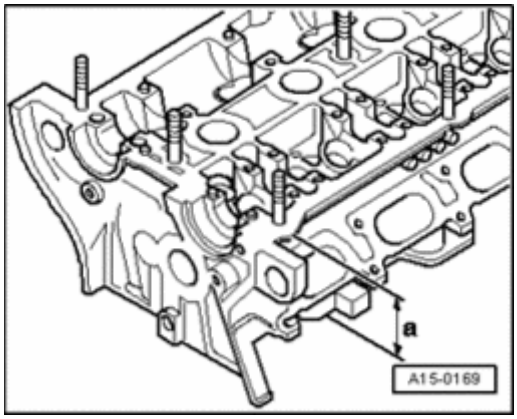

Fig. 282: Reworking Dimension, Cylinder Head
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Resurfacing cylinder head (face grinding) is only permissible to minimum dimension - **a** -.

- Minimum dimension: - **a** - = 139.5 mm.

Left Cylinder Head Cover, Removing and Installing

Left Cylinder Head Cover, Removing and Installing

Special tools, testers and auxiliary items required

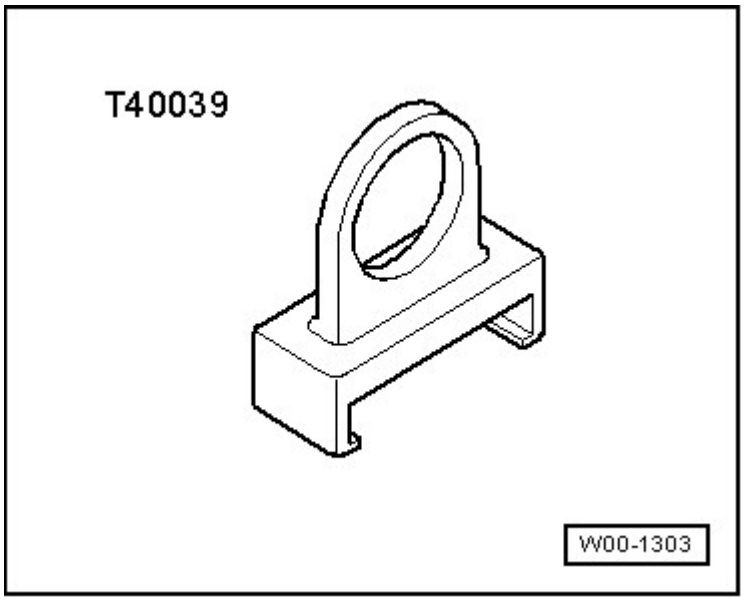

Fig. 283: Ignition Coil Puller T40039
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Ignition Coil Puller T40039

Removing

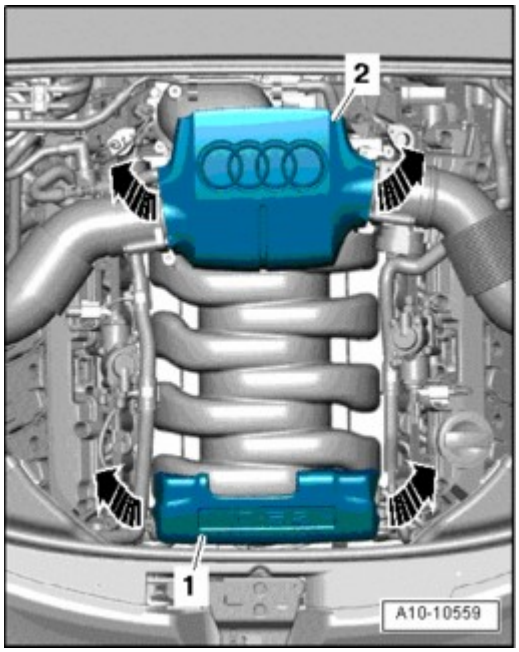

Fig. 284: Removing Front Engine Cover And Rear
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove front engine cover - **1** - and rear - **2** - - **arrows** -.

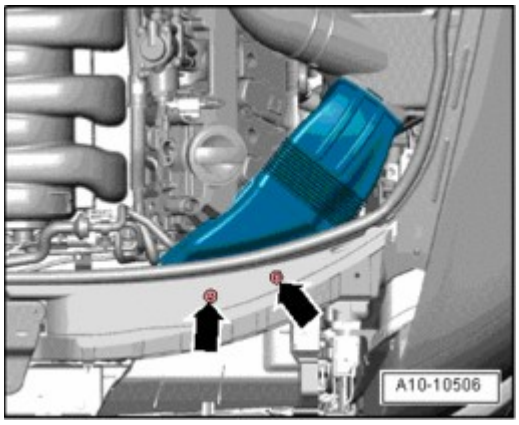

Fig. 285: Removing Bolts And Left Air Duct
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** - and remove left air duct.

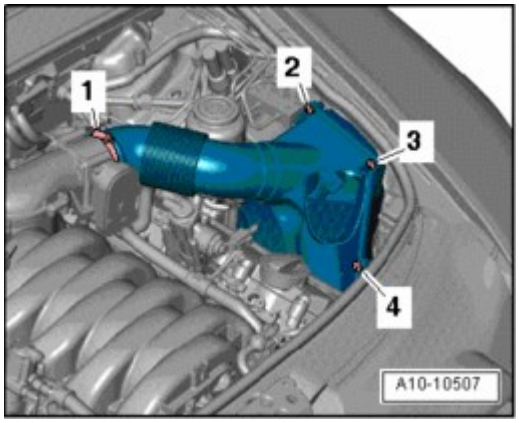

Fig. 286: Identifying Hose Clamps And Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen hose clamp - **1** - and remove bolts - **2 to 4** -.
- Remove upper part of left air filter housing.

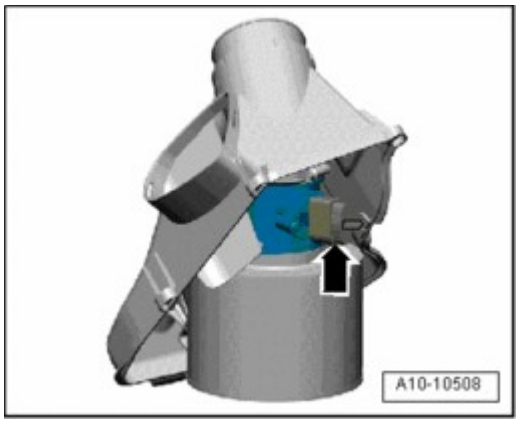

Fig. 287: Identifying Electrical Connector On Mass Air Flow Sensor
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connector - **arrow** - on mass air flow (MAF) sensor 2 G246.

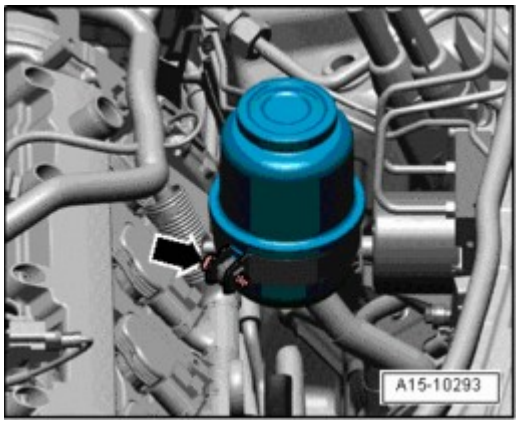

Fig. 288: Removing Bolt And Remove Power Steering Reservoir From Bracket, Hydraulic Lines Remain Connected
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolt - **arrow** - and remove power steering reservoir from bracket, hydraulic lines remain connected.

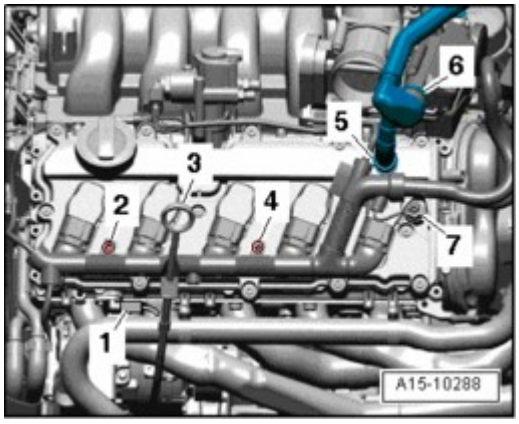

Fig. 289: Identifying Separator, Cylinder Head Cover, Oil Dipstick, Electrical Harness Connectors & Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove crankcase ventilation hose from separator - **5** - and from cylinder head cover - **6** -.
- Remove oil dipstick - **3** - from guide tube.
- Disconnect electrical harness connectors - **1** - and - **7** -.
- Remove bolts - **2** - and - **4** -.

- Disconnect electrical connectors to ignition coils.
- Free up electrical wiring harness by removing harness bracket.

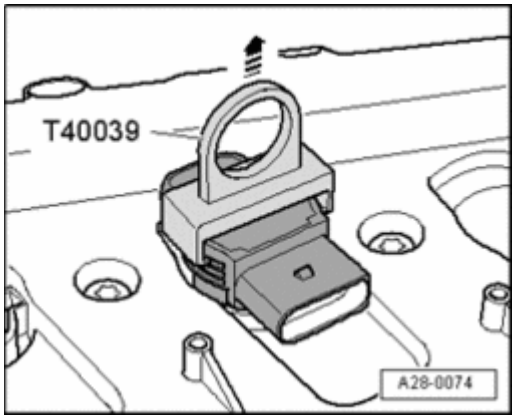

Fig. 290: Removing Ignition Coils Using Ignition Coil Puller T40039.
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove ignition coils using Ignition Coil Puller T40039.

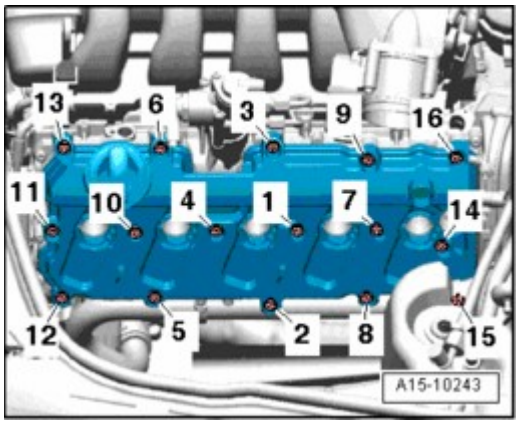

Fig. 291: Identifying Bolts Removal Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen bolts - **16 to 1** - in sequence and remove them.
- Remove left cylinder head cover.

Installing

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

NOTE:

- **Replace cylinder head cover if damaged or leaking.**
- **Replace bolts for cylinder head cover if gasket is damaged.**

- Clean sealing surfaces, they must be free of oil and grease.
- Tighten cylinder head cover in sequence **- 1 to 16 -**.
- Install left upper section of air filter housing --> **24 - MULTIPORT FUEL INJECTION (MFI)** .

Tightening Specifications

Component	Nm
Cylinder head cover to cylinder head	9
Wiring for ignition coils at cylinder head cover	5

Right Cylinder Head Cover, Removing and Installing

Right Cylinder Head Cover, Removing and Installing

Special tools, testers and auxiliary items required

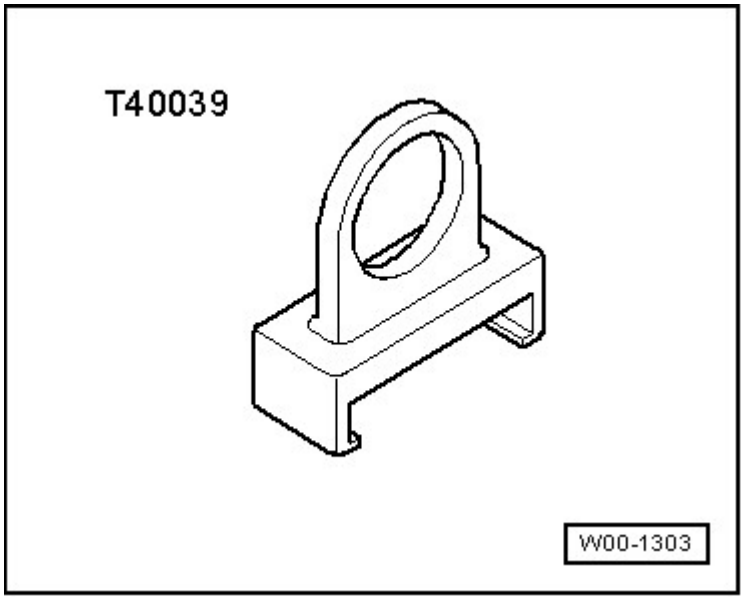

Fig. 292: Ignition Coil Puller T40039
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Ignition Coil Puller T40039

Removing

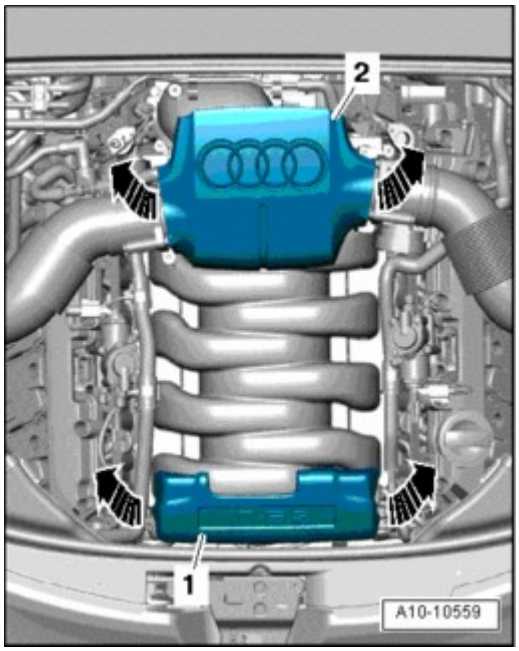

Fig. 293: Removing Rear Engine Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove front engine cover - **1** - and rear - **2** - - **arrows** -.

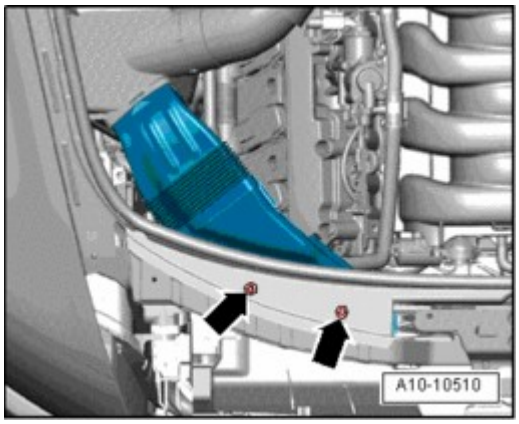

Fig. 294: Identifying Vacuum Hoses And Bolts For Right Air Guide
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** - and remove right air duct.

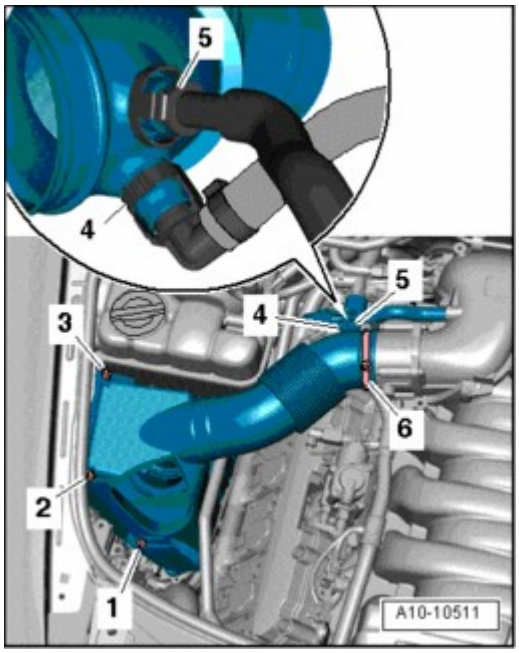

Fig. 295: Identifying Hose Clamps And Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect vacuum hose - **5** - from air guide hose.

CAUTION: Hose connectors - 4 - must not be opened. Lay aside right upper part of air filter housing with connected crankcase ventilation hose.

- Loosen hose clamp - **6** - and remove bolts - **1, 2 and 3** -.
- Remove upper part of right air filter housing.

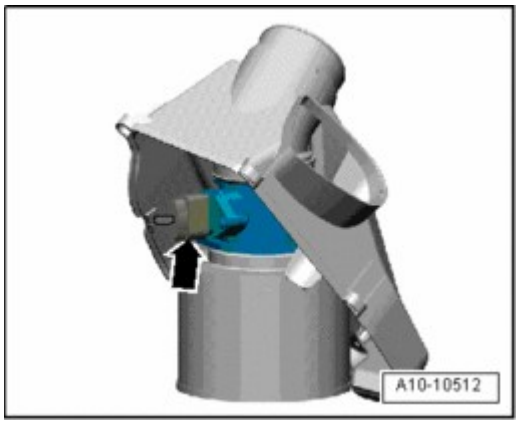

Fig. 296: Identifying Electrical Connector On Mass Air Flow Sensor
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connector - **arrow** - on Mass Air Flow (MAF) Sensor G70.
- Remove lower part of air filter housing from side connection.

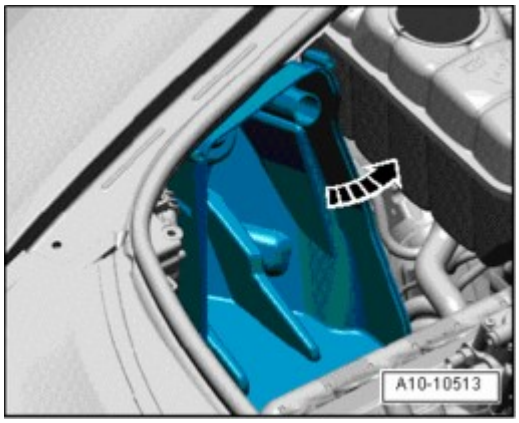

Fig. 297: Tilting Upper Part Of Air Filter Housing Up/Out
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tilt upper part of air filter housing up and out - **arrow** -.

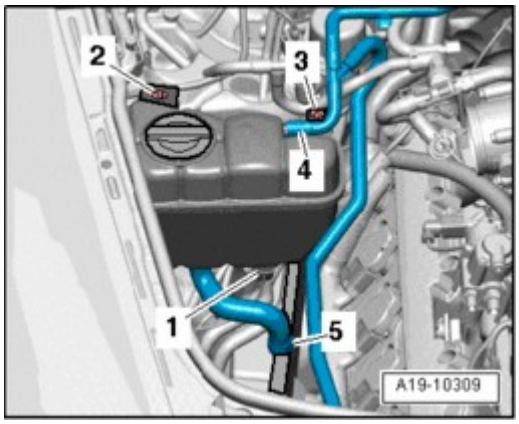

Fig. 298: Identifying Bolts And Coolant Hoses
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connector - **1** - on Engine Coolant Level (ECL) Warning Switch F66 at bottom of coolant expansion tank.
- Remove bolts - **2** - and - **3** - and lay aside coolant reservoir with connected coolant hoses - **4** - and - **5** -.

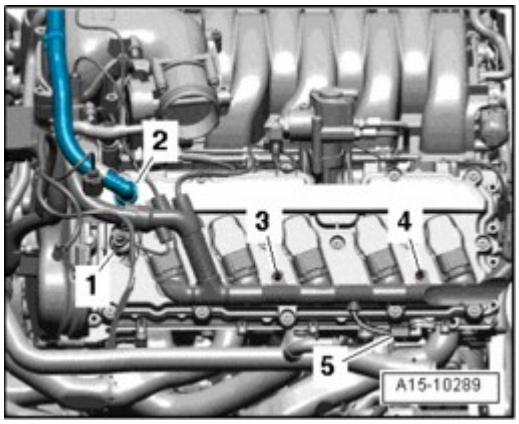

Fig. 299: Identifying Crankcase Ventilation Hose, Electrical Harness Connectors & Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect crankcase ventilation hose - **2** -.
- Disconnect electrical harness connectors - **1** - and - **5** -.
- Remove bolts - **3** - and - **4** -.
- Disconnect electrical connectors to ignition coils.

- Free up electrical wiring harness by removing harness bracket.

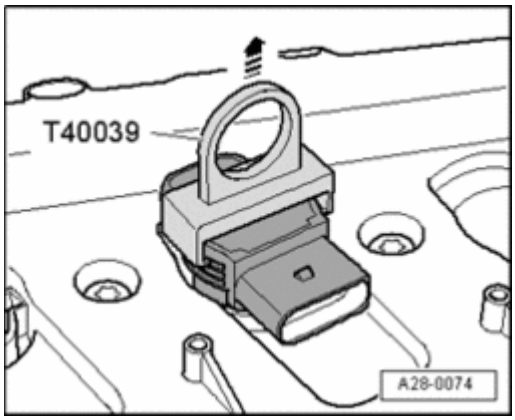

Fig. 300: Removing Ignition Coils Using Ignition Coil Puller T40039.
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove ignition coils using Ignition Coil Puller T40039.

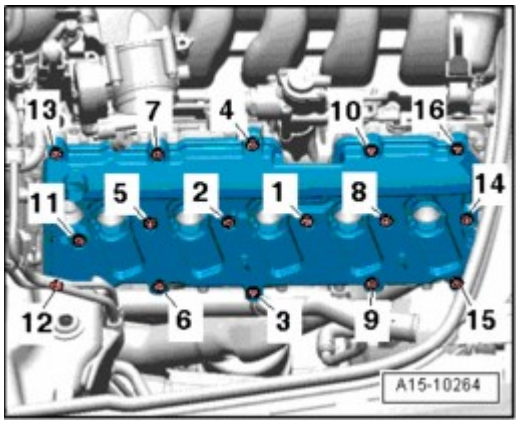

Fig. 301: Bolts Removal Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen bolts - **16 to 1** - in sequence and remove them.
- Remove cylinder head cover.

Installing

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

NOTE:

- **Replace cylinder head cover if damaged or leaking.**
- **Replace bolts for cylinder head cover if gasket is damaged.**

- Clean sealing surfaces, they must be free of oil and grease.
- Tighten cylinder head cover in sequence - **1 to 16** -.
- Install right air filter housing --> **24 - MULTIPORT FUEL INJECTION (MFI)** .

Torque specifications

Component	Nm
Cylinder head cover to cylinder head	9
Wiring for ignition coils at cylinder head cover	5

Cylinder Head, Removing and Installing

Cylinder Head, Removing and Installing

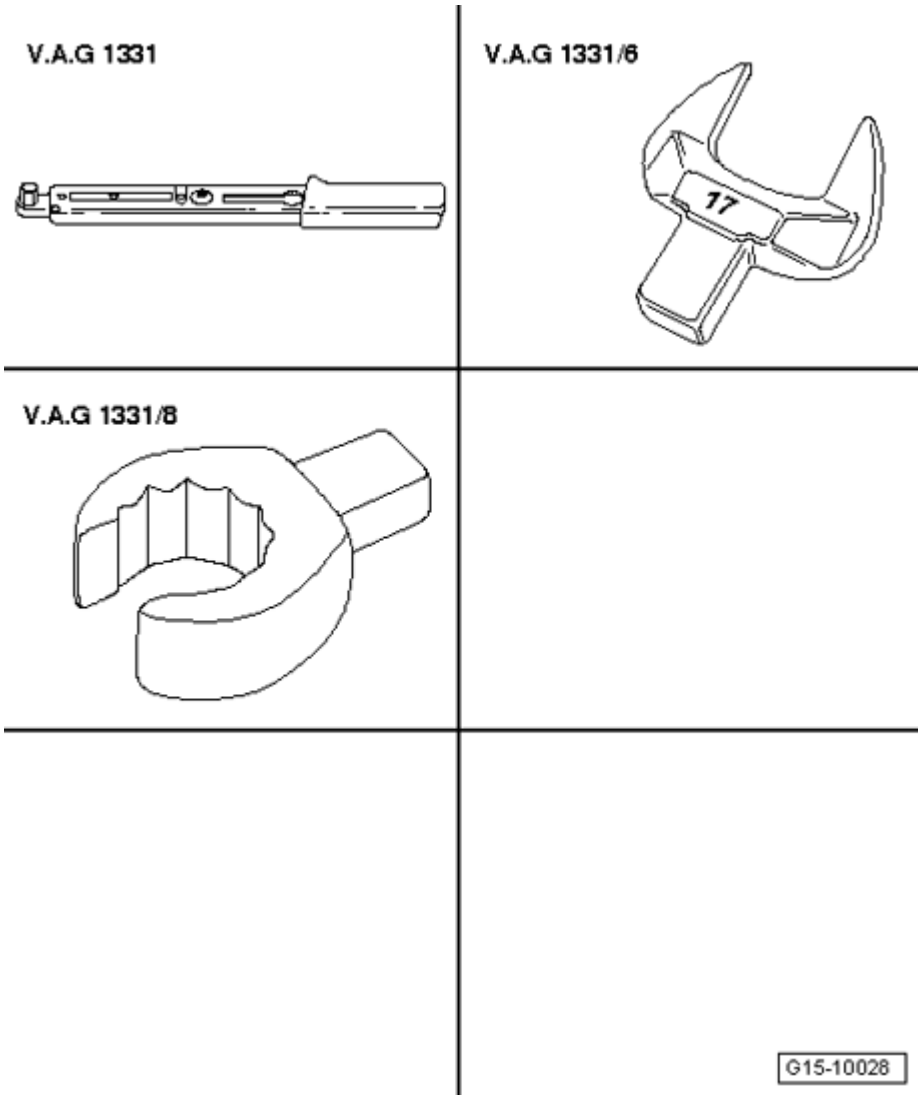

Fig. 302: Identifying Special Tools - Cylinder Head, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Torque wrench V.A.G 1331
- SW 17 socket V.A.G 1331/6
- SW 14 socket, open ring V.A.G 1331/8

Removing

NOTE:

- **All cable ties opened or cut during engine removal must be reinstalled at the same locations during installation.**
- **The following removal and installation procedure is for the left cylinder head. The procedure for the other side is identical.**

- Remove engine --> **Engine, Removing**.
- Leave engine with transmission installed on scissor lift platform VAS 6131.

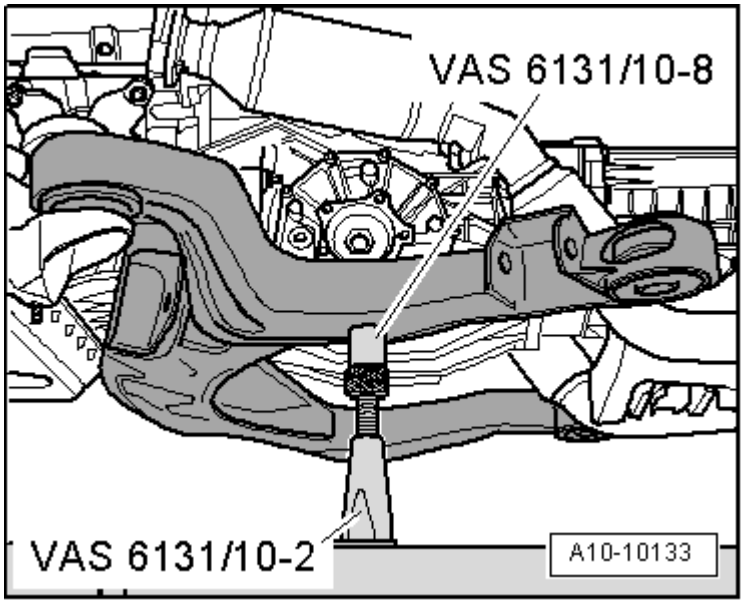

Fig. 303: Positioning Support Elements From VAS 6131/10 At Left/Right On Subframe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Twist spindles of support elements at left and right at subframe completely downward.
- Remove Tapered Mounting Pin VAS 6131/10-2 from Scissor Lift Table VAS 6131.
- Remove subframe to side.
- Remove exhaust system tract: left --> **Left Exhaust System Tract, Removing and Installing** , right --> **Right Exhaust System Tract, Removing and Installing**.

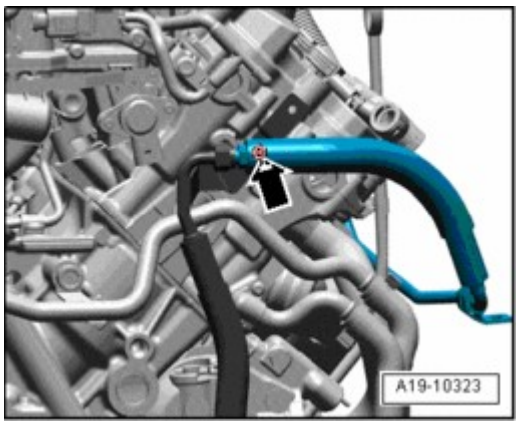

Fig. 304: Removing Front Power Steering Pressure Line Bracket From Cylinder Head
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove front power steering pressure line bracket from cylinder head - **arrow** -.

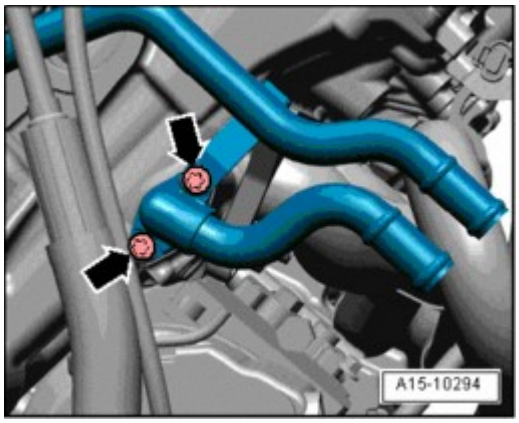

Fig. 305: Removing Front Secondary Air Injection Connecting Piece From Cylinder Head
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove front secondary air injection connecting piece from cylinder head - **arrows** -.
- Remove intake manifold --> **24 - MULTIPORT FUEL INJECTION (MFI)** .
- Remove camshaft timing chains from camshafts --> **Camshaft Timing Chains, Removing from Camshafts**.

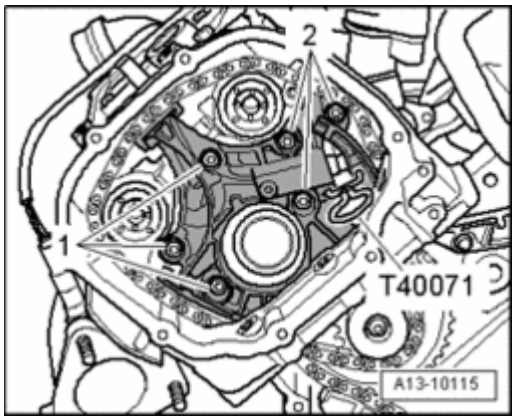

Fig. 306: Tightening/Removing Bolts & Replacing Camshaft Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **1** - and - **2** - and remove right chain tensioner.

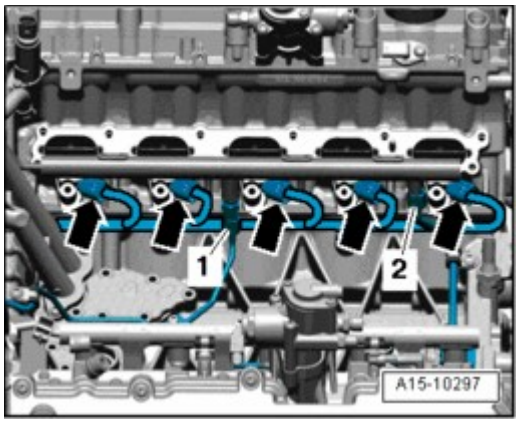

Fig. 307: Identifying Fuel Injectors Electrical Connectors & High Pressure Line
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connectors - **arrows** - at fuel injectors.
- Remove high pressure line - **2** - from connector on fuel rail.
- Remove high pressure line - **1** - from connector on fuel rail. To do this, counterhold at hex head with and open-end wrench and loosen the union nut.

NOTE:

- **Do not change bent shape of high pressure lines.**

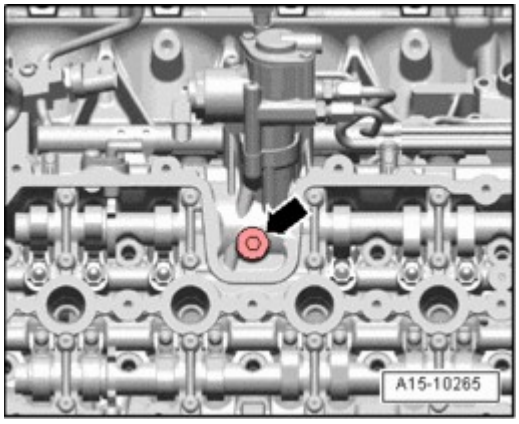

Fig. 308: Removing/Installing Locking Bolt
Courtesy of VOLKSWAGEN UNITED STATES, INC.

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

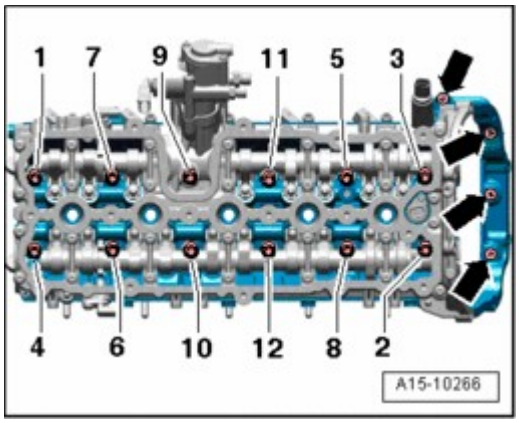

Fig. 309: Cylinder Head Bolts Removal Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** -.
- Loosen cylinder head bolts - **1 to 12** - in sequence and remove them.
- Remove cylinder head and place it on a soft surface (foam).

Installing

NOTE:

- **Replace cylinder head bolts.**
- **Replace self-locking nuts and bolts.**
- **Always replace bolts that are tightened to torque as well as O-rings and gaskets.**
- **Carefully remove sealant residue from cylinder head and cylinder block. Make sure that no long scrapes or scratches result.**
- **Carefully remove all grinding and sanding residue.**
- **There must be no oil or coolant in the blind holes for the cylinder head bolts in the cylinder block.**
- **Only unpack new cylinder head gasket immediately prior to installation.**
- **Handle gasket carefully. Damage in silicon layer and recessed area lead to leakage.**
- **Cylinder heads with cracks between the valve seats, or between the valve seat and the spark plug threads, can continue to be used without reducing the service life, as long as the cracks have a width of max. 0.3 mm, or only the first 4 threads of the spark plug threads are cracked.**
- **After installing a replacement cylinder head with camshafts installed, oil contact surfaces between roller rocker levers and cam lubricating surfaces after installing cylinder head.**
- **Do not remove plastic bases protecting freed up valves until immediately before installing cylinder head.**
- **Secure all hose connections using hose clamps appropriate for the model type .**

- **During installation, all cable ties must be re-installed at the same location.**
- **After working on the valvetrain and lifters, carefully rotate the crankshaft by hand at least 2 full revolutions before starting to be sure that valves do not strike the pistons.**
- **When replacing the cylinder head or cylinder head seal, all of the coolant and engine oil must be replaced.**

- Check whether camshafts of both cylinder heads stand in "TDC" position.

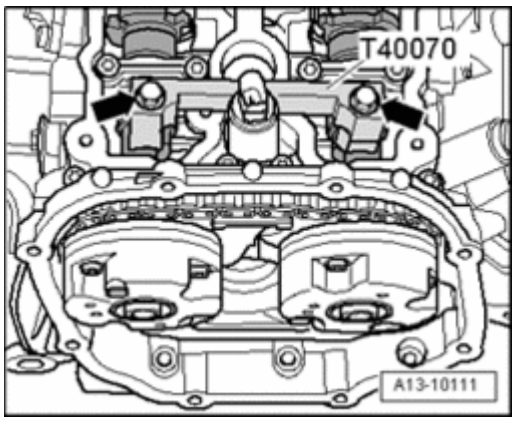

Fig. 310: Mounting Camshaft Locating Tool T40070 To Both Cylinder Heads And Tightening Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Camshaft Clamp T40070 must be installed on both cylinder heads and tightened to 25 Nm - **arrows** -.

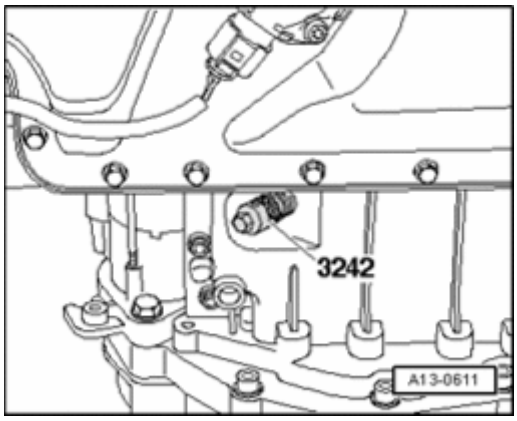

Fig. 311: Securing Crankshaft In TDC Position Using Crankshaft Holder 3242
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Crankshaft holder 3242 must be installed.

- Position cylinder head gasket.

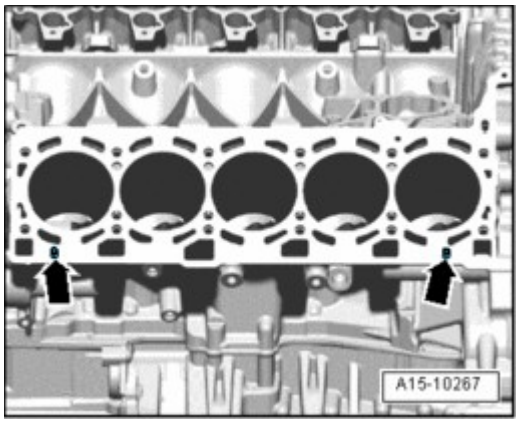

Fig. 312: Identifying Alignment Bushings In Cylinder Block
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pay close attention to alignment bushings in cylinder block - **arrows** -.
- Pay attention to installation position of cylinder head gasket, marking "oben" (top) or part number must face toward cylinder head.

- Install cylinder head.
- Insert new cylinder head bolts and tighten by hand.

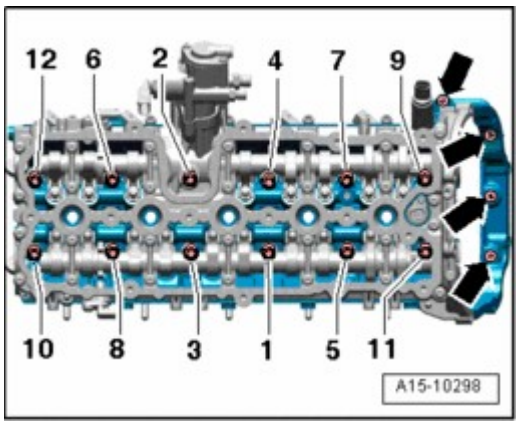

Fig. 313: Cylinder Head Bolts Tightening Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tighten cylinder head bolts in 4 stages - **1 to 12** - in sequence as follows :
- Using torque wrench, tighten to 30 Nm.
- Using torque wrench, tighten to 60 Nm.
- With Torx key, 90 ($^{1}/_{4}$ turn) additional turn.
- With Torx key, 90 ($^{1}/_{4}$ turn) additional turn.

NOTE:

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

- Tighten bolts - **arrows** - to 9 Nm.

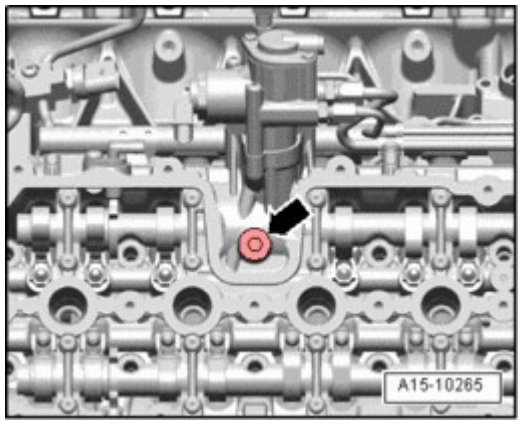

Fig. 314: Removing/Installing Locking Bolt
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tighten locking bolt - **arrow** -.

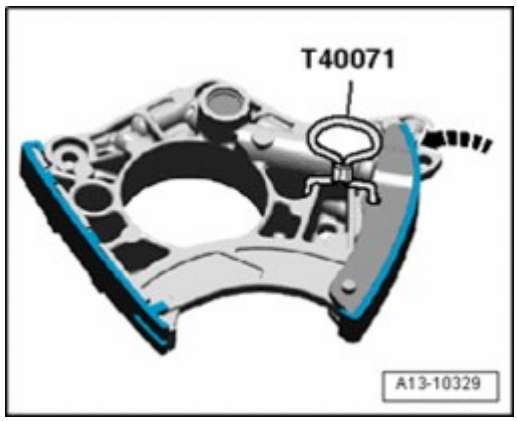

Fig. 315: Pressing Left/Right Camshaft Timing Chain Guide Rail Inward And Securing Chain Tensioner With Locking Pin T40071
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Check whether camshaft timing chain tensioner guide rail is secured using Locking Pin T40071.

NOTE:

- **If the tensioning element is to be removed from the chain tensioner, observe the installed position: Hole in housing floor faces toward chain tensioner, piston faces toward tensioning rail.**
- **Disregard - arrow -.**

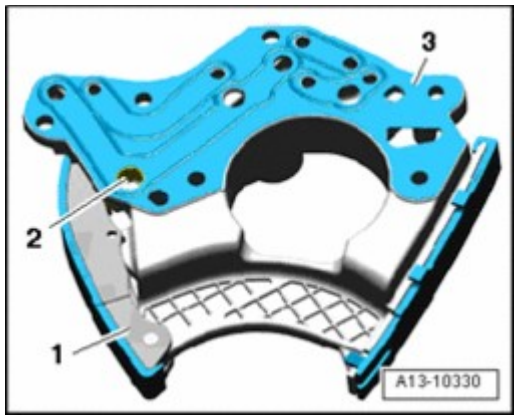

Fig. 316: Identifying Chain Tensioner Oil Screen, Gasket & Chain Tensioner
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Clean chain tensioner oil screen - **2** - if necessary.
- Place a new gasket - **3** - onto rear of chain tensioner - **1** -.

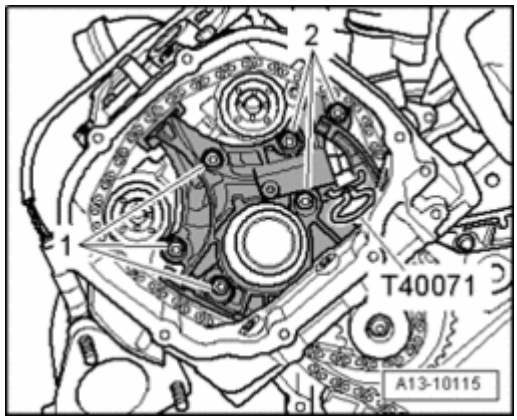

Fig. 317: Tightening/Removing Bolts & Replacing Camshaft Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Set chain tensioner in place and install camshaft timing chain, as shown in the illustration.
- Tighten bolts - **1** - and - **2** -.

The rest of installation is in reverse order of removal, note the following:

- Install camshaft timing chains --> **Camshaft Timing Chain, Removing and Installing** .
- Install left and right timing chain covers --> **Timing Chain Covers, Removing and Installing** .
- Install cylinder head cover: Left --> **Left Cylinder Head Cover, Removing and Installing** , right --> **Right Cylinder Head Cover, Removing and Installing**.

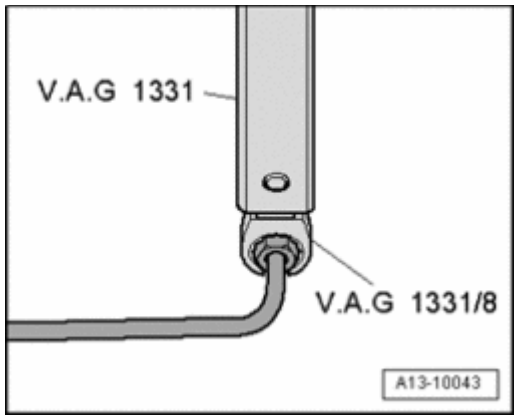

Fig. 318: Tightening Union Nut At Fuel Rail Using Torque Wrench V.A.G 1331 With 14 Mm Open End Wrench Socket V.A.G 1331/8
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- To tighten union nut (14 mm) at fuel rail use torque wrench V.A.G 1331 with 14 mm open end wrench socket V.A.G 1331/8.

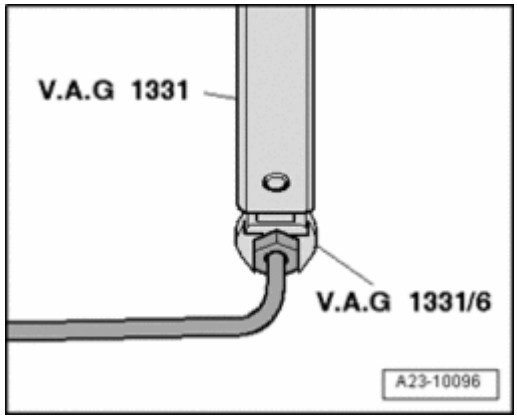

Fig. 319: Tightening SW 17 Union Nut At Fuel Rail Using Torque Wrench V.A.G 1331 With SW 17 Socket V.A.G 1331/6
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- To tighten SW 17 union nut at fuel rail, use torque wrench V.A.G 1331 with SW 17 socket V.A.G 1331/6.
- Install intake manifold --> **24 - MULTIPORT FUEL INJECTION (MFI)** .
- Install exhaust system tract: left --> **Left Exhaust System Tract, Removing and Installing** , right --> **Right Exhaust System Tract, Removing and Installing**.
- Install engine --> **Engine, Installing**.
- Replace coolant --> **Cooling System, Draining and Filling**.

Torque specifications

Component	Nm
Locking bolt to guide frame	35

High pressure lines to fuel rail	25
Chain tensioner to cylinder head	5 + 90° 1)2)
Secondary air injection connecting piece to cylinder head	9
Power steering pressure line bracket to cylinder head	9
1) Replace bolts. 2) 90° corresponds to a quarter turn.	

Compression, Checking

Compression, Checking

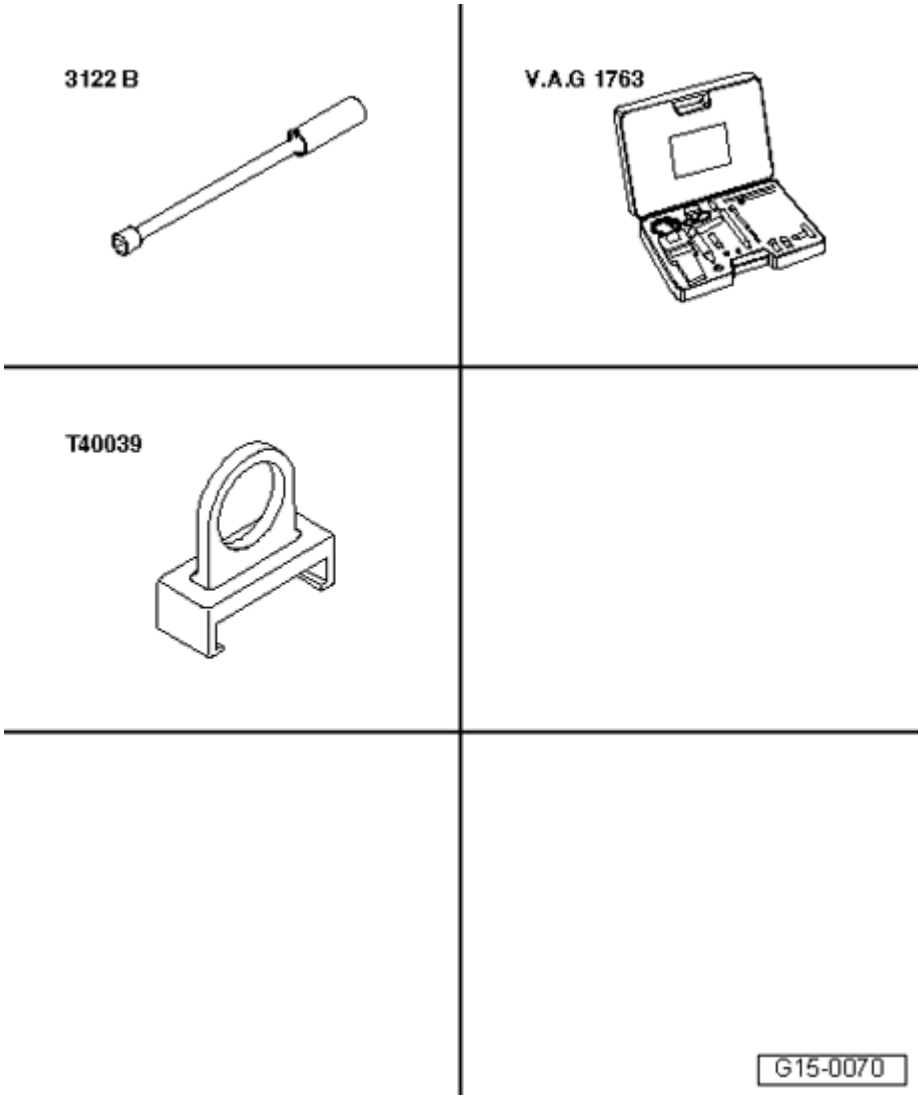

Fig. 320: Identifying Special Tools - Compression, Checking
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Spark plug removal tool 3122 B
- Compression tester V.A.G 1763
- Ignition Coil Puller T40039

Procedure

- Engine oil temperature min. 30 C.
- Battery voltage min. 12.5 V.

  - Switch off ignition.

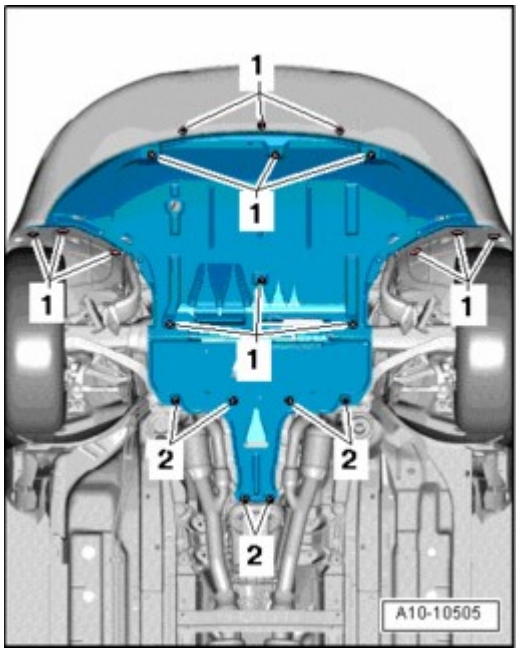

Fig. 321: Identifying Noise Insulation Quick-Release Fasteners
Courtesy of VOLKSWAGEN UNITED STATES, INC.

  - Loosen quick-release fasteners - **1** - and remove front noise insulation.

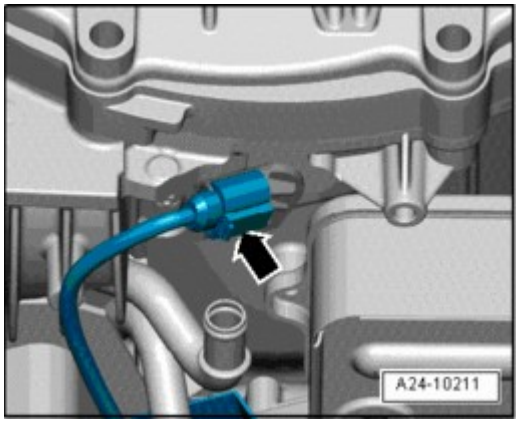

Fig. 322: Disconnecting Electrical Connector On Engine Speed (RPM) Sensor G28

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connector on Engine Speed (RPM) Sensor G28 - **arrow** - at bottom of transmission.

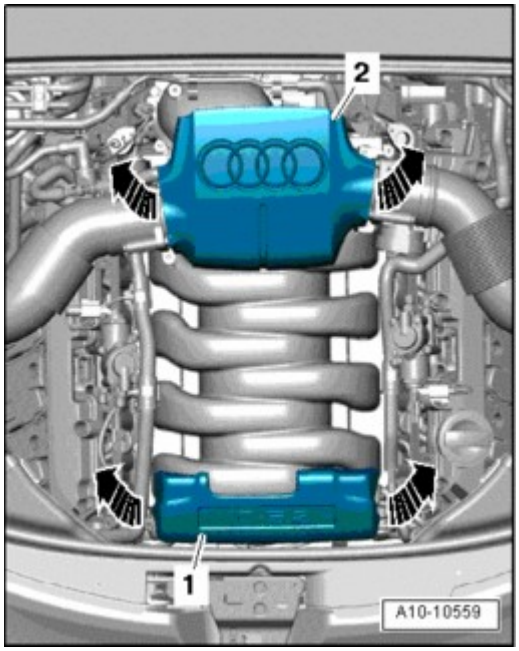

Fig. 323: Removing Rear Engine Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove front engine cover - **1** - and rear - **2** - - **arrows** -.

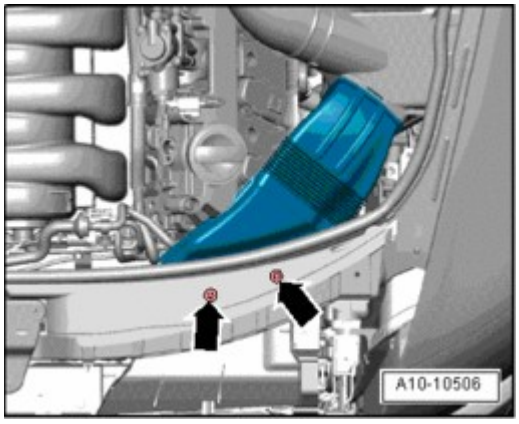

Fig. 324: Removing Bolts And Left Air Duct
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** - and remove left air duct.

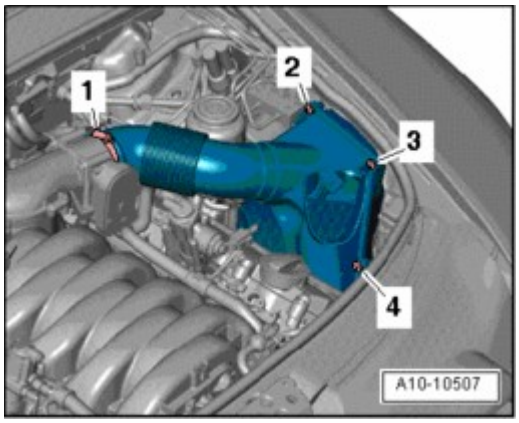

Fig. 325: Identifying Hose Clamps And Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen hose clamp - **1** - and remove bolts - **2, 3, 4** -.
- Remove upper part of left air filter housing.

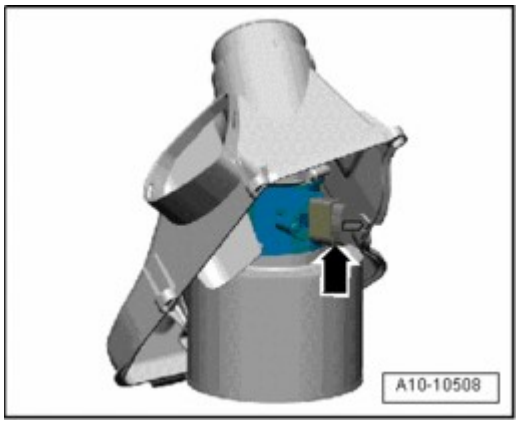

Fig. 326: Identifying Electrical Connector On Mass Air Flow Sensor
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connector - **arrow** - on mass air flow (MAF) sensor 2 G246.

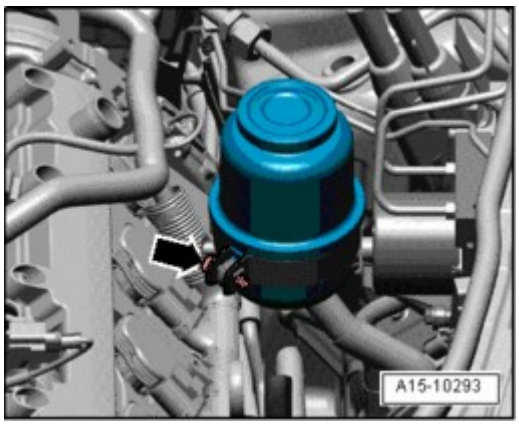

Fig. 327: Removing Bolt And Remove Power Steering Reservoir From Bracket, Hydraulic Lines Remain

Connected
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolt - **arrow** - and remove power steering reservoir from bracket, hydraulic lines remain connected.

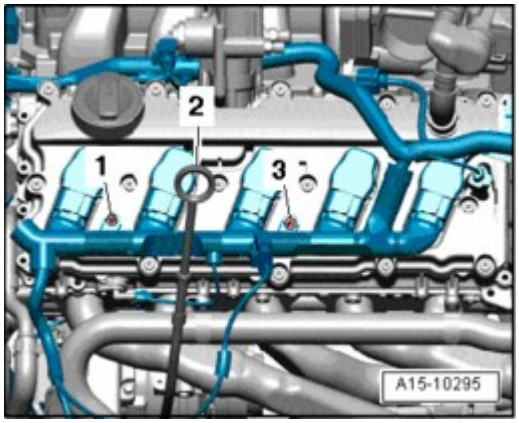

Fig. 328: Removing Oil Dipstick & Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove oil dipstick - **2** - from guide tube.
- Remove bolts - **1** - and - **3** -.
- Disconnect electrical connectors to ignition coils and press wiring harness to side.

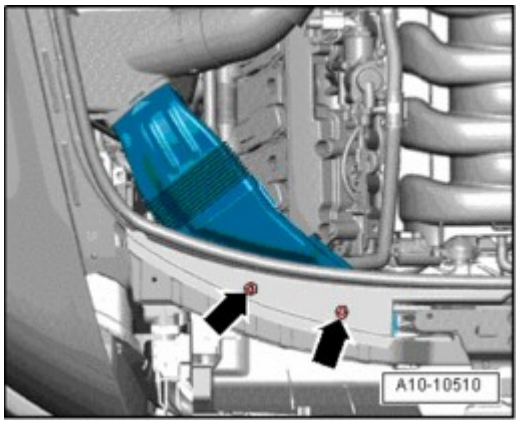

Fig. 329: Identifying Vacuum Hoses And Bolts For Right Air Guide
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** - and remove right air duct.

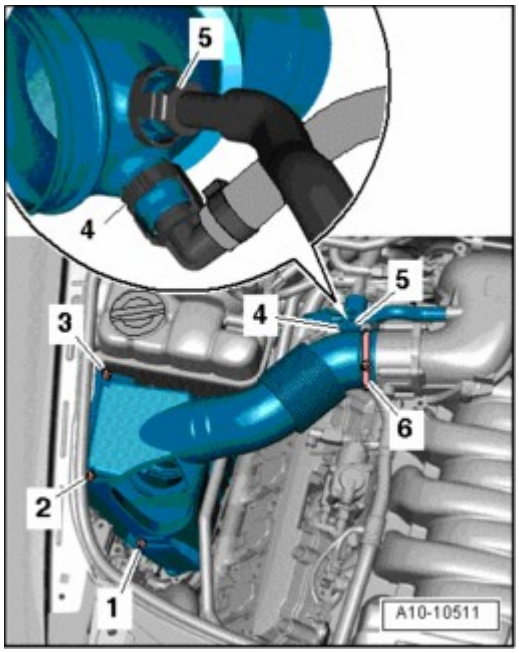

Fig. 330: Identifying Hose Clamps And Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect vacuum hose - **5** - from air guide hose.

CAUTION: Hose connectors - 4 - must not be opened. Lay aside right upper part of air filter housing with connected crankcase ventilation hose.

- Loosen hose clamp - **6** - and remove bolts - **1 ,2 and 3** -.
- Remove upper part of right air filter housing.

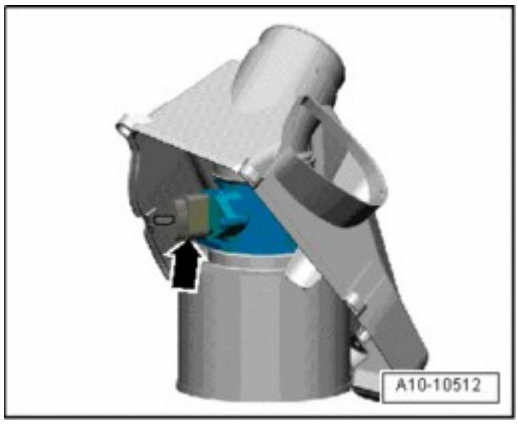

Fig. 331: Identifying Electrical Connector On Mass Air Flow Sensor
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connector - **arrow** - on Mass Air Flow (MAF) Sensor G70.

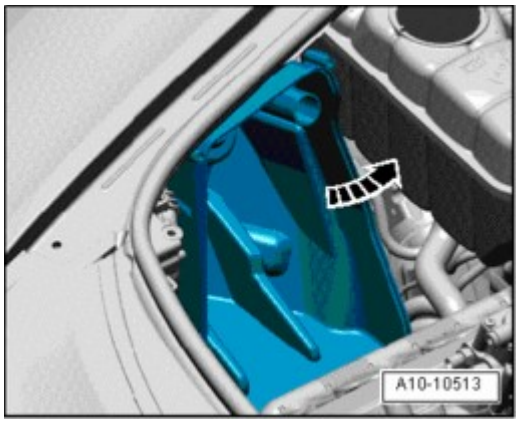

Fig. 332: Tilting Upper Part Of Air Filter Housing Up/Out
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove lower part of air filter housing from side connection.
- Tilt upper part of air filter housing up and out - **arrow** -.

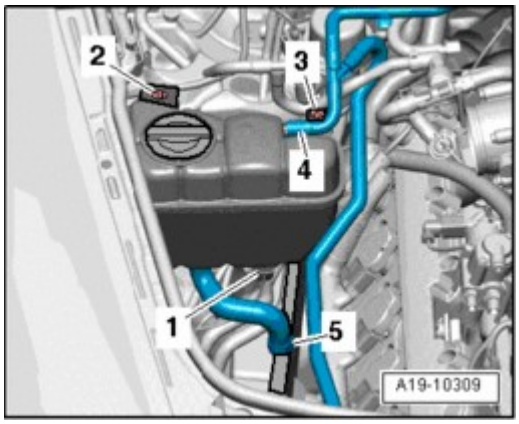

Fig. 333: Identifying Bolts And Coolant Hoses
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connector - **1** - on Engine Coolant Level (ECL) Warning Switch F66 at bottom of coolant expansion tank.
- Remove bolts - **2** - and - **3** - and lay aside coolant reservoir with connected coolant hoses - **4** - and - **5** -.

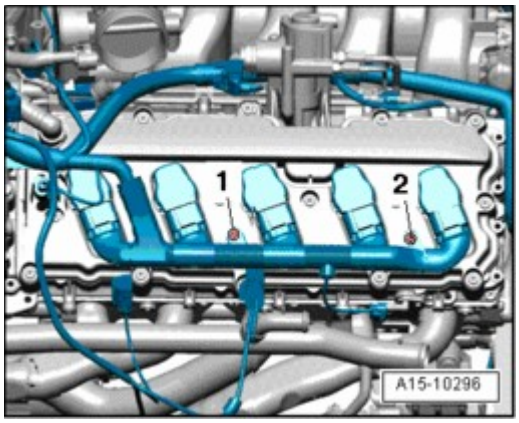

Fig. 334: Removing Bolts & Disconnecting Electrical Connectors To Ignition Coils
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **1** - and - **2** -.
- Disconnect electrical connectors to ignition coils and press wiring harness to side.

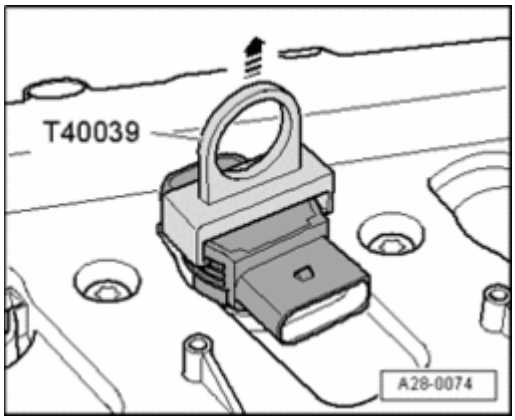

Fig. 335: Removing Ignition Coils Using Ignition Coil Puller T40039.
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove all ignition coils using Ignition Coil Puller T40039.
- Using spark plug removal tool 3122 B , remove spark plugs.
- Check compression using compression tester V.A.G 1763.

NOTE:

- **Using tester --> operating instructions.**

- Have a second technician press accelerator pedal completely and at the same time operate starter long enough until pressure increase no longer appears on tester.

Compression pressure	Bar pressure
New	10.0 to 14.0
Wear limit	9,0
Difference between cylinders	max. 3.0

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

- Install left upper part of air filter housing and right air filter housing --> **24 - MULTIPORT FUEL INJECTION (MFI)** .
- Install spark plugs --> **28 - IGNITION/GLOW PLUG SYSTEM** .
- As a final step, check Engine Control Module (ECM) DTC memory and erase it, since malfunctions were stored by disconnecting electrical connectors

Torque specifications

Component	Nm
Wiring for ignition coils at cylinder head cover	5

VALVETRAIN, SERVICING

Valvetrain, Servicing

--> **Valvetrain, Component Overview**

--> **Camshafts, Checking Axial Clearance**

--> **Camshafts, Removing and Installing**

--> **Valve Stem Seals, Cylinder Head Installed, Replacing**

--> **Valve Stem Seals, Cylinder Head Removed, Replacing**

--> **Hydraulic Adjusting Elements, Checking**

--> **Valve Dimensions**

--> **Valve Guides, Checking**

--> **Valves, Checking**

NOTE:

- **Cylinder heads with cracks between the valve seats, or between the valve seat and the spark plug threads, can continue to be used without reducing the service life, as long as the cracks have a width of max. 0.3 mm, or only the first 4 threads of the spark plug threads are cracked.**
- **After installing the camshafts, the engine may not be started for approximately 30 minutes. The hydraulic adjusting elements must seat themselves (otherwise the valves will seat themselves on the pistons).**
- **After working on the valvetrain, carefully rotate engine by hand at least 2 full revolutions to ensure that valves do not strike the pistons when starting.**

Valvetrain, Component Overview

Valvetrain, Component Overview

NOTE:

- **Cylinder head for cylinder bank 2 (left) is shown in illustration.**

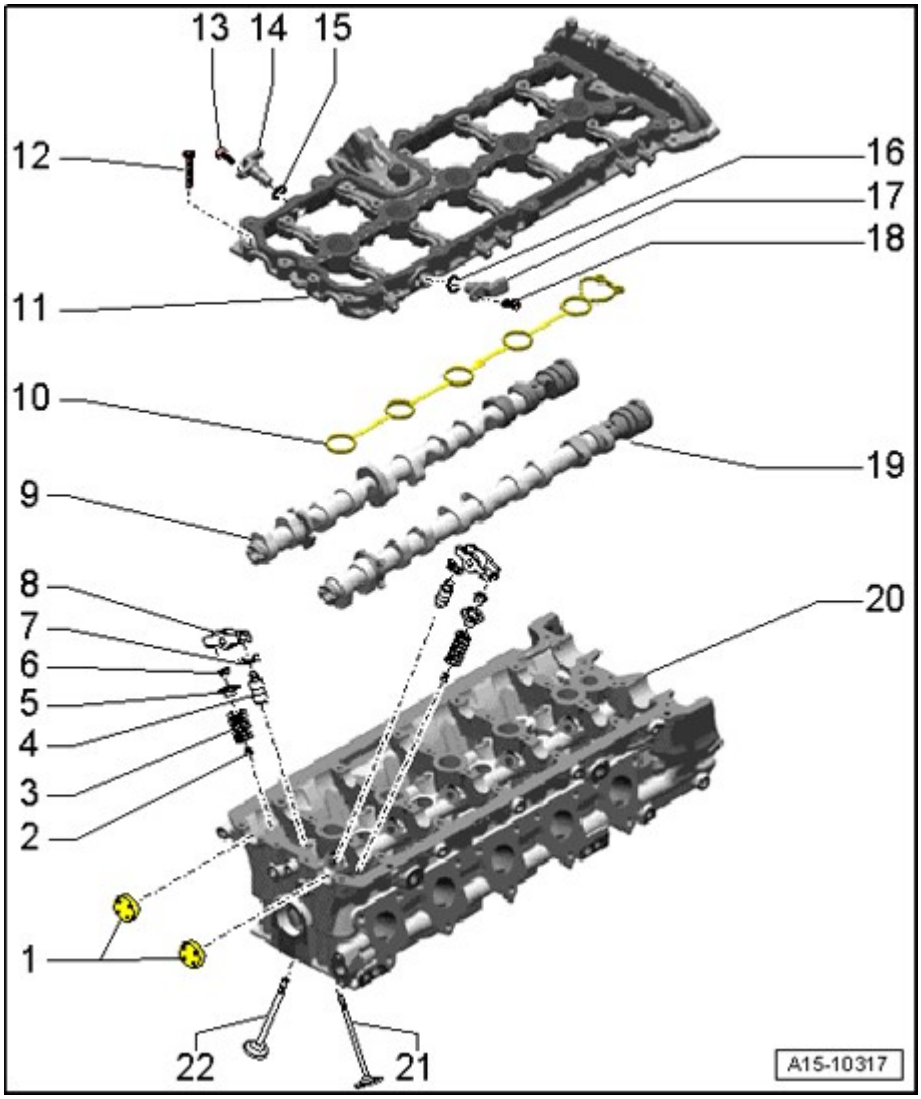

Fig. 336: Valvetrain, Component Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Sealing plug

- Insert with sealant; sealant

2 - Valve stem seal

- Replacing, Cylinder Head Installed --> **Valve Stem Seals, Cylinder Head Installed, Replacing**

- Replacing, Cylinder Head Removed --> **Valve Stem Seals, Cylinder Head Removed, Replacing**

3 - Valve spring

- Installed location --> **Installed position of valve spring**

4 - Hydraulic adjusting element

- Clipped into roller rocker lever - **8** -
- Checking --> **Hydraulic Adjusting Elements, Checking**
- Do not interchange
- Lubricate contact surface

5 - Valve spring plate

6 - Valve keys

7 - Securing clip

- Not available individually
- Check for secure seat

8 - Roller rocker lever

- Do not interchange
- Check roller for easy movement
- Lubricate contact surface
- To assemble, clip onto the hydraulic adjusting element - **4** - using a circlip - **7** -

9 - Intake camshaft

- Removing and installing --> **Camshafts, Removing and Installing**
- Checking axial play --> **Camshafts, Checking Axial Clearance**
- Check radial clearance using Plastigage (roller rocker lever removed)
- Radial clearance at bearing-dia. 24 mm: 0.024 to 0.066 mm
- Radial clearance at bearing-dia. 36 mm: 0.100 to 0.325 mm
- Run-out: max. 0.04 mm

10 - Gasket

- Replace

11 - Bearing bracket

- With integrated camshaft bearings
- Removing and installing --> **Camshafts, Removing and Installing**

12 - 8 Nm plus an additional 90 ($^{1}/_{4}$ turn)

- Replace
- Observe tightening sequence --> **Camshaft guide frame, tightening sequence**

13 - 9 Nm

14 - Camshaft position (CMP) sensor 2 G163

15 - O-ring

- Replace

16 - O-ring

- Replace

17 - Camshaft position (CMP) sensor 4 G301

18 - 9 Nm

19 - Exhaust camshaft

- Removing and installing --> **Camshafts, Removing and Installing**
- Checking axial play --> **Camshafts, Checking Axial Clearance**
- Check radial clearance using Plastigage (roller rocker lever removed)
- Radial clearance at bearing-dia. 24 mm: 0.024 to 0.066 mm
- Radial clearance at bearing-dia. 36 mm: 0.100 to 0.325 mm
- Run-out: max. 0.04 mm

20 - Cylinder Head

- Check valve guides --> **Valve Guides, Checking**

21 - Intake valve

- Do not rework, only lapping is permitted
- Mark installed position for re-installation
- Valve dimensions --> **Valve Dimensions**
- Check valve guides --> **Valve Guides, Checking**

22 - Exhaust valve

- Do not rework, only lapping is permitted
- Mark installed position for re-installation
- Valve dimensions --> **Valve Dimensions**
- Check valve guides --> **Valve Guides, Checking**

Installed position of valve spring

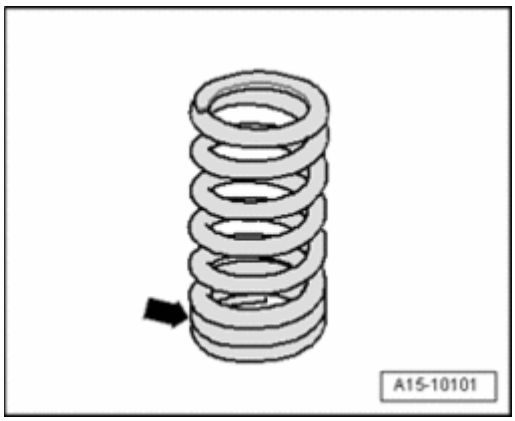

Fig. 337: Identifying Tight Spring Coils Face Toward Cylinder Head
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- The tight spring coils - **arrow** - face toward cylinder head.

Camshaft guide frame, tightening sequence

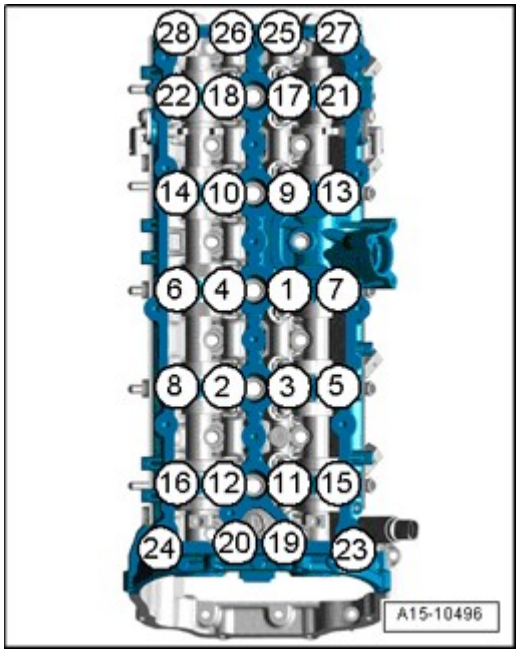

Fig. 338: Loosening Guide Frame Bolts Sequence

Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE:

- **The illustration shows the guide frame for the left cylinder head.**

- Tighten bolts in 3 stages in sequence - **1 to 28** - :
- Tighten bolts by hand.

- The guide frame must be in contact with the entire contact surface of the cylinder head.

- Tighten bolts to 8 Nm.
- Tighten bolts an additional 90.

Camshafts, Checking Axial Clearance

Camshafts, Checking Axial Clearance

Special tools, testers and auxiliary items required

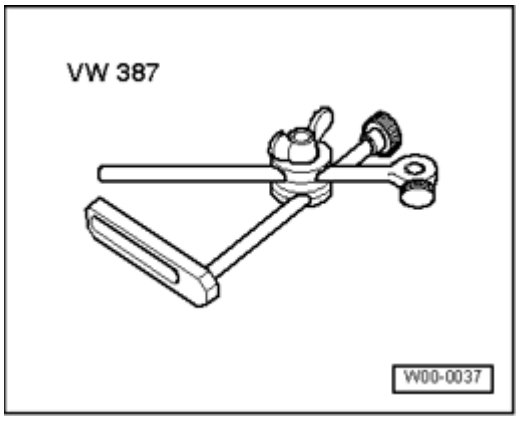

Fig. 339: Dial Gauge Holder VW 387
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Dial gauge holder VW 387

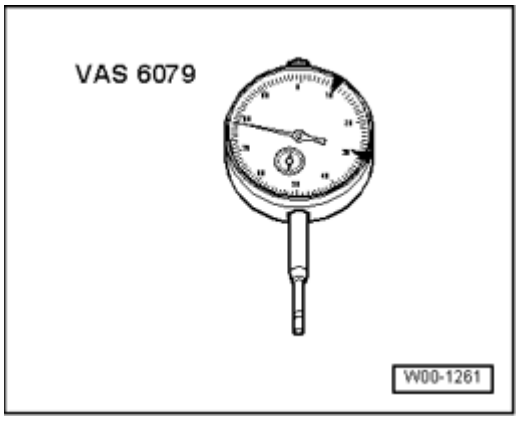

Fig. 340: Dial Gauge VAS 6079
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Dial gauge VAS 6079

Test sequence

- Perform measurement with guide frame removed.

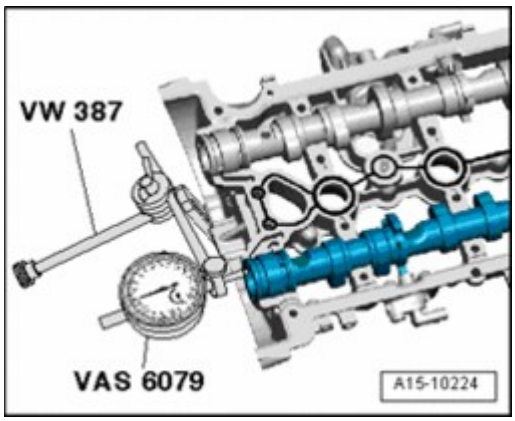

Fig. 341: Securing Dial Gauge Holder VW 387 To Dial Gauge VAS 6079 On Cylinder Head
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Secure dial gauge holder VW 387 to dial gauge VAS 6079 on cylinder head.
- Determine axial clearance.

- Axial clearance: 0.100 to 0.191 mm.

Camshafts, Removing and Installing

Camshafts, Removing and Installing

Special tools, testers and auxiliary items required

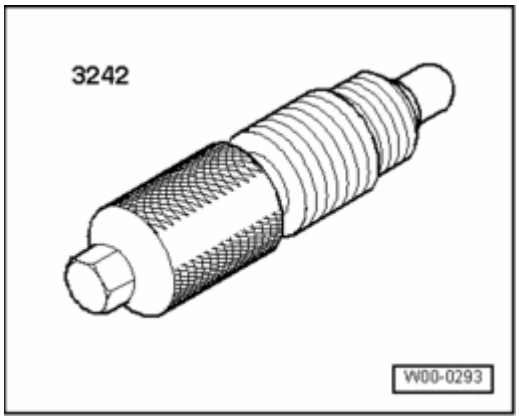

Fig. 342: Locking Pin 3242

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Locking pin 3242

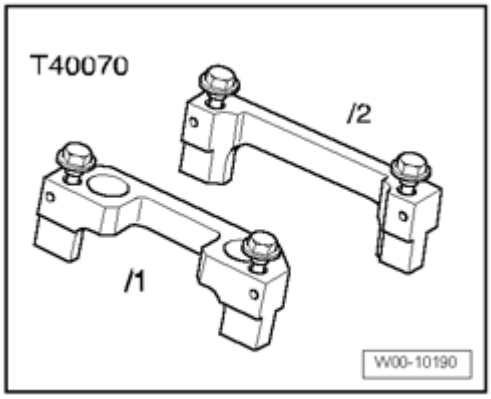

Fig. 343: Camshaft Clamp T40070 , Qty. 2
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Camshaft Clamp T40070 , qty. 2

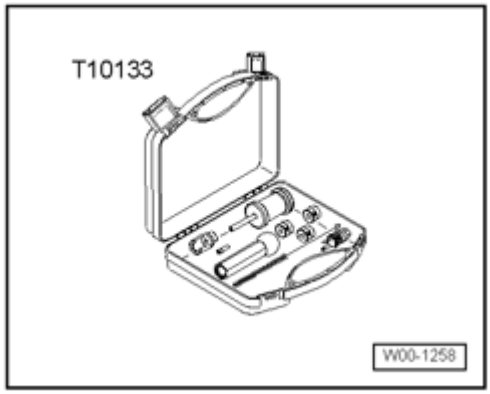

Fig. 344: Impact Puller T10133/3 From The Tool Set T10133
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Impact puller T10133/3 from the tool set T10133

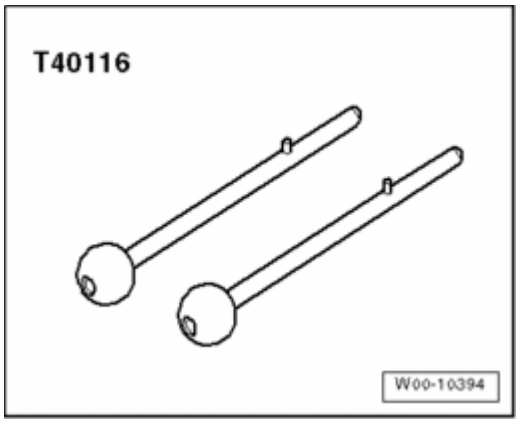

Fig. 345: Securing Pins 1 Set = Qty. 2 T40116
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Securing pins 1 set = qty. 2 T40116
- Hand drill with plastic brush attachment
- Protective glasses
- Sealant

NOTE:

- **Removal and installation at left cylinder head is depicted in the following description.**

Removing

- Remove engine --> **Engine, Removing**.
- Leave engine with transmission installed on the scissor lift platform VAS 6131 A.
- Remove camshaft timing chains from camshafts --> **Camshaft Timing Chains, Removing from Camshafts**.

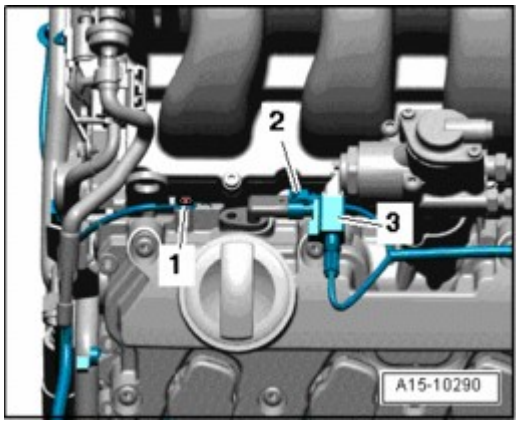

Fig. 346: Removing Ground Wire, Electrical Connectors & High-Pressure Pump
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove ground wire - **1** - from guide frame.

- Disconnect electrical connectors - **2** - and - **3** -.
- Remove high-pressure pump --> **24 - MULTIPORT FUEL INJECTION (MFI)** .

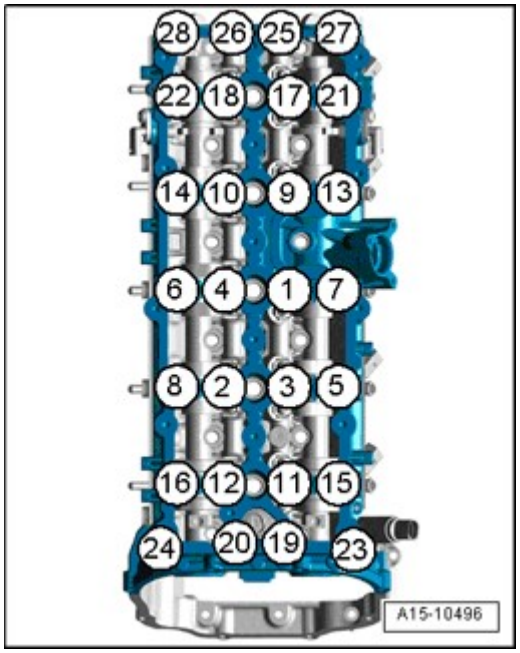

Fig. 347: Loosening Guide Frame Bolts Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen guide frame bolts in sequence - **28 to 1** -.

NOTE:

- **Proceed in the same way with right guide frame.**

- Carefully remove guide frame and lay it on a soft surface on the workbench.

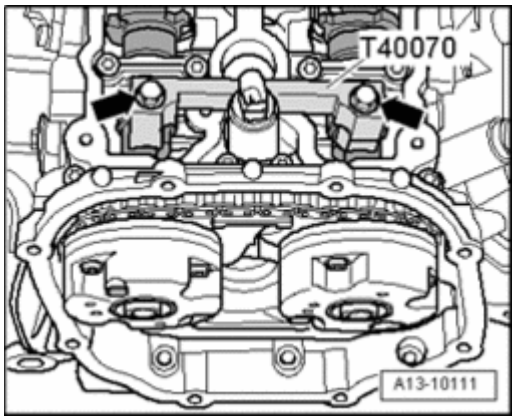

Fig. 348: Removing Camshaft Clamp T40070 At Left Cylinder Head
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove Camshaft Clamp T40070 at left cylinder head.

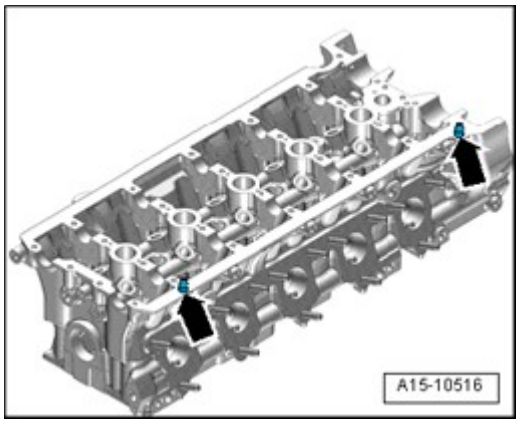

Fig. 349: Identifying Guide Frame Alignment Pins
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Mark camshafts and remove.

CAUTION: On engines equipped with guide frame alignment pins - arrows - , these must be driven out with a cotter pin driver.

Installing

NOTE:

- **Always replace gaskets and seals.**

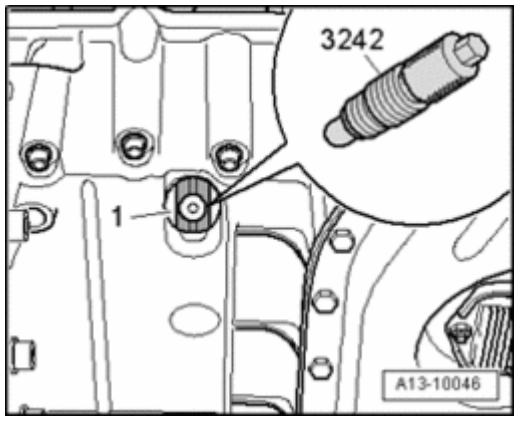

Fig. 350: Installing/Removing Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- **Secure crankshaft - 1 - using crankshaft holder 3242.**
- **The hydraulic adjusting elements and roller rocker lever are inserted.**

CAUTION: Wear safety glasses.

CAUTION: Make sure that no sealant residue enters the cylinder head and bearings.

- Remove sealant residue on cylinder head and guide frame, e.g. with rotating plastic brush.
- Clean sealing surfaces, they must be free of oil and grease.
- Oil journal surfaces of camshafts.
- Set camshafts into guide frame.

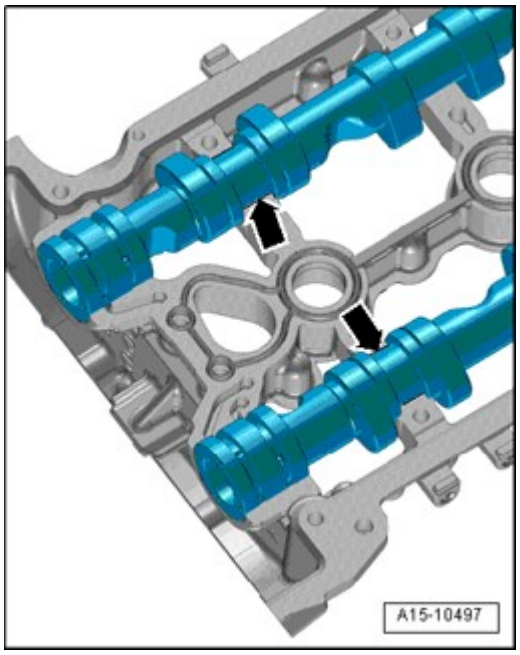

Fig. 351: Identifying Axial Bearings
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- The placement of the camshafts must be exactly within the axial bearings - **arrows** - of the guide frame.

- Rotate guide frame with the camshafts installed while holding camshafts inside the frame.

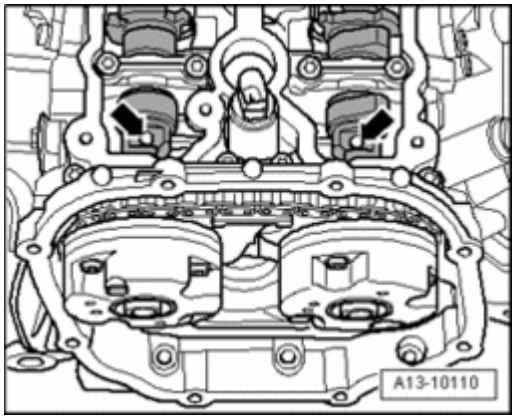

Fig. 352: Identifying Threaded Holes In Camshafts Must Face Upward
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Rotate camshafts until threaded holes - **arrows** - point upward.
- Check whether camshafts still lie exactly in axial bearings of guide frame.

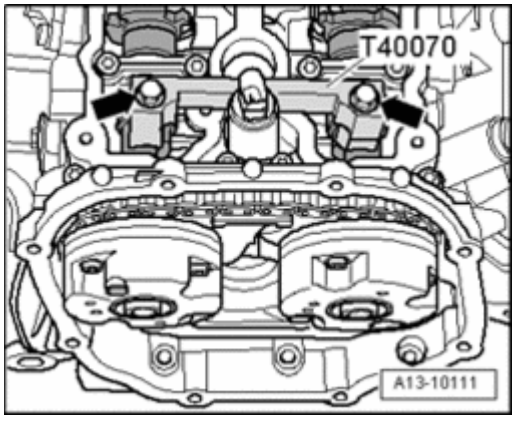

Fig. 353: Mounting Camshaft Locating Tool T40070 To Both Cylinder Heads And Tightening Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install camshaft clamp T40070 at the intake and exhaust camshafts as shown in the illustration and tighten bolts to 25 Nm.

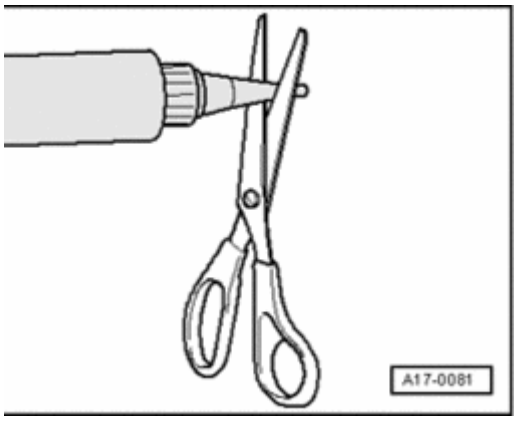

Fig. 354: Cutting Tube Nozzle At Front Marking
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Cut off the nozzle on the tube of sealant at the front mark (dia. of nozzle approximately 2 mm).

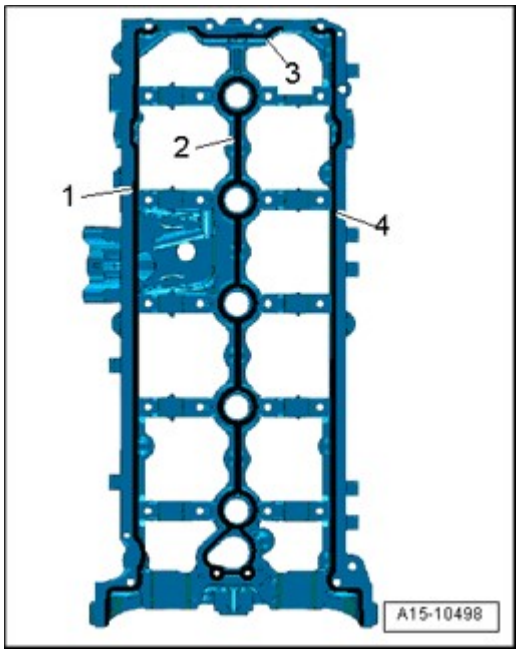

Fig. 355: Identifying Guide Seal & Sealant Beads
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Turn around guide frame again.
- Lay a new seal - **2** - in guide frame groove.

NOTE:

- **Sealant beads must not be thicker than specified, otherwise extra sealant can enter camshaft bearing.**

- Apply sealant beads - **1, 3, 4** - on clean guide frame sealing surfaces as shown in illustration.

- Thickness of sealant beads: 2.5 mm.

NOTE:

- **Because the sealant begins hardening immediately, guide frame must be promptly positioned and tightened.**

- Place guide frame on cylinder head.

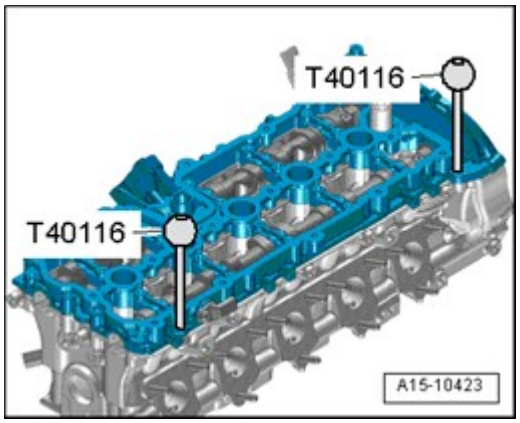

Fig. 356: Inserting Locating Pins T40116 In Guide Frame And Cylinder Head
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert locating pins T40116 in guide frame and cylinder head.

NOTE:

- **After installing guide frame, sealant must dry for approximately 30 minutes.**

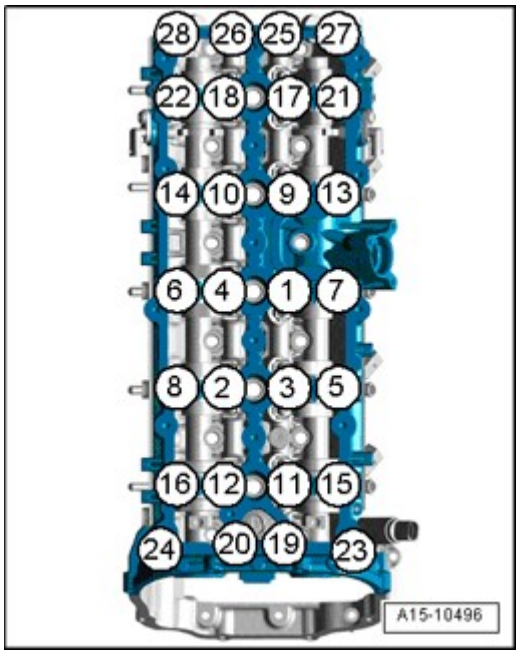

Fig. 357: Loosening Guide Frame Bolts Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tighten guide frame bolts evenly by hand in the sequence - **1 to 28** -.
- Fasten guide frame bolts in sequence - **28 to 1** - until they stop.
- Clean sealing plug hole in the cylinder head. It must be free of oil and grease.

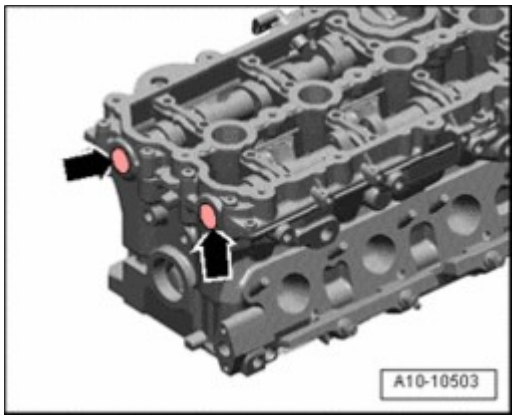

Fig. 358: Identifying Sealing Plugs With Sealant
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Coat outer circumference of the sealing plugs - **arrows** - with sealant; sealant .
- Install sealing plugs so they are flush.

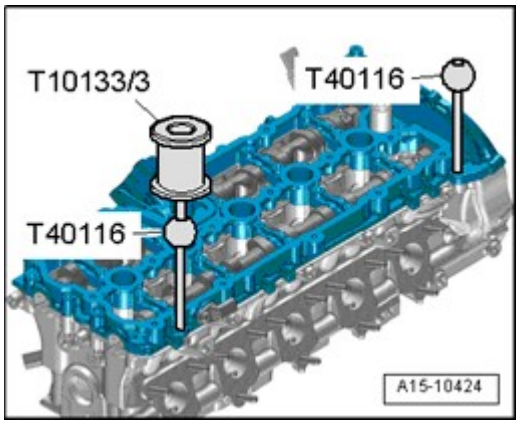

Fig. 359: Removing Locating Pins T40116 Using Impact Puller T10133/3
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove locating pins T40116 using impact puller T10133/3.

The rest of the installation is in reverse order of removal, noting the following:

- Install high pressure pump --> **24 - MULTIPORT FUEL INJECTION (MFI)** .
- Position camshaft timing chains on camshafts --> **Camshaft Timing Chain, Removing and Installing** .
- Install left and right timing chain covers --> **Timing Chain Covers, Removing and Installing** .
- Install cylinder head cover: Left --> **Left Cylinder Head Cover, Removing and Installing** , right --> **Right Cylinder Head Cover, Removing and Installing**.
- Install engine --> **Engine, Installing**.

NOTE:

- **After installing the camshafts, the engine may not be started for**

approximately 30 minutes. The hydraulic adjusting elements must seat themselves (otherwise the valves will seat themselves on the pistons).

- **After working on the valvetrain, carefully rotate engine by hand at least 2 full revolutions to ensure that valves do not strike the pistons when starting.**

Tightening specifications

Component	Nm
Bearing bracket to cylinder head	8 + 90° 1)2)
1) Replace bolts. 2) 90° corresponds to a quarter turn.	

Valve Stem Seals, Cylinder Head Installed, Replacing

Valve Stem Seals, Cylinder Head Installed, Replacing

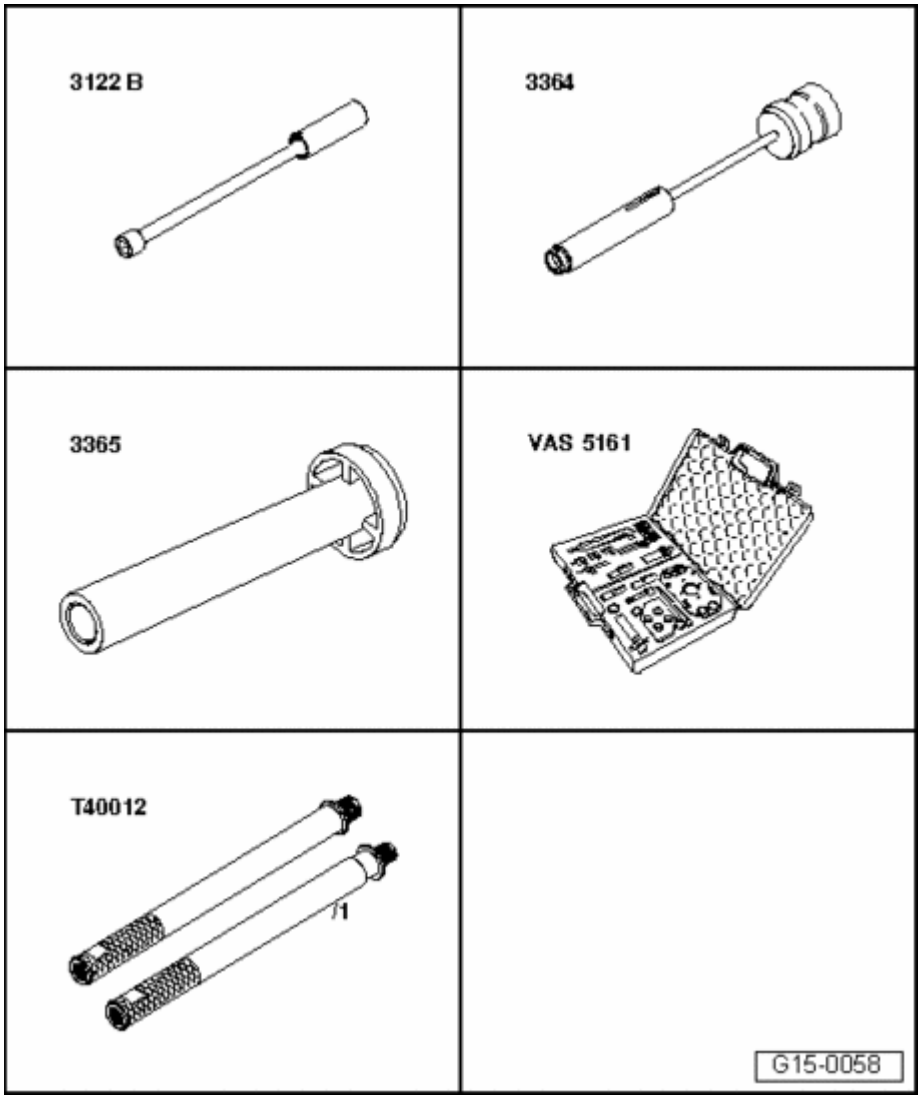

Fig. 360: Identifying Special Tools - Valve Stem Seals, Cylinder Head Installed, Replacing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Spark plug removal tool 3122 B
- Valve seal removal tool 3364
- Valve stem seal driver 3365
- Valve cotter disassembly and assembly device VAS 5161
- Adapter T40012

Removing

- Remove engine --> **Engine, Removing**.
- Leave engine with transmission installed on scissor lift platform VAS 6131 A.
- Remove camshaft timing chains from camshafts --> **Camshaft Timing Chains, Removing from Camshafts**.
- Remove camshafts --> **Camshafts, Removing and Installing**.
- Using spark plug removal tool 3122 B , remove spark plugs.

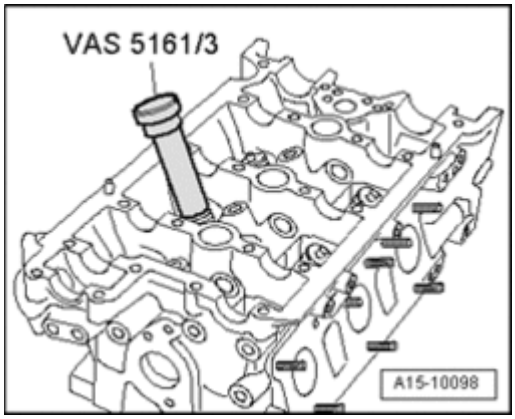

Fig. 361: Placing Drift VAS 5161/3 On Valve Spring Plate And Loosening Stuck Valve Keepers Using Plastic Hammer
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place drift VAS 5161/3 on valve spring plate and loosen stuck valve keepers using a plastic hammer.

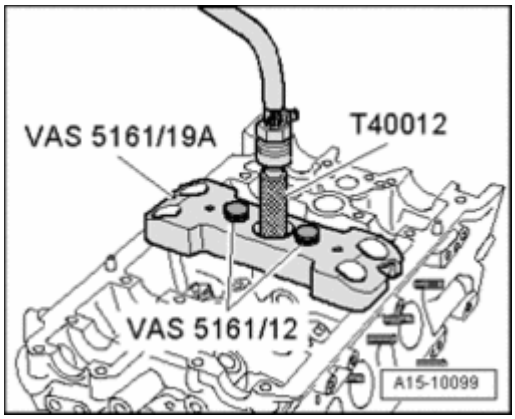

Fig. 362: Placing Guide Plate VAS 5161/19 A From Valve Cotter Disassembly And Assembly Device VAS 5161 On Cylinder Head
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place guide plate VAS 5161/19 A from valve cotter disassembly and assembly device VAS 5161 on cylinder head.
- Secure guide plate with knurled screws VAS 5161/12.
- Install adapter T40012 with gasket by hand into respective spark plug thread and apply constant pressure.

- Minimum pressure: 6 bar positive pressure.

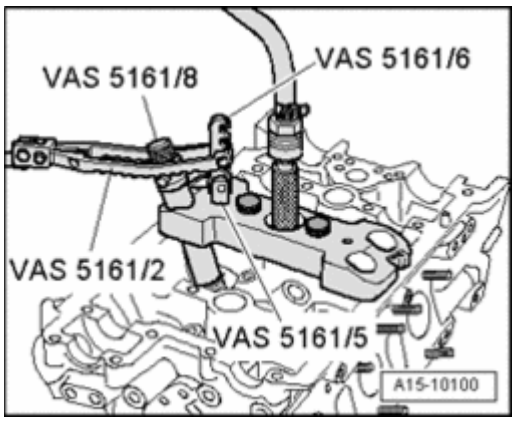

Fig. 363: Installing Engaging Device VAS 5161/6 With Installation Fork VAS 5161/5 Into Guide Plate
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install engaging device VAS 5161/6 with installation fork VAS 5161/5 into guide plate.
- Push installation cartridge VAS 5161/8 into guide plate.
- Hook in pressure fork VAS 5161/2 at engaging device and press down installation cartridge.
- At the same time, turn knurled bolt of installation cartridge to the right, until the points engage in the valve keepers.

- Lightly move knurled bolt back and forth, causing the valve keepers to be pressed apart and be captured in the installation cartridge.
- Release pressure fork.

- Take out installation cartridge.
- Unfasten guide plate and turn it aside.

- Pressurized air hose remains connected.

- Remove valve spring with valve spring plate.

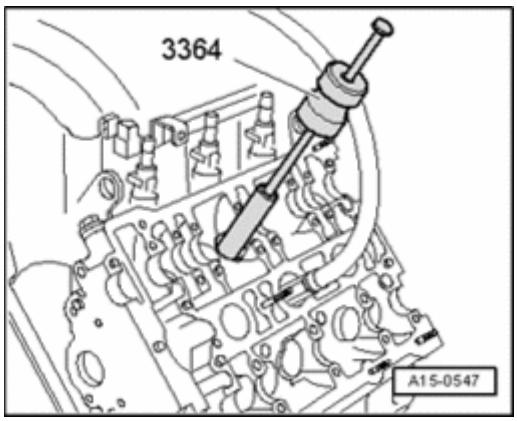

Fig. 364: Pulling Off Valve Stem Oil Seals Using Valve Seal Removal Tool 3364
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull off valve stem oil seals using Valve Seal Removal Tool 3364.

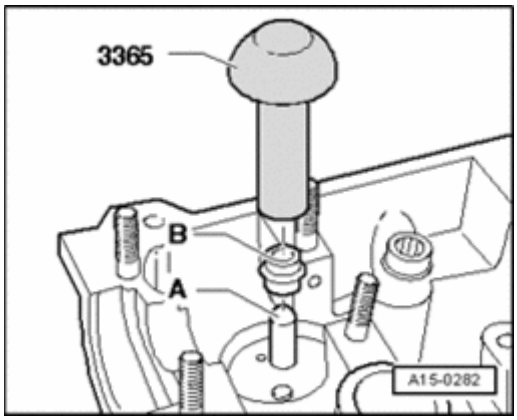

Fig. 365: Identifying Plastic Sleeve, Valve Stem Oil Seal & Valve Stem Seal Driver 3365
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE:

- **A plastic sleeve - A - is supplied with the new valve shaft seals.**

- Place plastic sleeve - **A** - on valve stem to prevent damage to new valve stem seals - **B** -.
- Lightly coat sealing lips of valve stem seal with oil.
- Push valve stem seal onto plastic sleeve.
- Carefully press valve stem oil seal onto valve guide using Valve Stem Seal Driver 3365.

- Remove plastic sleeve again.

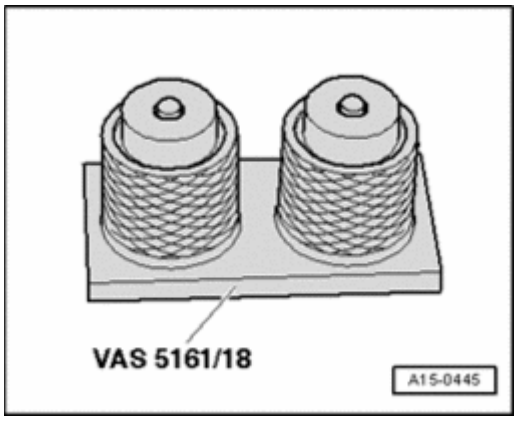

Fig. 366: Identifying Installation Cartridge VAS 5161/8
Courtesy of VOLKSWAGEN UNITED STATES, INC.

If the valve keys were removed from the installation cartridge, they must be inserted into insertion device VAS 5161/18 next.

- The large diameter of the valve keepers point upward.

- Install valve spring and valve spring plate.

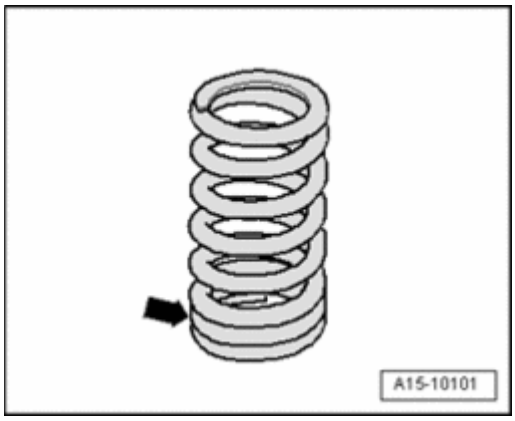

Fig. 367: Identifying Tight Spring Coils Face Toward Cylinder Head
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- The tight spring coils - **arrow** - face toward cylinder head.

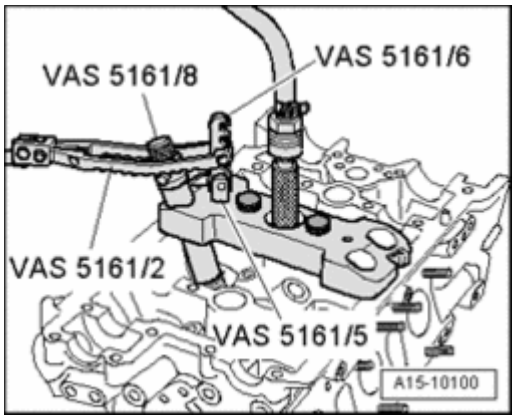

Fig. 368: Installing Engaging Device VAS 5161/6 With Installation Fork VAS 5161/5 Into Guide Plate
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install guide plate onto cylinder head again.
- Insert installation cartridge into guide plate.
- Press pressure fork down and pull the knurled bolt upward while turning it left and right to insert the valve keepers.
- Release pressure fork with the knurled bolt still pulled.

- Make sure all the roller rocker levers seat properly on the valve stem ends and are clipped onto the respective hydraulic adjusting elements.
- Install camshafts --> **Camshafts, Removing and Installing**.
- Position camshaft timing chains on camshafts --> **Camshaft Timing Chain, Removing and Installing** .
- Install left and right timing chain covers --> **Timing Chain Covers, Removing and Installing** .

- Install cylinder head cover: Left --> **Left Cylinder Head Cover, Removing and Installing** , right --> **Right Cylinder Head Cover, Removing and Installing**.
- Install engine --> **Engine, Installing**.

NOTE:

- **After installing camshafts, do not crank engine for at least 30 minutes. The hydraulic adjusting elements must seat themselves (otherwise the valves will seat themselves on the pistons).**
- **After working on the valvetrain and lifters, carefully rotate the crankshaft by hand at least 2 full revolutions before starting to be sure that valves do not strike the pistons.**

Valve Stem Seals, Cylinder Head Removed, Replacing

Valve Stem Seals, Cylinder Head Removed, Replacing

Special tools, testers and auxiliary items required

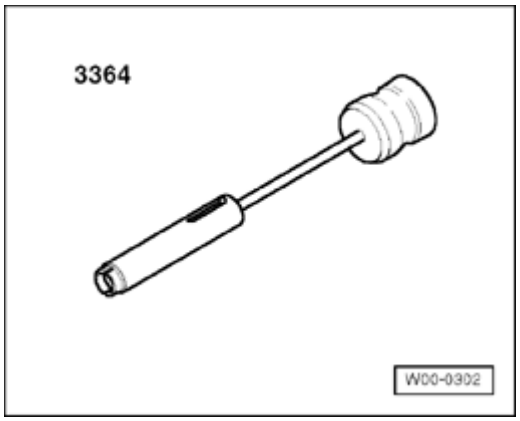

Fig. 369: Valve Seal Removal Tool 3364
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Valve seal removal tool 3364

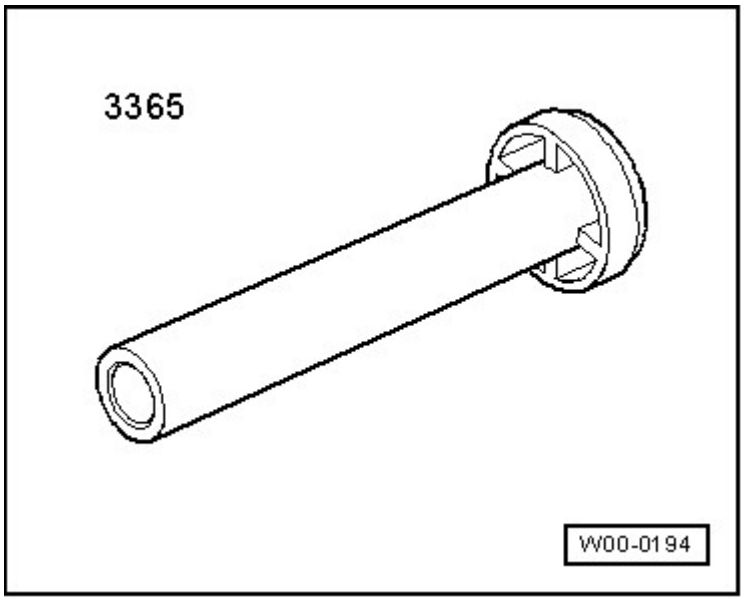

Fig. 370: Valve Stem Seal Driver 3365
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Valve stem seal driver 3365

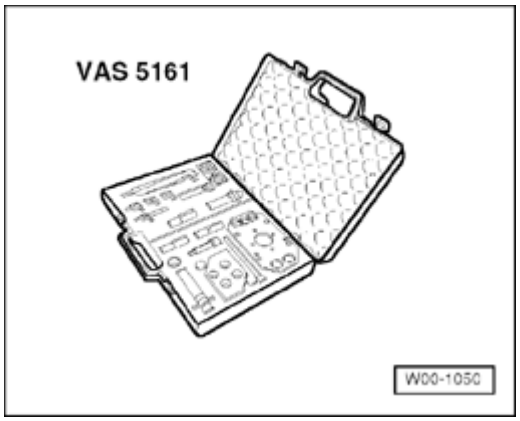

Fig. 371: Valve Cotter Disassembly/Assembly Device VAS 5161
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Valve cotter disassembly and assembly device VAS 5161

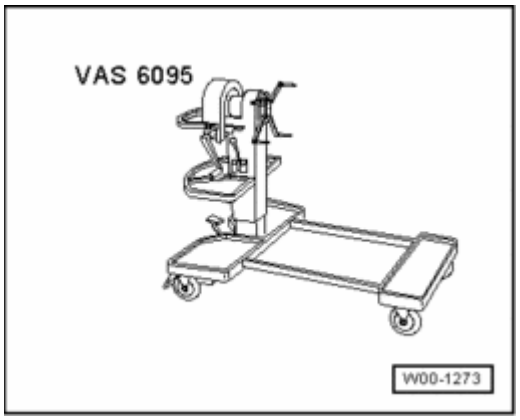

Fig. 372: Special Tool - Engine And Transmission Holder VAS 6095
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Engine and transmission holder VAS 6095
- Tensioning element VAS 6419

Procedure

- Remove camshafts --> **Camshafts, Removing and Installing**.

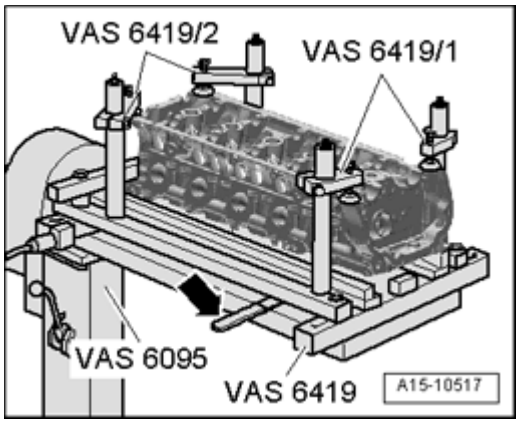

Fig. 373: Inserting Tensioning Element VAS 6419 In Engine And Transmission Holder VAS 6095
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert tensioning element VAS 6419 in the engine and transmission holder VAS 6095.
- Tension cylinder head on tensioning element VAS 6419 as shown in the illustration.
- Connect tensioning element VAS 6419 to compressed air.
- Slide air cushion with lever - **arrow** - under cylinder onto the valve stem seal that will be removed.
- Let enough compressed air flow into the air cushion until it contacts the valve plate.

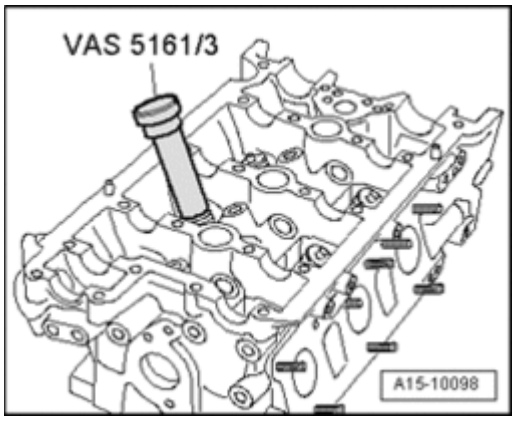

Fig. 374: Placing Drift VAS 5161/3 On Valve Spring Plate And Loosening Stuck Valve Keepers Using Plastic Hammer
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place drift VAS 5161/3 on valve spring plate and loosen stuck valve keepers using a plastic hammer.

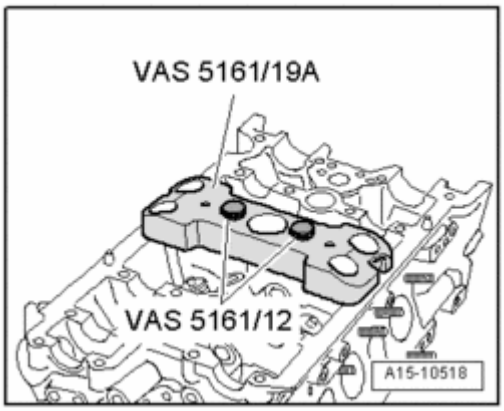

Fig. 375: Placing Guide Plate VAS 5161/19 A From Valve Cotter Disassembly/Assembly Device VAS 5161 On Cylinder Head
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place guide plate VAS 5161/19 A from valve cotter disassembly and assembly device VAS 5161 on cylinder head.
- Secure guide plate with knurled screws VAS 5161/12.

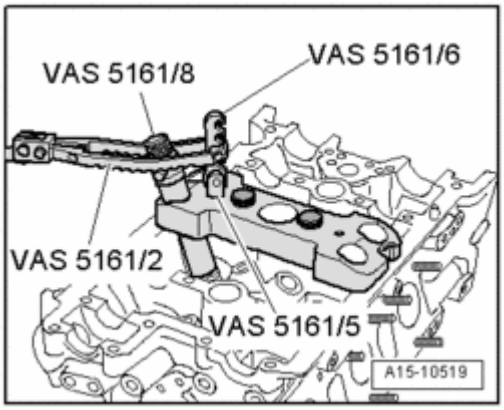

Fig. 376: Installing Engaging Device VAS 5161/6 With Installation Fork VAS 5161/5 Into Guide Plate
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install engaging device VAS 5161/6 with installation fork VAS 5161/5 into guide plate.
- Push installation cartridge VAS 5161/8 into guide plate.
- Hook in pressure fork VAS 5161/2 at engaging device and press down installation cartridge.
- At the same time, turn knurled bolt of installation cartridge to the right, until the points engage in the valve keepers.

- Lightly move knurled bolt back and forth, causing the valve keepers to be pressed apart and captured in the installation cartridge.
- Release pressure fork.
- Take out installation cartridge.
- Unfasten guide plate and turn it aside.

- Remove valve spring with valve spring plate.

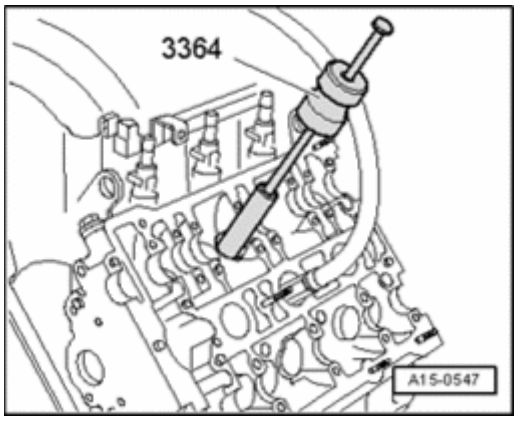

Fig. 377: Pulling Off Valve Stem Oil Seals Using Valve Seal Removal Tool 3364
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull off valve stem oil seals using Valve Seal Removal Tool 3364.

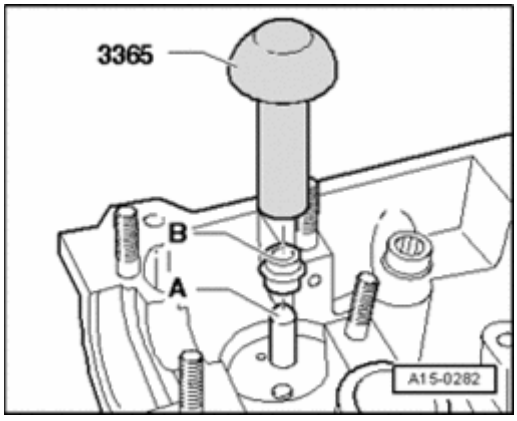

Fig. 378: Identifying Plastic Sleeve, Valve Stem Oil Seal & Valve Stem Seal Driver 3365
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE:

- **A plastic sleeve - A - is supplied with the new valve shaft seals.**

- Place plastic sleeve - **A** - on valve stem to prevent damage to new valve stem seals - **B** -.
- Lightly coat sealing lips of valve stem seal with oil.
- Push valve stem seal onto plastic sleeve.
- Carefully press valve stem oil seal onto valve guide using Valve Stem Seal Driver 3365.

- Remove plastic sleeve again.

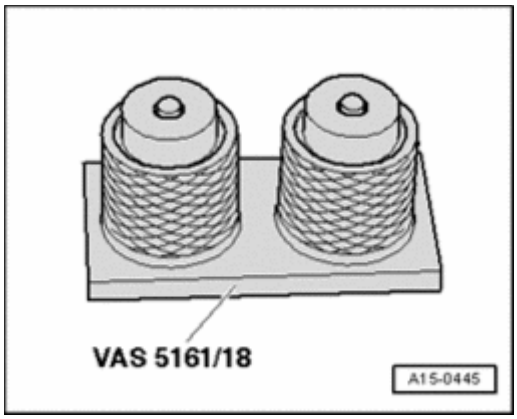

Fig. 379: Identifying Installation Cartridge VAS 5161/8
Courtesy of VOLKSWAGEN UNITED STATES, INC.

If the valve keys were removed from the installation cartridge, they must be inserted into insertion device VAS 5161/18 next.

- The large diameter of the valve keepers point upward.

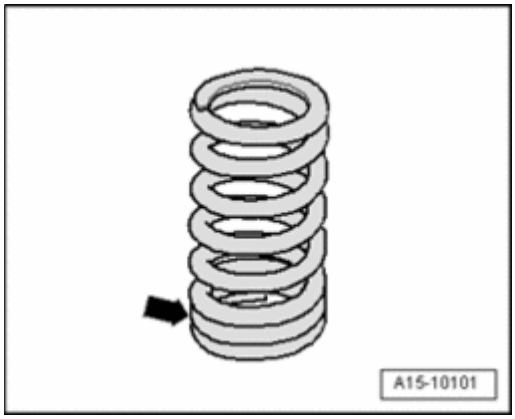

Fig. 380: Identifying Tight Spring Coils Face Toward Cylinder Head
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install valve spring and valve spring plate.
- The tight spring coils - **arrow** - face toward cylinder head.

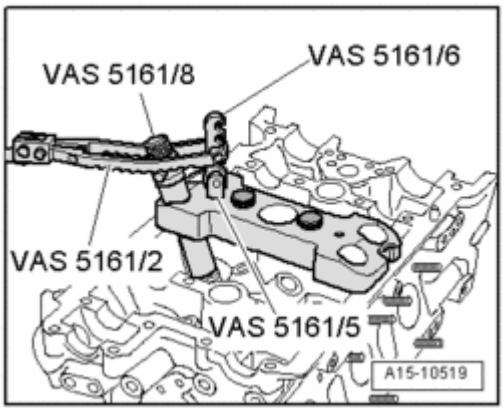

Fig. 381: Installing Engaging Device VAS 5161/6 With Installation Fork VAS 5161/5 Into Guide Plate
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install guide plate onto cylinder head again.
- Insert installation cartridge into guide plate.
- Press pressure fork down and pull the knurled bolt upward while turning it left and right to insert the valve keepers.
- Release pressure fork with the knurled bolt still pulled.

- Make sure all the roller rocker levers seat properly on the valve stem ends and are clipped onto the respective hydraulic adjusting elements.
- Install camshafts --> **Camshafts, Removing and Installing**.

Hydraulic Adjusting Elements, Checking

Hydraulic Adjusting Elements, Checking

Special tools, testers and auxiliary items required

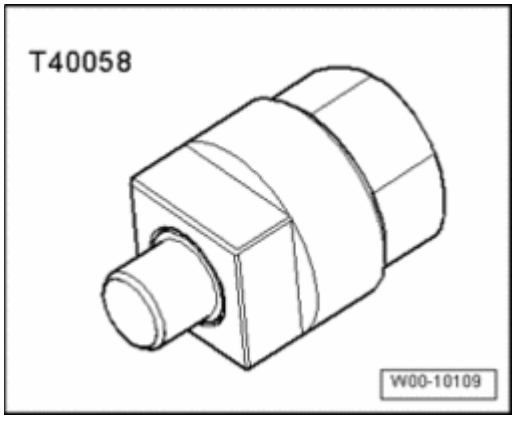

Fig. 382: Adapter T40058
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Adapter T40058

- Feeler gauge

NOTE:

- **The hydraulic adjusting elements cannot be repaired.**
- **Irregular valve noises are normal while starting the engine.**

Procedure

- Start the engine and let it run until the radiator fan has switched on once.
- Increase engine speed for about 2 minutes to approximately 2500 RPM, perform road test if necessary.

NOTE:

- **If irregular valve noises disappear but reappear during short drives, replace the oil check valve --> Oil Check Valve and Spray Nozzle Valve, Removing and Installing.**

If the hydraulic adjusting elements are still loud, determine which element is faulty:

- Bring lock carrier into service position --> **50 - BODY - FRONT** .
- Remove cylinder head cover: Left --> **Left Cylinder Head Cover, Removing and Installing** , right --> **Right Cylinder Head Cover, Removing and Installing**.

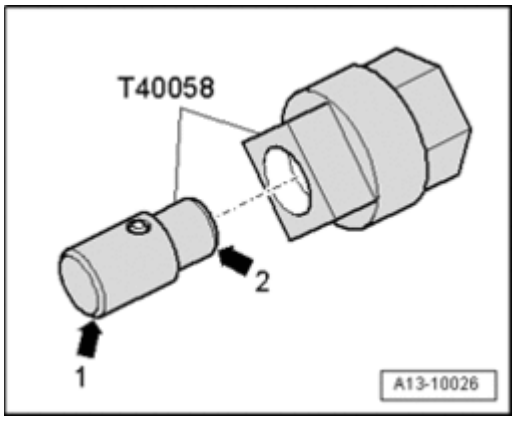

Fig. 383: Inserting Guide Pin Of Adapter T40058 So Small Diameter Points To Engine
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert Socket T40058 adapter so that small diameter - **arrow 2** - points to engine. Large diameter - **arrow 1** - points to socket.

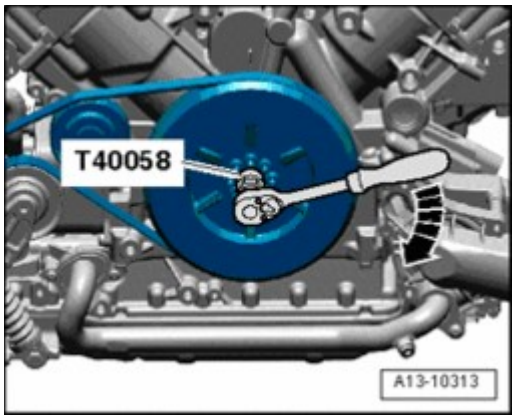

Fig. 384: Using Socket T40058 To Rotate Crankshaft To TDC
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Rotate crankshaft in direction of engine rotation - **arrow** - using adapter T40058 until the camshafts on the hydraulic adjuster that needs to be checked face upward.

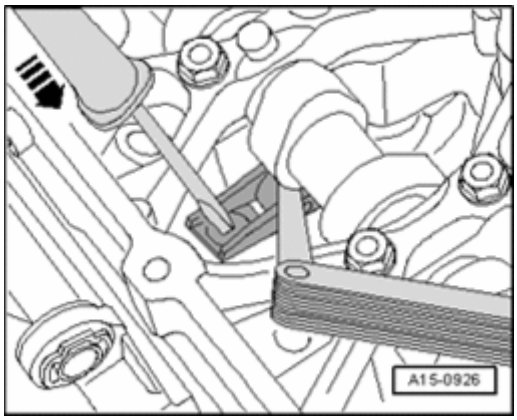

Fig. 385: Checking Play Between Cam Lobes And Roller Rocker Lever
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Determine play between the camshaft and roller rocker lever by pressing the lever down using a screwdriver - **arrow** -.

If a 0.20 mm feeler gauge can be inserted between camshaft and roller rocker lever:

- Replace hydraulic adjusting element --> **Camshafts, Removing and Installing**.

Final procedures

- Install cylinder head cover: Left --> **Left Cylinder Head Cover, Removing and Installing** , right --> **Right Cylinder Head Cover, Removing and Installing**.
- Install lock carrier with attachments --> **50 - BODY - FRONT** .

Valve Dimensions

Valve Dimensions

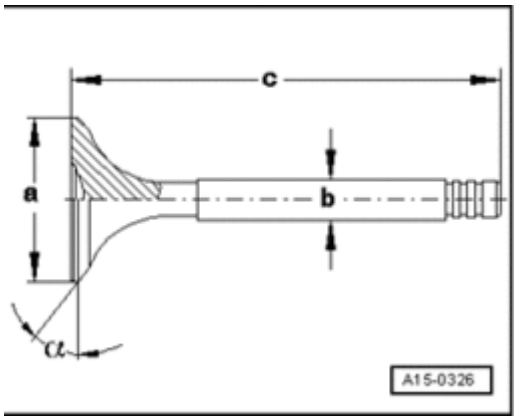

Fig. 386: Valve Dimensions
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE:

- **Intake and exhaust valves must not be refaced by grinding. Only lapping is permitted.**

Dimension		Intake valve	Exhaust valve
Diameter a	mm	33.85 ± 0.10	28.0 ± 0.1
Diameter b	mm	5.980 ± 0.007	5.965 ± 0.007
c	mm	103.97 ± 0.20	101.87 ± 0.20
a	Angle°	45	45

CAUTION:

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

Valve Guides, Checking

Valve Guides, Checking

Special tools, testers and auxiliary items required

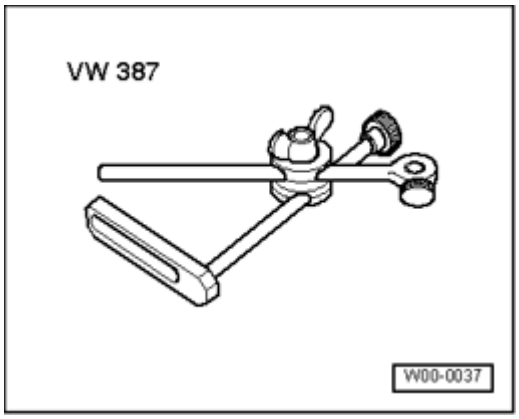

Fig. 387: Dial Gauge Holder VW 387
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Dial gauge holder VW 387

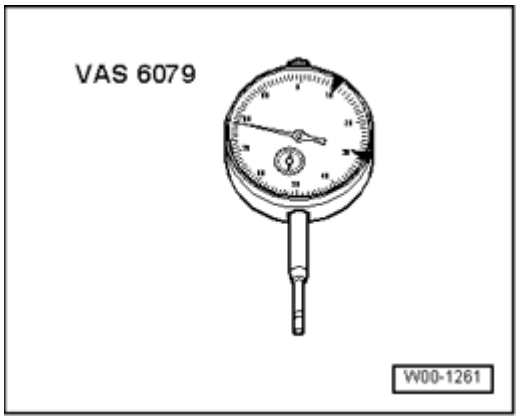

Fig. 388: Dial Gauge VAS 6079
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Dial gauge VAS 6079

Test sequence

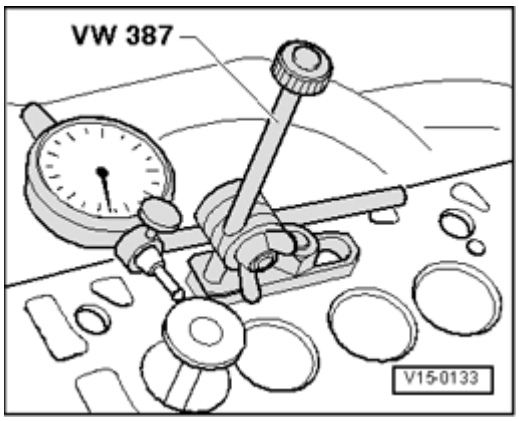

Fig. 389: Identifying Special Tool - VW 387 Installed

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert valve into valve guide. Due to the slight difference in stem dimensions, ensure that only an intake valve is used in the intake guide and an exhaust valve in the exhaust guide.
- Valve stem tip must seal with valve guide.
- Determine tilt clearance.
- Wear limit: 0.8 mm.

NOTE:

- **If the valve is to be replaced as part of a repair, use a new valve for the calculation.**
- **If wear limit is exceeded, re-measure using new valves. If wear limit is still exceeded, replace cylinder head.**

Valves, Checking

Valves, Checking

- Perform a visual check for signs of wear at stem and at seating surface.

If significant wear is discovered:

- Replace respective valve.

17 - ENGINE - LUBRICATION

LUBRICATION SYSTEM COMPONENTS, REMOVING AND INSTALLING

Lubrication System Components, Removing and Installing

--> **Oil Pump, Oil Pan Lower Section, Component Overview**

--> **Oil Pan Lower Section, Removing and Installing**

--> **Oil Pump, Removing and Installing**

--> **Oil Pan Upper Section, Component Overview**

--> **Oil Pan Upper Section, Removing and Installing**

--> **Oil Check Valve and Spray Nozzle Valve, Component Overview**

--> **Oil Check Valve and Spray Nozzle Valve, Removing and Installing**

--> **Crankcase Ventilation Hose, Removing and Installing**

--> **Oil Filter Housing, Component Overview**

--> **Oil Filter Housing, Removing and Installing**

--> **Oil Cooler, Removing and Installing**

--> **Oil Pressure Switch, Removing and Installing**

--> **Oil Pressure and Oil Pressure Switch, Checking**

--> **Engine Oil Specifications**

--> **Oil Level, Checking**

NOTE:

- **If large quantities of metal shavings or abraded material are found in the engine oil while servicing the engine, the oil passages, lines and hoses must be carefully cleaned to prevent resulting damage and the oil cooler must be replaced.**
- **Oil level must not exceed max. marking danger of catalytic converter damage!**
- **The oil level must not exceed the max. marking or the catalytic converter could be damaged.**
- **Oil quantities, oil specifications and viscosity classes --> Fluid Capacity Chart located in ServiceNet.**

Oil Pump, Oil Pan Lower Section, Component Overview

Oil Pump, Oil Pan Lower Section, Component Overview

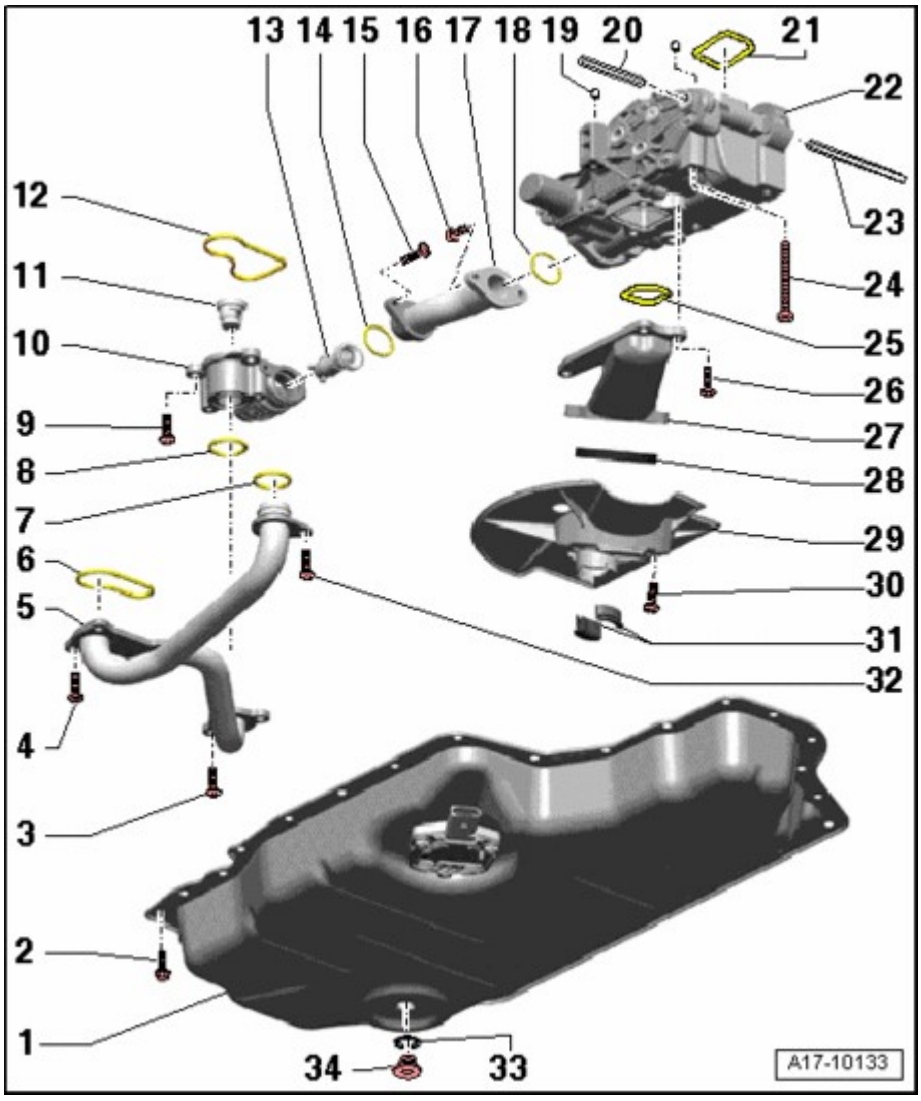

Fig. 390: Oil Pump, Oil Pan Lower Section, Component Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Oil pan (lower section)

- Removing and installing --> **Oil Pan Lower Section, Removing and Installing**
- With Oil Level Thermal Sensor G266
- Oil Level Thermal Sensor G266 , removing and installing --> **Oil Level Thermal Sensor, Removing and Installing**

2 - 9 Nm

- Tighten diagonally in 2 stages --> *Tighten bolts for lower part of oil pan in 2 stages as follows.* under **Oil Pan Lower Section, Removing and Installing**

3 - 9 Nm

4 - 9 Nm

5 - Oil pipe

6 - Gasket

- Replace

7 - O-ring

- Replace

8 - O-ring

- Replace

9 - 9 Nm

10 - Housing

- For oil cooler by-pass valve

11 - Oil cooler by-pass valve

12 - Gasket

- Replace

13 - Oil check valve

14 - O-ring

- Replace

15 - 9 Nm

16 - 9 Nm

17 - Oil pipe

18 - O-ring

- Replace

19 - Alignment bushing

- 2 pieces

20 - Drive shaft for coolant pump

21 - Gasket

- Replace

22 - Oil pump

- Do not disassemble
- With relief valve approx. 5.5 bar
- Removing and installing --> **Oil Pump, Removing and Installing**

23 - Drive shaft for oil pump

24 - 8 Nm plus an additional 90 ($^{1}/_{4}$ turn)

- Replace

25 - Gasket

- Replace

26 - 9 Nm

27 - Intake tube

- For oil pump

28 - Oil strainer

- Clean

29 - Oil baffle

30 - 5 Nm plus an additional 45 ($^{1}/_{8}$ turn)

- Replace

31 - Rubber buffer

32 - 9 Nm

33 - Seal

- Replace

34 - Oil drain plug, 25 Nm

Oil Level Thermal Sensor, Removing and Installing

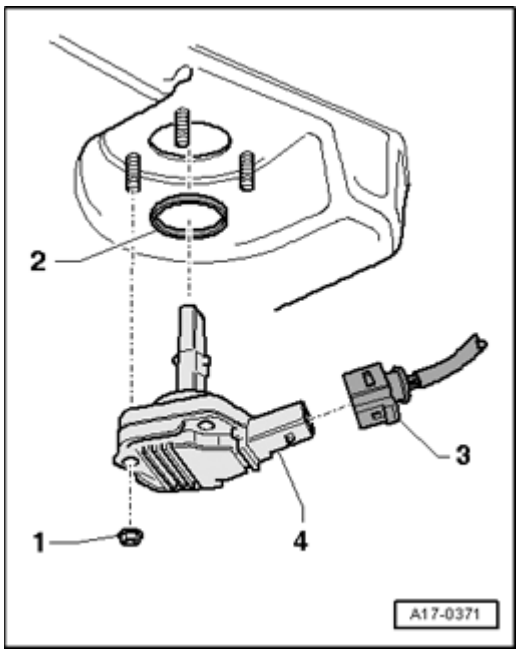

Fig. 391: Oil Level Thermal Sensor, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1. Nut, 9 Nm
2. Sealing ring; replace
3. Electrical harness connector
4. Oil Level Thermal Sensor G266

Oil Pan Lower Section, Removing and Installing

Oil Pan Lower Section, Removing and Installing

Special tools, testers and auxiliary items required

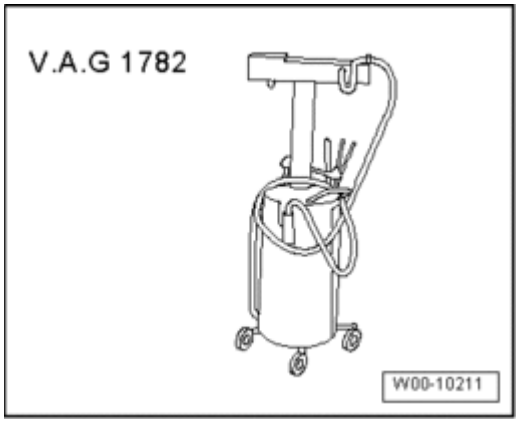

Fig. 392: Identifying Old Oil Collecting And Extracting Device V.A.G 1782
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Old oil collecting and extracting device V.A.G 1782
- Hand drill with plastic brush attachment
- Protective glasses
- Sealant

Removing

- Remove stabilizer bar --> **40 - FRONT SUSPENSION** .

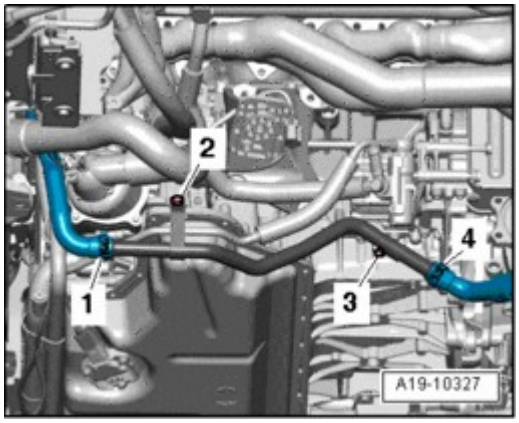

Fig. 393: Removing Nut And Bolt On Lower Left Coolant Pipe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove nut - **2** - and bolt - **3** - on lower left coolant pipe.

NOTE:

- **Ignore - 1 - and - 4 -.**

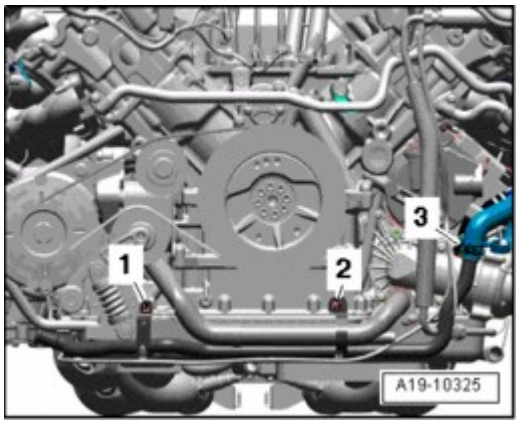

Fig. 394: Removing Bolts On Front Lower Coolant Pipe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **1** - and - **2** - on front lower coolant pipe.

NOTE:

- **Ignore - 3 -.**

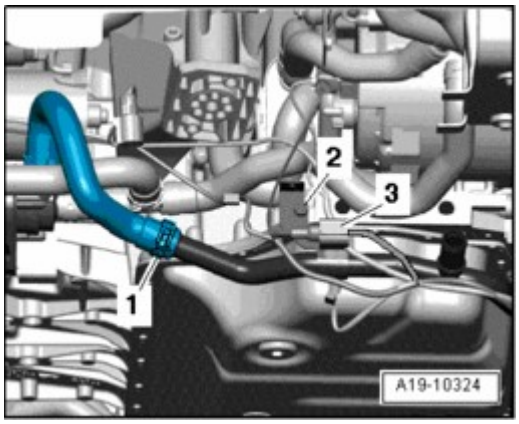

Fig. 395: Removing Bolt On Front Lower Coolant Pipe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolt - **2** - on front lower coolant pipe.

NOTE:

- **Ignore - 1 - and - 3 -.**

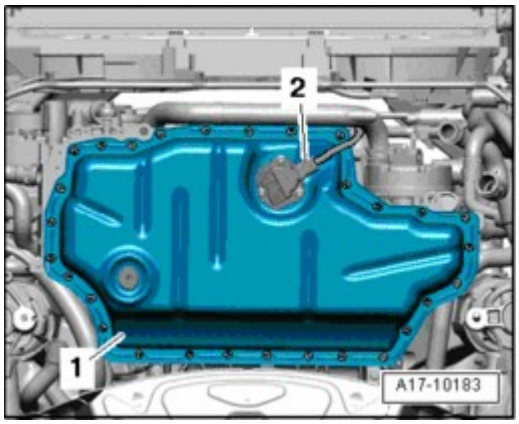

Fig. 396: Identifying Oil Level Thermal Sensor G266 Electrical Connector & Oil Pan (Lower Part)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connector - **2** - at Oil Level Thermal Sensor G266.
- Place old oil collecting and extracting device V.A.G 1782 under engine and drain engine oil.
- Remove oil pan (lower part) - **1** - and pry out carefully.

NOTE:

- **There is still a residual amount of oil in lower section of oil pan.**

Installing

NOTE:

- **Replace seals.**

CAUTION: Wear safety glasses.

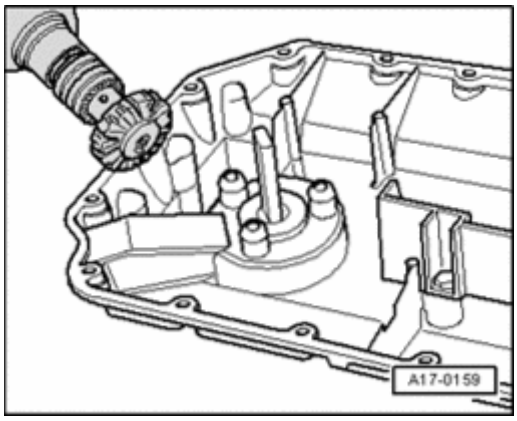

Fig. 397: Using Rotating Plastic Brush To Remove Any Remaining Sealant From Oil Pan (Lower Part) And At Upper Part
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove sealant residue lower part and upper part of oil pan, e.g. with rotating plastic brush.
- Clean sealing surfaces, they must be free of oil and grease.

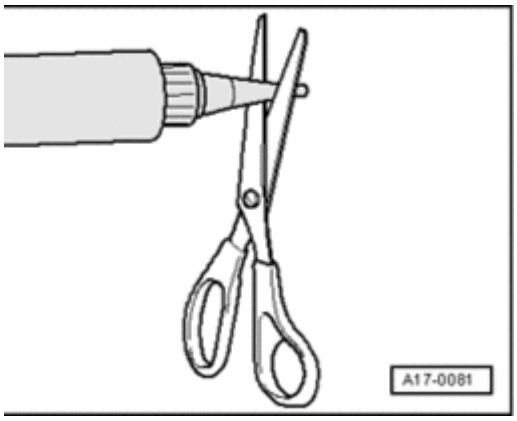

Fig. 398: Cutting Tube Nozzle At Front Marking
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Cut off nozzle on tube of sealant at front mark (dia. of nozzle approximately 2 mm).

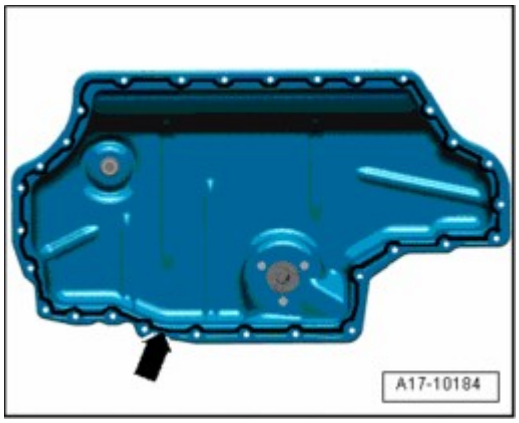

Fig. 399: Applying Sealant Bead On Clean Sealing Surface Of Lower Part Of Oil Pan
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Apply sealant bead - **arrow** - on clean sealing surface of lower part of oil pan as shown in illustration.
- Thickness of sealant bead: 2.5 mm.

NOTE:

- **Sealant bead must not be thicker than specified, otherwise excess sealant may get into lower section of oil pan and clog strainer in intake tube.**
- **The oil pan (lower part) must be installed within 5 minutes after application of sealant.**

- Position lower part of oil pan and hand tighten all bolts.
- Tighten bolts for lower part of oil pan in 2 stages as follows.
- Pre-tighten all bolts in a diagonal sequence to 5 Nm.
- Tighten all bolts in a diagonal sequence to 9 Nm.

The rest of installation is in reverse order of removal, note the following:

- Install stabilizer bar --> **40 - FRONT SUSPENSION** .
- Add engine oil and check oil level --> **Oil Level, Checking**.

Tightening Specifications

Component	Nm
Lower part of oil pan to upper part of oil pan	9
Oil drain plug	25
Front lower coolant pipe to upper part of oil pan	9
Lower left coolant pipe to upper part of oil pan	9

Oil Pump, Removing and Installing

Oil Pump, Removing and Installing

Special tools, testers and auxiliary items required

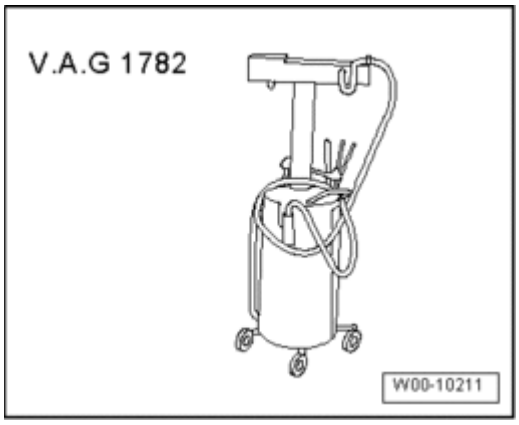

Fig. 400: Identifying Old Oil Collecting And Extracting Device V.A.G 1782
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Old oil collecting and extracting device V.A.G 1782

Removing

- Remove coolant pump --> **Coolant Pump, Removing and Installing**.

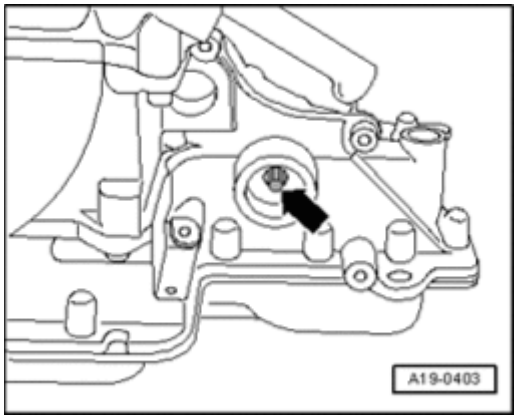

Fig. 401: Removing/Installing Drive Shaft For Coolant Pump From Oil Pump
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove drive shaft - **arrow** - for coolant pump from oil pump.
- Remove lower section of oil pan --> **Oil Pan Lower Section, Removing and Installing**.

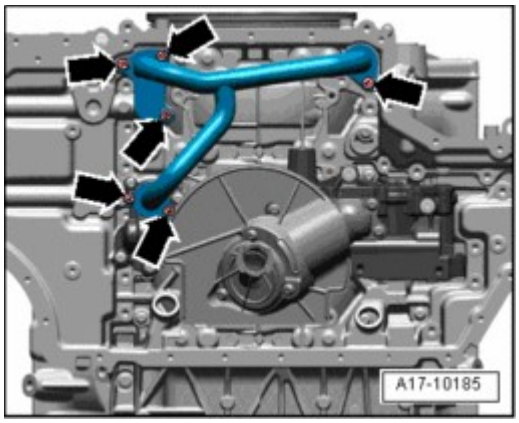

Fig. 402: Placing Old Oil Collecting, Extracting Device V.A.G 1782 Under Engine, Bolts & Oil Pipe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place old oil collecting and extracting device V.A.G 1782 under engine.
- Remove bolts - **arrows** - and remove oil pipe.

NOTE:

- **Oil escapes when removing oil pipes.**

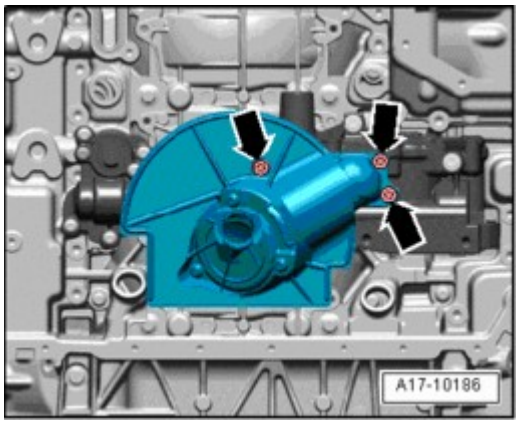

Fig. 403: Removing Bolts And Intake Tube With Oil Baffle
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** - and remove intake tube with oil baffle.

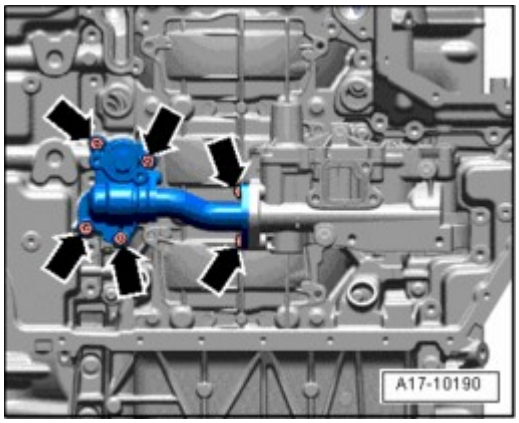

Fig. 404: Removing Bolts And Oil Pipe Together With Oil Cooler By-Pass Valve Housing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** - and remove oil pipe together with oil cooler by-pass valve housing.

NOTE:

- **Oil escapes when removing oil pipes.**

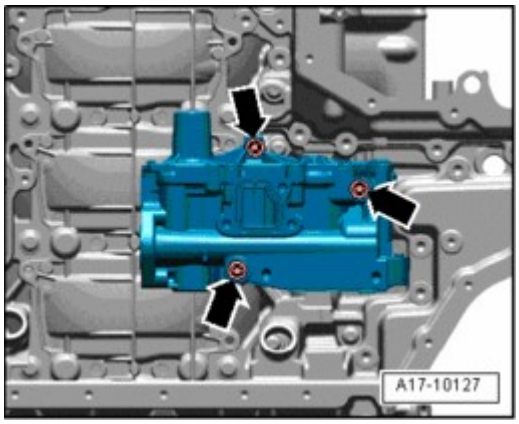

Fig. 405: Removing Oil Pump Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** - and hold oil pump securely with hand.

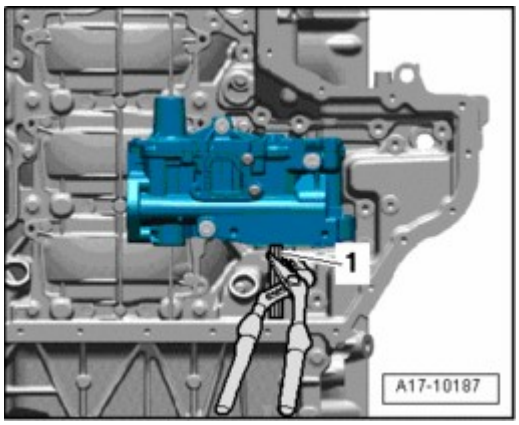

Fig. 406: Pulling Oil Pump Input Shaft Back Against Spring Force With Water Pump Pliers
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull oil pump input shaft - **1** - back against spring force with water pump pliers and remove oil pump.

Installing

NOTE:

- **Always replace bolts that are tightened to torque as well as sealing rings and O-rings.**

- Check whether 2 alignment bushings are present in cylinder block, install if necessary.
- Press oil pump input shaft - **1** - back with water pump pliers and place oil pump on cylinder block.
- Open water pump pliers and let input shaft - **1** - glide into oil pump.

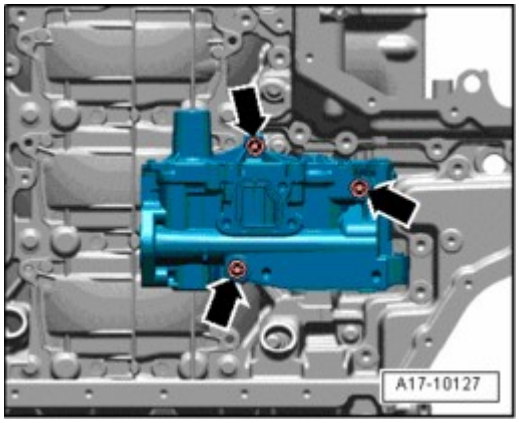

Fig. 407: Removing Oil Pump Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tighten oil pump bolts - **arrows** -.

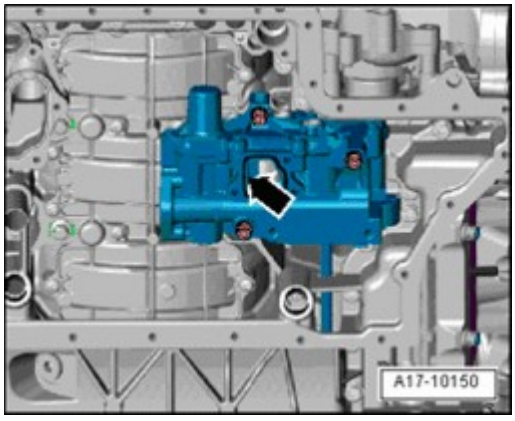

Fig. 408: Checking Whether Drive Shaft Is Friction Locked To Oil Pump
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Check whether drive shaft is friction locked to oil pump. To do so, reach into intake opening - **arrow** - of

oil pump and try to rotate oil pump gears.

- Toothed gears must not be able to be rotated.

The rest of installation is in reverse order of removal, note the following:

- Install lower section of oil pan --> **Oil Pan Lower Section, Removing and Installing** .
- Install coolant pump --> **Coolant Pump, Removing and Installing**.
- Add engine oil and check oil level --> **Oil Level, Checking**.
- Fill with coolant --> **Cooling System, Draining and Filling** .

Tightening Specifications

Component	Nm
Oil pump to cylinder block	8 + 90° 1)2)
Housing for intake tube to oil pump	9
Oil pipes to upper section of oil pan and oil pump	9
1) Replace bolts. 2) 90° corresponds to a quarter turn.	

Oil Pan Upper Section, Component Overview

Oil Pan Upper Section, Component Overview

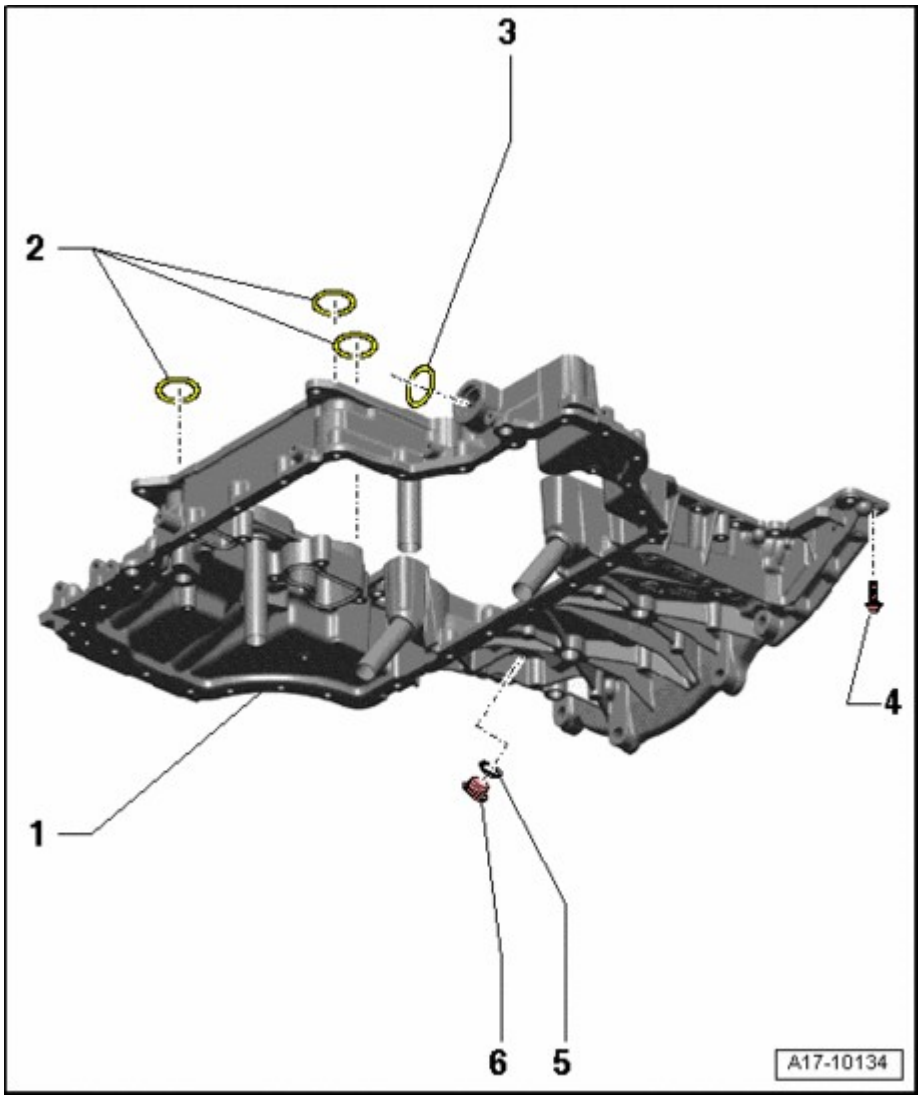

Fig. 409: Oil Pan Upper Section, Component Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Oil pan (upper section)

- Removing and installing --> **Oil Pan Upper Section, Removing and Installing**

2 - Seals

- Replace

3 - O-ring

- Replace

4 - 14 Nm

5 - Seal

- Replace

6 - Locking bolt, 35 Nm

Oil Pan Upper Section, Removing and Installing

Oil Pan Upper Section, Removing and Installing

Special tools, testers and auxiliary items required

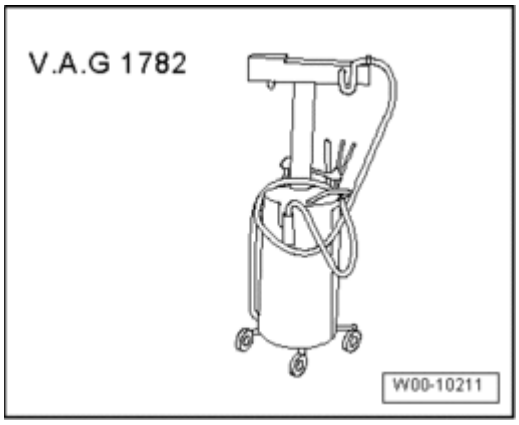

Fig. 410: Identifying Old Oil Collecting And Extracting Device V.A.G 1782
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Old oil collecting and extracting device V.A.G 1782
- Protective glasses
- Hand drill with plastic brush attachment
- Sealant

Removing

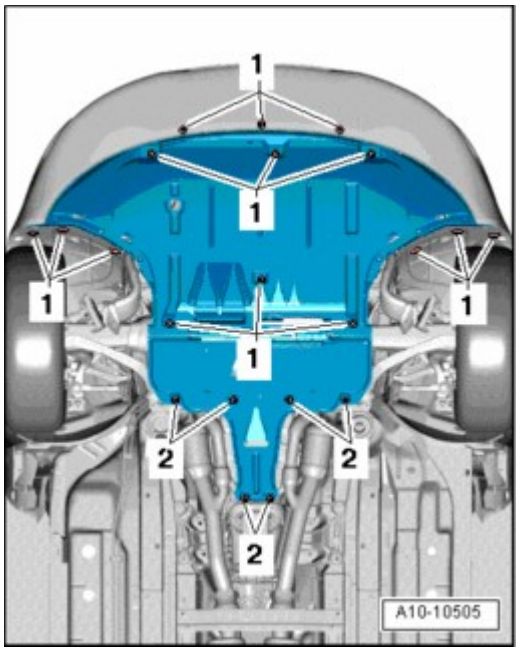

Fig. 411: Identifying Noise Insulation Quick-Release Fasteners
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen quick-release fasteners - **1** - and - **2** - and remove noise insulation.
- Place old oil collecting and extracting device V.A.G 1782 under engine and drain engine oil.
- Remove engine --> **Engine, Removing**.
- Separate engine and transmission --> **Engine and Transmission, Separating**.

- Secure engine to assembly stand --> **Engine, Securing to Assembly Stand**.
- Remove drive plate --> **Drive Plate, Removing and Installing**.
- Remove left and right timing chain covers --> **Timing Chain Covers, Removing and Installing**.
- Remove intake manifold --> **24 - MULTIPORT FUEL INJECTION (MFI)** .

- Remove oil filter housing --> **Oil Filter Housing, Removing and Installing**.
- Remove lower timing chain cover --> **Lower Timing Chain Cover, Removing and Installing**.
- Remove generator --> **27 - STARTER, GENERATOR, CRUISE CONTROL** .
- Remove front coolant pipe --> **Front Coolant Line, Removing and Installing**.

- Remove coolant pump --> **Coolant Pump, Removing and Installing**.

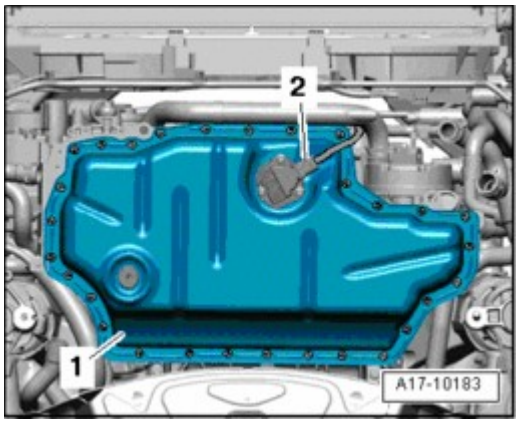

Fig. 412: Identifying Oil Level Thermal Sensor G266 Electrical Connector & Oil Pan (Lower Part)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connector - **2** - at Oil Level Thermal Sensor G266.
- Remove oil pan (lower part) - **1** - and pry out carefully.

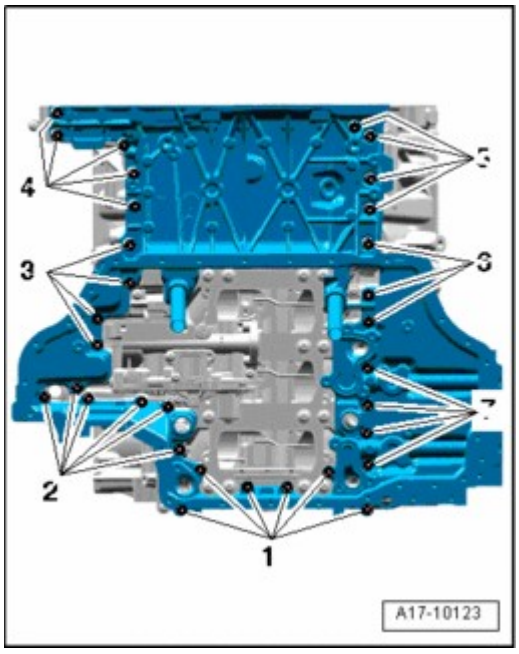

Fig. 413: Removing/Installing Oil Pump & Bolts For Upper Section Of Oil Pan
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove oil pump --> **Oil Pump, Removing and Installing**.
- Remove bolts - **1 to 7** - for upper section of oil pan.
- Press upper part of oil pan from alignment pins of cylinder block.

Installing

NOTE:

- **Replace seals and O-rings.**

CAUTION: Wear safety glasses.

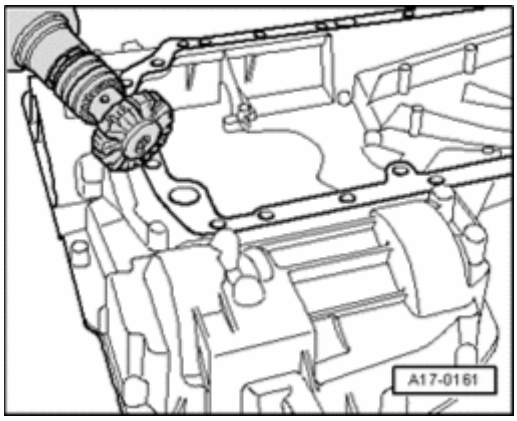

Fig. 414: Using Rotating Plastic Brush To Remove Remaining Sealant From Oil Pan (Upper Part) And At Cylinder Block
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Using rotating plastic brush, remove any remaining sealant from oil pan (upper part) and at cylinder block.
- Clean sealing surfaces, they must be free of oil and grease.

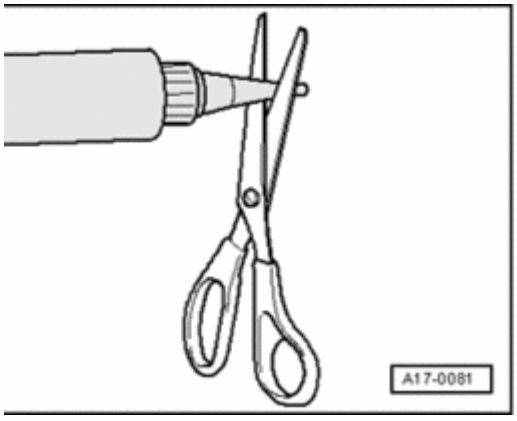

Fig. 415: Cutting Tube Nozzle At Front Marking
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Cut off nozzle on tube of sealant at the front mark (dia. of nozzle approx. 2 mm).

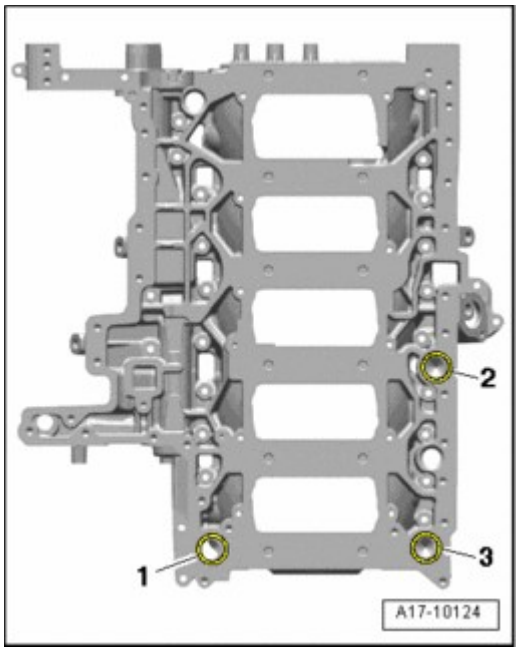

Fig. 416: Inserting New Seals Into Grooves On Cylinder Block
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert new seals - **1, 2 and 3** - into grooves on cylinder block.

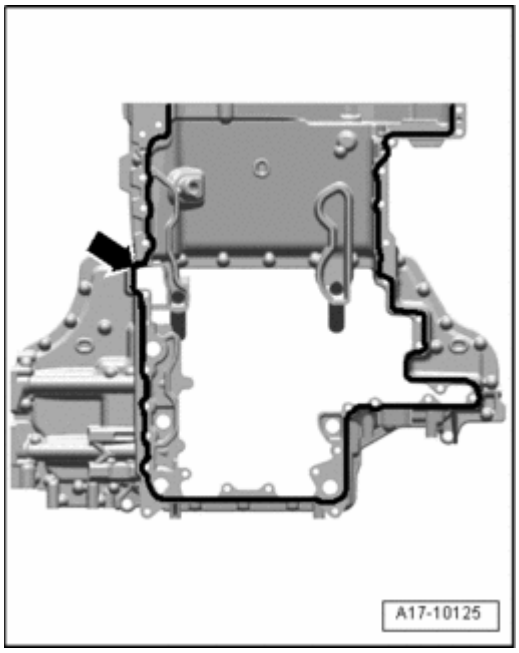

Fig. 417: Applying Sealant Bead On Clean Sealing Surface Of Upper Section Of Oil Pan
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Apply sealant bead - **arrow** - on clean sealing surface of upper section of oil pan as shown in illustration.

- Thickness of sealant beads: 2.5 mm.

NOTE:

- **Sealant bead must not be thicker than specified, otherwise sealant could get into oil pan and clog the strainer on intake tube.**
- **The oil pan (upper part) must be installed within 5 minutes after application of sealant.**

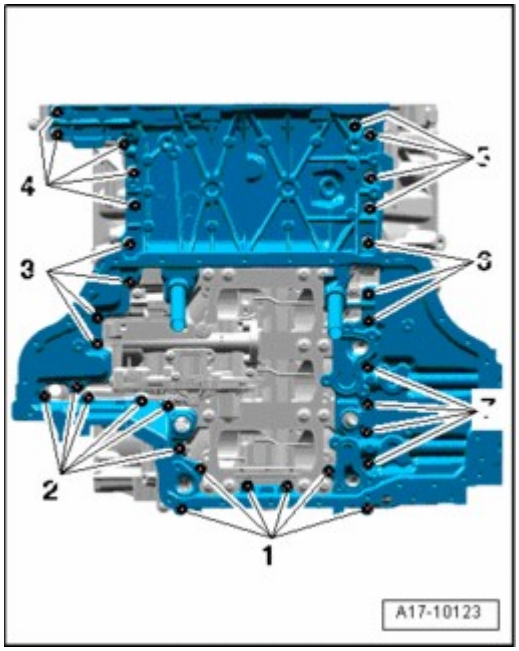

Fig. 418: Removing/Installing Oil Pump & Bolts For Upper Section Of Oil Pan
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position lower part of oil pan and hand tighten all bolts.
- Tighten bolts - **1 to 7** - in 2 stages as follows.
- Pre-tighten all bolts in a diagonal sequence to 5 Nm.
- Tighten bolts in a diagonal sequence to 14 Nm.

The rest of installation is in reverse order of removal, note the following:

- Install oil pump --> **Oil Pump, Removing and Installing**.
- Install lower section of oil pan --> **Oil Pan Lower Section, Removing and Installing** .
- Install coolant pump --> **Coolant Pump, Removing and Installing**.
- Install front coolant pipe --> **Front Coolant Line, Removing and Installing**.

- Install generator --> **27 - STARTER, GENERATOR, CRUISE CONTROL** .
- Install lower timing chain cover --> **Lower Timing Chain Cover, Removing and Installing**.
- Install crankshaft seal, timing chain side --> **Crankshaft Seal, Timing Chain Side, Replacing**.
- Install oil filter housing --> **Oil Filter Housing, Removing and Installing**.

- Install intake manifold --> **24 - MULTIPORT FUEL INJECTION (MFI)** .

- Install left and right timing chain covers --> **Timing Chain Covers, Removing and Installing** .
- Install drive plate --> **Drive Plate, Removing and Installing**.
- Install engine --> **Engine, Installing**.

- Add engine oil and check oil level --> **Oil Level, Checking**.

Tightening specifications

Component	Nm
Upper part of oil pan to cylinder block	14

Oil Check Valve and Spray Nozzle Valve, Component Overview

Oil Check Valve and Spray Nozzle Valve, Component Overview

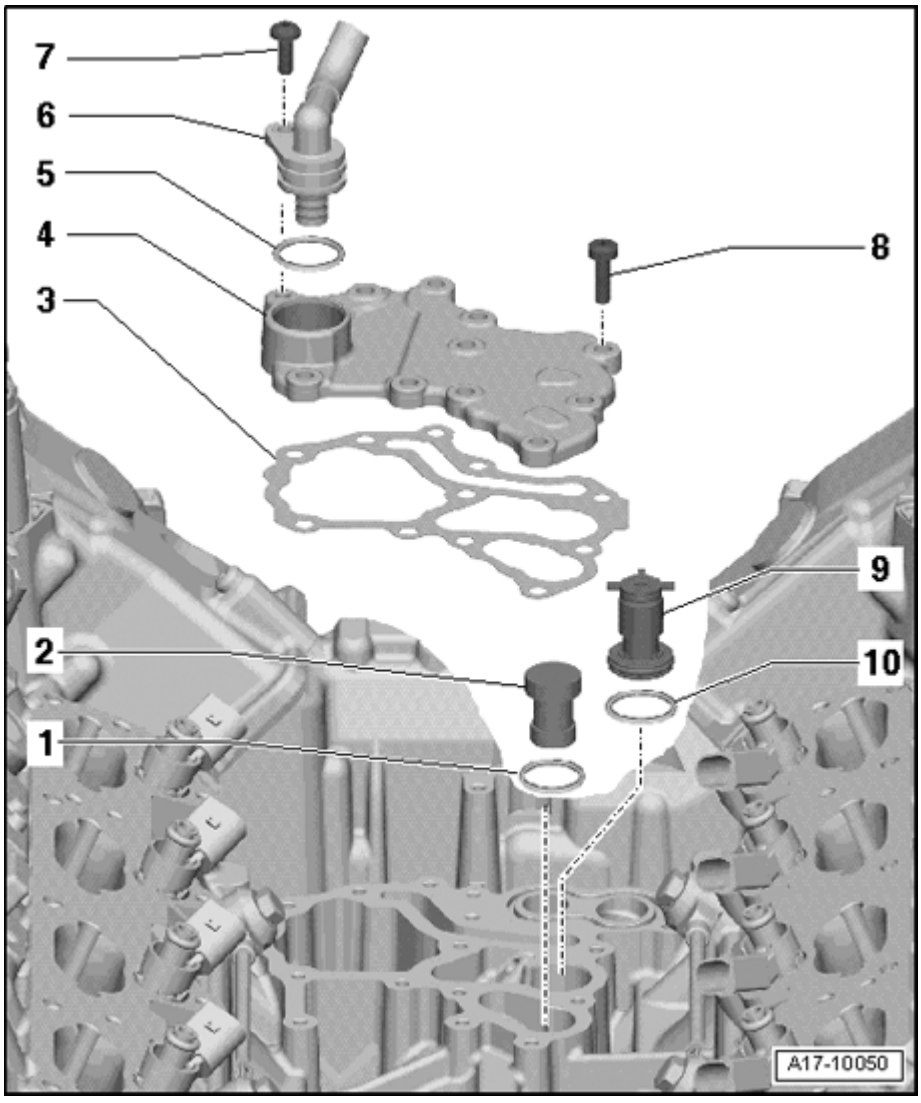

Fig. 419: Oil Check Valve And Spray Nozzle Valve, Component Overview

Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - O-ring

- Replace

2 - Spray nozzle valve

- Removing and installing --> **Oil Check Valve and Spray Nozzle Valve, Removing and Installing**

3 - Gasket

- Replace

4 - Cover

5 - O-ring

- Replace

6 - Hose

- For crankcase ventilation

7 - 9 Nm

8 - 9 Nm

9 - Oil check valve

- Removing and installing --> **Oil Check Valve and Spray Nozzle Valve, Removing and Installing**

10 - O-ring

- Replace

Oil Check Valve and Spray Nozzle Valve, Removing and Installing

Oil Check Valve and Spray Nozzle Valve, Removing and Installing

NOTE:

- **If irregular valve noise occurs repeatedly during short journeys and disappears after extended driving, the oil check valve must be replaced.**

Removing

- Remove intake manifold --> **24 - MULTIPORT FUEL INJECTION (MFI)** .

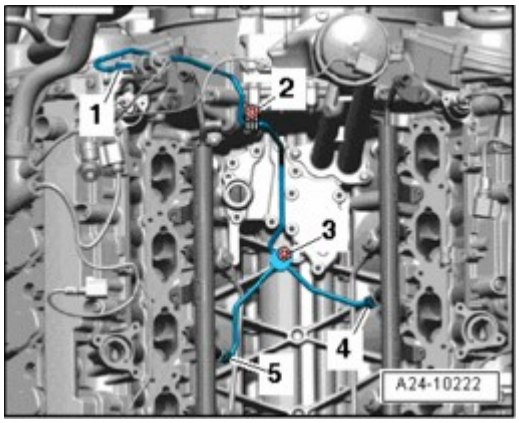

Fig. 420: Removing Bolts, High Pressure Line, Connections & Fuel Rail
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **2** - and - **3** -.
- Remove high pressure line - **1** - from fuel rail.
- Remove high pressure line from connections - **4** - and - **5** - on fuel rail. To do this, counterhold at hex head with and open-end wrench and loosen union nut.
- Remove high pressure lines.

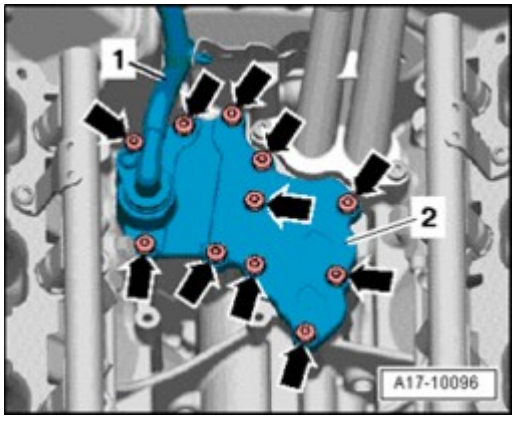

Fig. 421: Removing Bolts & Cover With Crankcase Ventilation Hose
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** -.
- Remove cover - **2** - with crankcase ventilation hose - **1** -.

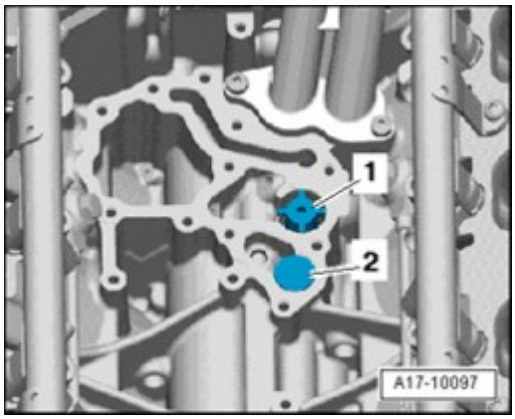

Fig. 422: Removing Oil Check Valve And Spray Nozzle Valve
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove oil check valve - **1** - and spray nozzle valve - **2** -.

Installing

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

NOTE:

- **Replace gaskets and O-rings.**

- Install high pressure lines --> **24 - MULTIPORT FUEL INJECTION (MFI)** .
- Install intake manifold --> **24 - MULTIPORT FUEL INJECTION (MFI)** .

Tightening specifications

Component	Nm
Cover to cylinder block	9

Crankcase Ventilation Hose, Removing and Installing

Crankcase Ventilation Hose, Removing and Installing

Removing

- Remove intake manifold --> **24 - MULTIPORT FUEL INJECTION (MFI)** .

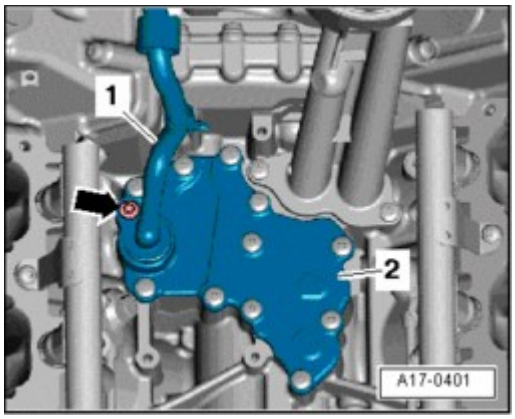

Fig. 423: Removing Bolt And Crankcase Ventilation Hose From Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolt - **arrow** - and remove crankcase ventilation hose - **1** - from cover - **2** -.

Installing

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

NOTE:

- **Replace O-ring.**

- Install intake manifold --> **24 - MULTIPORT FUEL INJECTION (MFI)** .

Tightening specifications

Component	Nm
Crankcase ventilation hose to cover	9

Oil Filter Housing, Component Overview

Oil Filter Housing, Component Overview

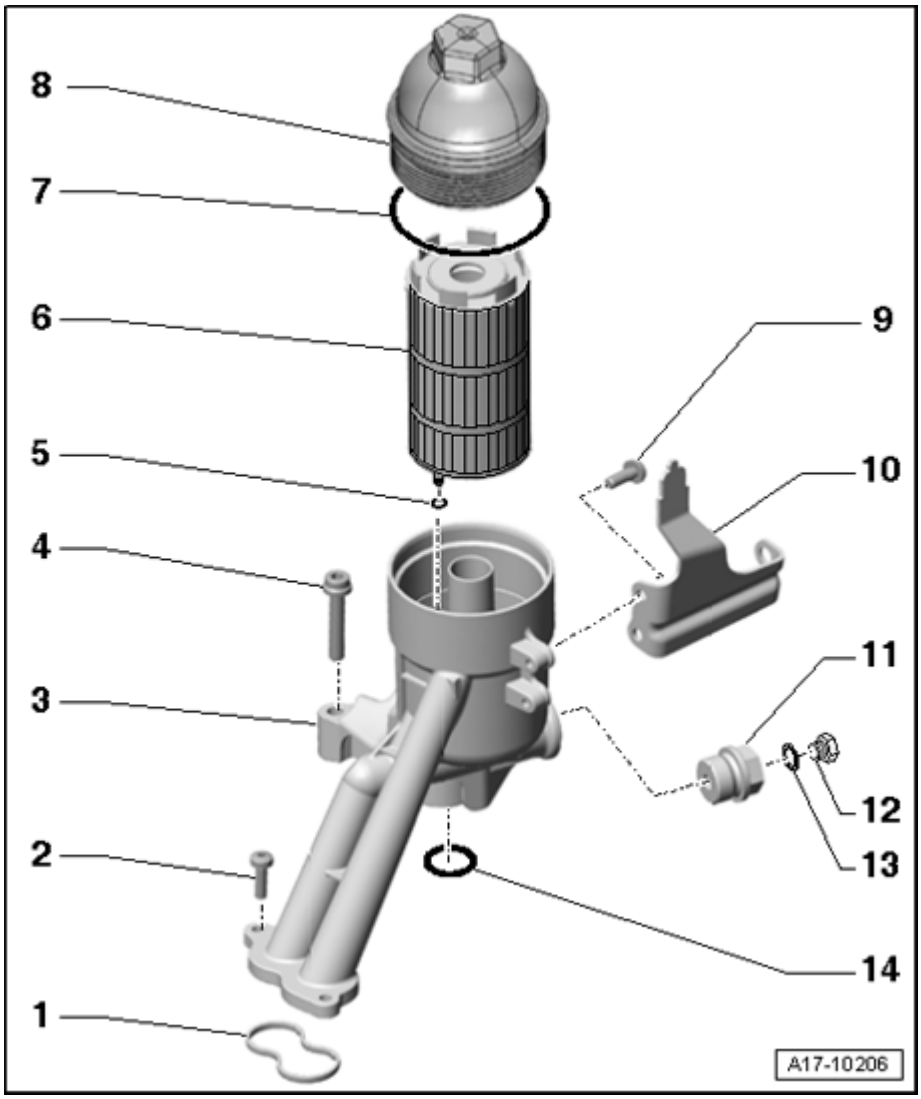

Fig. 424: Oil Filter Housing, Component Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Gasket

- Replace

2 - 9 Nm

3 - Oil filter housing

- With oil filter by-pass valve 1.3 bar

4 - 22 Nm

5 - O-ring

- Oil filter element component

6 - Oil filter element

- Removing and installing --> **01 - MAINTENANCE**

7 - O-ring

- Replace

8 - Cover - 25 Nm

9 - Not installed

10 - Not installed

11 - Locking bolt - 50 Nm

12 - Locking bolt - 9 Nm

13 - Seal

- Replace

14 - O-ring

- Replace

Oil Filter Housing, Removing and Installing

Oil Filter Housing, Removing and Installing

Removing

- Remove intake manifold --> **24 - MULTIPORT FUEL INJECTION (MFI)** .

NOTE:

- **Place a rag around oil filter housing to catch escaping engine oil.**

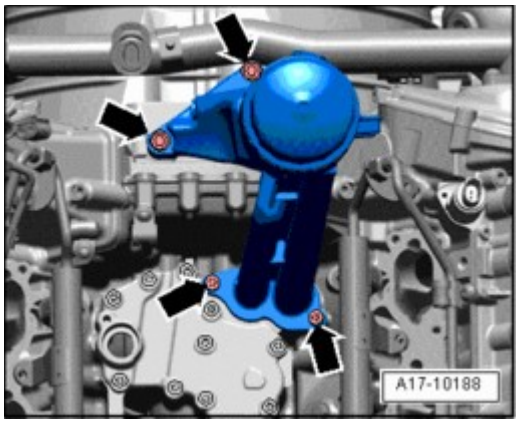

Fig. 425: Removing Bolts And Oil Filter Housing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** - and remove oil filter housing.

Installing

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

NOTE:

- **Replace seals and O-rings.**

- Install intake manifold --> **24 - MULTIPORT FUEL INJECTION (MFI)** .
- Check oil level --> **Oil Level, Checking**.

Tightening Specifications

Component		Nm
Oil filter housing to cylinder block	M8	9
	M10	22
Cap to oil filter housing		25

Oil Cooler, Removing and Installing

Oil Cooler, Removing and Installing

Special tools, testers and auxiliary items required

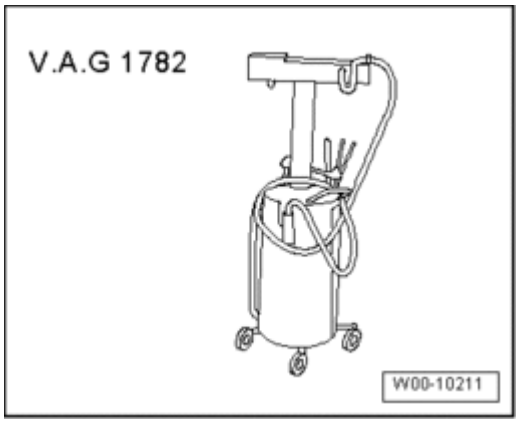

Fig. 426: Identifying Old Oil Collecting And Extracting Device V.A.G 1782
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Old oil collecting and extracting device V.A.G 1782

Removing

- Drain coolant --> **Cooling System, Draining and Filling**.
- Remove Generator --> **27 - STARTER, GENERATOR, CRUISE CONTROL** .

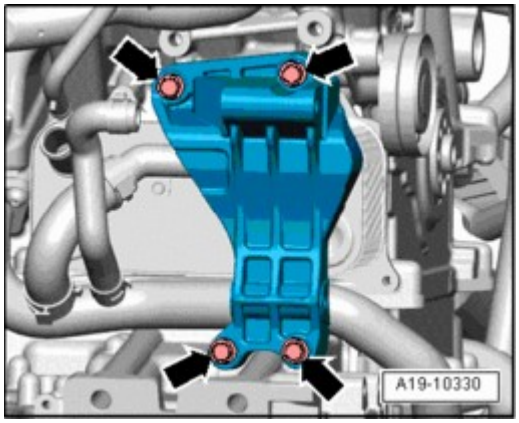

Fig. 427: Removing Bolts And Air Generator Bracket
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** - and remove air generator bracket.

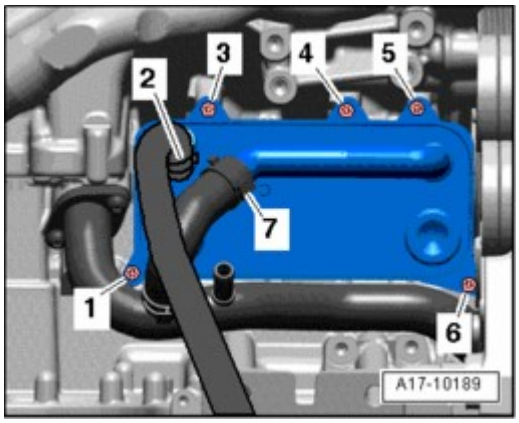

Fig. 428: Removing Coolant Hoses From Oil Cooler
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove coolant hoses - **2** - and - **7** - from oil cooler.
- Place old oil collecting and extracting device V.A.G 1782 under engine.
- Remove bolts - **1, 3, 4, 5, 6** - and remove oil cooler.

Installing

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

NOTE:

- **Replace O-rings.**
- **Secure all hose connections using hose clamps appropriate for the model type .**

- Install Generator --> **27 - STARTER, GENERATOR, CRUISE CONTROL** .
- Check oil level --> **Oil Level, Checking**.
- Fill with coolant --> **Cooling System, Draining and Filling** .

Tightening Specifications

Component		Nm
Oil cooler to cylinder block		9
Generator bracket to engine	M8	22
M10	46	

Oil Pressure Switch, Removing and Installing

Oil Pressure Switch, Removing and Installing

Removing

- Bring lock carrier into service position --> **50 - BODY - FRONT** .

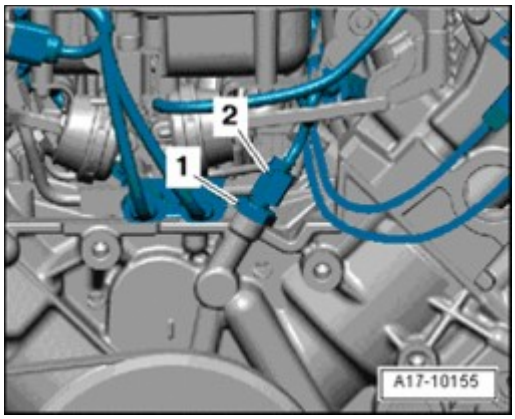

Fig. 429: Disconnecting Electrical Harness Connector From Oil Pressure Switch F1 & Oil Pressure Switch
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical harness connector from Oil Pressure Switch F1 - **2** -.
- Remove oil pressure switch - **1** -.

Installing

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

- Install lock carrier with attachments --> **50 - BODY - FRONT** .

Tightening specifications

Component	Nm
Oil pressure switch to cylinder block	20 1)
1) Replace seal.	

Oil Pressure and Oil Pressure Switch, Checking

Oil Pressure and Oil Pressure Switch, Checking

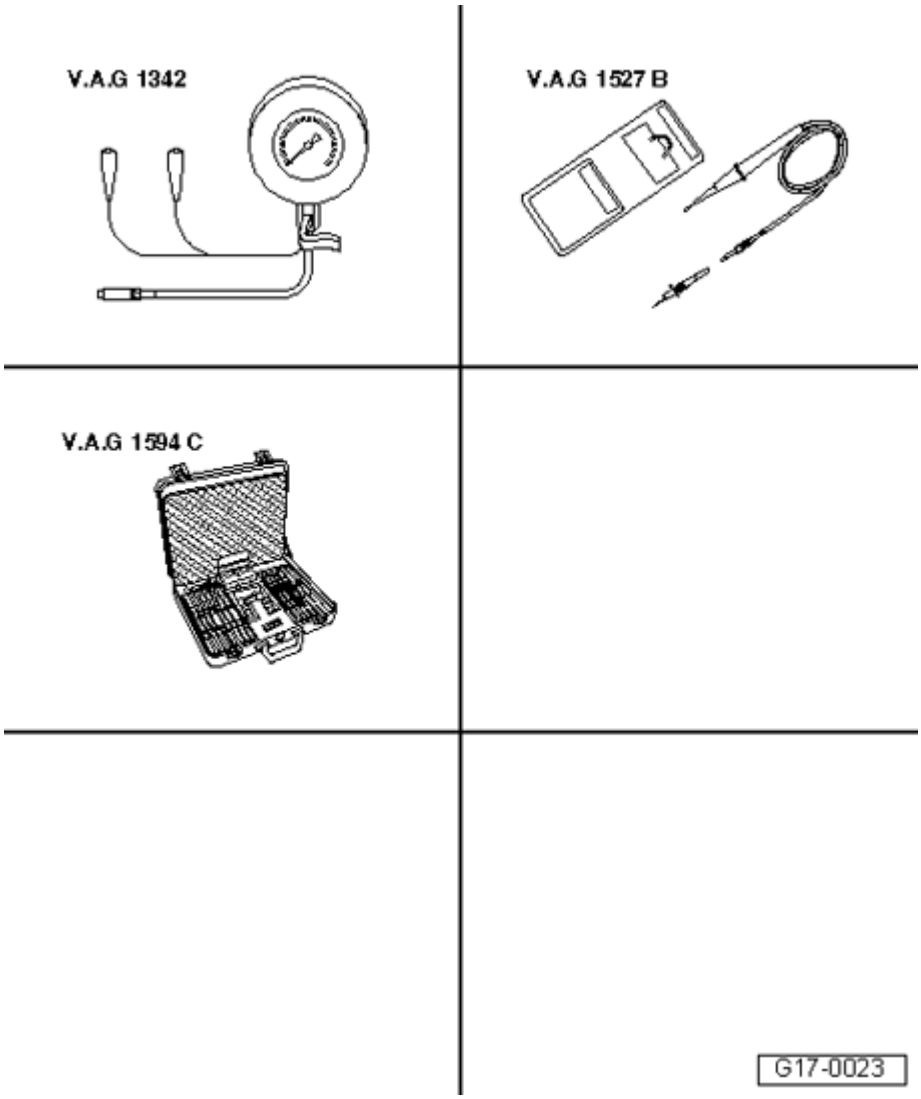

Fig. 430: Identifying Special Tools - Oil Pressure And Oil Pressure Switch, Checking
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

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

Procedure

- Oil level OK
- Engine oil temperature approximately 80 C.

- Remove Oil Pressure Switch F1 --> **Oil Pressure Switch, Removing and Installing**.

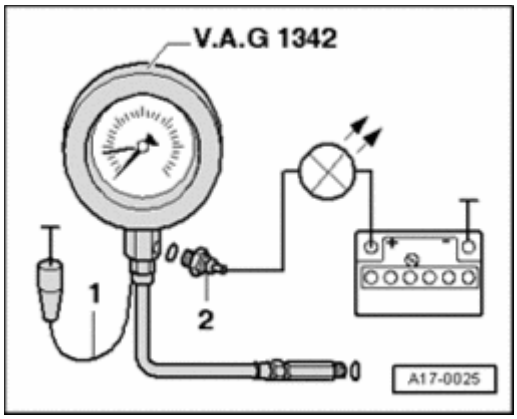

Fig. 431: Connecting Oil Pressure Gauge V.A.G 1342 With Adapter V.A.G 1342/14 To Hole For Oil Pressure Switch
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect Oil pressure gauge V.A.G 1342 with adapter V.A.G 1342/14 to hole for oil pressure switch.
- Install oil pressure switch - **2** - into oil pressure gauge V.A.G 1342.
- Place brown wire of oil pressure gauge on Ground (GND).

Oil pressure switch, checking

- Connect voltage tester V.A.G 1527 B using adapter cables from connector test kit V.A.G 1594 C to oil pressure switch and battery plus ("+").

- LED must not light up.

If LED lights up:

- Replace Oil Pressure Switch.
- Start engine.

NOTE:

- **While starting engine, watch Pressure Tester and LED as oil pressure switch may open during start.**
- **The LED must illuminate at 1.2 to 1.6 bar.**

If LED does not light up:

- Replace Oil Pressure Switch.

Oil pressure, checking

- Start engine.

- Oil pressure at idle: min. 1.5 bar.
- Oil pressure at 2000 RPM: min. 3.5 bar.

Assembling

- Install Oil Pressure Switch F1 --> **Oil Pressure Switch, Removing and Installing**.

Engine Oil Specifications

Engine Oil Specifications

"Manufacturer does not provide specific Fluid Capacity Charts"

Oil Level, Checking

Oil Level, Checking

Work procedure

- Engine oil temperature min. 60 C.
- Vehicle in level position.
- After stopping engine, wait a few minutes to allow oil to flow back into oil pan.

- Pull out oil dipstick, wipe off with a clean cloth and re-insert dipstick again up to stop.
- Withdraw dipstick again and read oil level.

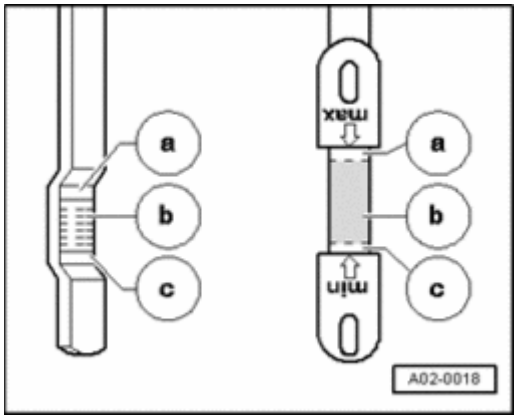

Fig. 432: Range Of Markings On Dipstick
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Range of markings on dipstick:

a - Oil must not be added.

b - Oil may be topped off.

c - Oil must be added.

NOTE:

- **The oil level may not exceed the "max" marking - a - or fall below the "min"**

marking - c -.

- **If the oil level exceeds the "max" marking, the catalytic converter could be damaged.**

19 - ENGINE - COOLING SYSTEM

COOLING SYSTEM COMPONENTS

Cooling System Components

--> **Coolant Hose Connection Plan, without Auxiliary Heater**

--> **Coolant Hose Connection Plan, with Auxiliary Heater**

--> **Cooling System, Draining and Filling**

--> **Coolant Pump and Coolant Regulator, Component Overview**

--> **Coolant Pump, Removing and Installing**

--> **Coolant Temperature Housing, Removing and Installing**

--> **Coolant Thermostat Opening Data**

--> **Engine Coolant Temperature Sensor, Removing and Installing**

--> **After-Run Coolant Pump, Removing and Installing**

--> **Coolant Pipes, Component Overview**

--> **Lower Front Coolant Line, Removing and Installing**

--> **Front Coolant Line, Removing and Installing**

--> **Rear Coolant Line, Removing and Installing**

--> **Left Coolant Pipe, Removing and Installing**

--> **Lower Left Coolant Pipe, Removing and Installing**

--> **Right Coolant Pipe, Removing and Installing**

--> **Radiator, Removing and Installing**

--> **Left Auxiliary Cooler, Removing and Installing**

--> **Right Auxiliary Cooler, Removing and Installing**

--> **Cooling System, Checking for Leaks**

--> **Fan Shroud, Removing and Installing**

--> **Coolant Fan, Removing and Installing**

CAUTION: Cover cap of coolant expansion tank with a rag and open carefully, as hot steam or hot coolant may escape when opening.

NOTE:

- **When the engine is warm the cooling system is under pressure. If necessary release pressure before commencing repair work.**
- **Arrows on coolant pipes and coolant hoses must line up across from each other.**
- **During installation, reinstall all heat insulation sleeves and heat shields at the same locations.**

Coolant Hose Connection Plan, without Auxiliary Heater

Coolant Hose Connection Plan, without Auxiliary Heater

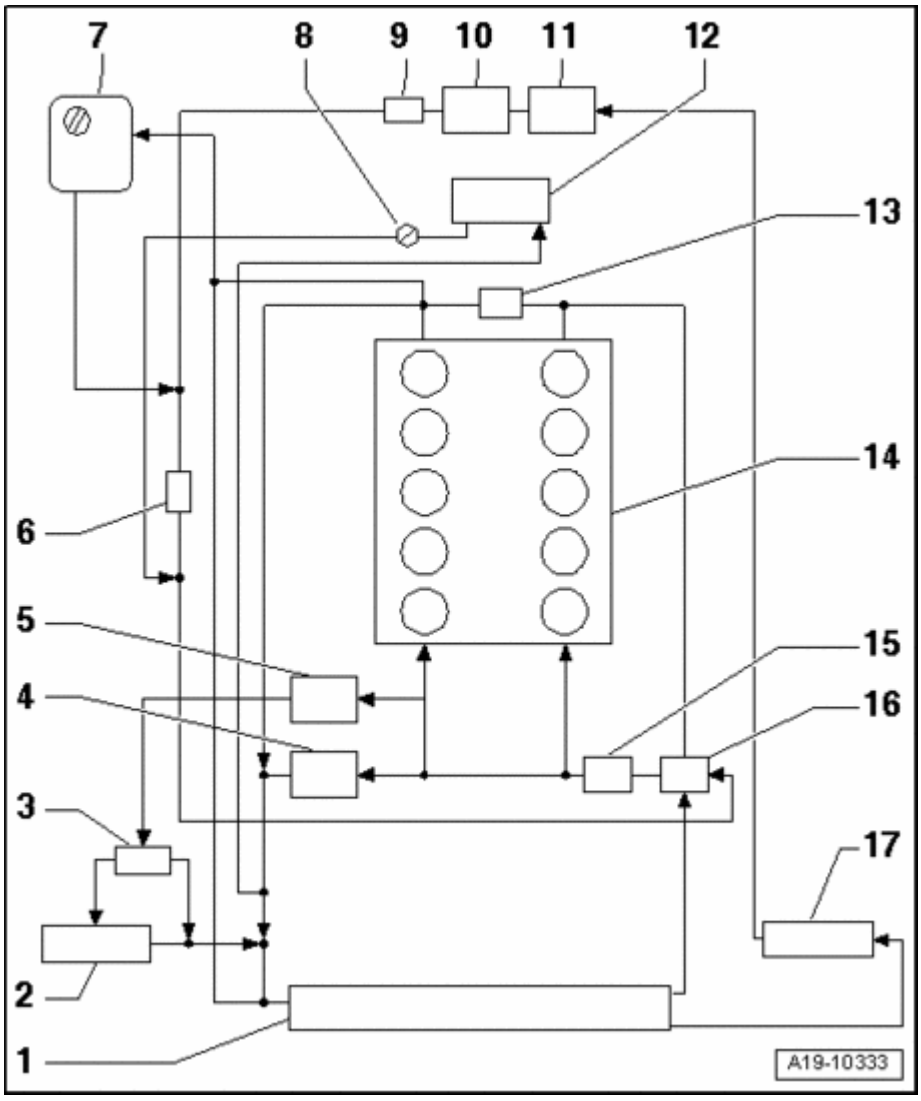

Fig. 433: Coolant Hose Connection Plan, Without Auxiliary Heater
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Radiator

- Removing and installing --> **Radiator, Removing and Installing**
- Replace coolant after replacing

2 - Right auxiliary cooler

- Removing and installing --> **Right Auxiliary Cooler, Removing and Installing**
- Replace coolant after replacing

3 - Coolant regulator for auxiliary cooler

4 - Generator

5 - Oil cooler

- Removing and installing --> **Oil Cooler, Removing and Installing**
- Replace coolant after replacing

6 - After-run coolant pump V51

- Removing and installing --> **After-Run Coolant Pump, Removing and Installing**

7 - Coolant expansion tank

- Pressure relief valve in cap, checking --> **Pressure relief valve in cap, checking**

8 - Bleeder hole

- At coolant hose to heater core

9 - Coolant thermostat

- For transmission oil cooler and ATF cooler

10 - Transmission oil cooler

11 - ATF cooler

12 - Heater core

- Replace coolant after replacing

13 - Engine Coolant Temperature (ECT) Sensor G62

14 - Cylinder head/cylinder block

- Replace coolant after replacing

15 - Coolant pump

- Removing and installing --> **Coolant Pump, Removing and Installing**

16 - Coolant thermostat

- Removing and installing --> **Coolant Temperature Housing, Removing and Installing**

17 - Left auxiliary cooler

- Removing and installing --> **Left Auxiliary Cooler, Removing and Installing**
- Replace coolant after replacing

Coolant Hose Connection Plan, with Auxiliary Heater

Coolant Hose Connection Plan, with Auxiliary Heater

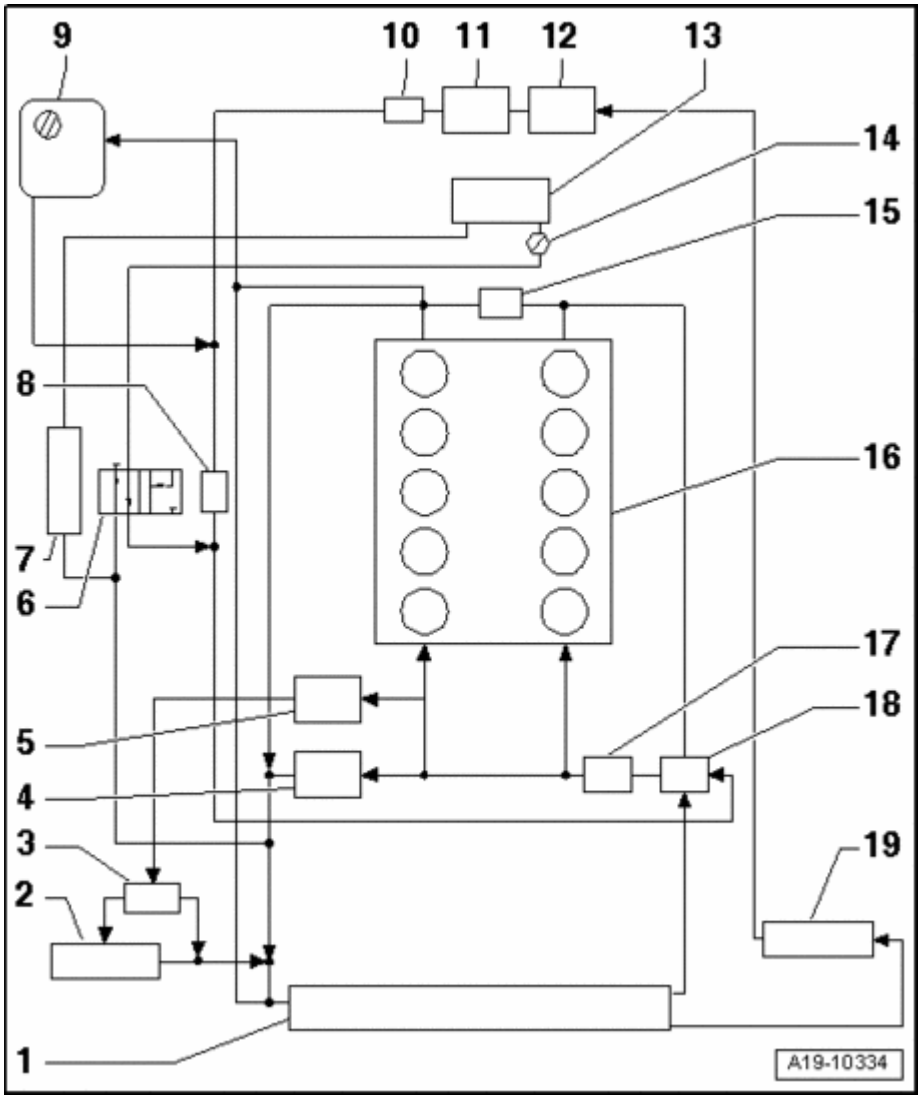

Fig. 434: Coolant Hose Connection Plan, With Auxiliary Heater
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Radiator

- Removing and installing --> **Radiator, Removing and Installing**
- Replace coolant after replacing

2 - Right auxiliary cooler

- Removing and installing --> **Right Auxiliary Cooler, Removing and Installing**
- Replace coolant after replacing

3 - Coolant regulator for auxiliary cooler

4 - Generator

5 - Oil cooler

- Removing and installing --> **Oil Cooler, Removing and Installing**
- Replace coolant after replacing

6 - Engine Coolant (EC) Switch-off Valve (heater) N279

7 - Auxiliary heater

8 - After-run coolant pump V51

- Removing and installing --> **After-Run Coolant Pump, Removing and Installing**

9 - Coolant expansion tank

- Pressure relief valve in cap, checking --> **Pressure relief valve in cap, checking**

10 - Coolant thermostat

- For transmission oil cooler and ATF cooler

11 - Transmission oil cooler

12 - ATF cooler

13 - Heater core

- Replace coolant after replacing

14 - Bleeder hole

- At coolant hose to heater core

15 - Engine Coolant Temperature (ECT) Sensor G62

16 - Cylinder head/cylinder block

- Replace coolant after replacing

17 - Coolant pump

- Removing and installing --> **Coolant Pump, Removing and Installing**

18 - Coolant thermostat

- Removing and installing --> **Coolant Temperature Housing, Removing and Installing**

19 - Left auxiliary cooler

- Removing and installing --> **Left Auxiliary Cooler, Removing and Installing**
- Replace coolant after replacing

Cooling System, Draining and Filling

Cooling System, Draining and Filling

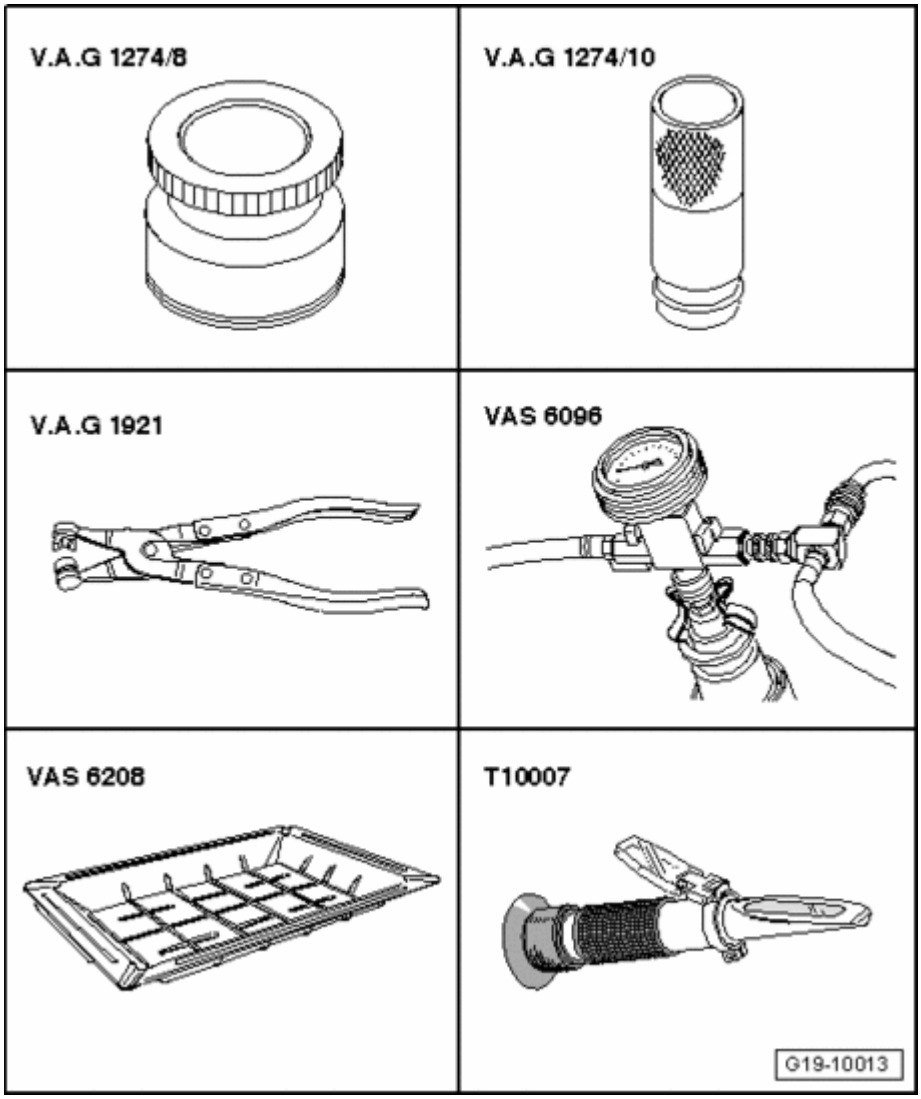

Fig. 435: Identifying Special Tools - Cooling System, Draining And Filling
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Adapter V.A.G 1274/8
- Adapter V.A.G 1274 tester V.A.G 1274/10
- Hose clamp pliers V.A.G 1921
- Cooling system charge unit VAS 6096
- Drip tray for workshop crane VAS 6208 or V.A.G 1306
- Refractometer T10007

Draining

NOTE:

- **Drained coolant must be stored in a clean container for disposal or reuse.**

CAUTION: Cover cap of coolant expansion tank with rag and open carefully, as hot steam or hot coolant may escape when opening.

- Open cap of coolant expansion tank.

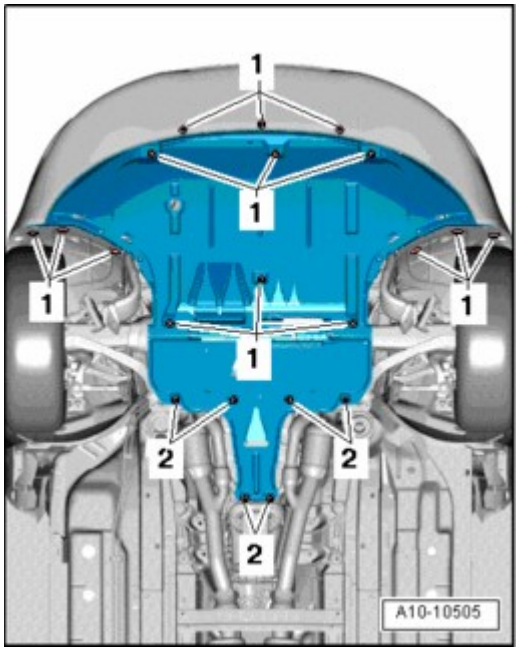

Fig. 436: Identifying Noise Insulation Quick-Release Fasteners
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen quick-release fasteners - **1** - and remove front noise insulation.

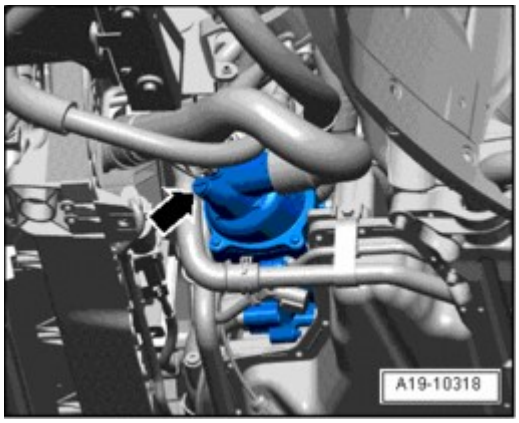

Fig. 437: Removing Drain Plug At Coolant Thermostat Housing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place drip tray for workshop crane VAS 6208 under engine.
- Remove drain plug - **arrow** - at coolant thermostat housing and drain coolant.

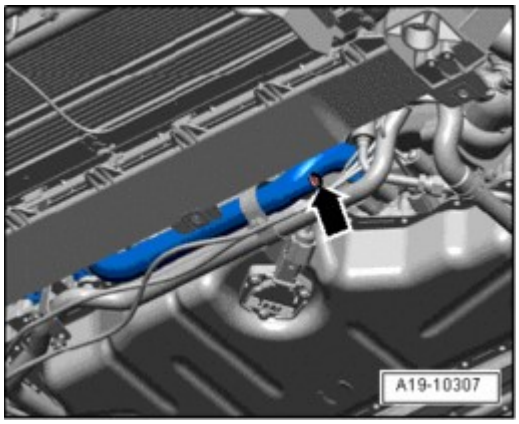

Fig. 438: Removing Drain Plug At Front Coolant Pipe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove drain plug - **arrow** - at front coolant pipe and drain coolant.

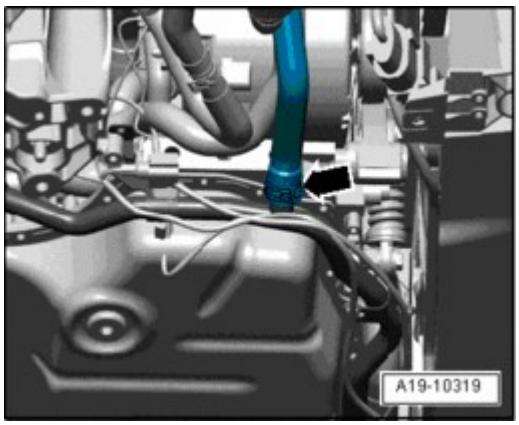

Fig. 439: Removing Coolant Hose From Front Lower Coolant Pipe

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove coolant hose from front lower coolant pipe - **arrow** - and drain remaining coolant.

Filling

- Ignition switched off.

NOTE:

- **The cooling system is filled all year round with a mixture of frost and corrosion protection additives and water.**
- **Use only *coolant additive Plus G 012 A8F A1* (short: G12+) "according to TL VW 774 F". Other coolant additives may above all reduce the corrosion protection effect significantly. The damage resulting from this may lead to loss of coolant and consequently to severe engine damage.**
- **G12+ and coolant additives with the designation "according to TL VW 774 F" reduce frost and corrosion damage as well as lime deposits. They also raise the boiling point. For this reason the system must be filled all year round with frost and corrosion protection additives.**
- **Because of its high boiling point, the coolant improves engine reliability under heavy loads, particularly in countries with tropical climates.**
- **Freeze protection must be assured to about -25 C (in arctic climatic countries to about -35 C).**
- **The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. The coolant additive portion must be at least 40%.**
- **If for climatic reasons greater frost protection is required, the amount of G12+ can be increased, but only up to 60% (frost protection to about -40 C), otherwise frost protection and cooling effectiveness will be reduced.**
- **Only clean drinking water may be used for mixing coolant.**
- **If the radiator, heater core, cylinder head and cylinder head gasket or cylinder block is replaced, completely replace the engine coolant.**
- **Dirty coolant must not be re-used.**
- **For coolant G12+ , use refractometer T10007 to test frost protection in cooling system.**

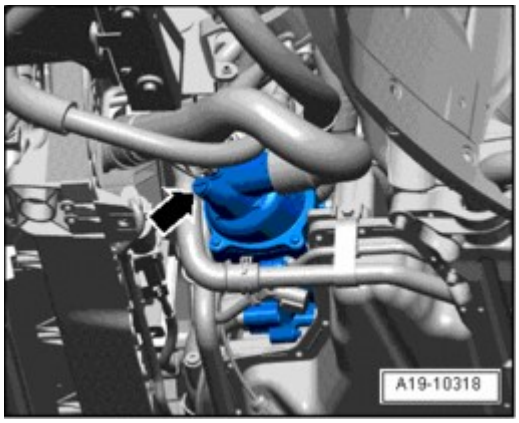

Fig. 440: Removing Drain Plug At Coolant Thermostat Housing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Reinstall drain plug - **arrow** - with new O-ring at coolant thermostat housing.

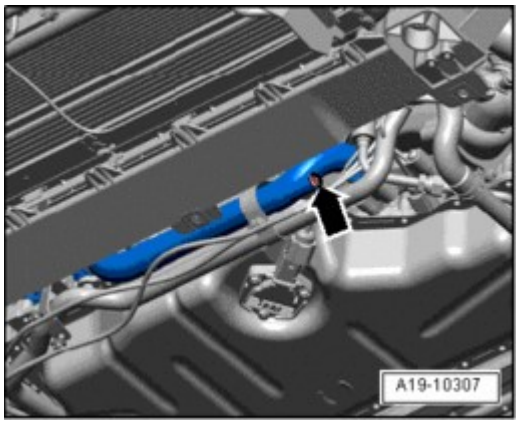

Fig. 441: Removing Drain Plug At Front Coolant Pipe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Reinstall drain plug - **arrow** - with new gasket at front coolant pipe.

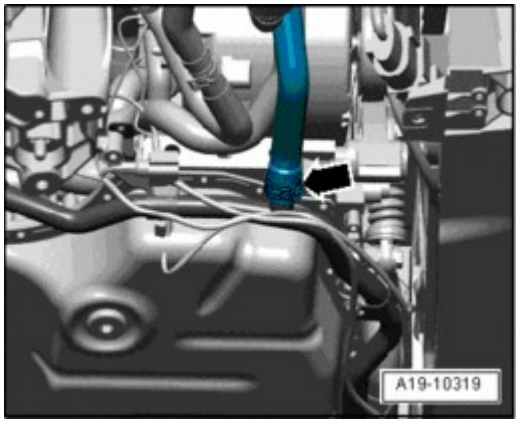

Fig. 442: Connecting Coolant Hose To Front Lower Coolant Pipe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect coolant hose to front lower coolant pipe - **arrow** -.

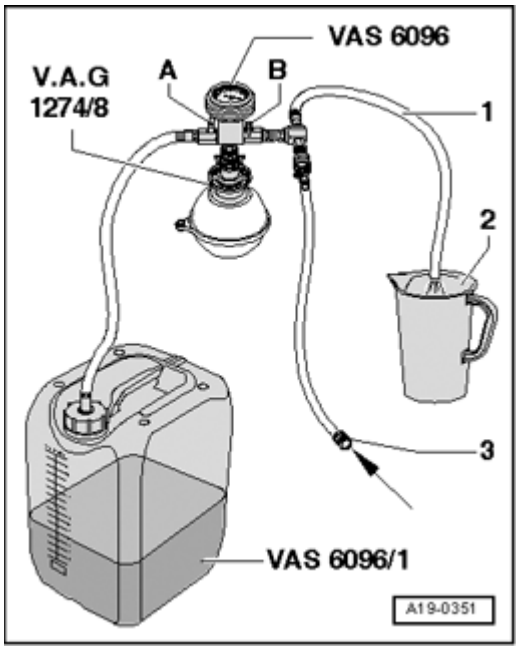

Fig. 443: Filling Reservoir VAS 6096/1 With At Least 15 Liters Of Premixed Coolant
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Fill coolant reservoir of Cooling System Charge Unit VAS 6096 with at least 15 liters of pre-mixed coolant with correct mixture ratio:

- G12+ (40%) and water (60%) for freeze protection down to -25 C
- G12+ (50%) and water (50%) for freeze protection down to -35 C
- G12+ (60%) and water (40%) for freeze protection down to -40 C

- Install adapter V.A.G 1274/8 onto expansion tank.
- Assemble Cooling System Charge Unit VAS 6096 on adapter V.A.G 1274/8.
- Place air outlet hose - **1** - into a small container - **2** -. (A small amount of coolant is drawn off which should be reserved with discharged air.)
- Close both valves - **A** - and - **B** - by turning lever perpendicular to direction of flow.

- Connect hose - **3** - to pressurized air.

- Pressure: 6 to 10 bar positive pressure.

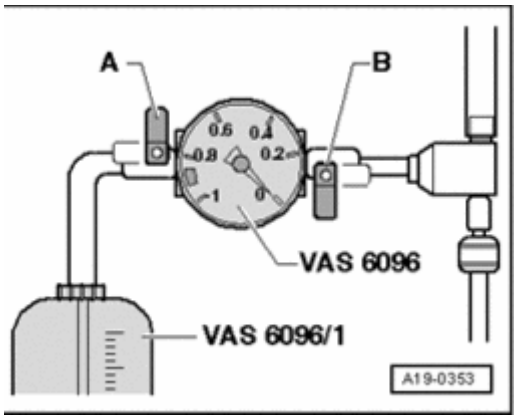

Fig. 444: Cooling System, Draining And Filling
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Open valve - **B** - , to do this turn lever in direction of flow.

A vacuum is created in cooling system by suction jet pump.

- Needle on instrument display must travel into green region.
- Also briefly open valve - **A** - , turn lever in direction of flow to do this, so that coolant reservoir hose of cooling system filler unit VAS 6096 is filled with coolant.
- Close valve - **A** - again.
- Let valve - **B** - remain open another 2 minutes.
- A further vacuum is created in the cooling system by the suction jet pump.
- Needle on instrument display must still remain in green region.
- Close valve - **B** -.
- Needle in display must remain in green region, then vacuum in cooling system is sufficient for subsequent filling.

If needle stands below the green region, repeat procedure.

If vacuum decreases, cooling system is leaking.

- Disconnect pressurized air hose.
- Open valve - **A** -.

The vacuum in the cooling system has the effect of extracting coolant from coolant reservoir VAS 6096/1 ; cooling system is filled.

- Detach cooling system filler unit VAS 6096 from adapter V.A.G 1274/8 on coolant expansion tank.

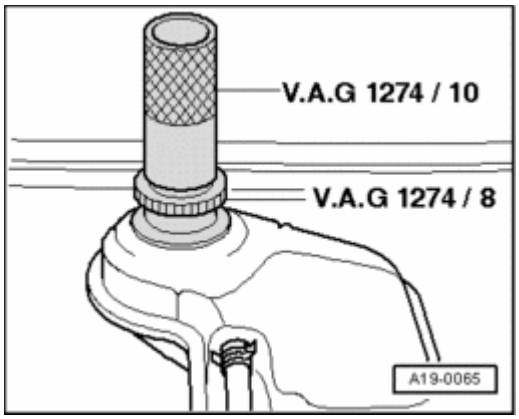

Fig. 445: Connecting Pipe For Cooling System Tester V.A.G 1274/10 To Adapter
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect pipe for cooling system tester V.A.G 1274/10 to adapter.

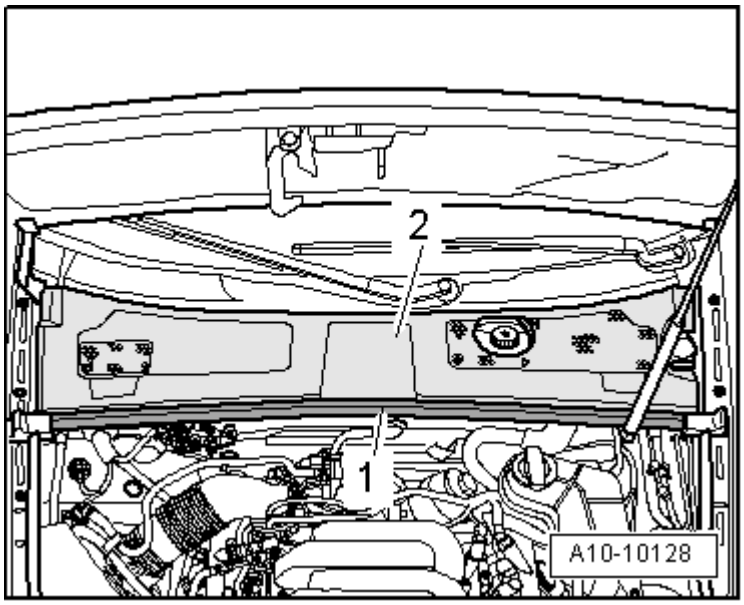

Fig. 446: Removing Rubber Seal For Plenum Chamber Cover & Plenum Chamber Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove rubber seal - **1** - and remove plenum chamber cover - **2** -.

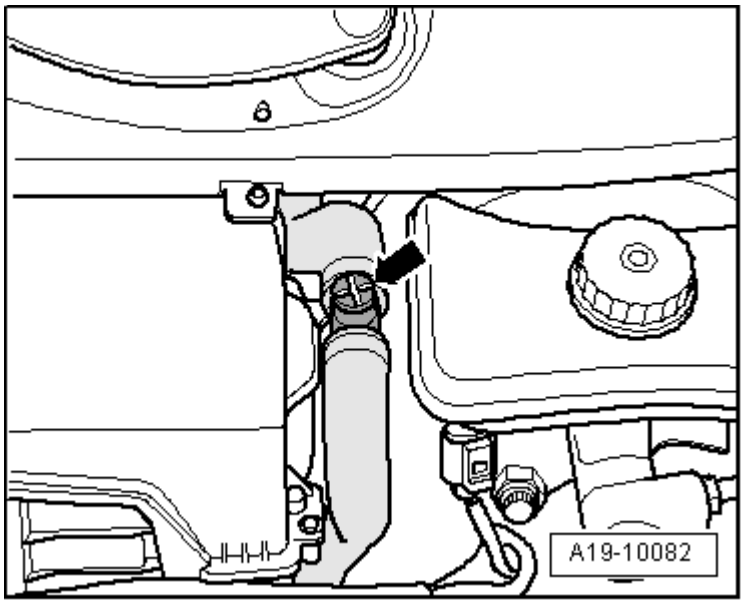

Fig. 447: Opening Bleeder Screw
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Open bleeder screw - **arrow** -.
- Fill up coolant until it escapes from the coolant hose bleeder hole.
- Close bleeder screw.
- If present, switch on auxiliary heater for about 30 seconds.

- Twist cap for expansion tank closed.
- Start engine.
- Set left and right heating/air conditioning system to "HI".
- Let engine run at 2000 RPM for 3 minutes.

- Let engine run at idle long enough until both large coolant hoses on main cooler are warm.
- Let engine run at 2000 RPM for 1 minute.
- Turn off engine and allow it to cool off.

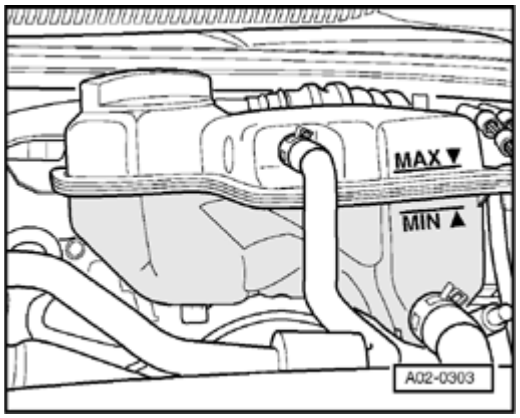

Fig. 448: Checking Coolant Level
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Check coolant level.

- With cold engine, coolant level must be at MAX marking.
- Coolant level may be above MAX-marking with engine at operating temperature.

Tightening Specifications

Component	Nm
Drain plug to coolant regulator housing	4
Drain plug to front coolant pipe	10

Coolant Pump and Coolant Regulator, Component Overview

Coolant Pump and Coolant Regulator, Component Overview

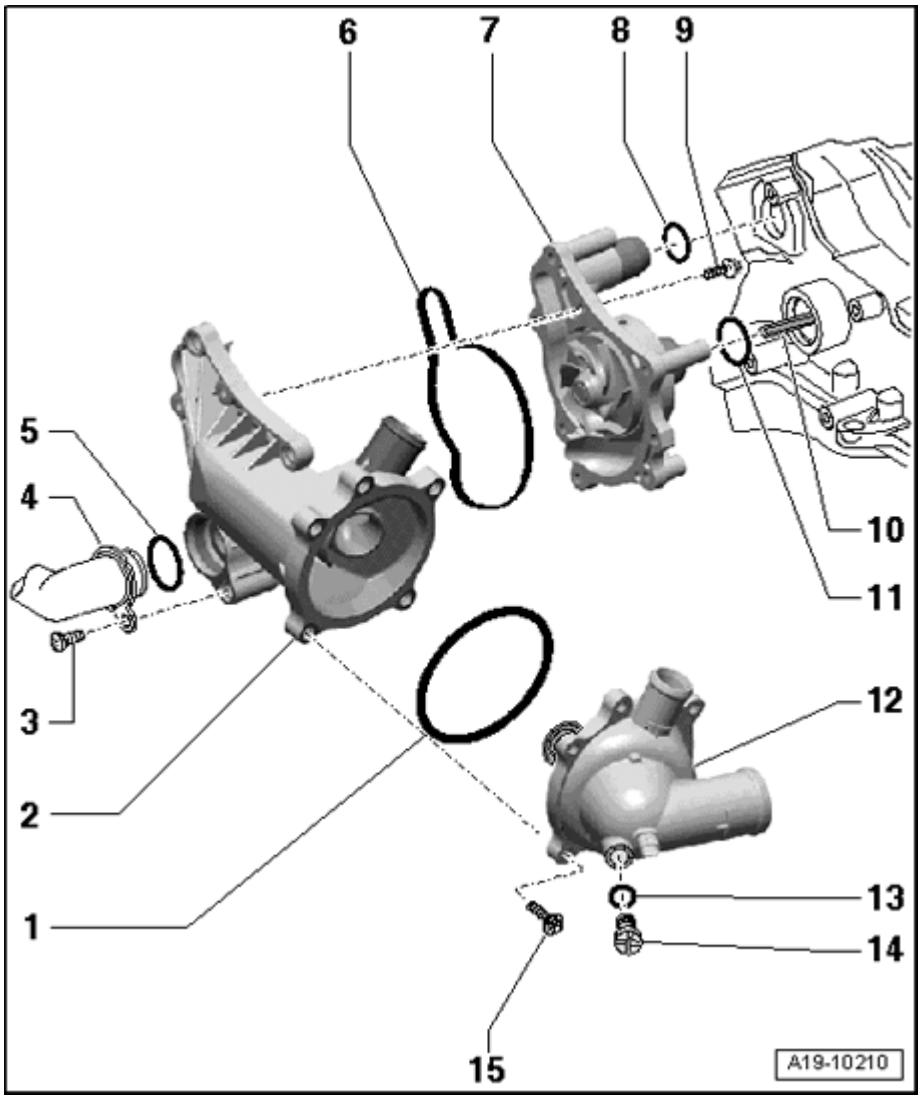

Fig. 449: Coolant Pump And Coolant Regulator, Component Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Seal

- Replace

2 - Coolant pump housing

- Removing and installing --> **Coolant Pump, Removing and Installing**

3 - 8 Nm plus an additional 90 ($^{1}/_{4}$ turn)

- Replace

4 - Front coolant line

- Removing and installing --> **Front Coolant Line, Removing and Installing**

5 - O-ring

- Replace

6 - Seal

- Replace

7 - Coolant pump

- Removing and installing --> **Coolant Pump, Removing and Installing**

8 - O-ring

- Replace

9 - 9 Nm

10 - Drive shaft for coolant pump

11 - O-ring

- Replace

12 - Thermostat housing

- Removing and installing --> **Coolant Temperature Housing, Removing and Installing**
- Coolant thermostat opening data --> **Coolant Thermostat Opening Data**

13 - O-ring

- Replace

14 - Drain plug - 4 Nm

15 - 9 Nm

Coolant Pump, Removing and Installing

Coolant Pump, Removing and Installing

Removing

- Remove front coolant pipe --> **Front Coolant Line, Removing and Installing**.

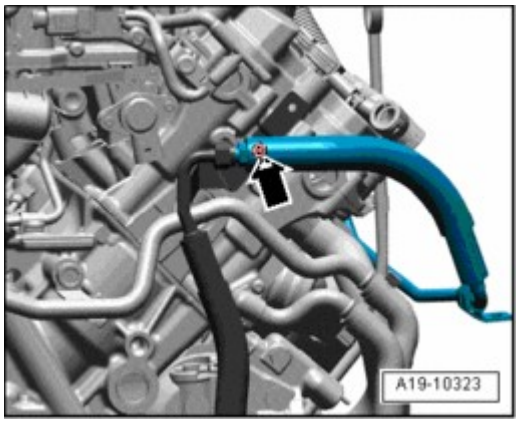

Fig. 450: Removing Front Power Steering Pressure Line Bracket From Cylinder Head
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove front power steering pressure line bracket from cylinder head - **arrow** -.

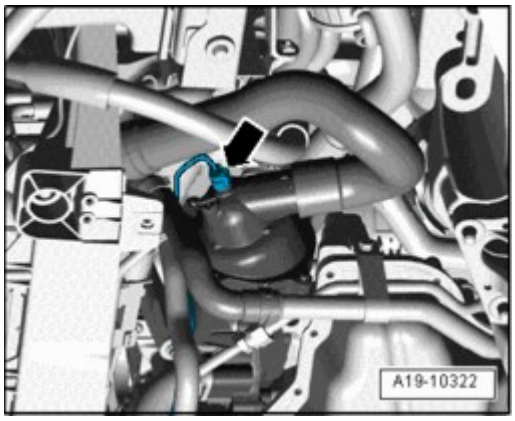

Fig. 451: Disconnecting Electrical Connector On Map Controlled Engine Cooling Thermostat F265
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connector - **arrow** - at Engine Coolant Temperature (ECT) Sensor (on Radiator) G83.

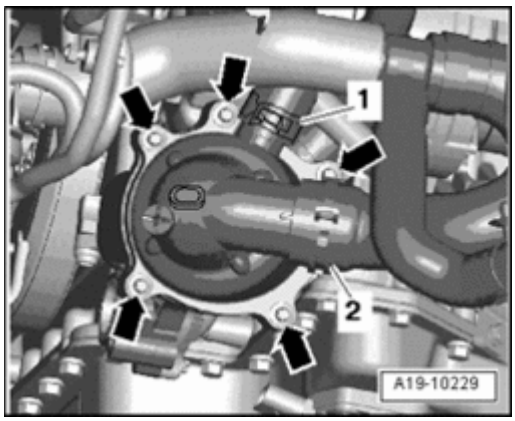

Fig. 452: Identifying Coolant Hose, Bolts & Coolant Thermostat Housing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove coolant hose - **2** - from bottom of coolant thermostat housing.
- Remove bolts - **arrows** -.
- Remove coolant thermostat housing and remove coolant hose - **1** - from top of coolant thermostat housing.

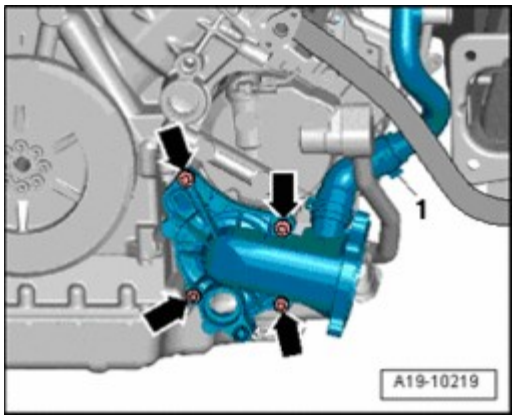

Fig. 453: Loosening Hose Clip At Coolant Hose
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen hose clip - **1** - at coolant hose.
- Remove bolts - **arrows** -.
- Remove coolant pump housing toward front, while doing this pay attention to drive shaft for coolant pump.

NOTE:

- **Coolant hose can only be removed with coolant pump removed.**

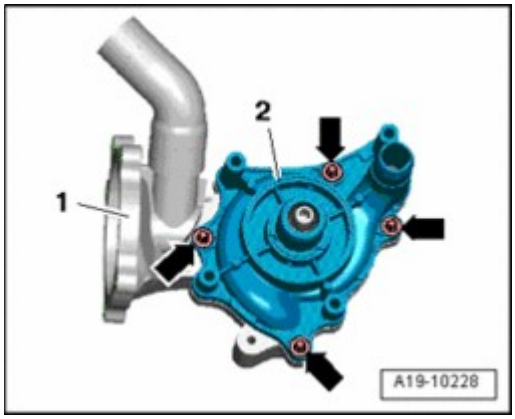

Fig. 454: Removing Bolts & Coolant Pump From Housing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** -.
- Remove coolant pump - **2** - from housing - **1** -.

Installing

NOTE:

- **Replace seals and O-rings.**
- **Secure all hose connections using hose clamps appropriate for the model type .**

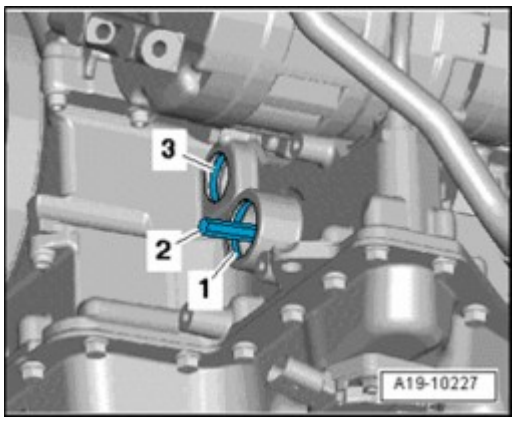

Fig. 455: Inserting New O-Rings & Coolant Pump Input Shaft In Oil Pump Mount
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Insert new O-rings - **1** - and - **3** -.
- Insert coolant pump input shaft - **2** - in oil pump mount as far as stop at engine.
- Slide coolant pump into mounts in upper part of oil pan.

NOTE:

- **To connect drive flange onto hex head of drive shaft, reach with the finger into the lower pipe connection of coolant pump and twist at impeller until coolant pump can be inserted completely.**

The rest of installation is in reverse order of removal, note the following:

- Install coolant thermostat housing --> **Coolant Temperature Housing, Removing and Installing**.
- Install front coolant pipe --> **Front Coolant Line, Removing and Installing**.
- Fill with coolant --> **Cooling System, Draining and Filling** .

Tightening Specifications

Component	Nm
Coolant pump to housing	9
Coolant pump housing to upper section of oil pan	9
Power steering pressure line bracket to cylinder head	9

Coolant Temperature Housing, Removing and Installing

Coolant Temperature Housing, Removing and Installing

Removing

- Drain coolant --> **Cooling System, Draining and Filling**.

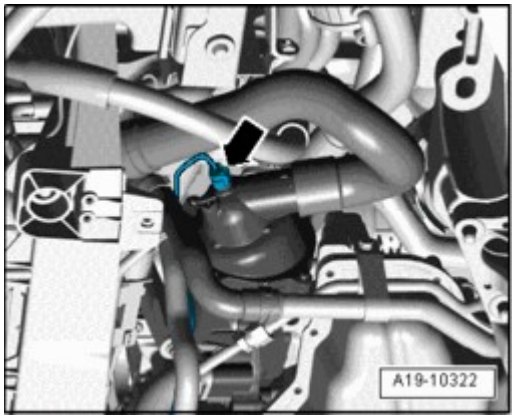

Fig. 456: Disconnecting Electrical Connector On Map Controlled Engine Cooling Thermostat F265
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connector - **arrow** - at Engine Coolant Temperature (ECT) Sensor (on Radiator) G83.

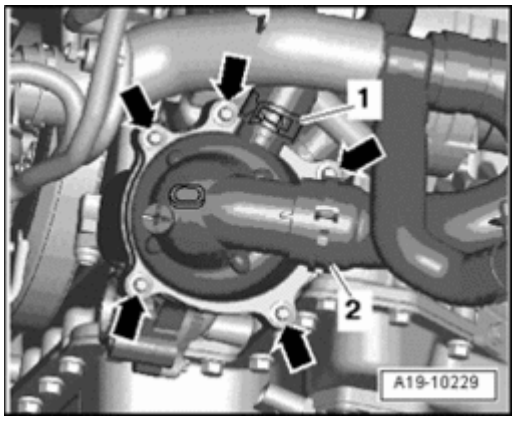

Fig. 457: Identifying Coolant Hose, Bolts & Coolant Thermostat Housing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove coolant hose - **2** - at bottom of coolant thermostat housing and drain remaining of coolant.
- Remove bolts - **arrows** -.
- Remove coolant thermostat housing and remove coolant hose - **1** - from top of coolant thermostat housing.

Installing

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

NOTE:

- **Replace seals and O-rings.**

- **Secure all hose connections using hose clamps appropriate for the model .**

- Fill with coolant --> **Cooling System, Draining and Filling** .

Torque specifications

Component	Nm
Coolant regulator housing to coolant pump housing	9

Coolant Thermostat Opening Data

Coolant Thermostat Opening Data

Opening begins	Opening ends	Opening lift	Voltage at thermostat
approximately 105° C	approximately 117° C	min. 8 mm	0 V
	approximately 105° C	min. 8 mm	14 V
1) Cannot be tested with workshop equipment.			

Engine Coolant Temperature Sensor, Removing and Installing

Engine Coolant Temperature Sensor, Removing and Installing

Removing

- Engine cold.

- Briefly open the coolant expansion tank cap to reduce residual pressure in the cooling system.

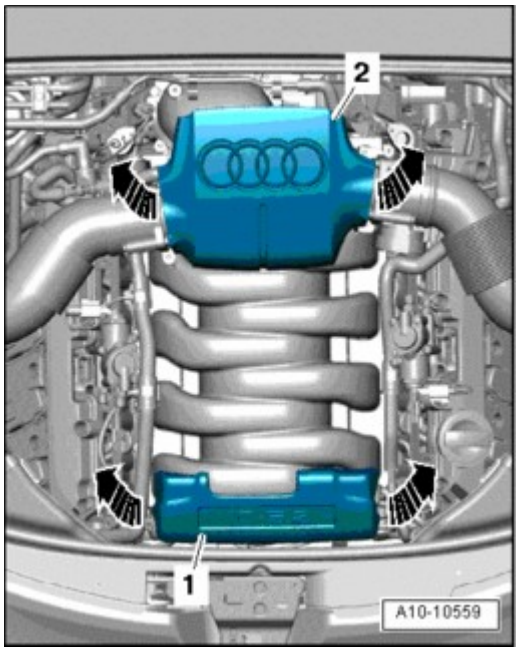

Fig. 458: Removing Rear Engine Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove engine cover - **2** - - **arrows** -.

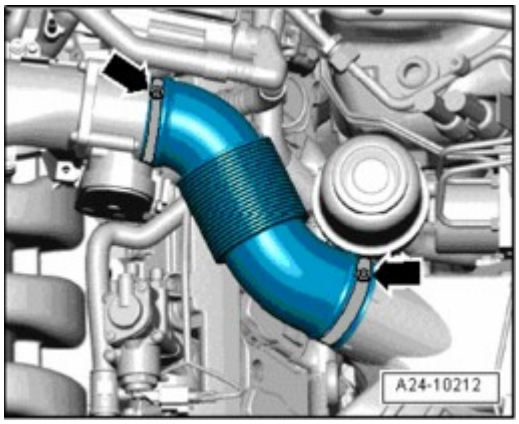

Fig. 459: Identifying Hose Clamps For Left Air Guide Hose
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove left air duct hose - **arrows** -.

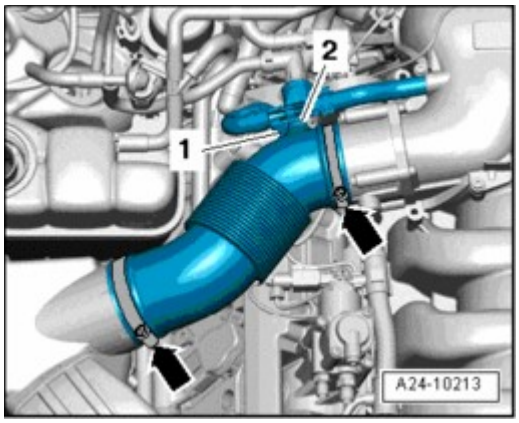

Fig. 460: Removing Right Air Guide Hose
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove right air guide hose - **arrows** -.

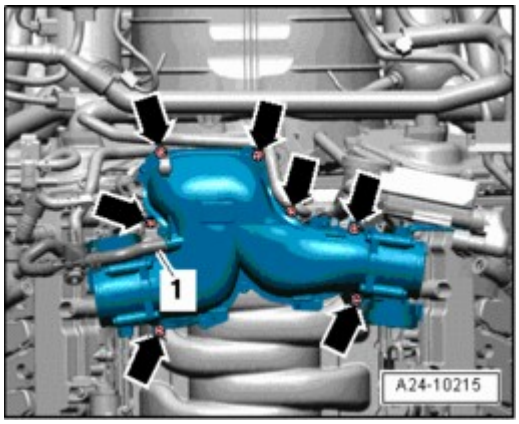

Fig. 461: Identifying Vacuum Hose And Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove vacuum hose - **1** - from intake manifold.
- Remove bolts - **arrows** - and remove air duct.

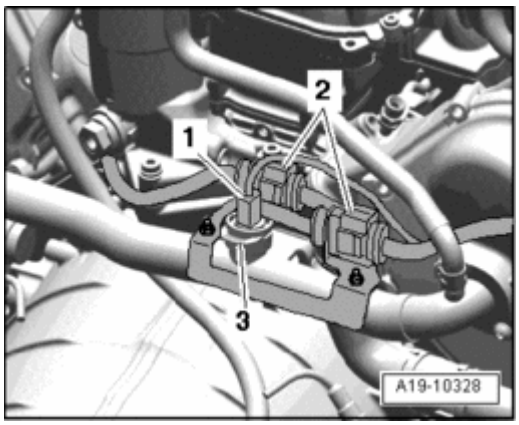

Fig. 462: Disconnecting Electrical Harness Connector At Engine Coolant Temperature (ECT) Sensor

G62
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove electrical connectors - **2** - from bracket.
- Disconnect electrical connector - **1** - on Engine Coolant Temperature (ECT) Sensor G62.
- Remove retaining clip - **3** - and remove Engine Coolant Temperature (ECT) Sensor G62.

Installing

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

NOTE:

- **To avoid coolant loss, insert new Engine Coolant Temperature (ECT) Sensor G62 immediately and secure it with retaining clip.**
- **Replace O-ring.**
- **Secure all hose connections using hose clamps appropriate for the model type .**

- Fill with coolant --> **Cooling System, Draining and Filling** .

Torque specifications

Component	Nm
Air duct to intake manifold	9

After-Run Coolant Pump, Removing and Installing

After-Run Coolant Pump, Removing and Installing

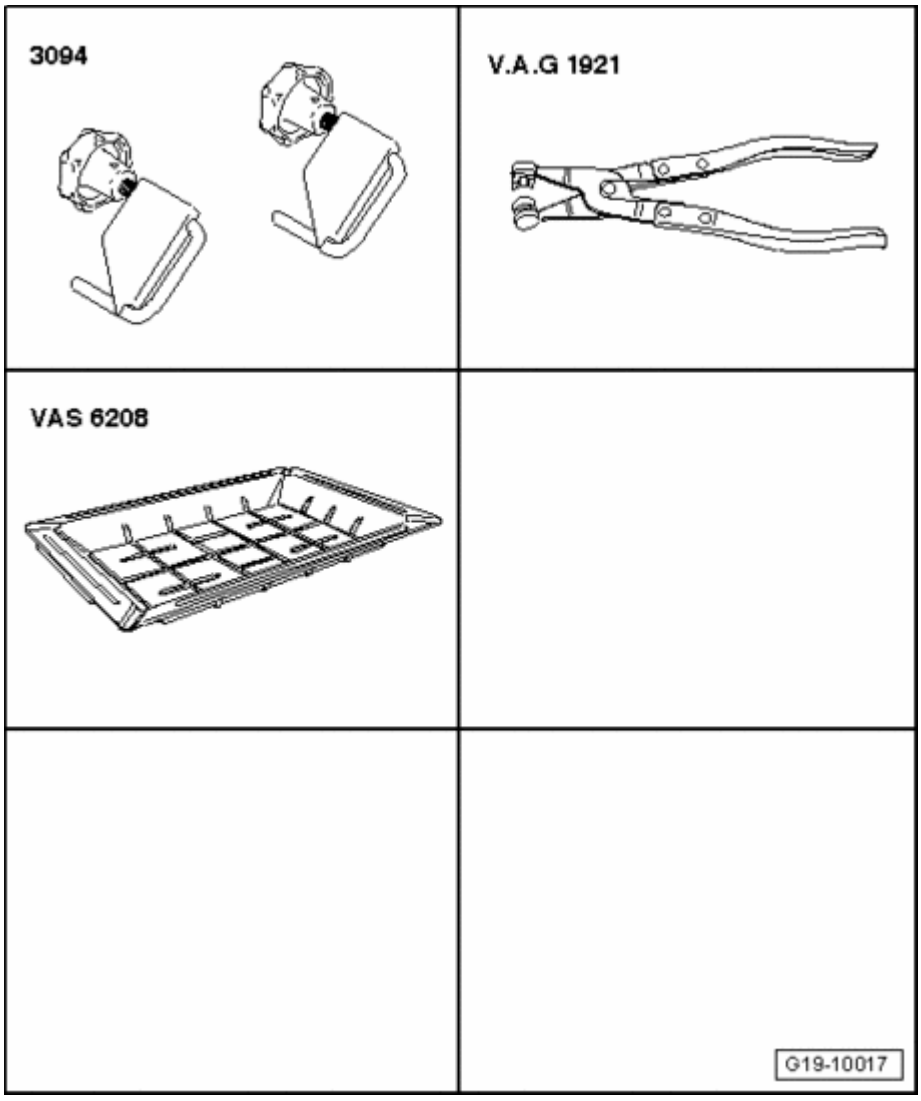

Fig. 463: Identifying Special Tools - After-Run Coolant Pump, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Hose clamps up to 25 mm dia. 3094
- Hose clamp pliers V.A.G 1921
- Drip tray for workshop crane VAS 6208

Removing

CAUTION: Cover cap of coolant expansion tank with rag and open carefully, as hot steam or hot coolant may escape when opening.

- Open cap of coolant expansion tank.

- Remove stabilizer bar --> **40 - FRONT SUSPENSION** .

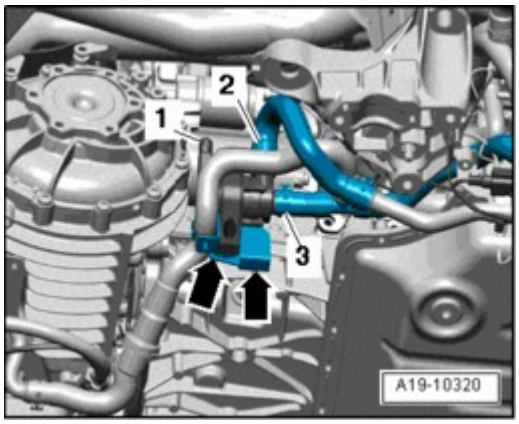

Fig. 464: Identifying Coolant Hoses, Hose Clamps 3094, Electrical Connector & Electrical Connector
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Clamp off coolant hoses - **2** - and - **3** - with Hose Clamps 3094.
- Disconnect electrical connector - **1** -.
- Remove bolts - **arrows** -.
- Place Drip Tray for VAS 6100 VAS 6208 below After-Run Coolant Pump V51.

- Remove coolant hoses at After-Run Coolant Pump V51.

Installing

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

NOTE:

- **Secure all hose connections using hose clamps appropriate for the model type .**

- Install stabilizer bar --> **40 - FRONT SUSPENSION** .
- Fill with coolant --> **Cooling System, Draining and Filling** .

Torque specifications

Component	Nm
After-run coolant pump screw clip	5
After-Run Coolant Pump V51 bracket to body	9

Coolant Pipes, Component Overview

Coolant Pipes, Component Overview

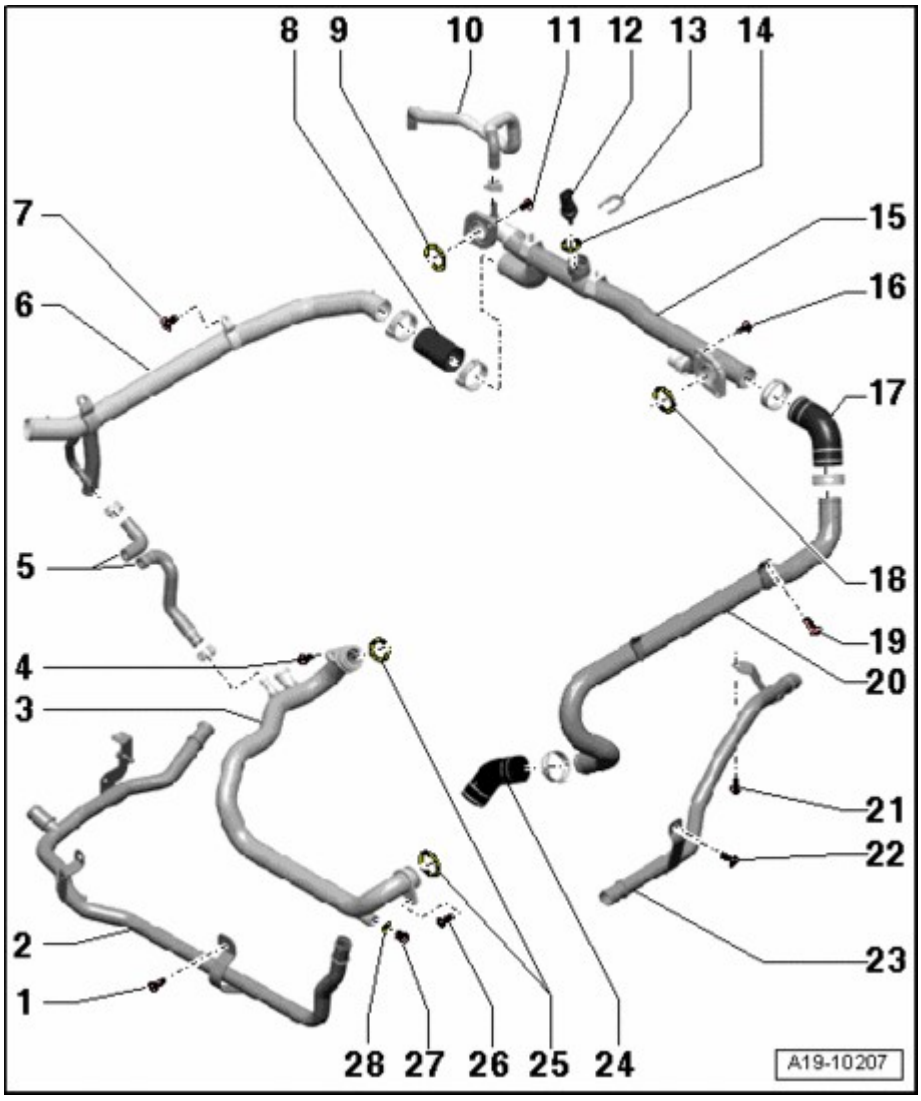

Fig. 465: Coolant Pipes, Component Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 9 Nm

2 - Lower front coolant pipe

- Removing and installing --> **Lower Front Coolant Line, Removing and Installing**

3 - Front coolant line

- Removing and installing --> **Front Coolant Line, Removing and Installing**

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

- Replace

5 - Coolant hoses

- To Generator

6 - Right coolant line

- Removing and installing --> **Right Coolant Pipe, Removing and Installing**

7 - 9 Nm

8 - Coolant hose

9 - O-ring

- Replace

10 - Coolant hose

- To Intake manifold

11 - 9 Nm

12 - Engine Coolant Temperature (ECT) Sensor G62

- Removing and installing --> **Engine Coolant Temperature Sensor, Removing and Installing**

13 - Retaining clip

14 - O-ring

- Replace

15 - Rear coolant pipe

- Removing and installing --> **Rear Coolant Line, Removing and Installing**

16 - 9 Nm

17 - Coolant hose

18 - O-ring

- Replace

19 - 9 Nm

20 - Left coolant line

- Removing and installing --> **Left Coolant Pipe, Removing and Installing**

21 - 9 Nm

22 - 9 Nm

23 - Lower left coolant pipe

- Removing and installing --> **Lower Left Coolant Pipe, Removing and Installing**

24 - Coolant hose

- To coolant regulator housing

25 - O-rings

- Replace

26 - 8 Nm plus an additional 90 ($^{1}/_{4}$ turn)

- Replace

27 - Drain plug - 10 Nm

28 - Seal

- Replace

Lower Front Coolant Line, Removing and Installing

Lower Front Coolant Line, Removing and Installing

Special tools, testers and auxiliary items required

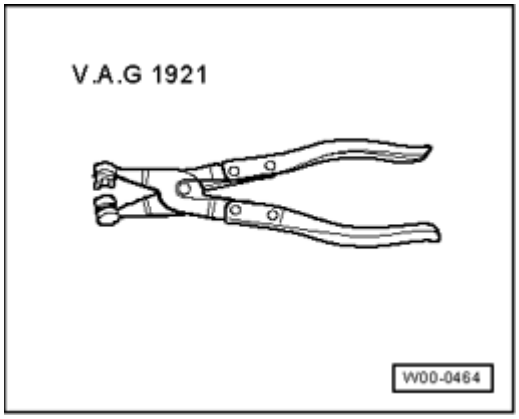

Fig. 466: Hose Clip Pliers V.A.G 1921

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Hose clamp pliers V.A.G 1921

Removing

NOTE:

- **All cable ties opened or cut during engine removal must be reinstalled at the same locations during installation.**

- Drain coolant --> **Cooling System, Draining and Filling**.

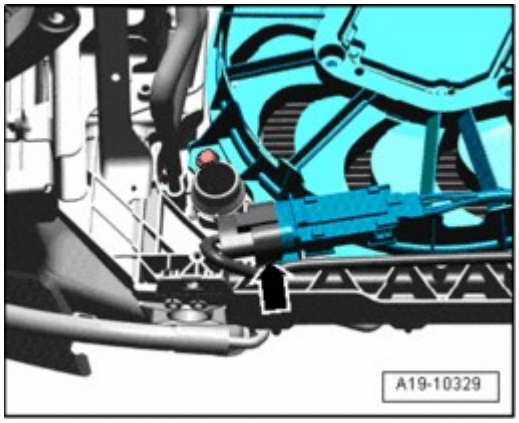

Fig. 467: Disengaging Electrical Connector From Bracket At Left Of Lock Carrier
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disengage electrical connector - **arrow** - from bracket at left of lock carrier, connector is not disconnected.

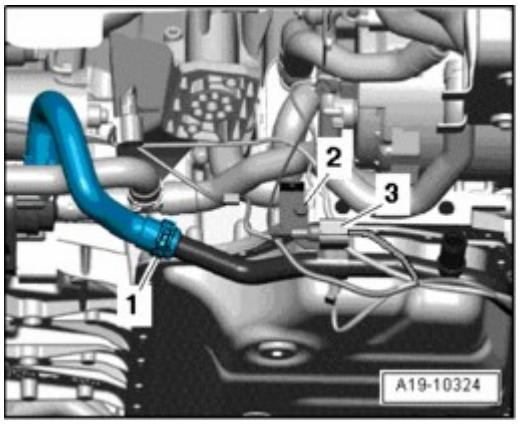

Fig. 468: Removing Bolt On Front Lower Coolant Pipe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove electrical connector - **3** - from bracket and free up electrical wiring.
- Remove coolant hose - **1** - from front coolant line.
- Remove bolts - **2** -.

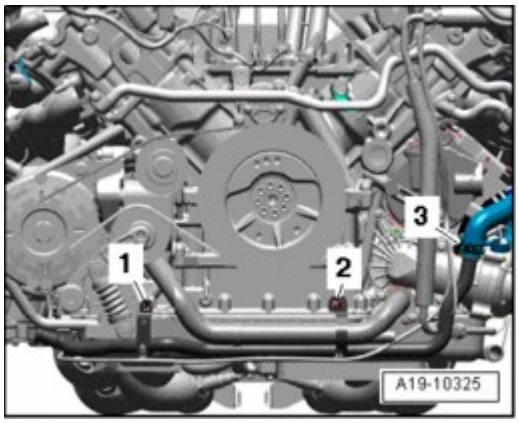

Fig. 469: Removing Bolts On Front Lower Coolant Pipe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **1** - and - **2** - and remove front lower coolant pipe from coolant hose - **3** -.

Installing

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

NOTE:

- **Secure all hose connections using hose clamps appropriate for the model type .**
- **During installation, all cable ties must be re-installed at the same location.**

- Fill with coolant --> **Cooling System, Draining and Filling** .

Tightening specifications

Component	Nm
Front lower coolant pipe to upper part of oil pan	9

Front Coolant Line, Removing and Installing

Front Coolant Line, Removing and Installing

Special tools, testers and auxiliary items required

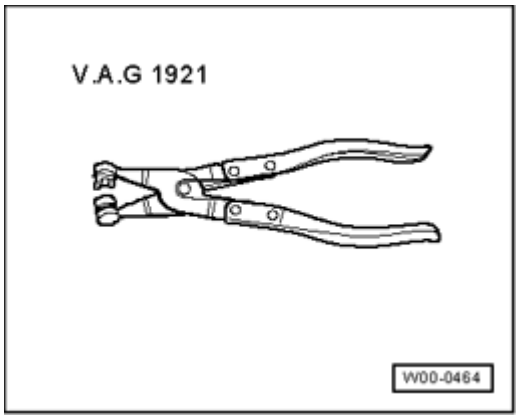

Fig. 470: Hose Clip Pliers V.A.G 1921
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Hose clamp pliers V.A.G 1921

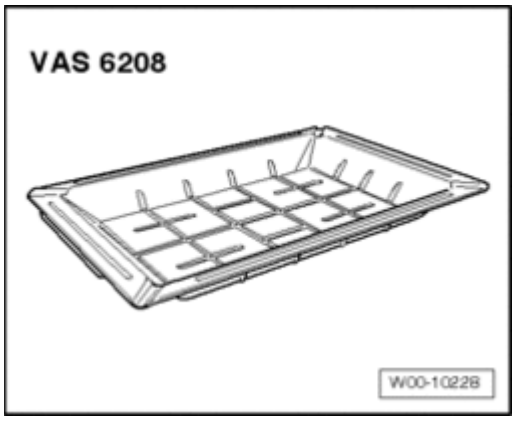

Fig. 471: Drip Tray For Workshop Crane VAS 6208
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Drip tray for workshop crane VAS 6208

Removing

- Drain coolant --> **Cooling System, Draining and Filling**.
- Remove generator --> **27 - STARTER, GENERATOR, CRUISE CONTROL** .

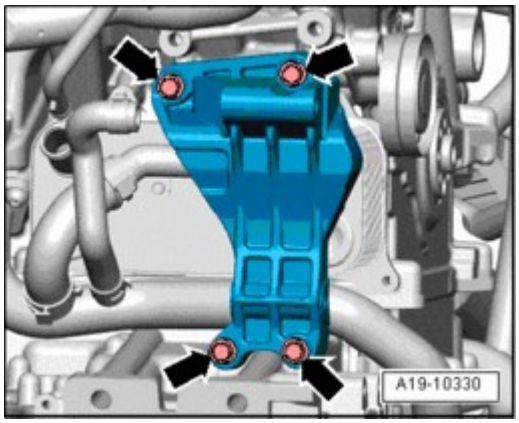

Fig. 472: Removing Bolts And Air Generator Bracket
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** - and remove air generator bracket.
- Remove front lower coolant pipe --> **Lower Front Coolant Line, Removing and Installing**.

NOTE:

- **Place a rag under separating point to catch escaping oil.**

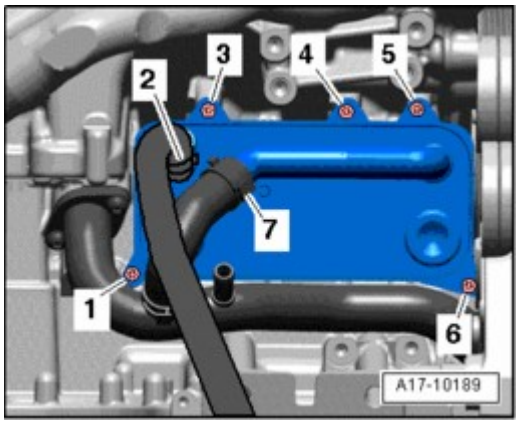

Fig. 473: Removing Coolant Hoses From Oil Cooler
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove coolant hoses - **2** - and - **7** -.
- Remove bolts - **1, 3, 4, 5, 6** - and remove oil cooler.

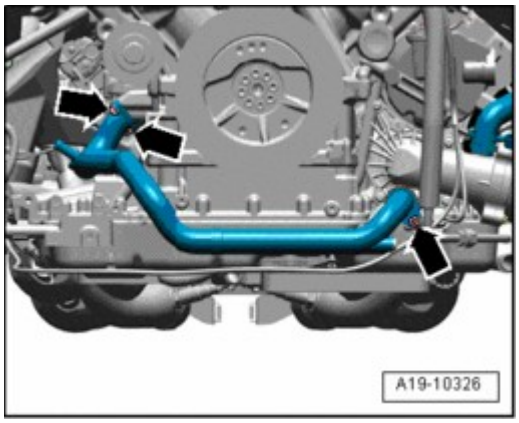

Fig. 474: Removing Bolts And Front Coolant Pipe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place drip tray for workshop crane VAS 6208 under engine.
- Remove bolts - **arrows** - and remove front coolant pipe.

Installing

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

NOTE:

- **Replace seals and O-rings.**

- Install oil cooler --> **Oil Cooler, Removing and Installing**.
- Install front lower coolant pipe --> **Lower Front Coolant Line, Removing and Installing**.
- Install generator --> **27 - STARTER, GENERATOR, CRUISE CONTROL** .
- Fill with coolant --> **Cooling System, Draining and Filling** .

Tightening Specifications

Component			Nm
Front coolant pipe to	Coolant pump		8 + 90° 1)2)
	Oil pan (upper section)		8 + 90° 1)2)
Generator bracket to engine		M8	22
		M10	46
1) Replace bolts. 2) 90° corresponds to a quarter turn.			

Rear Coolant Line, Removing and Installing

Rear Coolant Line, Removing and Installing

Special tools, testers and auxiliary items required

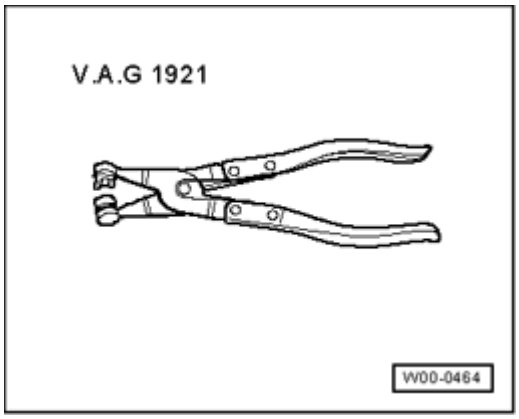

Fig. 475: Hose Clip Pliers V.A.G 1921
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Hose clamp pliers V.A.G 1921

Removing

NOTE:

- **All cable ties opened or cut during engine removal must be reinstalled at the same locations during installation.**

- Remove engine --> **Engine, Removing**.
- Leave engine with transmission installed on scissor lift platform VAS 6131.
- Remove left coolant pipe --> **Left Coolant Pipe, Removing and Installing**.
- Remove right coolant pipe --> **Right Coolant Pipe, Removing and Installing**.

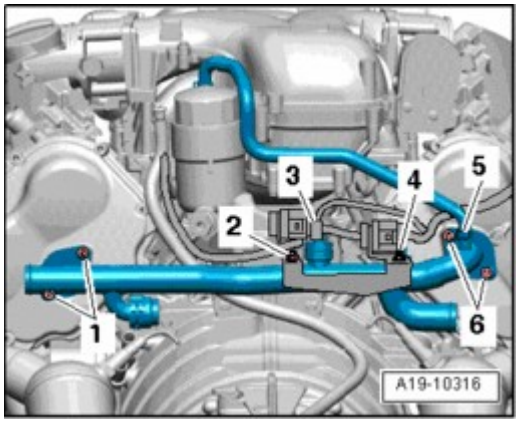

Fig. 476: Identifying Nuts, Bolts, Electrical Connector On Engine Coolant Temperature (ECT) Sensor G62 & Coolant Hose
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove nuts - **2** - and - **4** - and remove connector bracket from rear coolant pipe.
- Free up engine wiring harness on rear coolant pipe.
- Disconnect electrical connector - **3** - on Engine Coolant Temperature (ECT) Sensor G62.

- Disconnect coolant hose - **5** - from rear coolant pipe.
- Remove bolts - **1** - and - **6** - and remove rear coolant pipe.

Installing

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

NOTE:

- **Replace O-rings.**
- **During installation, all cable ties must be re-installed at the same location.**

- Clean or smooth O-ring sealing surfaces.
- Install left coolant pipe --> **Left Coolant Pipe, Removing and Installing**.
- Install right coolant pipe --> **Right Coolant Pipe, Removing and Installing**.
- Install engine --> **Engine, Installing**.

Tightening Specifications

Component	Nm
Rear coolant pipe to cylinder head	9
Connector bracket to rear coolant pipe	9

Left Coolant Pipe, Removing and Installing

Left Coolant Pipe, Removing and Installing

Special tools, testers and auxiliary items required

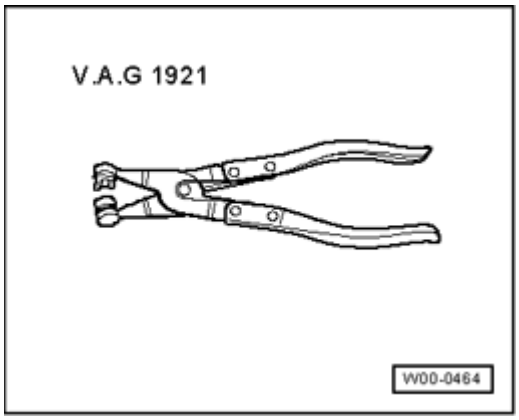

Fig. 477: Hose Clip Pliers V.A.G 1921
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Hose clamp pliers V.A.G 1921

Removing

- Remove engine --> **Engine, Removing**.
- Leave engine with transmission installed on scissor lift platform VAS 6131.

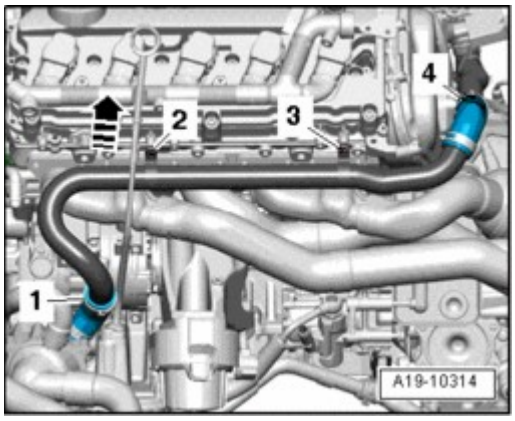

Fig. 478: Removing Bolts, Oil Dipstick Guide Tube Upward & Loosening Hose Clamps And Removing Left Coolant Pipe From Coolant Hoses
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **2** - and - **3** - and remove oil dipstick guide tube upward - **arrow** -.
- Loosen hose clamps - **1** - and - **4** - and remove left coolant pipe from coolant hoses.

Installing

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

NOTE:

- **Replace O-ring.**
- **Secure all hose connections using hose clamps appropriate for the model type .**

- Replace O-ring at guide tube for oil dipstick and insert guide tube into hole in oil pan (upper part).
- Install engine --> **Engine, Installing**.

Torque specifications

Component	Nm
Left coolant pipe to cylinder head	9

Lower Left Coolant Pipe, Removing and Installing

Lower Left Coolant Pipe, Removing and Installing

Special tools, testers and auxiliary items required

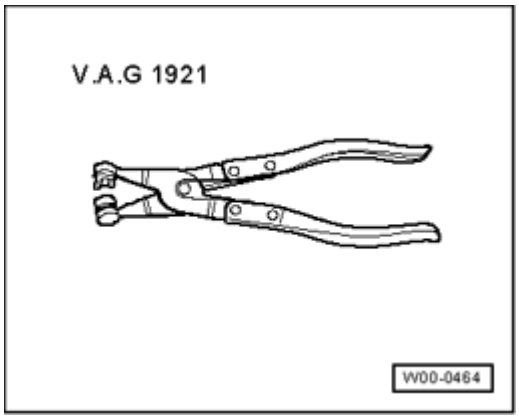

Fig. 479: Hose Clip Pliers V.A.G 1921
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Hose clamp pliers V.A.G 1921

Removing

- Drain coolant --> **Cooling System, Draining and Filling**.

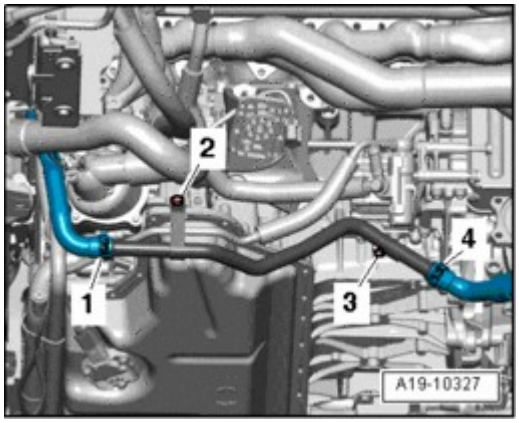

Fig. 480: Removing Nut And Bolt On Lower Left Coolant Pipe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove nut - **2** - and bolt - **3** -.
- Disconnect left coolant pipe from coolant hoses - **1** - and - **4** -.

Installing

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

NOTE:

- **Secure all hose connections using hose clamps appropriate for the model .**

- Fill with coolant --> **Cooling System, Draining and Filling** .

Tightening specifications

Component	Nm
Lower left coolant pipe to upper part of oil pan	9

Right Coolant Pipe, Removing and Installing

Right Coolant Pipe, Removing and Installing

Special tools, testers and auxiliary items required

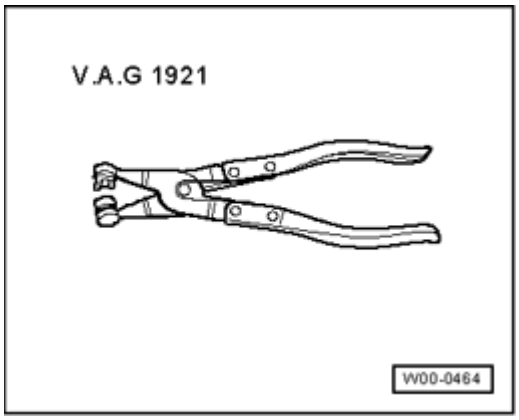

Fig. 481: Hose Clip Pliers V.A.G 1921
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Hose clamp pliers V.A.G 1921

Removing

- Remove engine --> **Engine, Removing**.
- Leave engine with transmission installed on scissor lift platform VAS 6131.

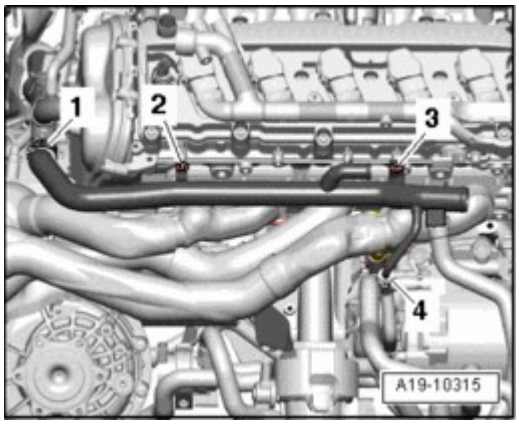

Fig. 482: Removing Bolts, Loosening Hose Clamps And Removing Right Coolant Pipe From Coolant Hoses
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **2** - and - **3** -.
- Loosen hose clamps - **1** - and - **4** - and remove right coolant pipe from coolant hoses.

Installing

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

NOTE:

- **Secure all hose connections using hose clamps appropriate for the model type .**

- Install engine --> **Engine, Installing**.

Tightening specifications

Component	Nm
Right coolant pipe to cylinder head	9

Radiator, Removing and Installing

Radiator, Removing and Installing

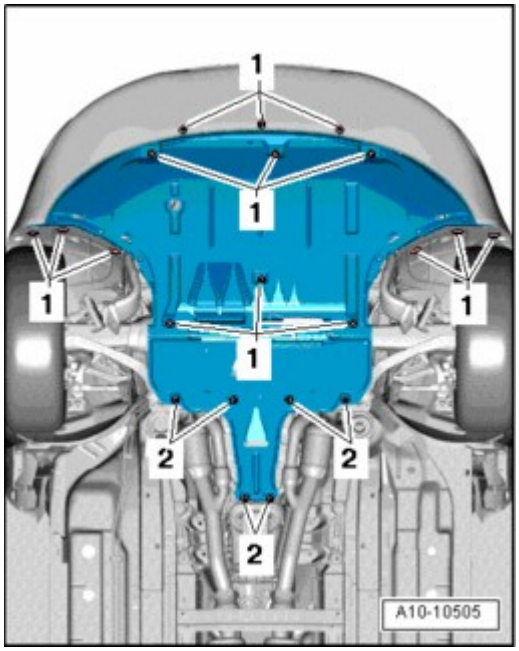

Fig. 483: Identifying Noise Insulation Quick-Release Fasteners
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Removing

NOTE:

- **When assembled correctly, radiator and condenser can show slight**

impressions on fins. This is not damage. Radiators or condensers should not be replaced because of slight impressions like these.

- Loosen quick-release fasteners - **1** - and remove front noise insulation.
- Remove front bumper cover --> **63 - BUMPERS** .

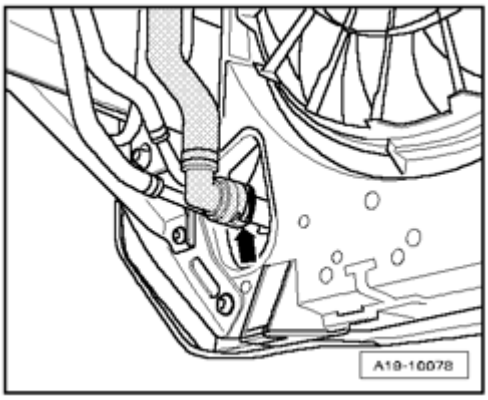

Fig. 484: Disconnecting Coolant Hose From Lower Left Of Radiator
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Drain coolant --> **Cooling System, Draining and Filling**.
- Disconnect left lower coolant hose - **arrow** - from radiator.

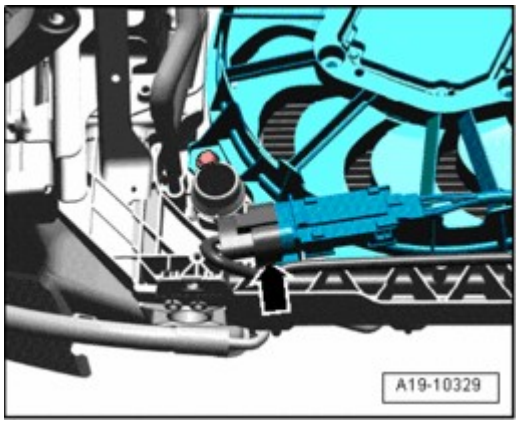

Fig. 485: Disengaging Electrical Connector From Bracket At Left Of Lock Carrier
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connector - **arrow** - and disengage it from bracket at left of lock carrier.

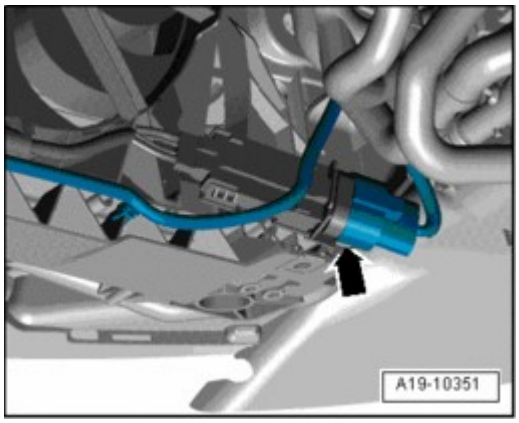

Fig. 486: Disconnecting Electrical Connector And Disengaging It From Bracket At Right Of Lock Carrier
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connector - **arrow** - and disengage it from bracket at right of lock carrier.

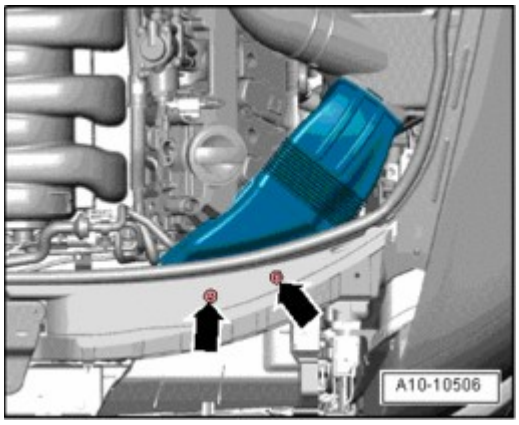

Fig. 487: Removing Bolts And Left Air Duct
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** - and remove left air duct.

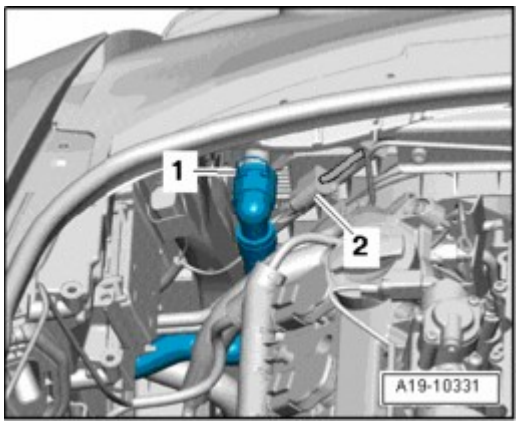

Fig. 488: Disconnecting Coolant Hose At Top Left Of Radiator & Removing Lid Lock Electrical

Connector From Bracket
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect coolant hose - **1** - at top left of radiator.
- Remove lid lock electrical connector - **2** - from bracket.

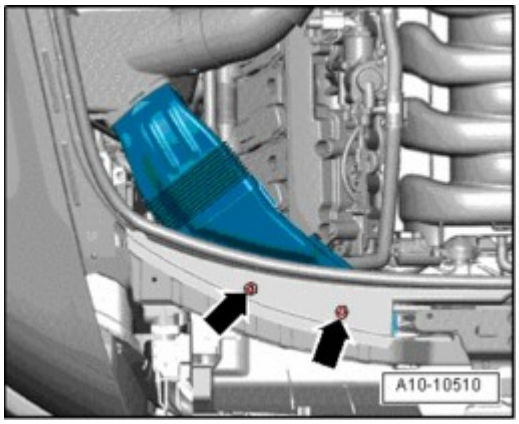

Fig. 489: Identifying Vacuum Hoses And Bolts For Right Air Guide
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** - and remove right air duct.

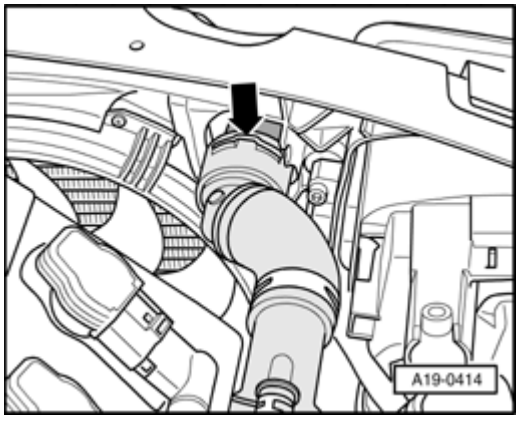

Fig. 490: Disconnecting Coolant Hose At Top Right From Radiator
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect coolant hose - **arrow** - at top right from radiator.

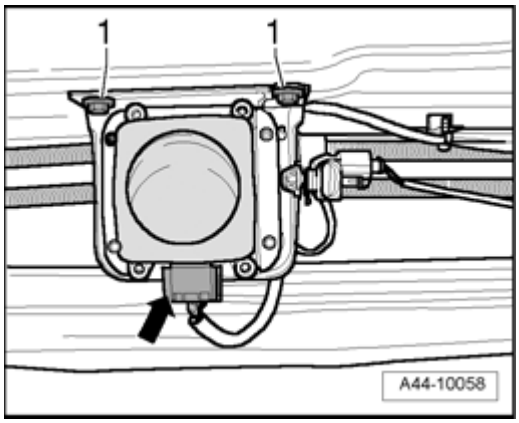

Fig. 491: Disconnecting Electrical Connector On Distance Regulation Control Module J428
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- If present, disconnect electrical connector - **arrow** - on Distance Regulation Control Module J428.

NOTE:

- **Ignore - 1 -.**

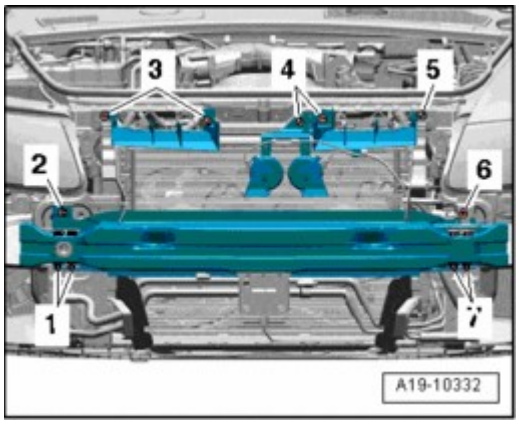

Fig. 492: Identifying Bolts, Headlamp Bracket, Bumper, Nuts & Air Ducts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **3** - and - **5** - and remove air ducts.
- Remove bolts - **4** - and remove bracket for horns; leave electrical connections intact.
- Unfasten bracket - **2** - and - **6** - for headlamp.
- Remove nuts - **1** - and - **7** - and remove bumper.

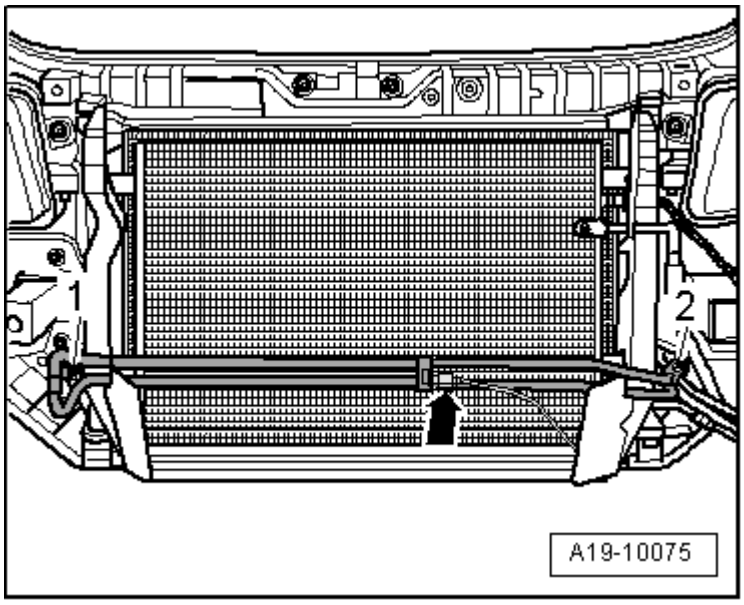

Fig. 493: Unclipping Outside Air Temperature Sensor G17 From Bracket & Removing Power Steering Cooling Coil Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Unclip Outside Air Temperature Sensor G17 - **arrow** - from bracket.
- Remove bolts - **1** - and - **2** - for power steering cooling coil; leave hydraulic hose connections intact.
- Remove air guides at left and right from radiator.

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

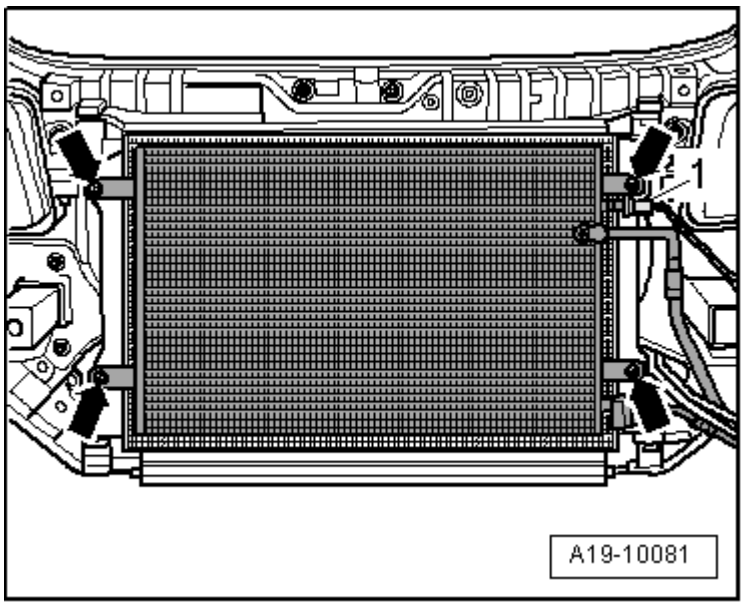

Fig. 494: Separating Electrical Connector & Removing Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connector - **1** -.
- Remove bolts - **arrows** -.

NOTE:

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

- Pivot condenser downward with lines connected.

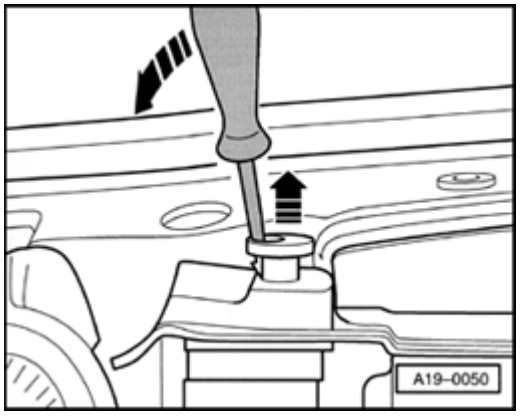

Fig. 495: Releasing Both Radiator Retaining Pins And Removing By Pulling Upward
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Release both radiator retaining pins and remove by pulling upward - **arrows** -.
- Swivel cooler forward and remove upward.

Installing

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

- Install bumper and front bumper cover --> **63 - BUMPERS** .
- Fill with coolant --> **Cooling System, Draining and Filling** .

NOTE:

- **Complete coolant must be replaced if the radiator was replaced.**

Tightening Specifications

Component	Nm
Condenser to lock carrier	6
Cooling coil for power steering to lock carrier	9
Bracket for horns to lock carrier	8

Left Auxiliary Cooler, Removing and Installing

Left Auxiliary Cooler, Removing and Installing

Removing

- Drain coolant --> **Cooling System, Draining and Filling**.
- Remove front bumper cover --> **63 - BUMPERS** .

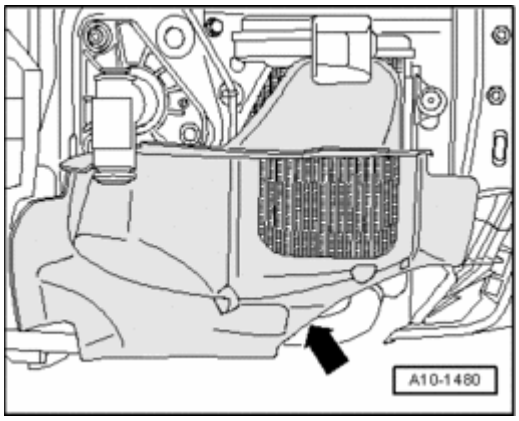

Fig. 496: Removing Air Duct In Front Of Left Auxiliary Cooler
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove air duct - **arrow** - in front of left auxiliary cooler.

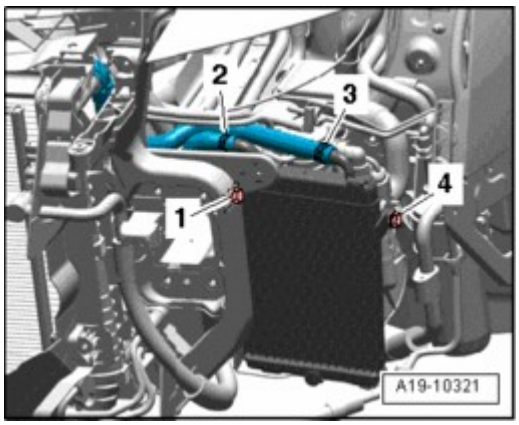

Fig. 497: Removing Bolts, Coolant Hoses, Left Auxiliary Cooler & Disengaging Auxiliary Cooler Downward From Bracket
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **1** - and - **4** - and disengage auxiliary cooler downward from bracket.
- Remove coolant hoses - **2** - and - **3** - and remove left auxiliary cooler.

NOTE:

- **To improve clarity, the illustration is shown with headlamp removed.**

Installing

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

NOTE:

- **Secure all hose connections using hose clamps appropriate for the model .**

- Install front bumper cover --> **63 - BUMPERS** .
- Fill with coolant --> **Cooling System, Draining and Filling** .

NOTE:

- **Complete coolant must be replaced if the radiator was replaced.**

Tightening specifications

Component	Nm
Left auxiliary cooler to bracket	9

Right Auxiliary Cooler, Removing and Installing

Right Auxiliary Cooler, Removing and Installing

Removing

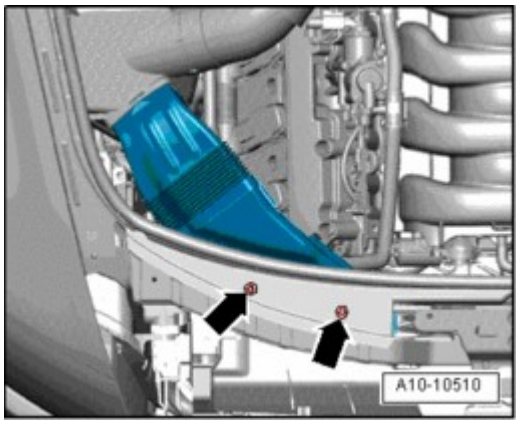

Fig. 498: Identifying Vacuum Hoses And Bolts For Right Air Guide
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** - and remove right air duct.

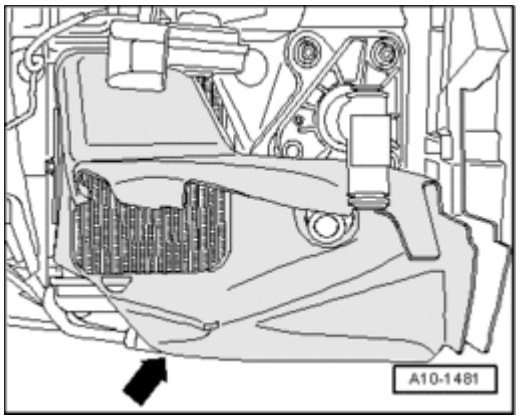

Fig. 499: Removing Right Air Guide In Front Of Auxiliary Cooler
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove front bumper cover --> **63 - BUMPERS** .
- Remove air duct - **arrow** - in front of right auxiliary cooler.

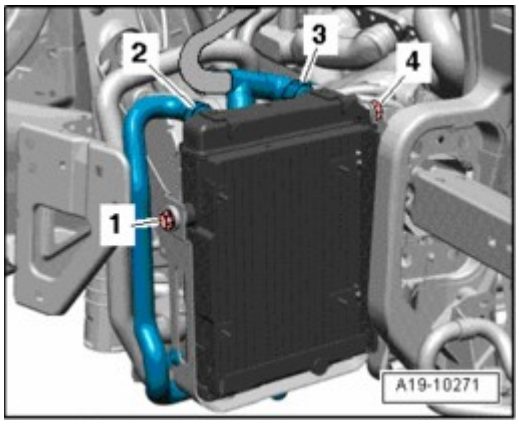

Fig. 500: Removing Bolts, Coolant Hoses, Right Auxiliary Cooler & Disengaging Auxiliary Cooler Downward From Bracket
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **1** - and - **4** - and disengage auxiliary cooler downward from bracket.
- Remove coolant hoses - **2** - and - **3** - and remove right auxiliary cooler.

NOTE:

- **To improve clarity, the illustration is shown with headlamp removed.**

Installing

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

NOTE:

- **Secure all hose connections using hose clamps appropriate for the model .**

- Install front bumper cover --> **63 - BUMPERS** .
- Fill with coolant --> **Cooling System, Draining and Filling** .

NOTE:

- **Complete coolant must be replaced if the radiator was replaced.**

Tightening specifications

Component	Nm
Right auxiliary cooler to bracket	9

Cooling System, Checking for Leaks

Cooling System, Checking for Leaks

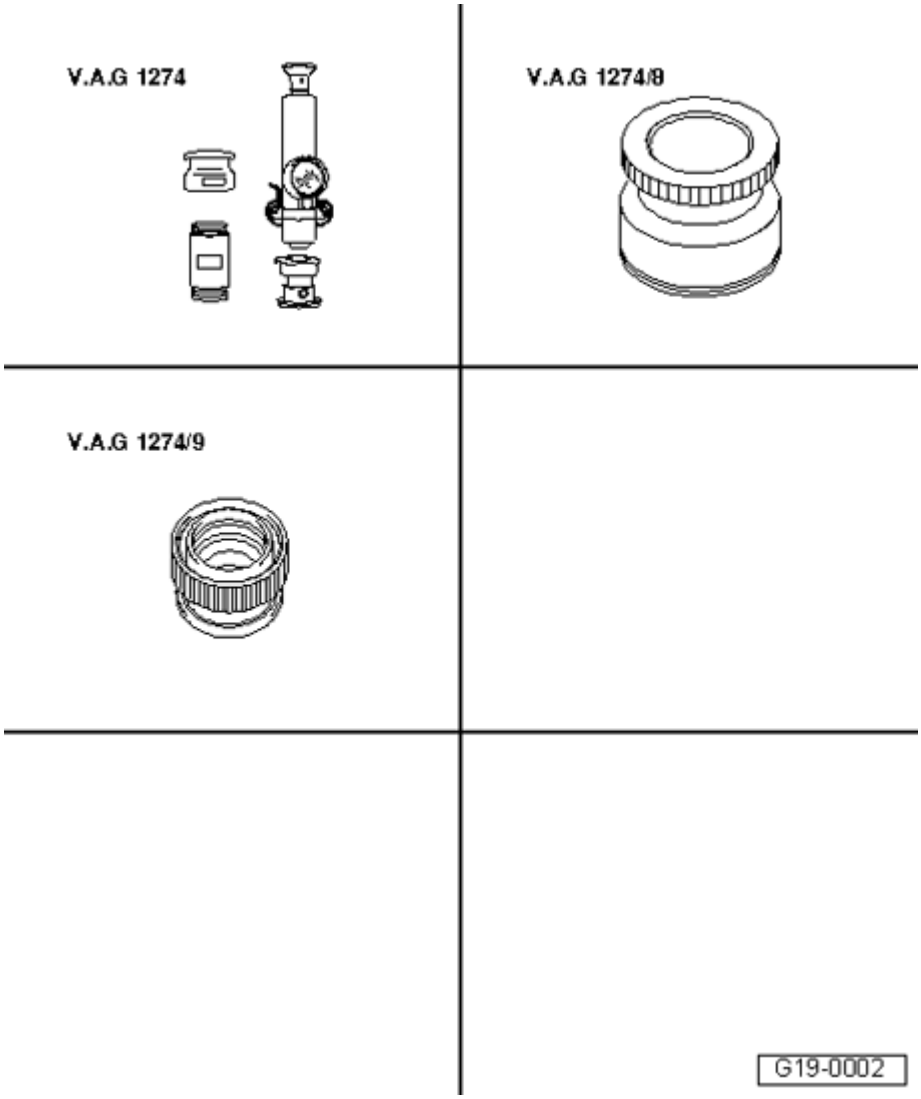

Fig. 501: Identifying Special Tools - Cooling System, Checking For Leaks
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Cooling system tester V.A.G 1274
- Adapter V.A.G 1274/8
- Adapter V.A.G 1274/9

Procedure

- Engine at operating temperature.

CAUTION: Cover cap of coolant expansion tank with rag and open carefully, as hot steam or hot coolant may escape when opening.

  - Open cap of coolant expansion tank.

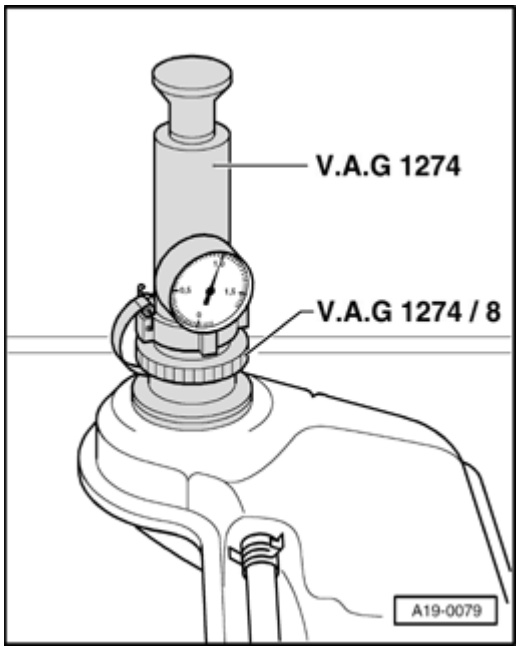

Fig. 502: Positioning Cooling System Tester V.A.G 1274 With Adapter V.A.G 1274/8 On Expansion Tank
Courtesy of VOLKSWAGEN UNITED STATES, INC.

  - Position cooling system tester V.A.G 1274 with adapter V.A.G 1274/8 on coolant expansion tank.
  - Generate a positive pressure of approx. 1.0 bar using hand pump of cooling system tester.

If pressure drops:

  - Look for leaks and fix them.

Pressure Relief Valve In Cap, Checking

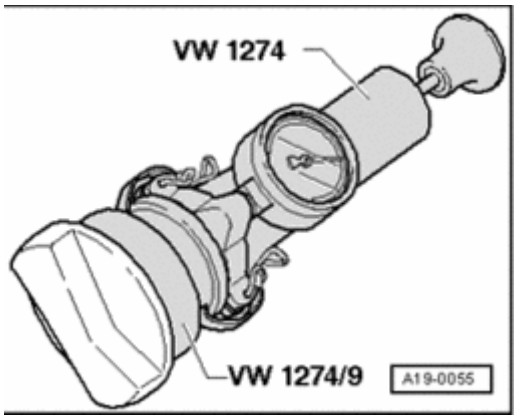

Fig. 503: Pressure Relief Valve In Cap, Checking
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position Cooling System Tester V.A.G 1274 With Adapter V.A.G 1274/9 On Cap.
- Generate A Positive Pressure Using Hand Pump Of Cooling System Tester.

- Pressure Release Valve Must Open At A Positive Pressure Of 1.4 To 1.6 Bar.

If Check-Valve Does Not Open As Indicated:

- Replace Cap.

Fan Shroud, Removing and Installing

Fan Shroud, Removing and Installing

Removing

- Drain coolant --> **Cooling System, Draining and Filling**.
- Remove radiator --> **Radiator, Removing and Installing**.

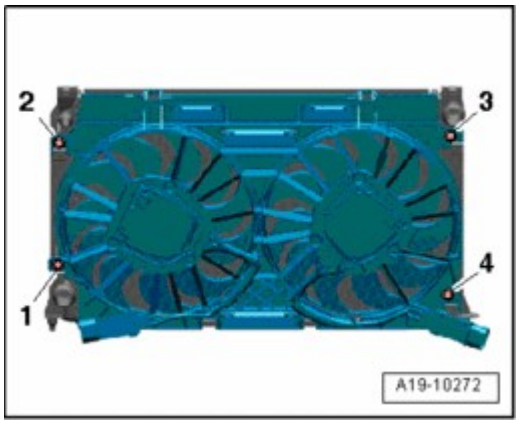

Fig. 504: Removing Screws And Fan Shroud
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove screws - **1 to 4** - and remove fan shroud.

Installing

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

- Install radiator --> **Radiator, Removing and Installing**.
- Fill with coolant --> **Cooling System, Draining and Filling** .

Tightening specifications

Component	Nm
Fan shroud to radiator	9

Coolant Fan, Removing and Installing

Coolant Fan, Removing and Installing

Removing

- Remove radiator --> **Radiator, Removing and Installing**.
- Remove fan shroud --> **Fan Shroud, Removing and Installing**.

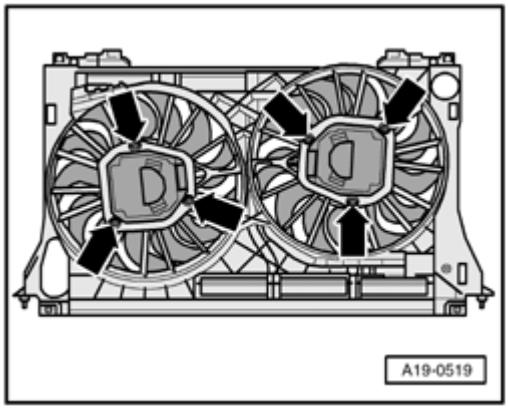

Fig. 505: Removing Coolant Fan Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** -.
- Unclip electrical harness connectors and expose electrical wires.
- Remove coolant fan.

Installing

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

- Install fan shroud --> **Fan Shroud, Removing and Installing**.
- Install radiator --> **Radiator, Removing and Installing**.
- Fill with coolant --> **Cooling System, Draining and Filling** .

Tightening specifications

Component	Nm
Coolant fan to fan shroud	10 1)
1) Replace bolts.	

26 - EXHAUST SYSTEM, EMISSION CONTROLS

EXHAUST SYSTEM COMPONENTS, REMOVING AND INSTALLING

Exhaust System Components, Removing and Installing

--> **Exhaust System, Component Overview**

--> **Center and Rear Mufflers, Separating**

--> **Left Exhaust System Tract, Removing and Installing**

--> **Right Exhaust System Tract, Removing and Installing**

--> **Left Y-Pipe, Removing and Installing**

--> **Right Y-Pipe, Removing and Installing**

--> **Left Front Muffler, Removing and Installing**

--> **Right Front Muffler, Removing and Installing**

--> **Exhaust System, Installing**

NOTE:

- **After exhaust system repairs, make sure exhaust system is not under stress and is far enough from the body. If necessary, loosen clamping sleeves and align mufflers and exhaust pipes so that there is adequate distance to vehicle body, and weight is evenly distributed among the exhaust hangers.**

Exhaust System, Component Overview

Exhaust System, Component Overview

Front exhaust system

NOTE:

- **The front exhaust system for cylinder bank 1 (right) is shown in the illustration.**

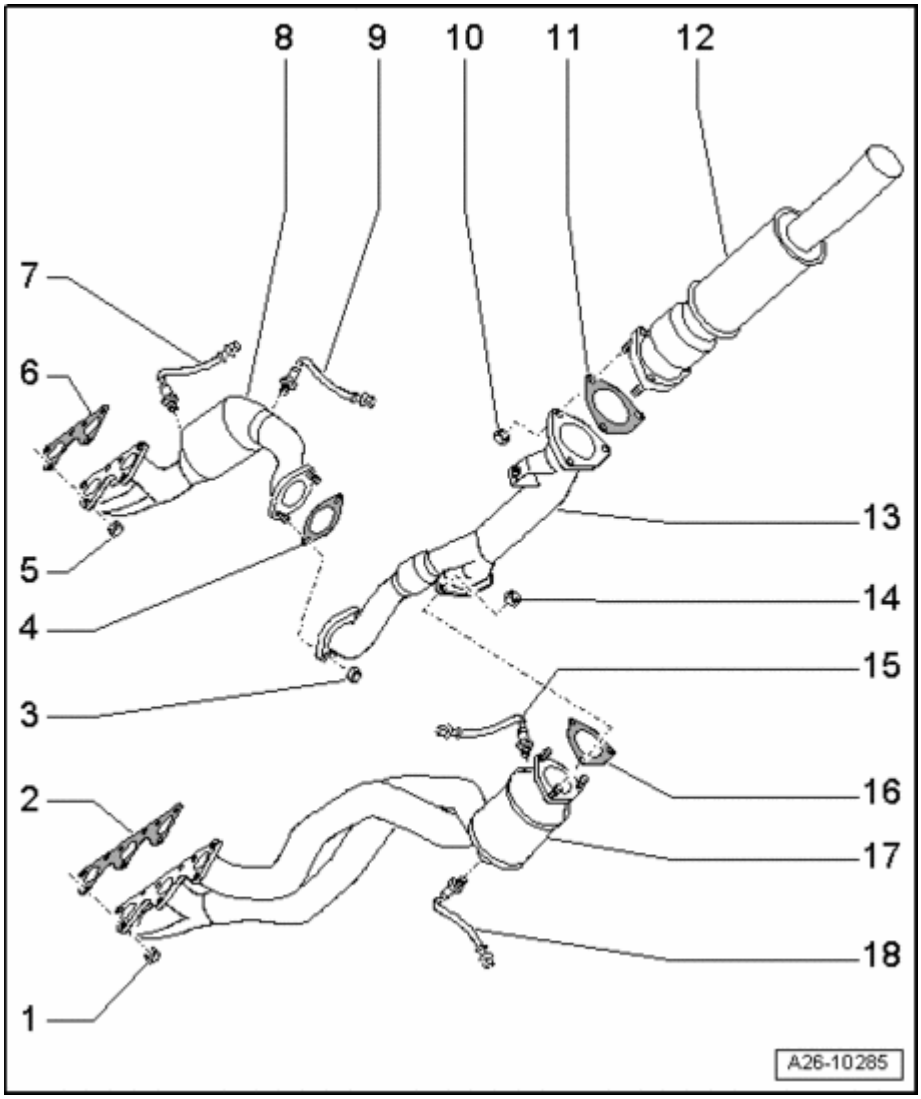

Fig. 506: Exhaust System, Component Overview - Front Exhaust System
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 25 Nm

- Replace
- Tightening torque and tightening sequence: left --> **Right Front Muffler, Removing and Installing** , right --> **Right Front Muffler, Removing and Installing**

2 - Gasket

- Replace

3 - 23 Nm

- Replace

4 - Gasket

- Replace

5 - 25 Nm

- Replace
- Tightening torque and tightening sequence: left --> **Right Front Muffler, Removing and Installing** , right --> **Right Front Muffler, Removing and Installing**

6 - Gasket

- Replace

7 - Heated Oxygen Sensor (HO2S) 2 G108 (before catalytic converter)

- For exhaust bank II (cylinder 4, 5)
- Threads of new oxygen sensors are coated with assembly paste
- When re-installing a used oxygen sensor, coat threads with hot bolt paste; hot bolt paste
- Assembly paste or hot bolt paste must not get onto slots of sensor body.

- Removing and installing --> **24 - MULTIPORT FUEL INJECTION (MFI)**
- Tighten to 55 Nm

8 - Rear exhaust manifold with catalytic converter

- For exhaust bank II (cylinder 4, 5)
- Protect from shocks and impact stress
- Removing and installing: Left --> **Left Exhaust System Tract, Removing and Installing** , right --> **Right Exhaust System Tract, Removing and Installing**.

9 - Oxygen Sensor (O2S) Behind Three Way Catalytic Converter (TWC) G131

- For exhaust bank II (cylinder 4, 5)
- Threads of new oxygen sensors are coated with assembly paste
- When re-installing a used oxygen sensor, coat threads with hot bolt paste; hot bolt paste
- Assembly paste or hot bolt paste must not get onto slots of sensor body.

- Removing and installing --> **24 - MULTIPORT FUEL INJECTION (MFI)**
- Tighten to 55 Nm

10 - 23 Nm

- Replace

11 - Gasket

- Replace

12 - Front muffler

- With flex joint
- Do not bend the decoupling element more than 10 or it could be damaged.
- Removing and installing: Left --> **Left Front Muffler, Removing and Installing** , right --> **Right Front Muffler, Removing and Installing**
- Install exhaust system free of stress --> **Exhaust System, Installing**

13 - Y pipe

- With flex joint
- Do not bend the decoupling element more than 10 or it could be damaged.
- Removing and installing: Left --> **Left Y-Pipe, Removing and Installing** , right --> **Right Y-Pipe, Removing and Installing**
- Install exhaust system free of stress --> **Exhaust System, Installing**

14 - 23 Nm

- Replace

15 - Oxygen Sensor (O2S) Behind Three Way Catalytic Converter (TWC) G130

- For exhaust bank I (cylinder 1, 2, 3)
- Threads of new oxygen sensors are coated with assembly paste
- When re-installing a used oxygen sensor, coat threads with hot bolt paste; hot bolt paste
- Assembly paste or hot bolt paste must not get onto slots of sensor body.

- Removing and installing --> **24 - MULTIPORT FUEL INJECTION (MFI)**
- Tighten to 55 Nm

16 - Gasket

- Replace

17 - Front exhaust manifold with catalytic converter

- For exhaust bank I (cylinder 1, 2, 3)

- Protect from shocks and impact stress
- Removing and installing: Left --> **Left Exhaust System Tract, Removing and Installing** , right --> **Right Exhaust System Tract, Removing and Installing**.

18 - Heated Oxygen Sensor (HO2S) G39 (before catalytic converter)

- For exhaust bank I (cylinder 1, 2, 3)
- Threads of new oxygen sensors are coated with assembly paste
- When re-installing a used oxygen sensor, coat threads with hot bolt paste; hot bolt paste
- Assembly paste or hot bolt paste must not get onto slots of sensor body.

- Removing and installing --> **24 - MULTIPORT FUEL INJECTION (MFI)**
- Tighten to 55 Nm

Exhaust system, rear

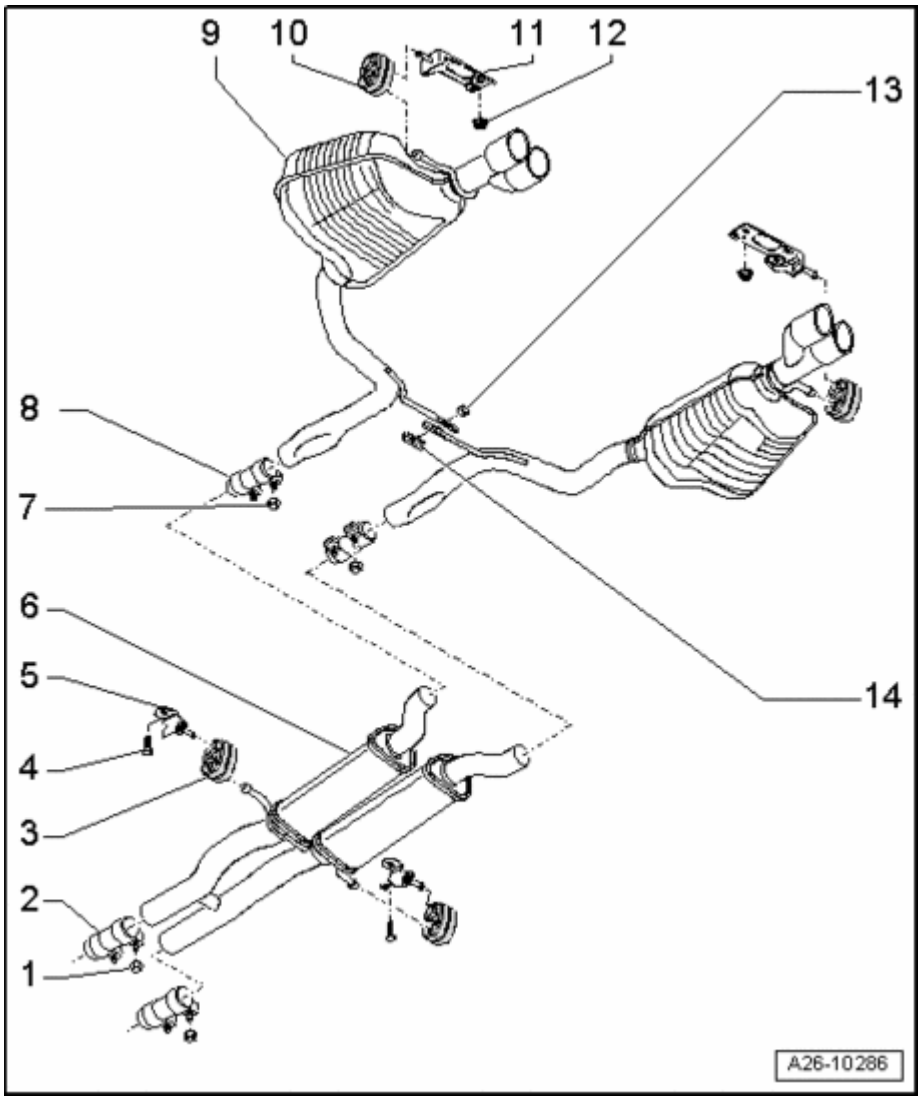

Fig. 507: Exhaust System, Component Overview - Exhaust System, Rear
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 23 Nm

2 - Front clamping sleeve

- Installed location --> **Installed position of front double clamps**
- Before tightening, align exhaust system tension-free --> **Exhaust System, Installing**
- Tighten threaded connections evenly.

3 - Retaining loop

- Replace if damaged

4 - 23 Nm

5 - Suspended mount

- Replace if damaged

6 - Center muffler

- Original equipment as one unit with rear muffler. For repairs, replace each separately.
- Separating point --> **Fig. 512**
- Install exhaust system free of stress --> **Exhaust System, Installing**

7 - 23 Nm

8 - Rear clamping sleeve

- For individual replacement of center and rear mufflers
- Installed location --> **Installed position of rear double clamps**
- Before tightening, align exhaust system tension-free --> **Exhaust System, Installing**
- Tighten threaded connections evenly.

9 - Rear muffler

- For left side of vehicle
- Original equipment as one unit with center muffler. For repairs, replace each separately.
- Separating point --> **Fig. 512**
- Install exhaust system free of stress --> **Exhaust System, Installing**

10 - Retaining loop

- Replace if damaged

11 - Suspended mount

- Replace if damaged

12 - 23 Nm

13 - 23 Nm

- Replace

14 - Clamping piece

Individual components of mounting

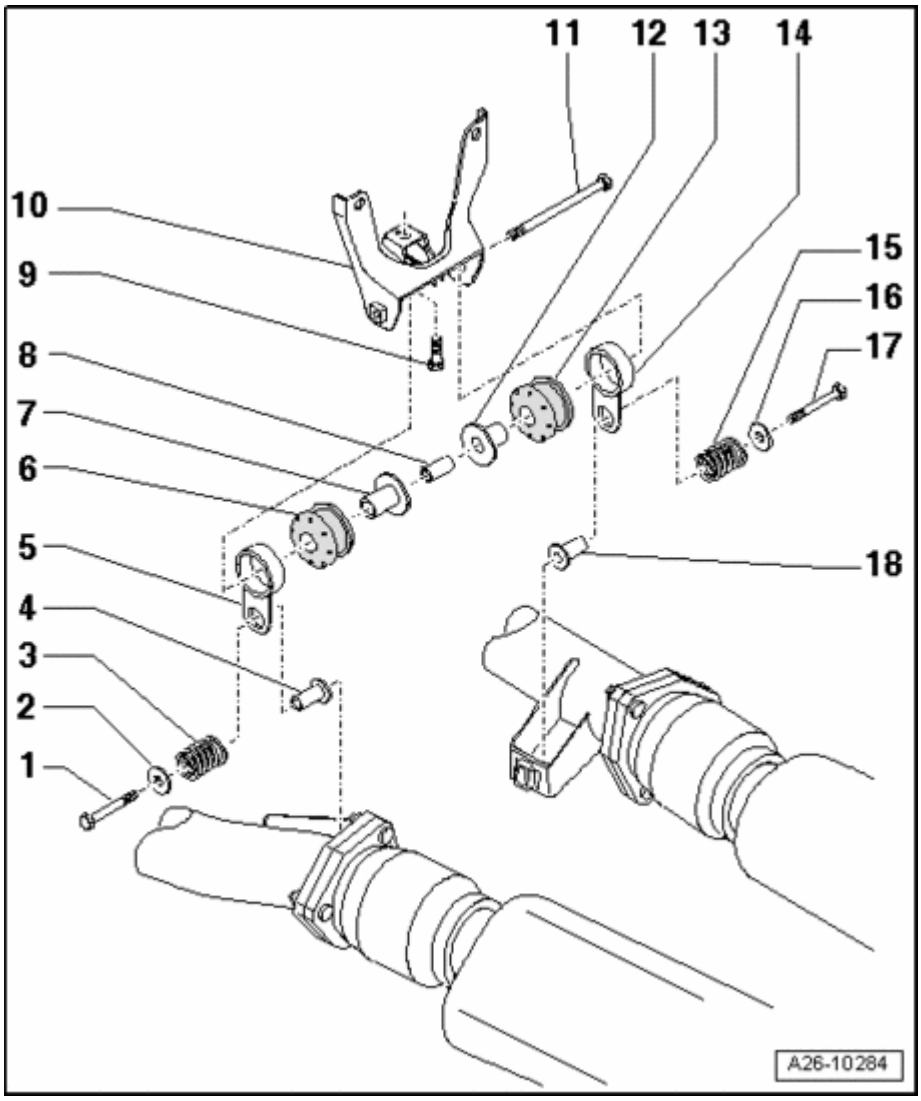

Fig. 508: Identifying Individual Components Of Mounting

Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 23 Nm

2 - Washer

3 - Spring

4 - Spacing sleeve

5 - Tab

6 - Buffer

7 - Spacing sleeve

8 - Sleeve

9 - 23 Nm

10 - Bracket

11 - 23 Nm

12 - Spacing sleeve

13 - Buffer

14 - Tab

15 - Spring

16 - Washer

17 - 23 Nm

18 - Spacing sleeve

Installed position of front double clamps

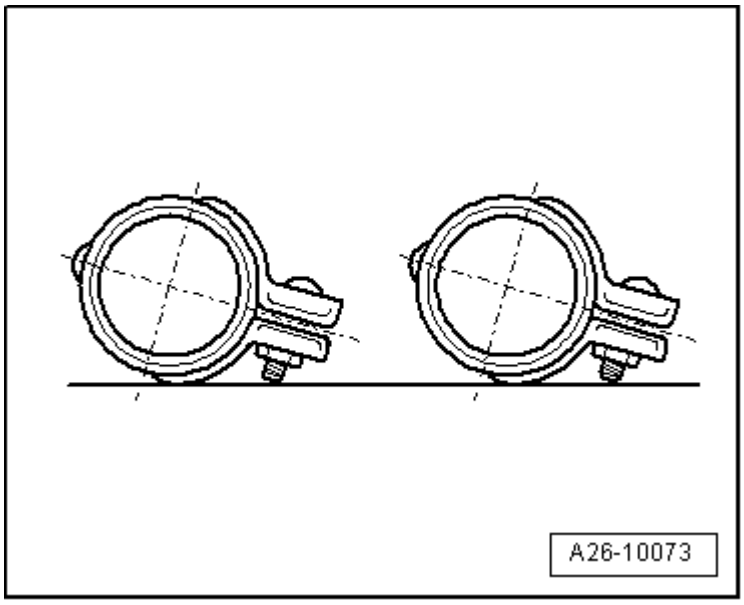

Fig. 509: Installed Position Of Front Double Clamps
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- When installing double clamps, ensure that the bolt ends do not project beyond lower edge of the double clamp.

- Threaded connections point toward the right.

Installed position of rear double clamps

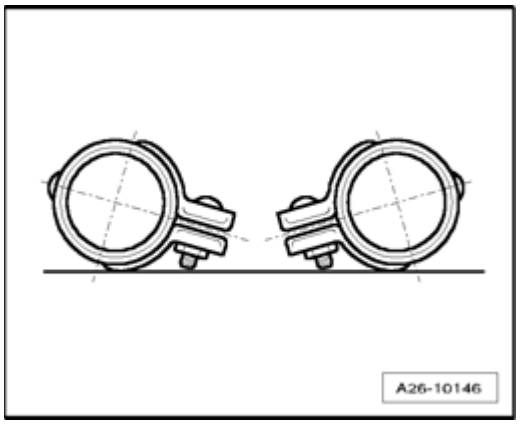

Fig. 510: Installed Position Of Front Double Clamps
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- When installing the double clamps, ensure that the bolt ends do not project beyond lower edge of the double clamp.

- The threaded connections face each other.

Center and Rear Mufflers, Separating

Center and Rear Mufflers, Separating

- A separating point has been provided in the connecting pipe for individual replacement of the center or rear muffler
- The separating point is marked by a depression around the circumference of the exhaust pipe.

Special tools, testers and auxiliary items required

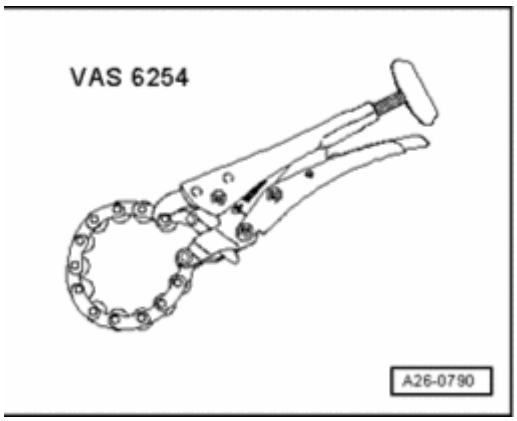

Fig. 511: Chain Pipe Cutter VAS 6254
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Chain pipe cutter VAS 6254

Procedure

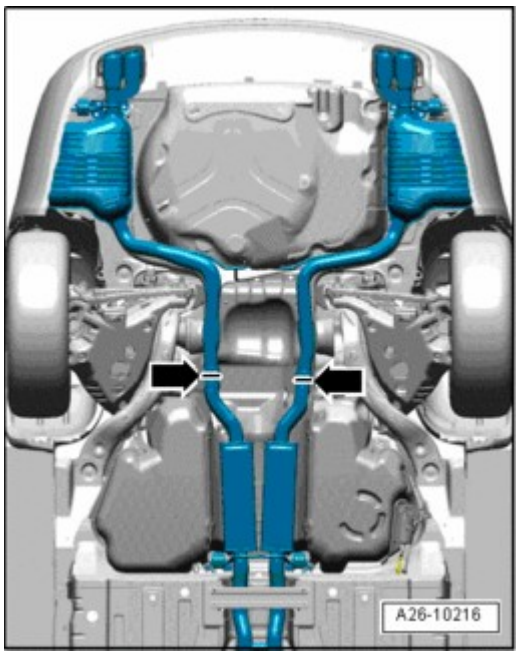

Fig. 512: Separating Exhaust Pipes At Separating Point Using Chain Pipe Cutter VAS 6254 At Right Angle
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Separate exhaust pipes at separating point - **arrows** - using chain pipe cutter VAS 6254 at a right angle.

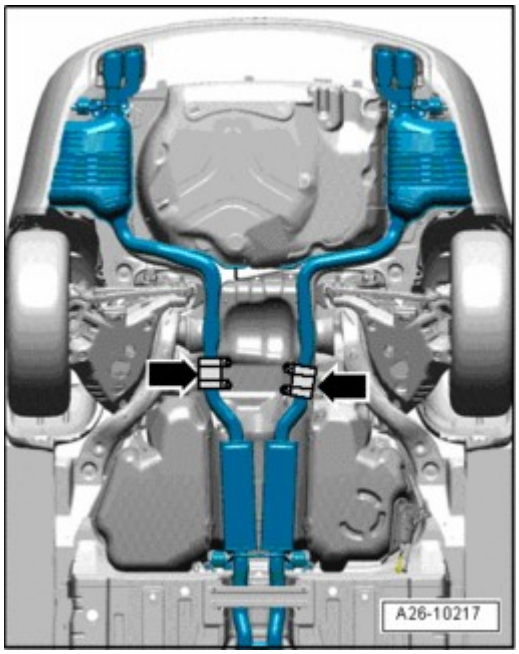

Fig. 513: Positioning Clamping Sleeves At Center Of Separating Cut
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position clamping sleeves - **arrows** - at center of separating cut.

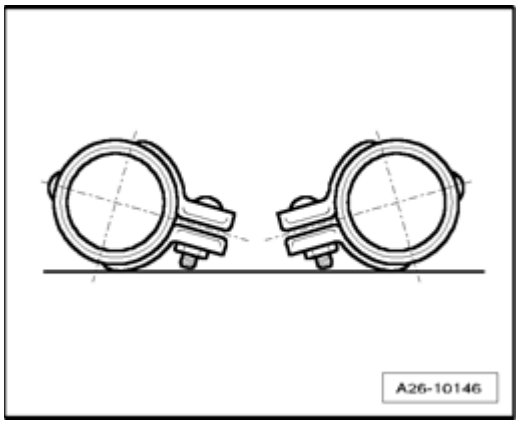

Fig. 514: Installed Position Of Front Double Clamps
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- When installing double clamps, ensure that the bolt ends do not project beyond lower edge of double clamp.

- The threaded connections face each other.

- Align exhaust system free of tension --> **Exhaust System, Installing**.

Left Exhaust System Tract, Removing and Installing

Left Exhaust System Tract, Removing and Installing

Removing

NOTE:

- **During installation, reinstall all heat insulation sleeves and heat shields at the same locations.**
- **All cable ties opened or cut during engine removal must be reinstalled at the same locations during installation.**

- Remove engine --> **Engine, Removing**.
- Leave engine with transmission installed on scissor lift platform VAS 6131.

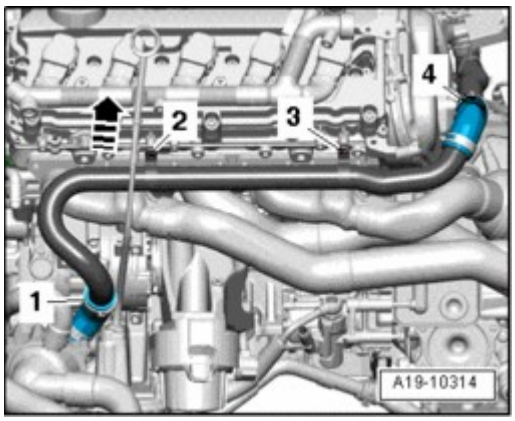

Fig. 515: Removing Bolts, Oil Dipstick Guide Tube Upward & Loosening Hose Clamps And Removing Left Coolant Pipe From Coolant Hoses
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **2** - and - **3** - and remove oil dipstick guide tube upward - **arrow** -.
- Loosen hose clamps - **1** - and - **4** - and remove left coolant pipe from coolant hoses.

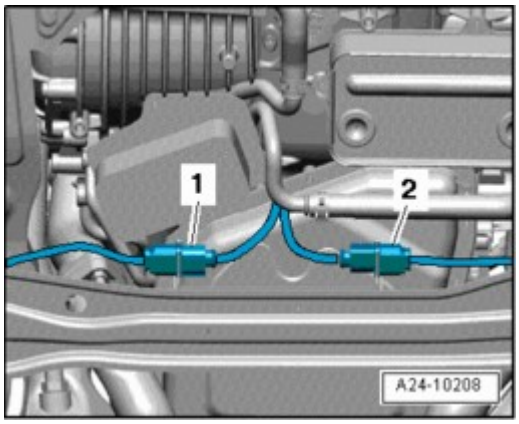

Fig. 516: Removing Electrical Connectors For Heated Oxygen Sensor (HO2S) G39 And For Heated Oxygen Sensor (HO2S) 3 G285 From Bracket

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove electrical connector - **2** - for Heated Oxygen Sensor (HO2S) 3 G285 (in front of catalytic converter) from bracket and disconnect it.

NOTE:

- **Ignore - 1 -.**

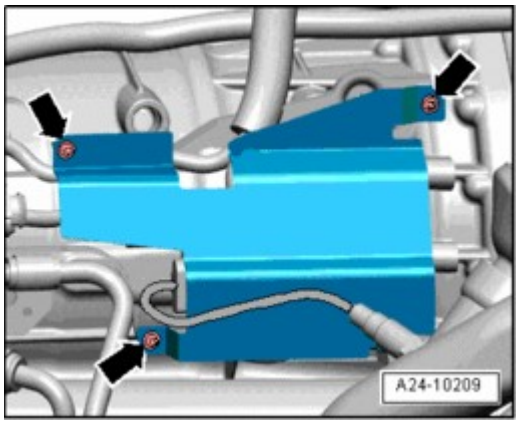

Fig. 517: Removing Right Oxygen Sensor Connection Heat Shield From Transmission
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove right oxygen sensor connection heat shield - **arrows** - from transmission.

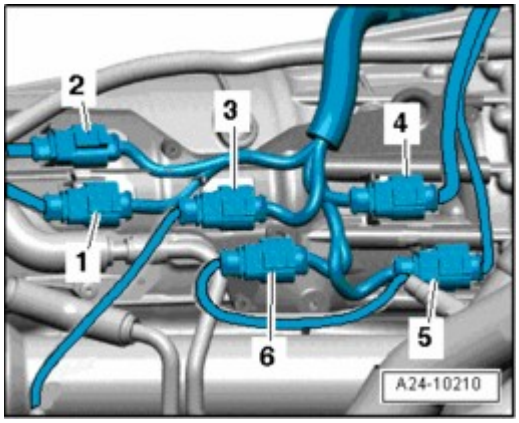

Fig. 518: Removing Oxygen Sensor Electrical Connectors From Bracket On Transmission
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove the following oxygen sensor electrical connectors from bracket on transmission and disconnect them.

1 - For Oxygen Sensor (O2S) 3 Behind Three Way Catalytic Converter (TWC) G287

2 - For Oxygen Sensor (O2S) 4 Behind Three Way Catalytic Converter (TWC) G288

4 - For Heated Oxygen Sensor (HO2S) 4 G286 (in front of catalytic converter)

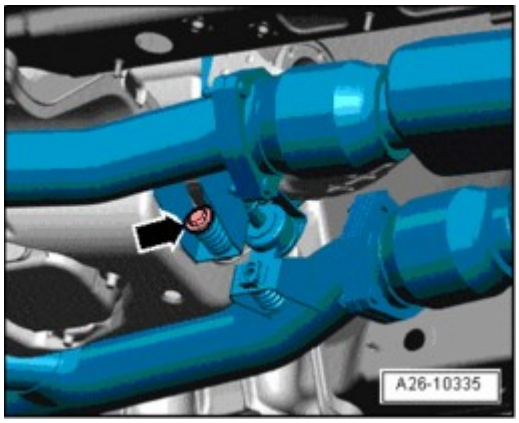

Fig. 519: Removing Bolt At Left Exhaust Tract Strap
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolt - **arrow** - at left exhaust tract strap.

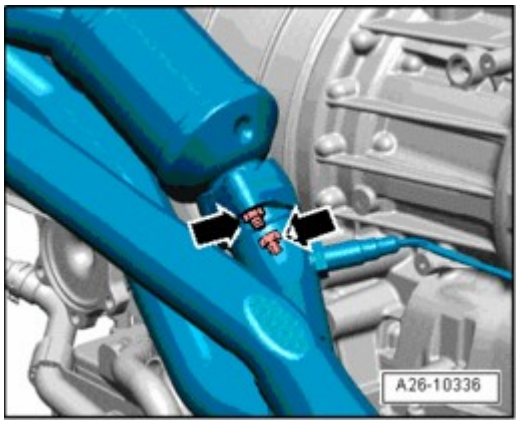

Fig. 520: Removing Nuts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove nuts - **arrows** -.

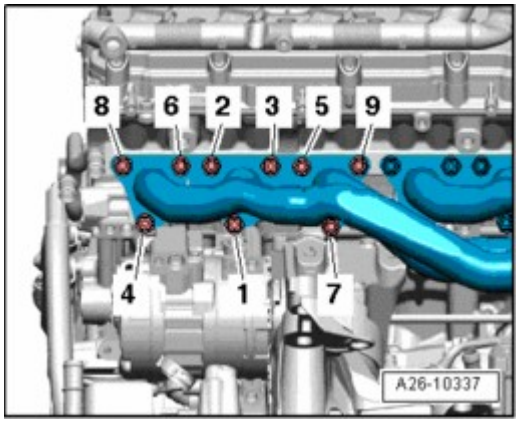

Fig. 521: Removing/Installing Nuts In Sequence And Left Front Exhaust Manifold With Catalytic Converter

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove nuts in - **9 to 1** - sequence and remove left front exhaust manifold with catalytic converter.

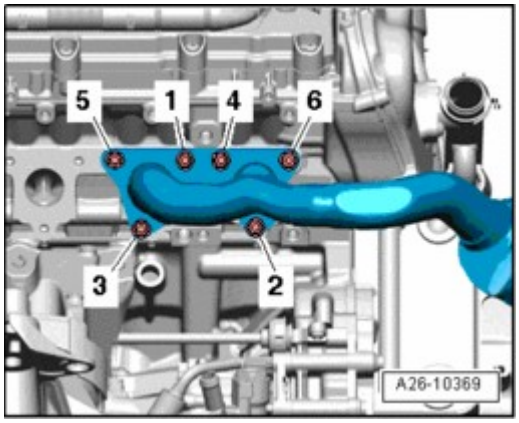

Fig. 522: Removing Nuts In Sequence And Left Rear Exhaust Manifold With Catalytic Converter
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove nuts in sequence - **6 to 1** - and remove left rear exhaust manifold with catalytic converter.

Installing

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

NOTE:

- **Replace gaskets and self-locking nuts.**
- **Secure all hose connections using hose clamps appropriate for the model .**
- **During installation, reinstall all heat insulation sleeves and heat shields at the same locations.**
- **During installation, all cable ties must be re-installed at the same location.**

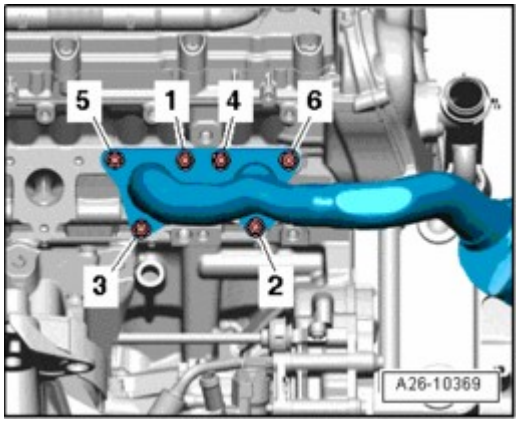

Fig. 523: Removing Nuts In Sequence And Left Rear Exhaust Manifold With Catalytic Converter
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position left rear exhaust manifold with catalytic converter on cylinder head and tighten nuts by hand.
- Tighten left rear exhaust manifold nuts in 2 stages as follows:
- Pre-tighten nuts in sequence - **1 to 6** - to 10 Nm.
- Pre-tighten nuts in sequence - **1 to 6** - to 25 Nm.

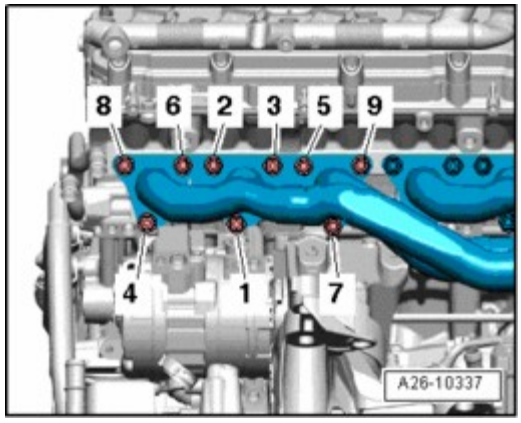

Fig. 524: Removing/Installing Nuts In Sequence And Left Front Exhaust Manifold With Catalytic Converter
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position left front exhaust manifold with catalytic converter on cylinder head and tighten nuts by hand.
- Tighten left front exhaust manifold nuts in 2 stages as follows:
- Pre-tighten nuts in sequence - **1 to 9** - to 10 Nm.
- Pre-tighten nuts in sequence - **1 to 9** - to 25 Nm.
- Install engine --> **Engine, Installing**.
- Align exhaust system free of tension --> **Exhaust System, Installing**.

Tightening Specifications

Component		Nm
Front exhaust manifold with catalytic converter to cylinder head		25 1)2)3)
Rear exhaust manifold with catalytic converter to	Cylinder head	25 1)2)3)
	Y pipe	23
Y pipe to strap		23
Coolant pipe to cylinder head		9
1) Replace nuts. 2) Grease with hot bolt paste; hot bolt paste . 3) Tighten in 2 stages.		

Right Exhaust System Tract, Removing and Installing

Right Exhaust System Tract, Removing and Installing

Removing

NOTE:

- **During installation, reinstall all heat insulation sleeves and heat shields at the same locations.**
- **All cable ties opened or cut during engine removal must be reinstalled at the same locations during installation.**

- Remove engine --> **Engine, Removing**.
- Leave engine with transmission installed on scissor lift platform VAS 6131.

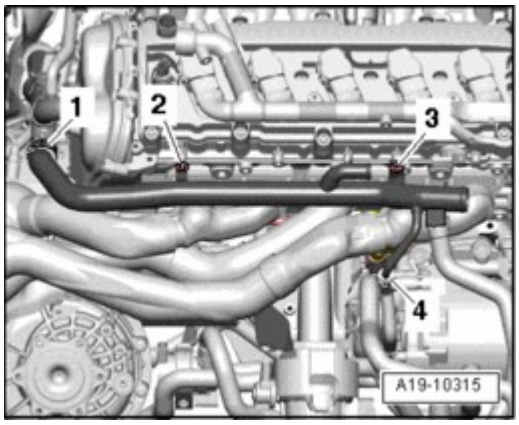

Fig. 525: Removing Bolts, Loosening Hose Clamps And Removing Right Coolant Pipe From Coolant Hoses
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **2** - and - **3** -.
- Loosen hose clamps - **1** - and - **4** - and remove right coolant pipe from coolant hoses.

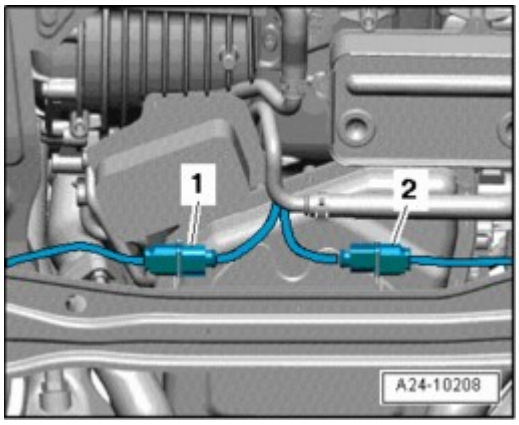

Fig. 526: Removing Electrical Connectors For Heated Oxygen Sensor (HO2S) G39 And For Heated Oxygen Sensor (HO2S) 3 G285 From Bracket
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove electrical connector - **1** - for Heated Oxygen Sensor (HO2S) G39 (in front of catalytic converter) from bracket and disconnect it.

NOTE:

- **Ignore - 2 -.**

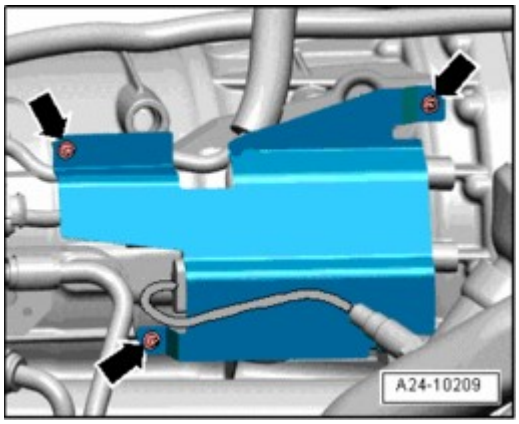

Fig. 527: Removing Right Oxygen Sensor Connection Heat Shield From Transmission
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove right oxygen sensor connection heat shield from transmission - **arrows** -.

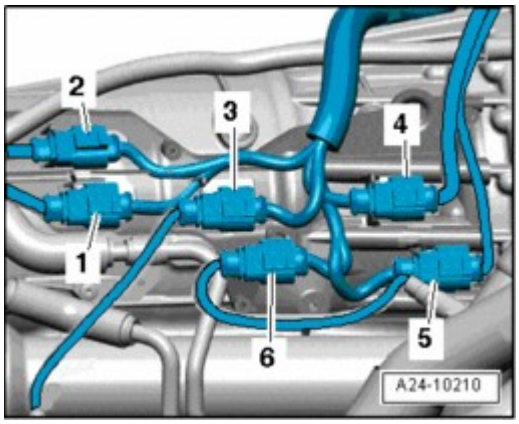

Fig. 528: Removing Oxygen Sensor Electrical Connectors From Bracket On Transmission
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove the following oxygen sensor electrical connectors from bracket on transmission and disconnect them.

3 - For Oxygen Sensor (O2S) Behind Three Way Catalytic Converter (TWC) G130

5 - For Heated Oxygen Sensor (HO2S) 2 G108 (in front of catalytic converter)

6 - For Oxygen Sensor (O2S) 2 Behind Three Way Catalytic Converter (TWC) G131

Fig. 529: Removing Bolt At Right Exhaust Tract Strap
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolt - **arrow** - at right exhaust tract strap.

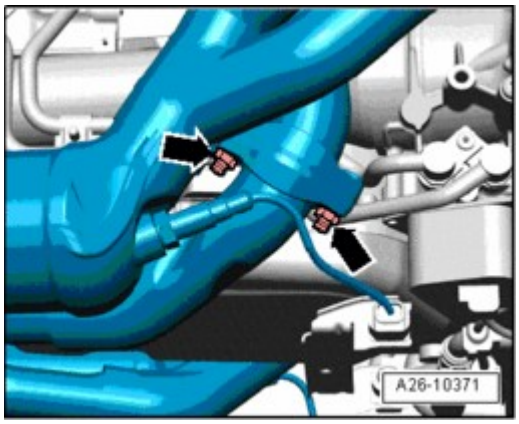

Fig. 530: Removing Nuts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove nuts - **arrows** -.

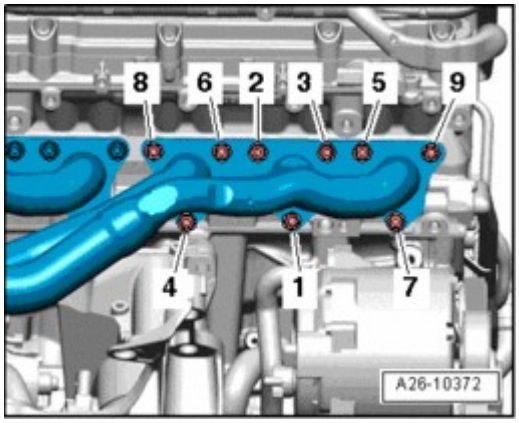

Fig. 531: Removing Nuts In Sequence And Right Front Exhaust Manifold With Catalytic Converter
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove nuts in - **9 to 1** - sequence and remove right front exhaust manifold with catalytic converter.

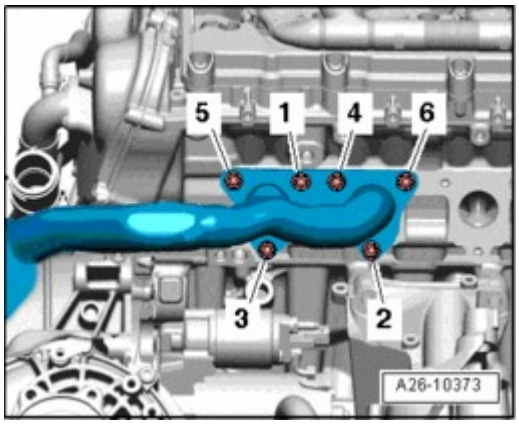

Fig. 532: Removing Nuts In Sequence And Right Rear Exhaust Manifold With Catalytic Converter
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove nuts in - **6 to 1** - sequence and remove right rear exhaust manifold with catalytic converter.

Installing

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

NOTE:

- **Replace gaskets and self-locking nuts.**
- **Secure all hose connections using hose clamps appropriate for the model .**
- **During installation, reinstall all heat insulation sleeves and heat shields at the same locations.**
- **During installation, all cable ties must be reinstalled at the same location.**

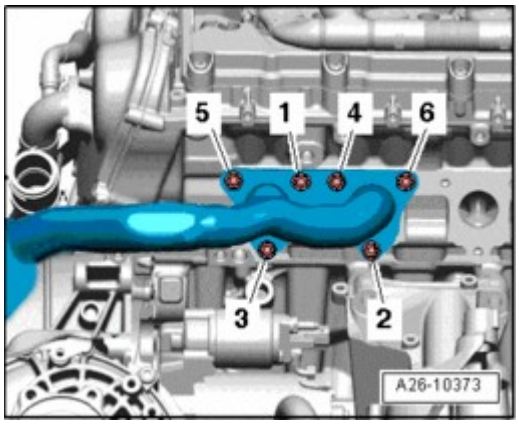

Fig. 533: Removing/Installing Nuts In Sequence And Right Rear Exhaust Manifold With Catalytic Converter
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position right rear exhaust manifold with catalytic converter on cylinder head and tighten nuts by hand.
- Tighten right rear exhaust manifold nuts in 2 stages as follows:
- Pre-tighten nuts in sequence - **1 to 6** - to 10 Nm.
- Pre-tighten nuts in sequence - **1 to 6** - to 25 Nm.

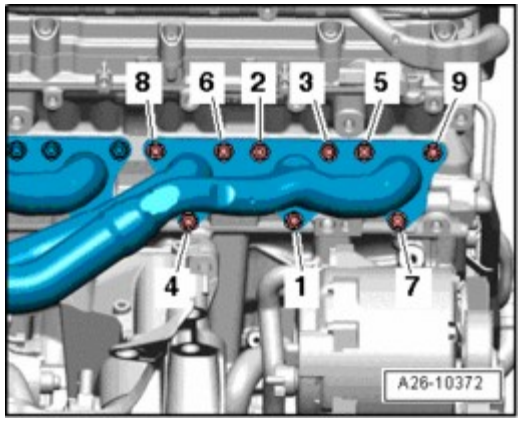

Fig. 534: Removing/Installing Nuts In Sequence And Right Front Exhaust Manifold With Catalytic Converter
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Position right front exhaust manifold with catalytic converter on cylinder head and tighten nuts by hand.
- Tighten right front exhaust manifold nuts in 2 stages as follows:
- Pre-tighten nuts in sequence - **1 to 9** - to 10 Nm.
- Pre-tighten nuts in sequence - **1 to 9** - to 25 Nm.
- Install engine --> **Engine, Installing**.
- Align exhaust system free of tension --> **Exhaust System, Installing**.

Tightening Specifications

Component		Nm
Front exhaust manifold with catalytic converter to cylinder head		25 1)2)3)
Rear exhaust manifold with catalytic converter to	Cylinder head	25 1)2)3)
	Y pipe	23
Y pipe to strap		23
Coolant pipe to cylinder head		9
1) Replace nuts. 2) Grease with hot bolt paste; hot bolt paste . 3) Tighten in 2 stages.		

Left Y-Pipe, Removing and Installing

Left Y-Pipe, Removing and Installing

Removing

- Remove engine --> **Engine, Removing**.
- Leave engine with transmission installed on scissor lift platform VAS 6131.
- Remove left exhaust system tract --> **Left Exhaust System Tract, Removing and Installing**.

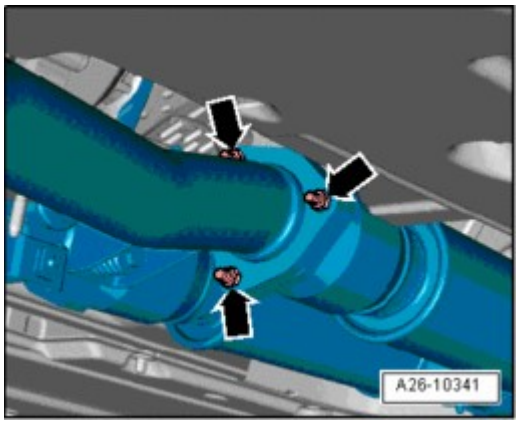

Fig. 535: Removing Nuts And Left Front Muffler From Y-Pipe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove nuts - **arrows** - and remove left front muffler from Y-pipe.

NOTE:

- **Shown installed in illustration.**

Installing

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

NOTE:

- **Replace gaskets and self-locking nuts.**

- Install left exhaust system tract --> **Left Exhaust System Tract, Removing and Installing**.
- Install engine --> **Engine, Installing**.
- Align exhaust system free of tension --> **Exhaust System, Installing**.

Tightening specifications

Component	Nm
Y pipe to front muffler	23 1)
1) Replace nuts.	

Right Y-Pipe, Removing and Installing

Right Y-Pipe, Removing and Installing

Removing

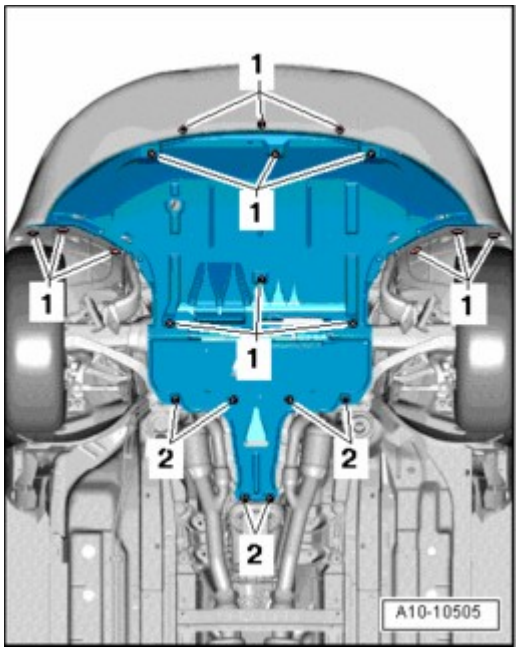

Fig. 536: Identifying Noise Insulation Quick-Release Fasteners
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen quick-release fasteners - **2** - and remove rear noise insulation.

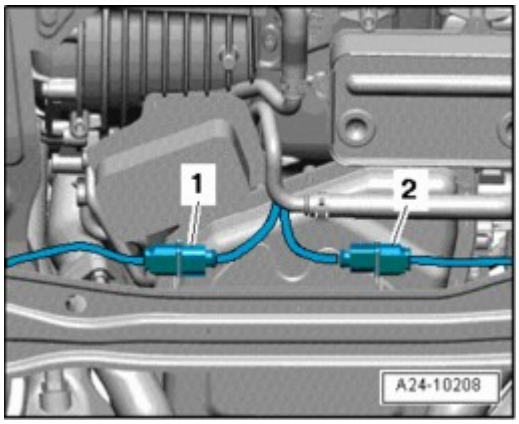

Fig. 537: Removing Electrical Connectors For Heated Oxygen Sensor (HO2S) G39 And For Heated Oxygen Sensor (HO2S) 3 G285 From Bracket
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove oxygen sensor electrical connectors - **1** - and - **2** - from bracket.
- Disconnect electrical connector - **1** -.

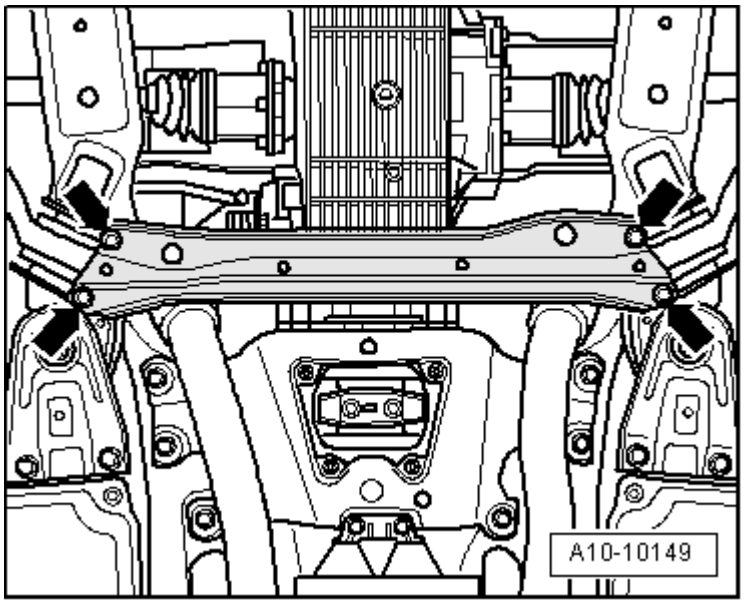

Fig. 538: Removing Subframe Transverse Beam
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove subframe transverse beam - **arrows** -.

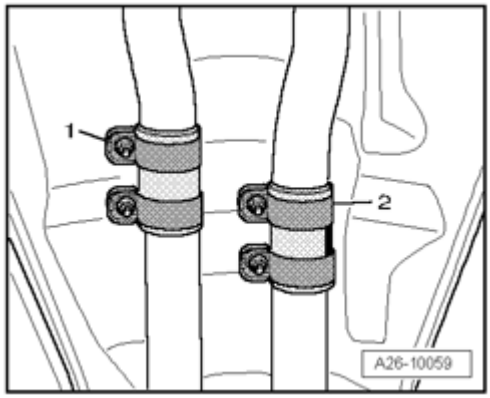

Fig. 539: Loosening Clamping Sleeves
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen right clamping sleeve - **1** - and slide it back.

Fig. 540: Removing Bolt At Right Exhaust Tract Strap
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolt - **arrow** - at right exhaust tract strap.

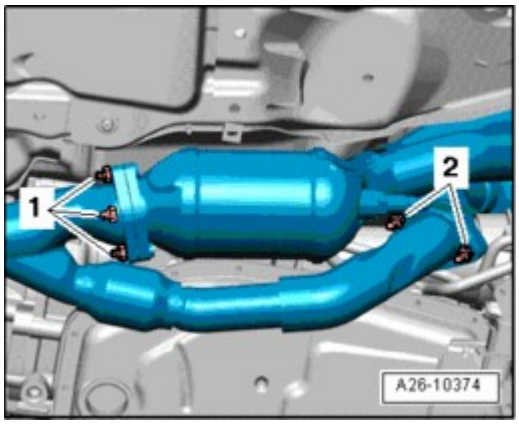

Fig. 541: Removing Nuts And Y-Pipe Together With Front Muffler
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove nuts - **1** - and - **2** - and remove Y-pipe together with front muffler.

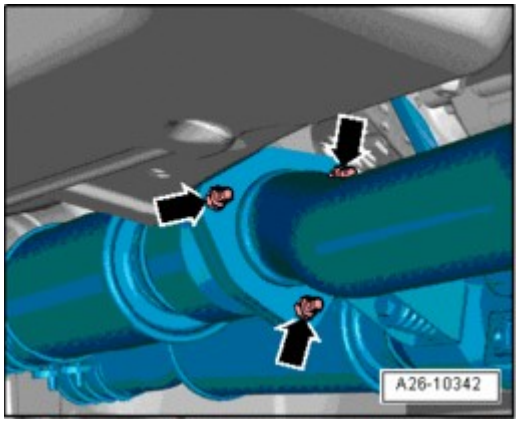

Fig. 542: Removing Nuts And Right Front Muffler From Y-Pipe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove nuts - **arrows** - and remove right front muffler from Y-pipe.

NOTE:

- **Shown installed in illustration.**

Installing

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

NOTE:

- **Replace gaskets and self-locking nuts.**

- Install subframe cross member --> **40 - FRONT SUSPENSION** .
- Align exhaust system free of tension --> **Exhaust System, Installing**.

Torque specifications

Component		Nm
Y-pipe to	Front muffler	23 1)
Catalytic converter		23 1)
1) Replace nuts.		

Left Front Muffler, Removing and Installing

Left Front Muffler, Removing and Installing

Removing

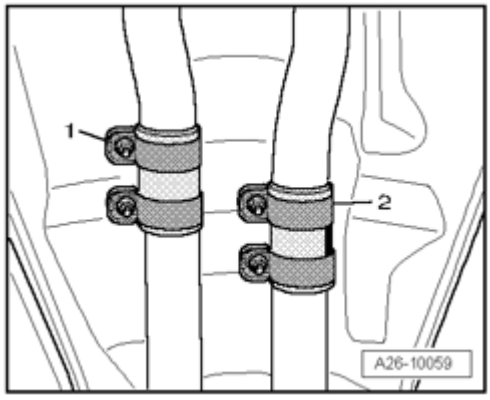

Fig. 543: Loosening Clamping Sleeves
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen left clamping sleeve - **2** - and slide it back.

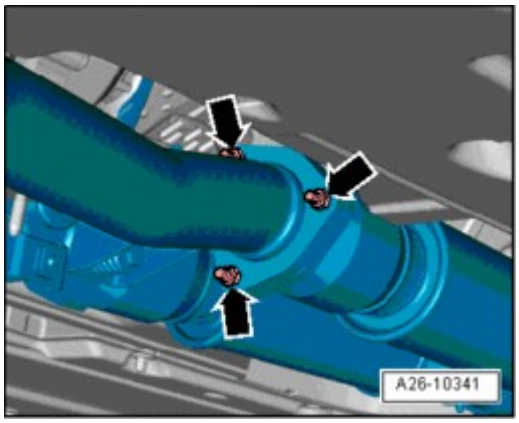

Fig. 544: Removing Nuts And Left Front Muffler From Y-Pipe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove nuts - **arrows** - and remove left front muffler from Y-pipe.

Installing

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

NOTE:

- **Replace gaskets and self-locking nuts.**

- Align exhaust system free of tension --> **Exhaust System, Installing**.

Tightening specifications

Component	Nm
Front muffler to Y pipe	23 1)
1) Replace nuts.	

Right Front Muffler, Removing and Installing

Right Front Muffler, Removing and Installing

Removing

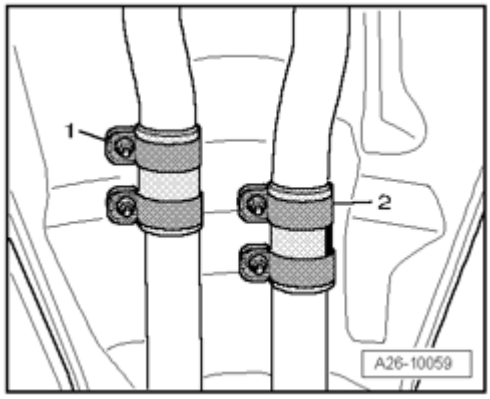

Fig. 545: Loosening Clamping Sleeves
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen right clamping sleeve - **1** - and slide it back.

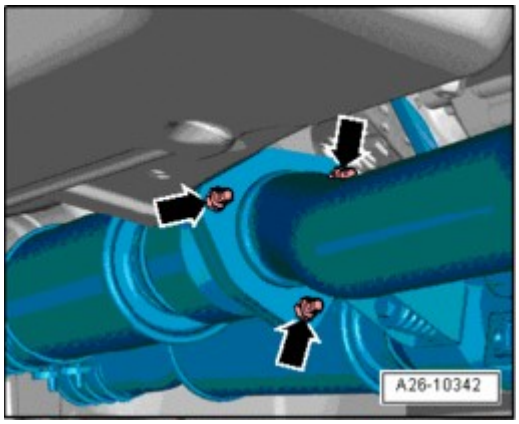

Fig. 546: Removing Nuts And Right Front Muffler From Y-Pipe
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove nuts - **arrows** - and remove right front muffler from Y-pipe.

Installing

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

NOTE:

- **Replace gaskets and self-locking nuts.**

- Align exhaust system free of tension --> **Exhaust System, Installing**.

Torque specifications

Component	Nm
Front muffler to Y pipe	23 1)
1) Replace nuts.	

Exhaust System, Installing

Exhaust System, Installing

- Align exhaust system when cold.

Vehicles without double clamps between center and rear muffler

- Loosen clamping sleeves bolts.

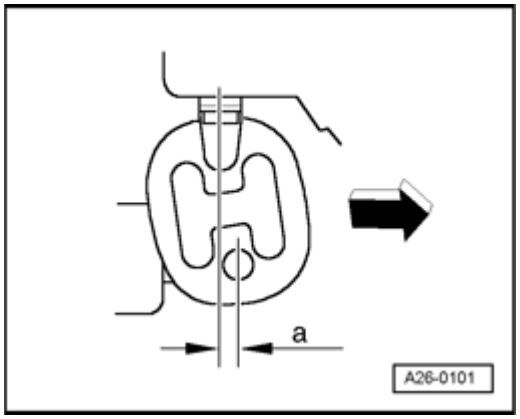

Fig. 547: Pushing Exhaust System Toward Front Of Vehicle
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press exhaust system forward - **arrow** - far enough until pretension on retaining loops at rear mufflers - **a** - = 13 to 17 mm.
- Tighten of clamping sleeve threaded connections evenly to 23 Nm.
- Align end pipes --> **Tailpipes, aligning** .

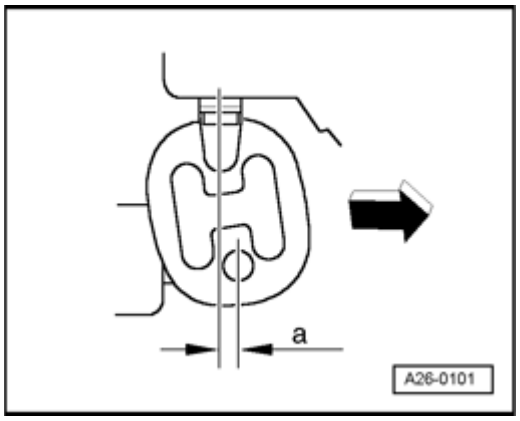

Fig. 548: Pushing Exhaust System Toward Front Of Vehicle
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Vehicles with double clamps between center and rear muffler

NOTE:

- **Only for vehicles with double clamps between center and rear mufflers, the center muffler must also be aligned.**

- Loosen bolts of double clamps and.
- Push forward part of exhaust system far enough forward - **arrow** - until pre-load on retaining loops on center muffler - **a** - = 9 to 13 mm.
- Tighten front clamping sleeve threaded connections evenly to 23 Nm.

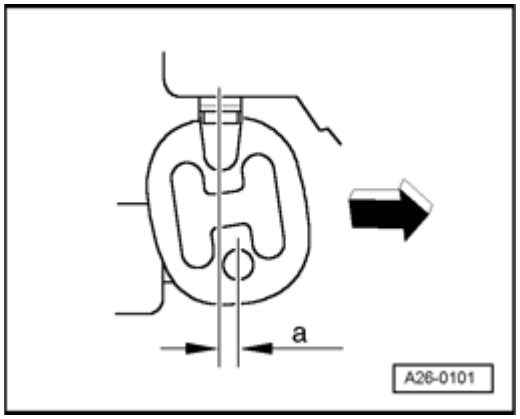

Fig. 549: Pushing Exhaust System Toward Front Of Vehicle
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Push rear part of exhaust system far enough forward - **arrow** - until pre-load on retaining loops at rear on rear muffler - **a** - = 13 to 17 mm.
- Align rear muffler horizontally.
- Tighten rear clamping sleeve threaded connections evenly to 23 Nm.
- Align end pipes.

Tailpipes, aligning

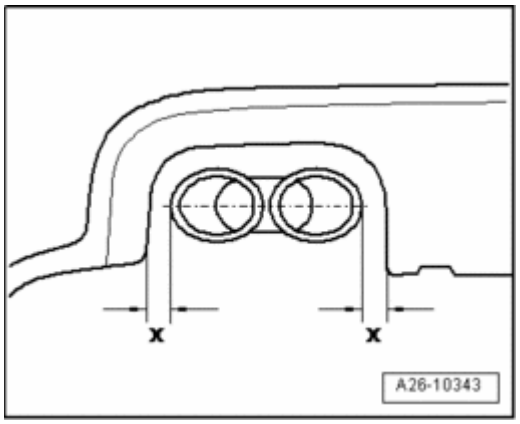

Fig. 550: Checking Distance Of End Pipes At Left/Right To Bumper Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Check distance of end pipes at left and right to bumper cover:

- Dimension - **x** - left = dimension - **x** - right.

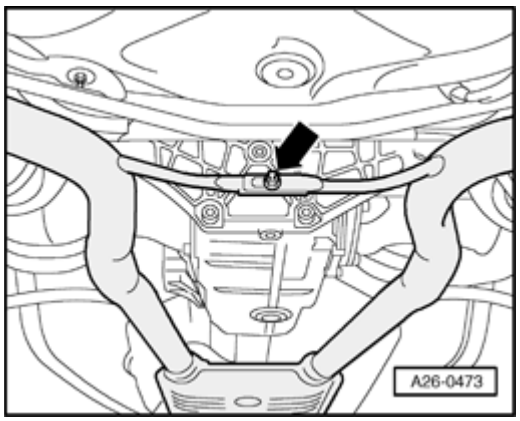

Fig. 551: Loosening Nut Of Brace Between Exhaust Pipes
Courtesy of VOLKSWAGEN UNITED STATES, INC.

If necessary, correct dimension "x" as follows:

- Loosen threaded connections - **arrow** - of brace between exhaust pipes.
- Adjust distance between rear mufflers.
- Tighten threaded fastener to 23 Nm.

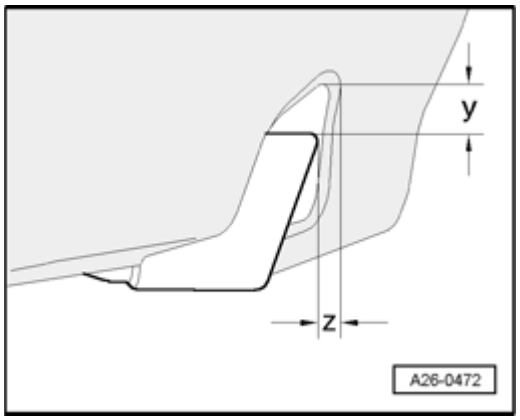

Fig. 552: Checking Distances Of End Pipes To Bumper Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Check distances - **y** - and - **z** - of end pipes to bumper cover:

- Dimension - **y** - = 18.5 to 23.0 mm.
- Dimension - **z** - sedan = 5.5. to 10.5 mm.
- Dimension - **z** - Avant = 11.5 to 16.5 mm.

- If necessary, check whether exhaust system is aligned tension-free --> **Exhaust System, Installing**.

SECONDARY AIR INJECTION, SERVICING

Secondary Air Injection, Servicing

--> **Principle and Function**

--> **Secondary Air Injection, Component Overview**

--> **Secondary Air Injection Pump, Removing and Installing**

--> **Secondary Air Injection Combination Valve, Checking**

--> **Secondary Air Injection Combination Valves, Removing and Installing**

Principle and Function

Principle and Function

Due to the rich mixture during the cold start phase, the exhaust emissions contain an increased level of unburned hydrocarbons. The Secondary Air Injection (AIR) system improves the secondary oxidation within the catalytic converter, thereby reducing harmful emissions. The heat released by secondary oxidation shortens the start-up time of the catalytic converter considerably, as well as significantly improves emissions quality during the cold-running phase.

- In the cold start phase, the engine control module controls the Secondary Air Injection (AIR) pump via the pump relay. Air reach secondary air injection combi-valves.
- The secondary air injection solenoid valve is activated in parallel which allows the vacuum to reach the secondary air injection combi-valves. The appropriate combination valve for Secondary Air Injection (AIR) thereby opens the path for secondary air to the exhaust channels of the cylinder head.

Secondary Air Injection, Component Overview

Secondary Air Injection, Component Overview

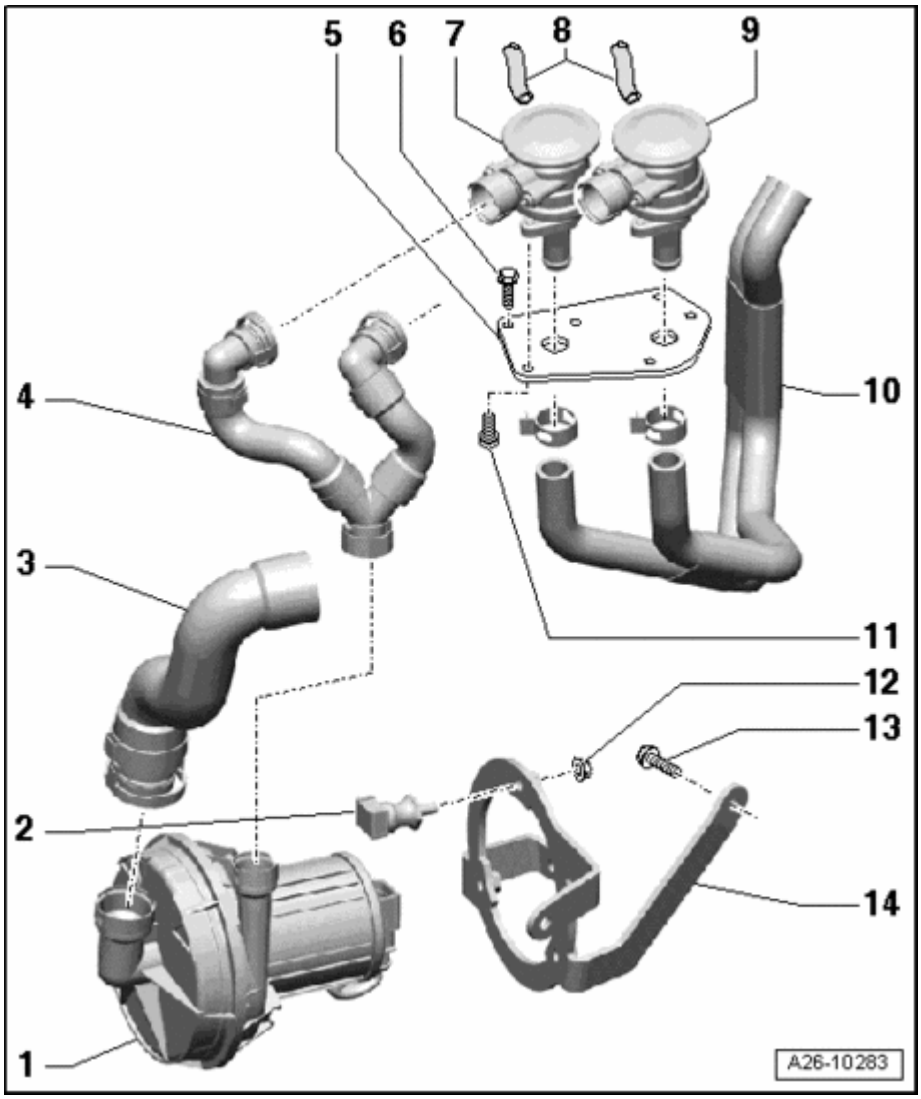

Fig. 553: Secondary Air Injection, Component Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Secondary Air Injection (AIR) Pump Motor V101

- Component location: At right front in engine compartment below longmember
- Removing and installing --> **Secondary Air Injection Pump, Removing and Installing**
- Check with Vehicle Diagnosis, Testing and Information System VAS 5051 in "Guided Fault-Finding" function

2 - Bonded rubber bushing

3 - Air guide hose

- From air filter

4 - Air guide hose

- From Secondary Air Injection (AIR) Pump Motor V101 to secondary air injection combi-valves

5 - Bracket

6 - 9 Nm

7 - Secondary Air Injection (AIR) combi-valve

- Component location: Left front in engine compartment
- Checking --> **Secondary Air Injection Combination Valve, Checking**
- Removing and installing --> **Secondary Air Injection Combination Valves, Removing and Installing**

8 - Vacuum hoses

9 - Secondary Air Injection (AIR) combi-valve

- Component location: Left front in engine compartment
- Checking --> **Secondary Air Injection Combination Valve, Checking**
- Removing and installing --> **Secondary Air Injection Combination Valves, Removing and Installing**

10 - Air guide hose

- To engine

11 - 9 Nm

12 - 9 Nm

13 - 9 Nm

14 - Bracket

Secondary Air Injection (AIR) Pump Relay J299 and Secondary Air Injection (AIR) Pump Fuse S130 installation location

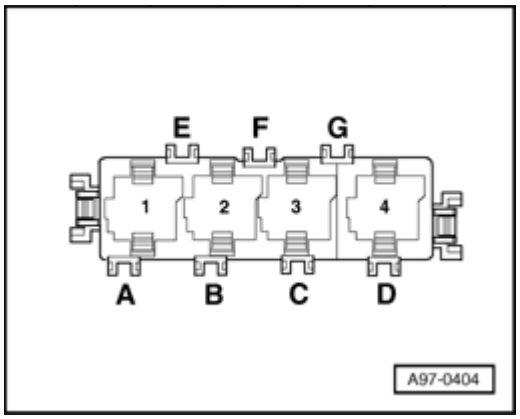

Fig. 554: Secondary Air Injection (AIR) Pump Relay J299 And Secondary Air Injection (AIR) Pump Fuse S130 Installation Location
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- In E-box, plenum chamber, passengers side.

1 - Secondary Air Injection (AIR) Pump Relay J299

B - Secondary Air Injection (AIR) Pump Fuse S130 (50 A)

Secondary Air Injection Pump, Removing and Installing

Secondary Air Injection Pump, Removing and Installing

Removing

NOTE:

- **All cable ties opened or cut during engine removal must be reinstalled at the same locations during installation.**

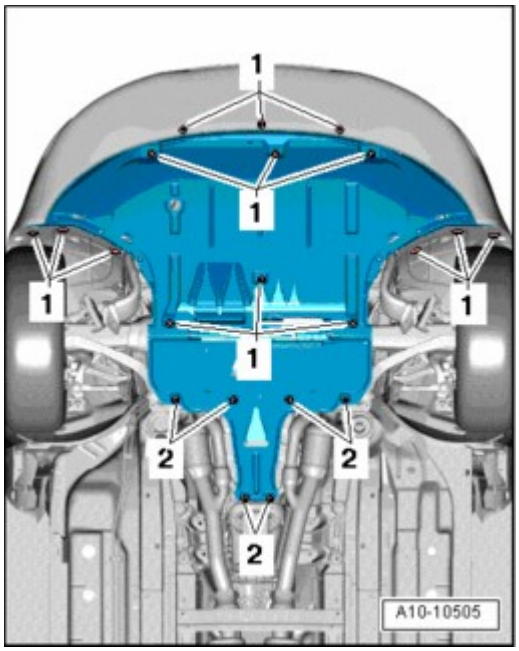

Fig. 555: Identifying Noise Insulation Quick-Release Fasteners
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen quick-release fasteners - **1** - and remove front noise insulation.

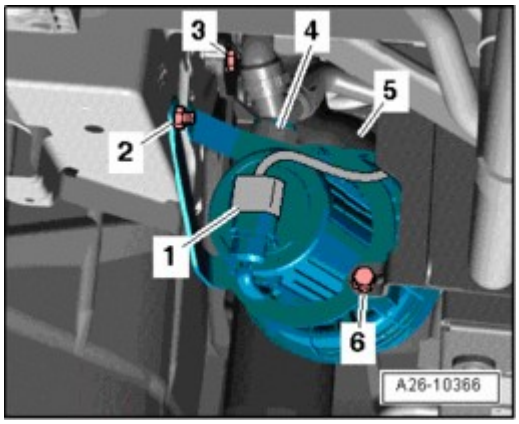

Fig. 556: Identifying Electrical Connector, Air Guide Hoses, Nut/Bolts & Secondary Air Injection Pump
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Separate electrical connector - **1** -.
- Remove air guide hoses - **4** - and - **5** - from secondary air injection pump by pressing release buttons.
- Remove nut or bolts - **2, 3, 6** - and remove secondary air injection pump.

Installing

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

NOTE:

- **During installation, all cable ties must be re-installed at the same location.**

Tightening Specifications

Component	Nm
Secondary Air Injection (AIR) pump to bracket	9
Secondary Air Injection (AIR) pump bracket to body	9

Secondary Air Injection Combination Valve, Checking

Secondary Air Injection Combination Valve, Checking

Special tools, testers and auxiliary items required

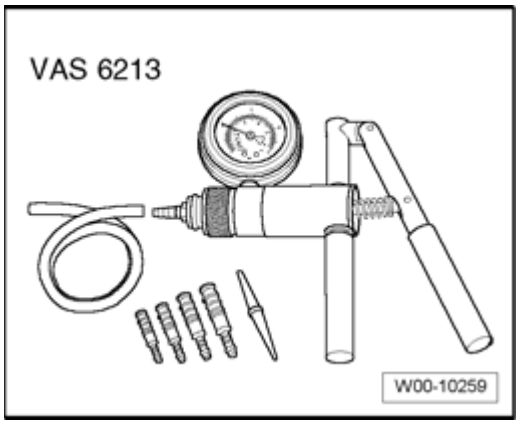

Fig. 557: Hand Vacuum Pump VAS 6213
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Hand vacuum pump VAS 6213

Procedure

- Hose connections properly sealed.
  - Remove affected secondary air injection combi-valve --> **Secondary Air Injection Combination Valves, Removing and Installing**.

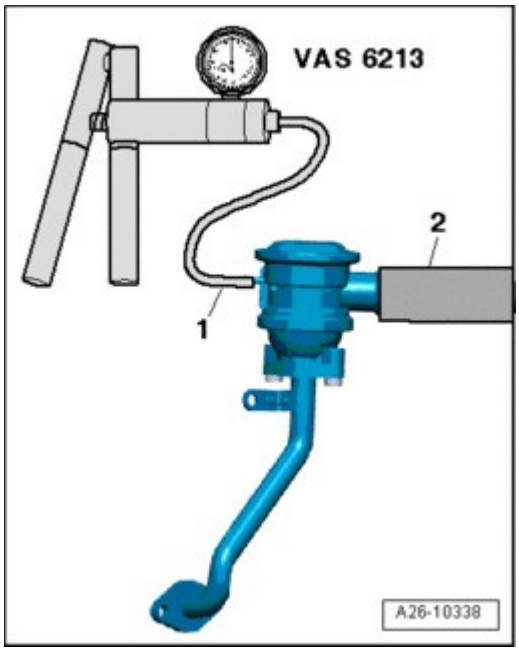

Fig. 558: Connecting Hand Vacuum Pump VAS 6213 To Vacuum Connection On Secondary Air Injection Combi-Valve
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect Hand Vacuum Pump VAS 6213 to vacuum connection - **1** - on secondary air injection combi-valve.
- Connect an appropriate assisting hose - **2** - to Secondary Air Injection (AIR) combi-valve.
- Blow into assisting hose - **2** - using light pressure (do not use pressurized air).

- Secondary Air Injection (AIR) combi-valve must be closed, it must not be possible to blow through.

- Operate hand vacuum pump.

- The Secondary Air Injection (AIR) combi-valve must open, it must be possible to blow through.

If secondary air injection combi-valve does not open:

- Replace affected Secondary Air Injection (AIR) combi-valve --> **Secondary Air Injection Combination Valves, Removing and Installing**.

Secondary Air Injection Combination Valves, Removing and Installing

Secondary Air Injection Combination Valves, Removing and Installing

Removing

- Remove Secondary Air Injection (AIR) pump --> **Secondary Air Injection Pump, Removing and Installing**.

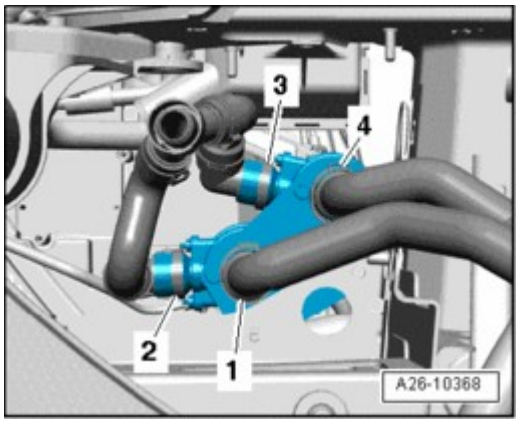

Fig. 559: Removing Air Guide Hoses From Secondary Air Injection Combi-Valves
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove air guide hoses - **1 through 4** - from secondary air injection combi-valves.

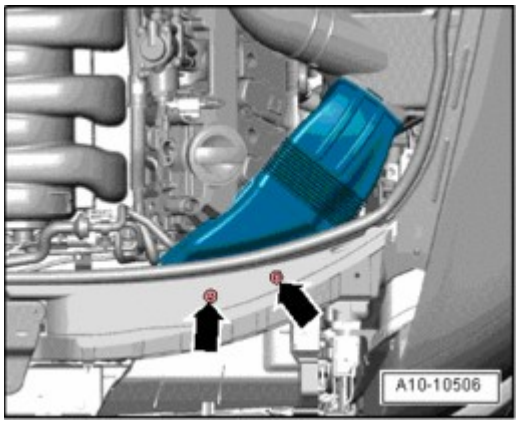

Fig. 560: Removing Bolts And Left Air Duct
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** - and remove left air duct.

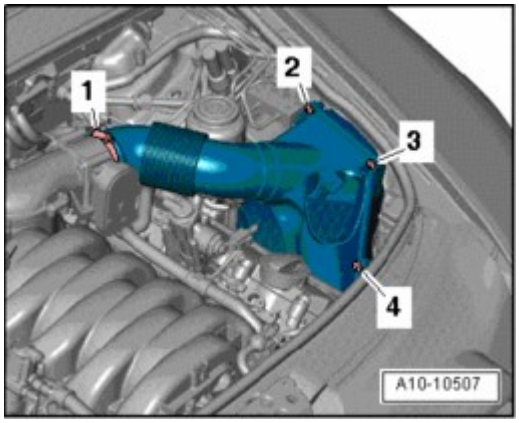

Fig. 561: Identifying Hose Clamps And Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen hose clamp - **1** - and remove bolts - **2, 3, 4** -.
- Remove upper part of left air filter housing.

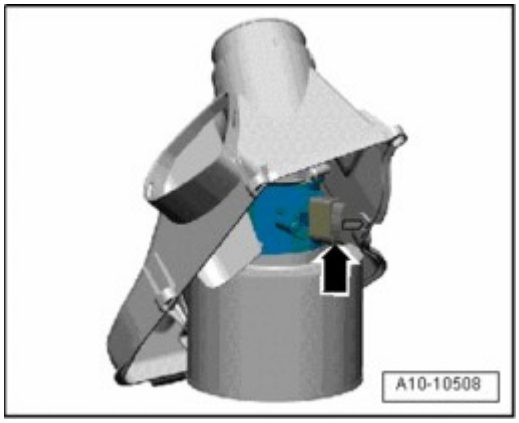

Fig. 562: Identifying Electrical Connector On Mass Air Flow Sensor
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connector - **arrow** - on mass air flow (MAF) sensor 2 G246.

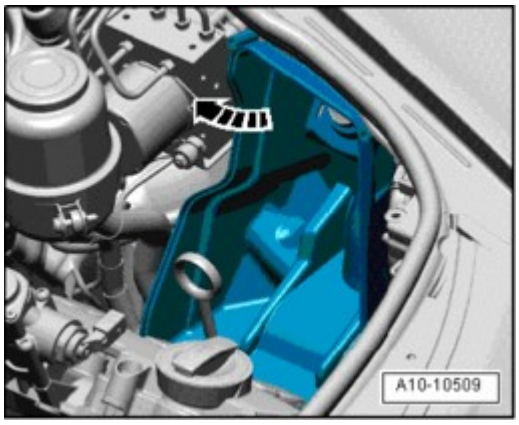

Fig. 563: Removing Lower Part Of Air Filter Housing From Side Connection
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove lower part of air filter housing from side connection.
- Tilt upper part of air filter housing up and out - **arrow** -.

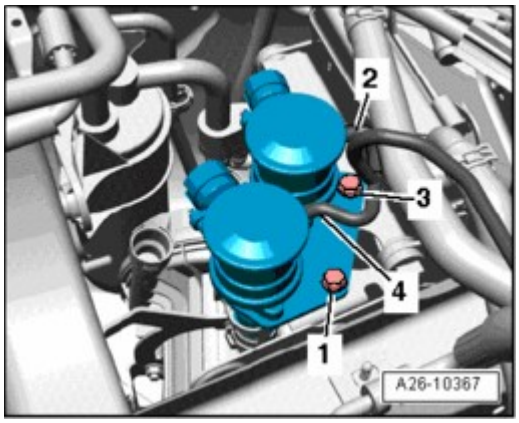

Fig. 564: Identifying Vacuum Hoses, Bolts, Secondary Air Injection Combi-Valves
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove vacuum hoses - **2** - and - **4** - from secondary air injection combi-valves.
- Remove bolts - **1** - and - **3** - and remove bracket with secondary air injection combi-valves.
- Remove affected secondary air injection combi-valve from bracket.

Installing

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

NOTE:

- **Replace seals.**

- Install Secondary Air Injection (AIR) pump --> **Secondary Air Injection Pump, Removing and Installing**.
- Install left air filter housing --> **24 - MULTIPORT FUEL INJECTION (MFI)** .

Tightening Specifications

Component	Nm
Secondary air injection combi-valve from bracket	9
Secondary air injection combi-valve bracket to auxiliary cooler	9

