2000-02 ENGINES

1.8L 4-Cylinder Turbo 5-Valve

ENGINE IDENTIFICATION

NOTE: For engine repair procedures not covered in this article, see ENGINE OVERHAUL PROCEDURES article in the GENERAL INFORMATION.

Engine identification number is stamped on a machined pad on front of engine block, below cylinder head, where engine and transaxle mate together. See **Fig. 1** . In addition there is a sticker on the valve with engine code and engine serial number. Engine code is also included on the vehicle data plate.

ENGINE CODES 1.8L TURBO

Model	Engine Code
2000-01	
Golf	AWD & AWW
GTI	AWD & AWW
Jetta	AWD & AWW
2002	
Beetle	AWP
GTI	AWP
Jetta	AWP

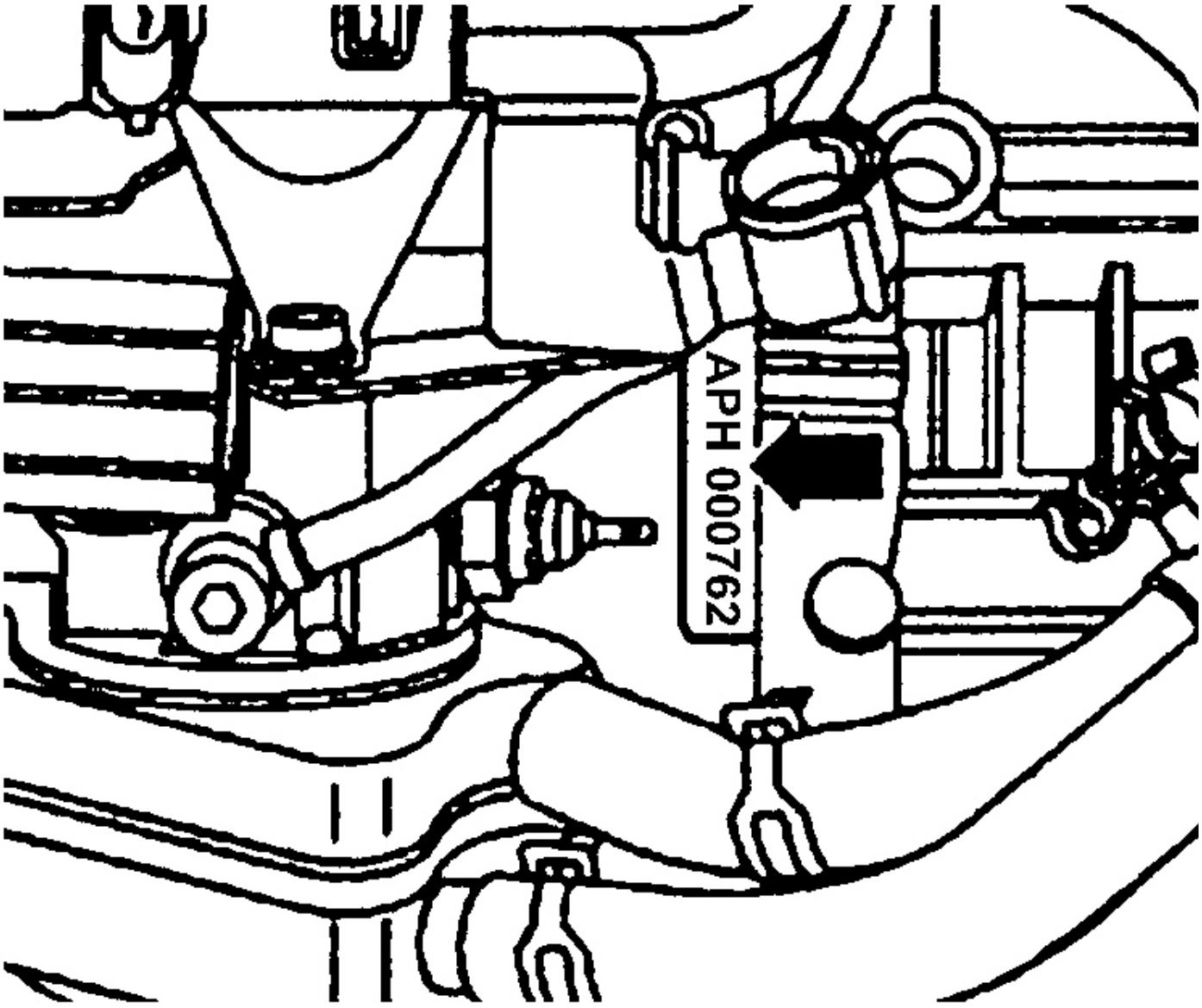

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Fig. 1: Locating Engine Identification Number
Courtesy of VOLKSWAGEN UNITED STATES, INC.

PROGRAMMING

NOTE: When battery is disconnected, vehicle computer and memory systems may lose memory data. Driveability problems may exist until computer systems have completed a relearn cycle.

After any repair which required that the battery be disconnected, the following should be performed. Refer to owners manual for additional information.

1. Ensure ignition switch is in OFF position. Reconnect battery positive cable first then connect the negative ground strap.
2. After connecting battery, enter anti-theft code for radio (if equipped).
3. Fully close all power windows, operate each window door switch in up position for at least one

second (windows closed) to activate "one touch" opening/closing function (if equipped).

4. Set clock to correct time.

ADJUSTMENTS

ACCELERATOR PEDAL

NOTE: A drive by wire throttle system is used on this model vehicle. No throttle cable adjustment required.

For testing and matching engine electronics control module to throttle valve control module. See **THROTTLE VALVE CONTROL MODULE (J338)** in appropriate SELF-DIAGNOSTICS article in ENGINE PERFORMANCE.

VALVE CLEARANCE

Engine is equipped with non-adjustable, non-serviceable hydraulic valve adjusters. Irregular valve adjuster noise during cranking is normal. If valve adjuster(s) are noisy under any other condition inspect valve adjusters. See **HYDRAULIC VALVE ADJUSTERS** .

HYDRAULIC VALVE ADJUSTERS

WARNING: ALWAYS release fuel pressure before disconnecting fuel injection related component. DO NOT allow fuel to contact engine or electrical components.

CAUTION: DO NOT start engine for about 30 minutes after installing camshafts. Hydraulic valve lifters must bleed down or valves may strike pistons. Rotate crankshaft by hand 2 full revolutions before starting engine to ensure valves do not strike pistons.

NOTE: Valve lifters are not repairable or adjustable. Replace faulty lifters. Irregular valve train noise is normal when starting engine.

Checking

1. Start engine and run until cooling fan cycles at least once. Increase engine speed to 2500 RPM for 2 minutes or test drive vehicle and observe valve train noise. If valve train noise is still considered noisy, go to next step.
2. Turn engine off. Remove valve cover. Rotate crankshaft until camshaft lobes point upward on lifter being checked. Using a wooden or plastic wedge, push down on top of lifter. See **Fig. 2** . Try inserting a .008" (.20 mm) feeler gauge between top of lifter and camshaft. If feeler gauge fits between top of lifter and camshaft, replace faulty lifter.

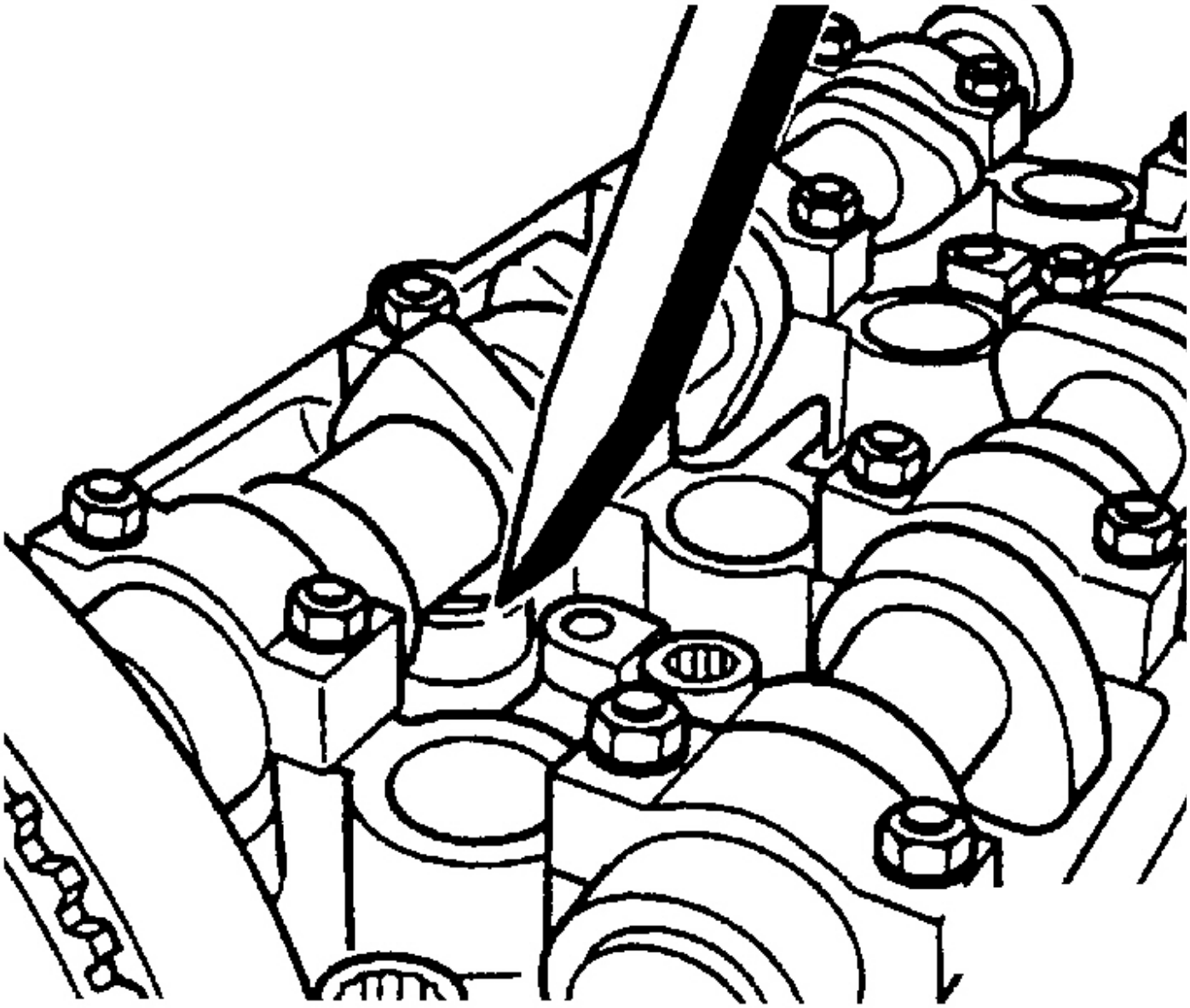

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Fig. 2: Placement Of Wedge On Lifter (Push Down)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

TROUBLESHOOTING

To trouble shoot mechanical engine components, see appropriate table in TROUBLE SHOOTING article in GENERAL INFORMATION.

REMOVAL & INSTALLATION

CAUTION: Radio/cassette or radio/CD player is equipped with an anti-theft protection circuit. Whenever battery is disconnected, radio will go into anti-theft mode. When battery is reconnected, radio will display CODE, and will be inoperative until proper code number is entered. Obtain security code before

disconnecting battery.

NOTE: When battery is disconnected, vehicle computer and memory systems may lose memory data. Driveability problems may exist until computer systems have completed a relearn cycle.

NOTE: For reassembly reference, label all electrical connectors, vacuum hoses and fuel lines before removal. Place mating marks on other major assemblies before removal.

FUEL PRESSURE RELEASE

Remove fuel pump relay located in fuse/relay panel (behind left side of dash). Start engine, allow engine to run until it stops. Turn ignition off. Disconnect negative battery cable. Install fuel pump relay. Slight pressure may remain in system. Before disconnecting any fuel system line, cover connector with a clean shop towel.

COOLING SYSTEM BLEEDING

1. Ensure coolant drain valve is closed and all hoses are secure. See **Fig. 3** and **Fig. 4** . For help in identifying components and component locations, refer to illustration. See **Fig. 5** and **Fig. 6**
2. Fill expansion tank to proper level. Fill to Max mark on expansion tank (up to 2001 models) or to upper portion of shaded area on expansion tank (2002 models). Install expansion tank cap. See **Fig. 7** and **Fig. 8** .
3. Put heater controls in Off position. Start engine and raise engine speed to 2000 RPM for about 3 minutes. Ensure cooling fan cycles on and off. Return engine to idle. Check coolant level in expansion tank. With engine at normal operating temperature, coolant should be at the Max mark indicated on expansion tank. Once engine has completely cooled, coolant should be between Max and Low marks. Add coolant as necessary.

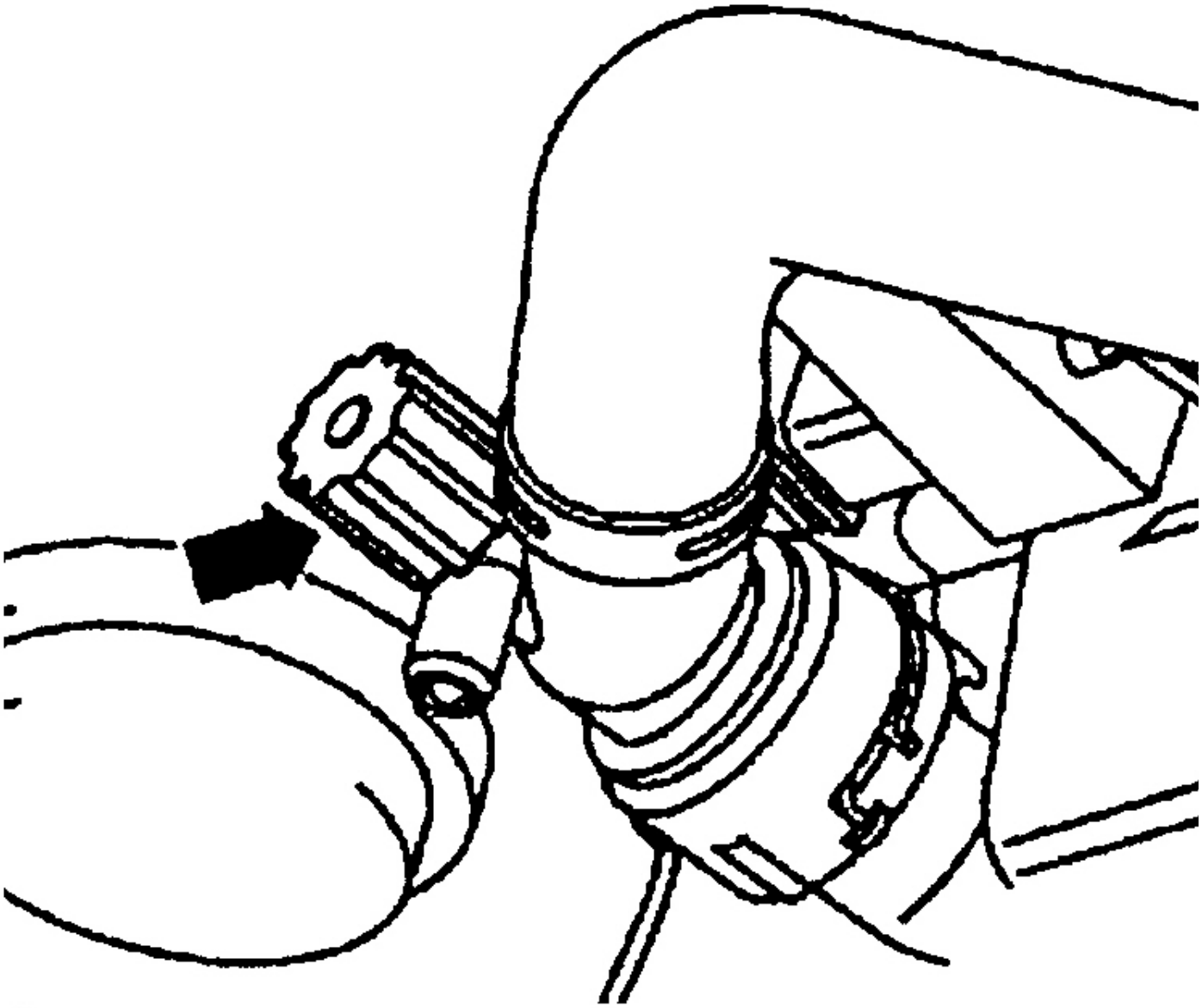

Fig. 3: Draining Coolant From Radiator
Courtesy of VOLKSWAGEN UNITED STATES, INC.

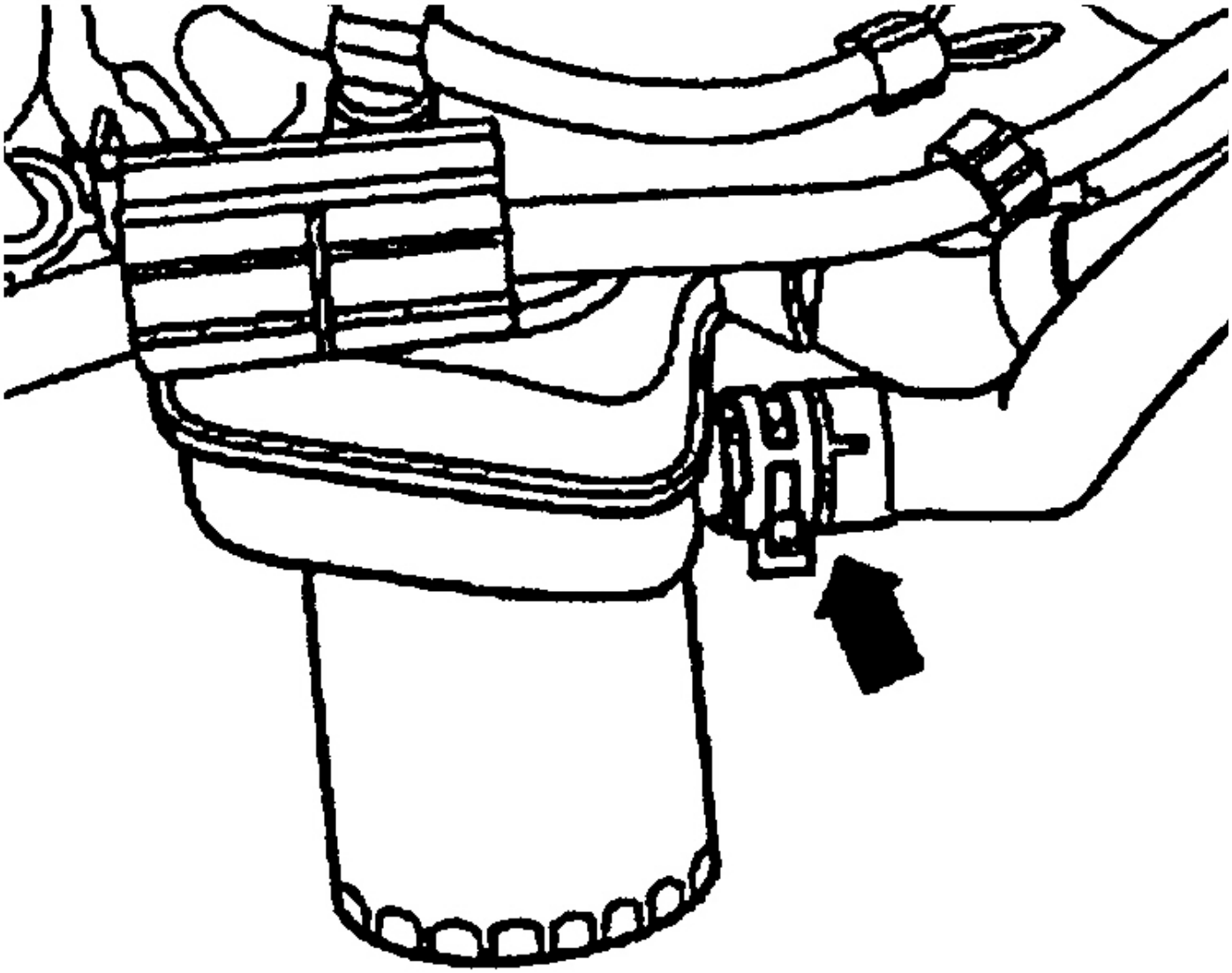

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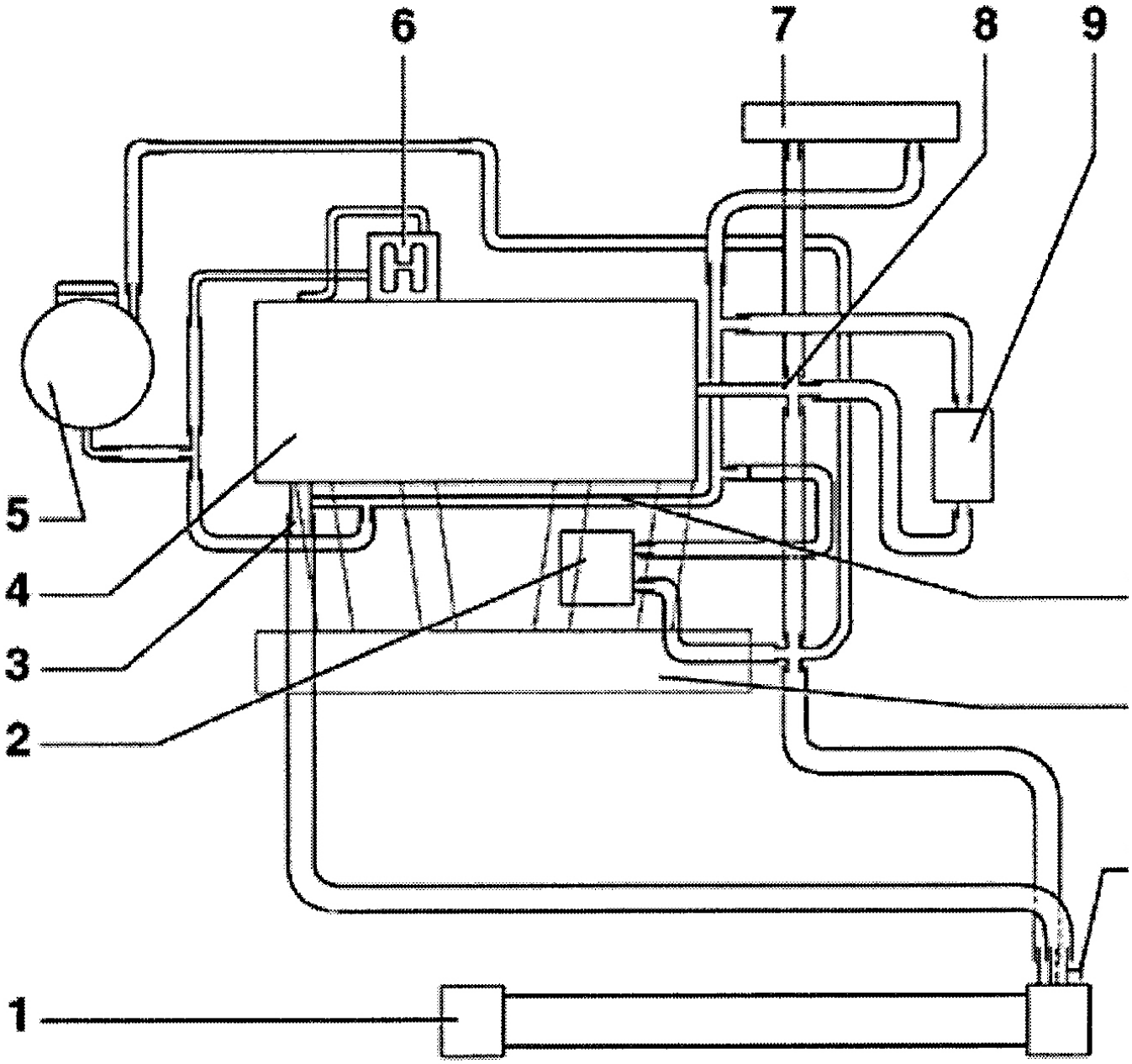
Fig. 4: Draining Coolant From Engine Block At Oil Cooler
Courtesy of VOLKSWAGEN UNITED STATES, INC.



1 - Radiator

2 - Oil cooler

3 - Coolant thermostat housing

4 Cylinder - head/cylinder

6 - Turbocharger

7 - Heating system heat exchanger

8 - Connection

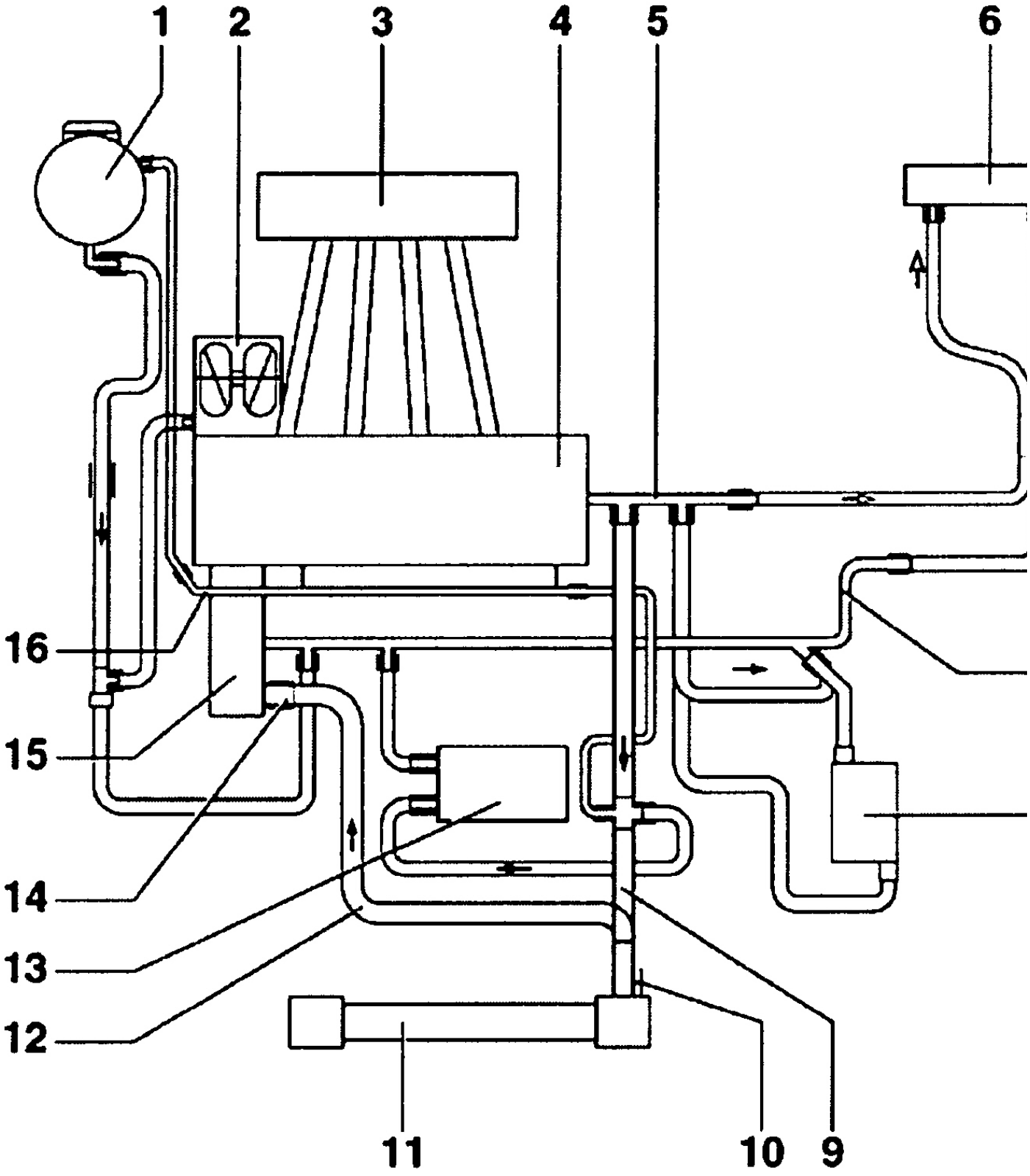
9 Transmission

♦ Only with automatic transmiss

10 - Lower coolant pipe

11 - Intake manifol

Fig. 5: Identifying Cooling System Components & Hose Routing (AWD)
Courtesy of VOLKSWAGEN UNITED STATES, INC.



1. Expansion Tank
2. Turbocharger
3. Intake Manifold
4. Cylinder Head/Cylinder Block
5. Connection
6. Heating System Heat Exchanger
9. Upper Coolant Hose
10. Drain Screw
11. Cooler
12. Lower Coolant Hose
13. Oil Cooler
14. Thermostat Housing

Fig. 6: Identifying Cooling System Components & Hose Routing (AWP Manual Trans & AWW Automatic Or Manual Transmission)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

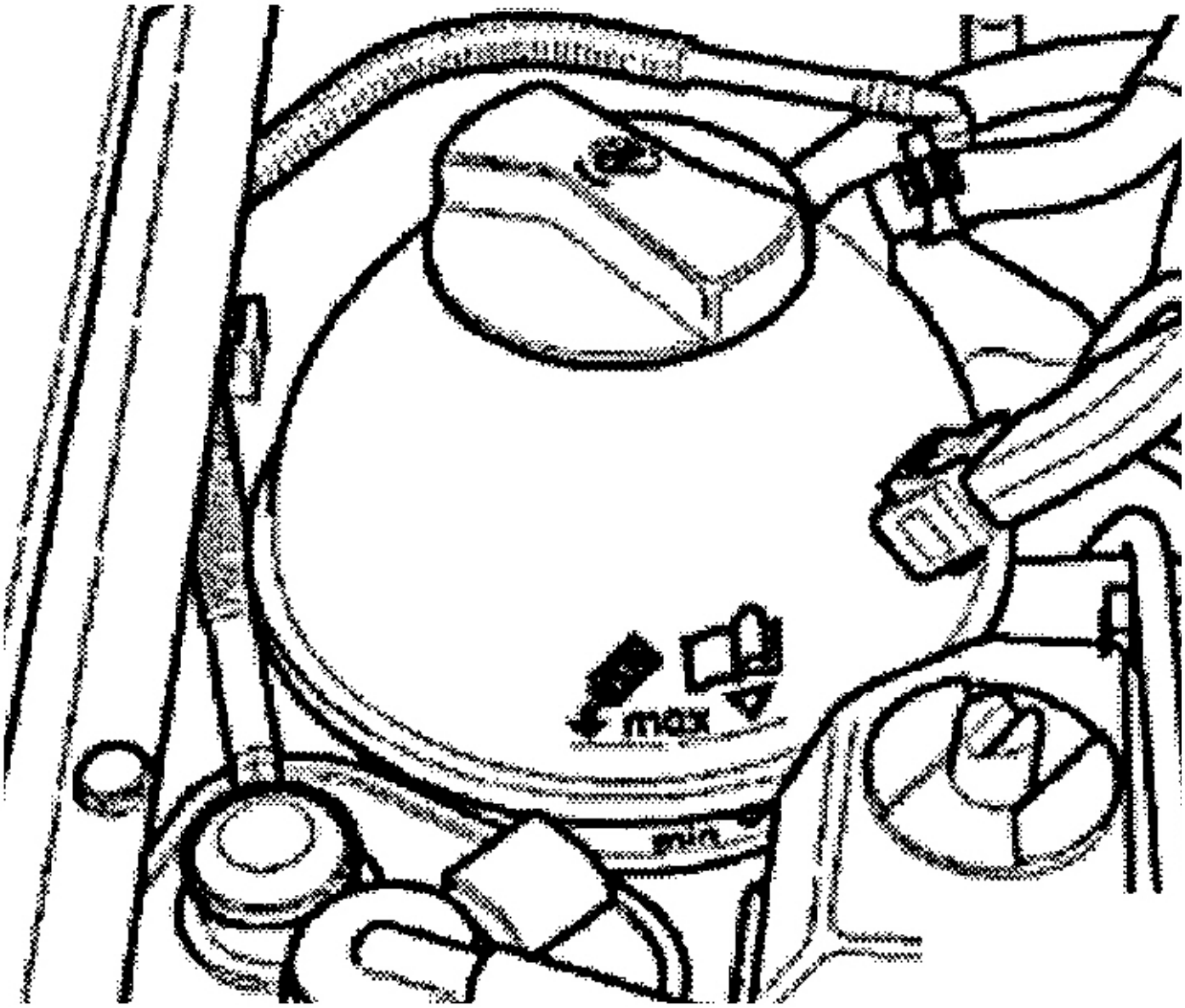


Fig. 7: Identifying Max Mark On Expansion Tank.
Courtesy of VOLKSWAGEN UNITED STATES, INC.

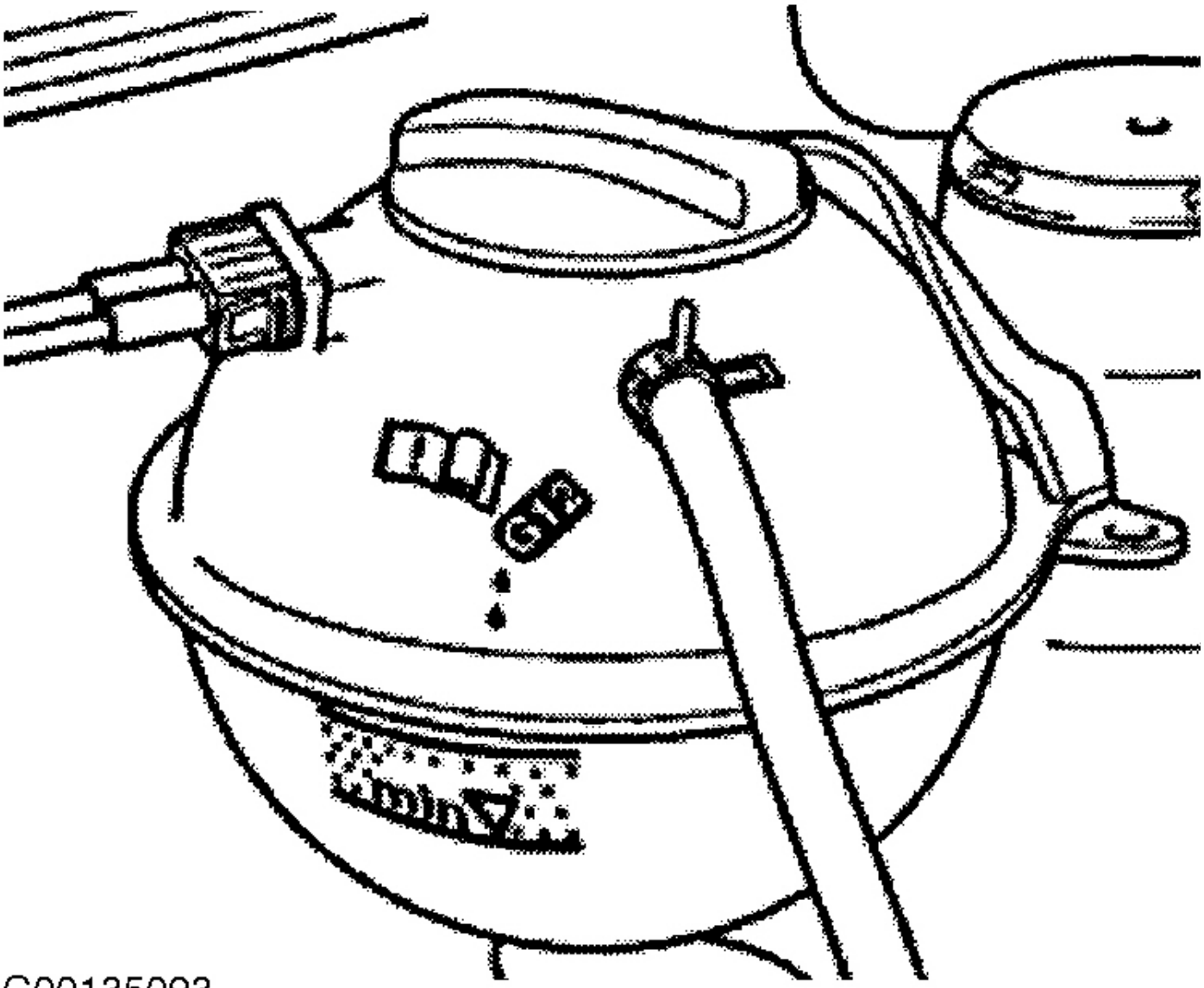


Fig. 8: Identifying Shaded Area Of Expansion Tank (Upper Shading Is Max Mark)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

DRAINING COOLING SYSTEM

WARNING: The cooling system is pressurized when the engine is warm. When opening the expansion tank, wear gloves and other appropriate protection, cover the cap with a cloth and open carefully to relieve system pressure slowly.

NOTE: Drain coolant into clean container if coolant is in good condition and is going to be reused.

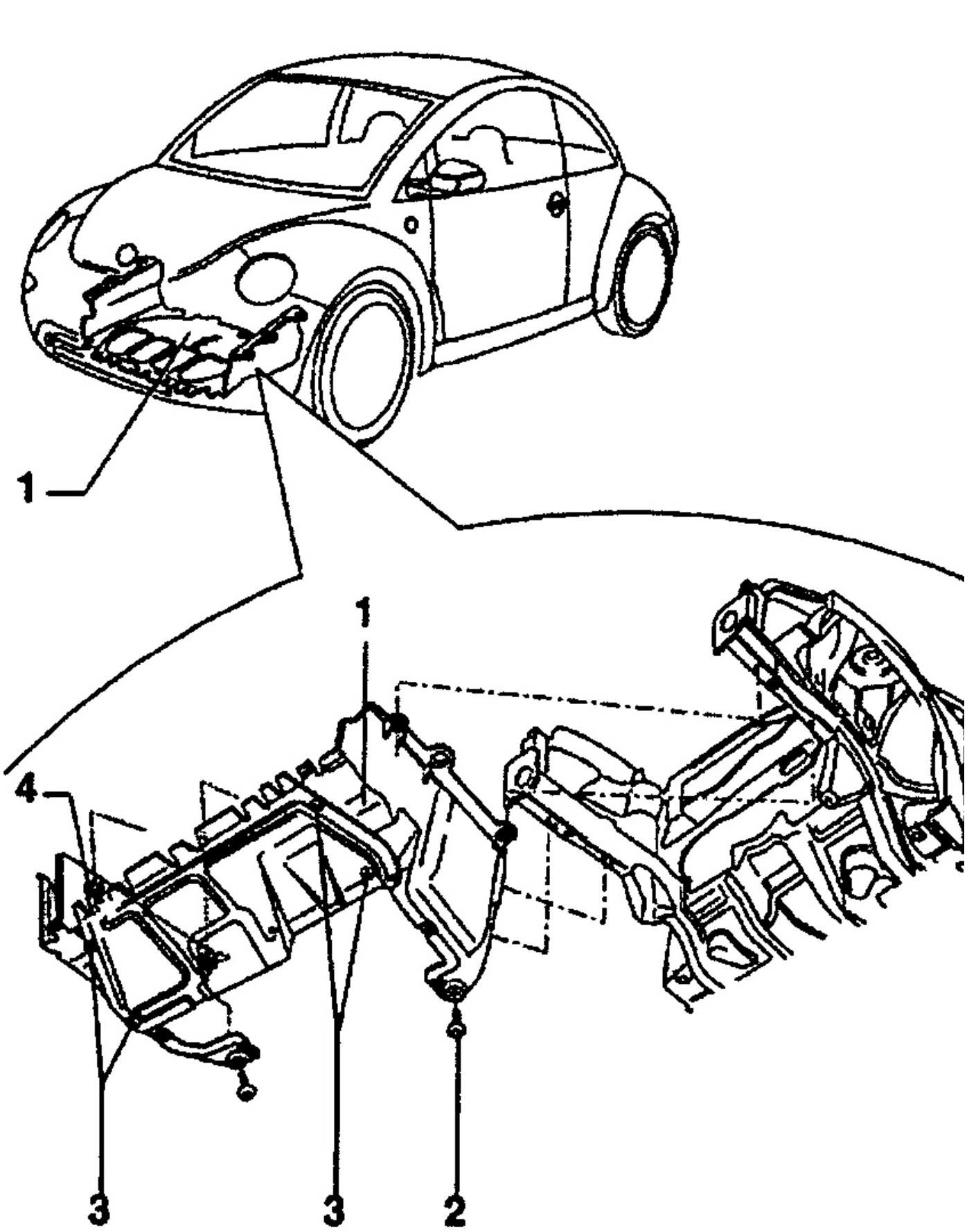
Open cap on engine coolant expansion tank. Remove lower engine shield (noise insulator). Open drain valve at lower radiator hose. Drain coolant from radiator. Remove the coolant line from oil cooler and allow coolant to drain from block. See **Fig. 3** and **Fig. 4** . To fill cooling system, see **COOLING SYSTEM BLEEDING** .

THERMOSTAT

Removal & Installation

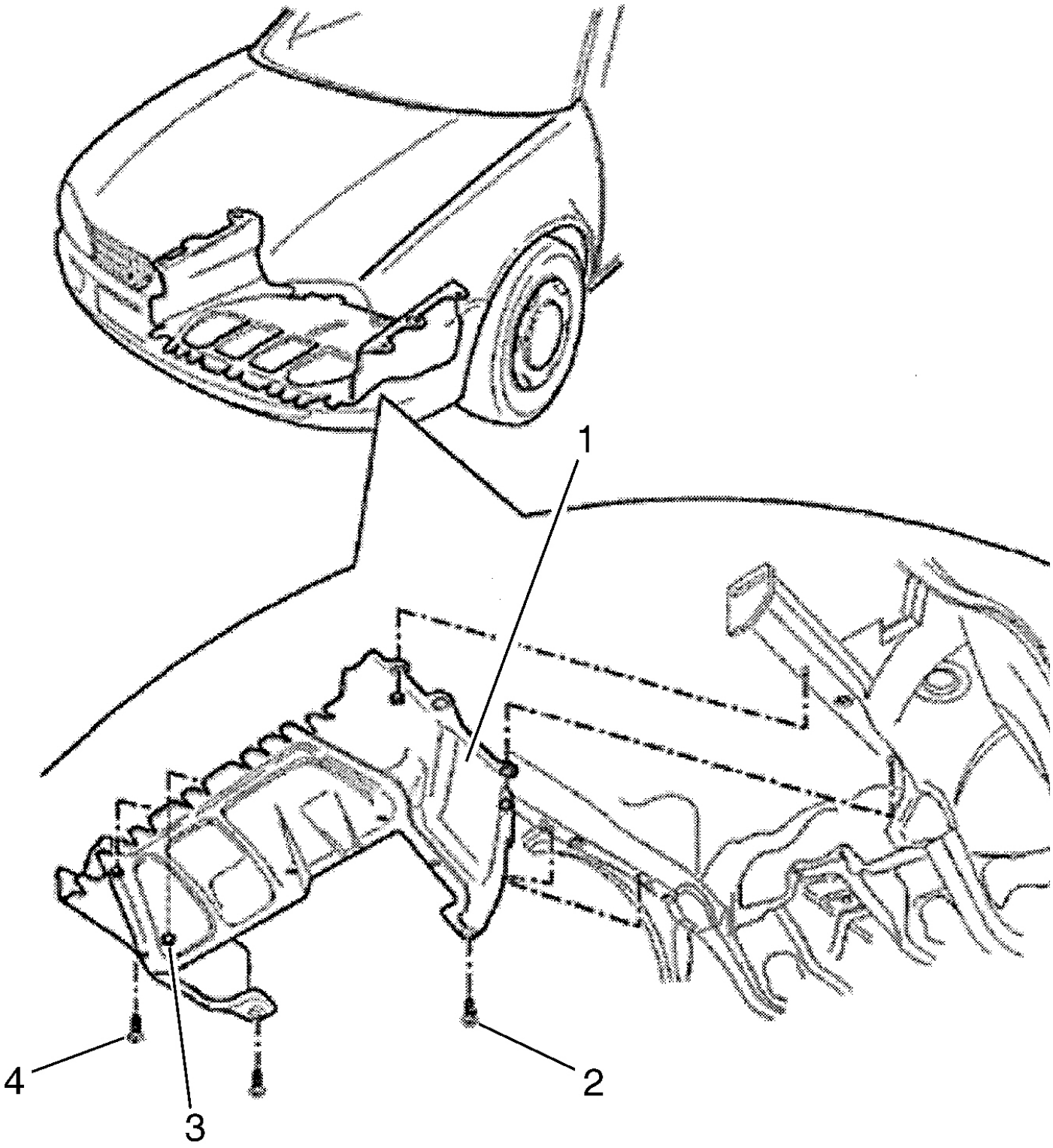
WARNING: The cooling system is pressurized when the engine is warm. When opening the expansion tank, wear gloves and other appropriate protection, cover the cap with a cloth and open carefully to relieve system pressure slowly.

1. Raise vehicle. Remove lower engine shield (noise insulator). See **Fig. 9** or **Fig. 10** . Drain coolant. See **DRAINING COOLING SYSTEM** .
2. Thermostat is located at front side of engine above A/C compressor. See **Fig. 11** . Remove the A/C compressor drive belt. Remove the A/C compressor. Support compressor with a heavy wire (DO NOT let hang by refrigerant hoses). Remove bolts from thermostat cover, note positioning of thermostat (reinforcement vertical). Remove thermostat.
3. Clean mating surfaces. Lube new O-ring gasket with coolant. Install thermostat (if equipped, bleed hole at top). Tighten thermostat housing bolts to speechification. See **TORQUE SPECIFICATIONS** . To complete installation, reverse removal procedure. Fill and bleed cooling system. See **COOLING SYSTEM BLEEDING** .



1 - Noise insulation **3 - Bolt**

Fig. 9: Identifying Lower Engine Shield (Noise Insulator) Mounting Points (Beetle)
Courtesy of VOLKSWAGEN UNITED STATES, INC.



1 - Sound insulation

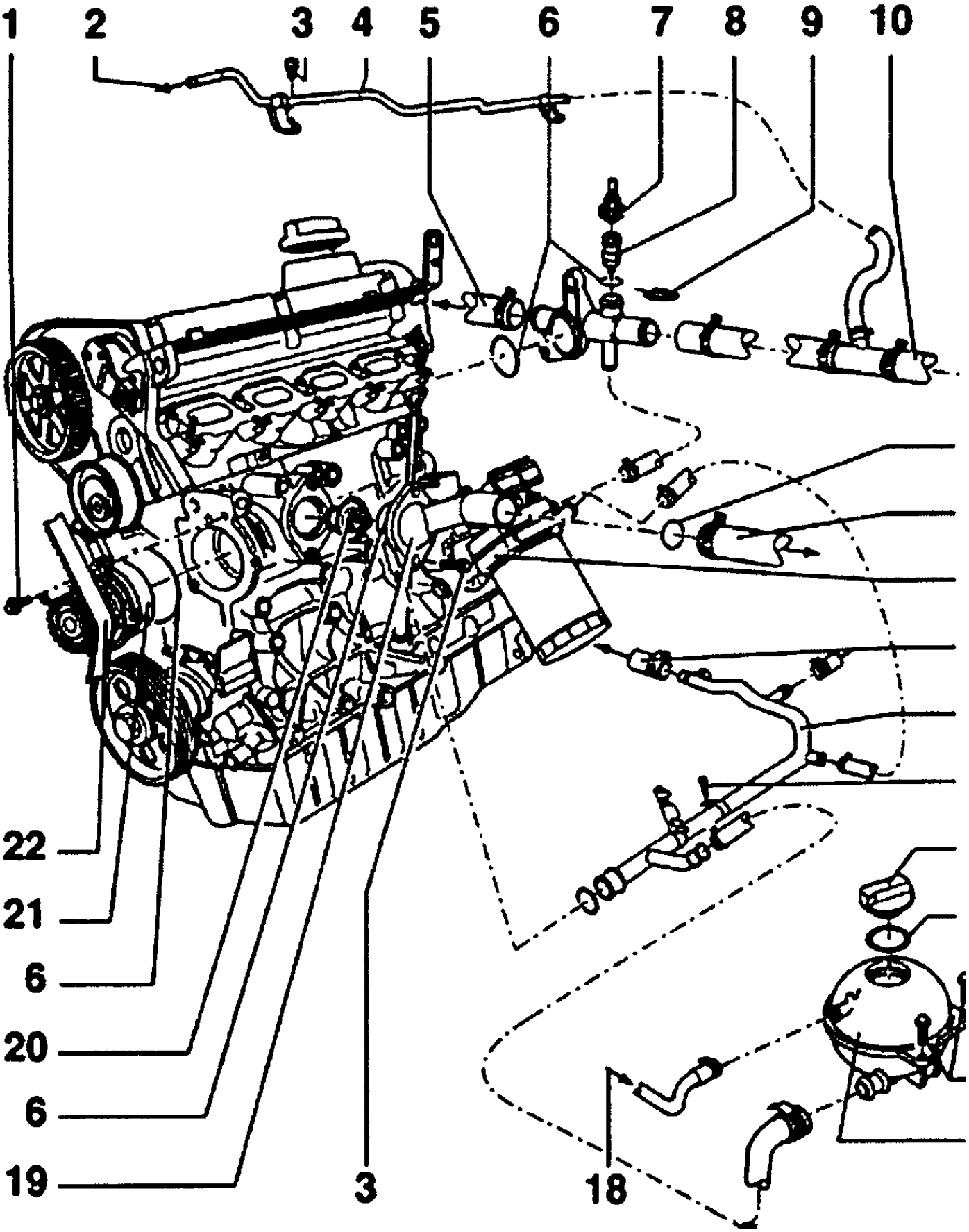
- Bolted and

2 - Bolt

- Qty. 2

3 - Clamping

Fig. 10: Identifying Lower Engine Shield (Noise Insulator) Mounting Points (Golf, GTI & Jetta)
Courtesy of VOLKSWAGEN UNITED STATES, INC.



1. Water Pump Fastner
2. Coolant Pipe to Reservoir
12. Oil Cooler
13. From Heater Core

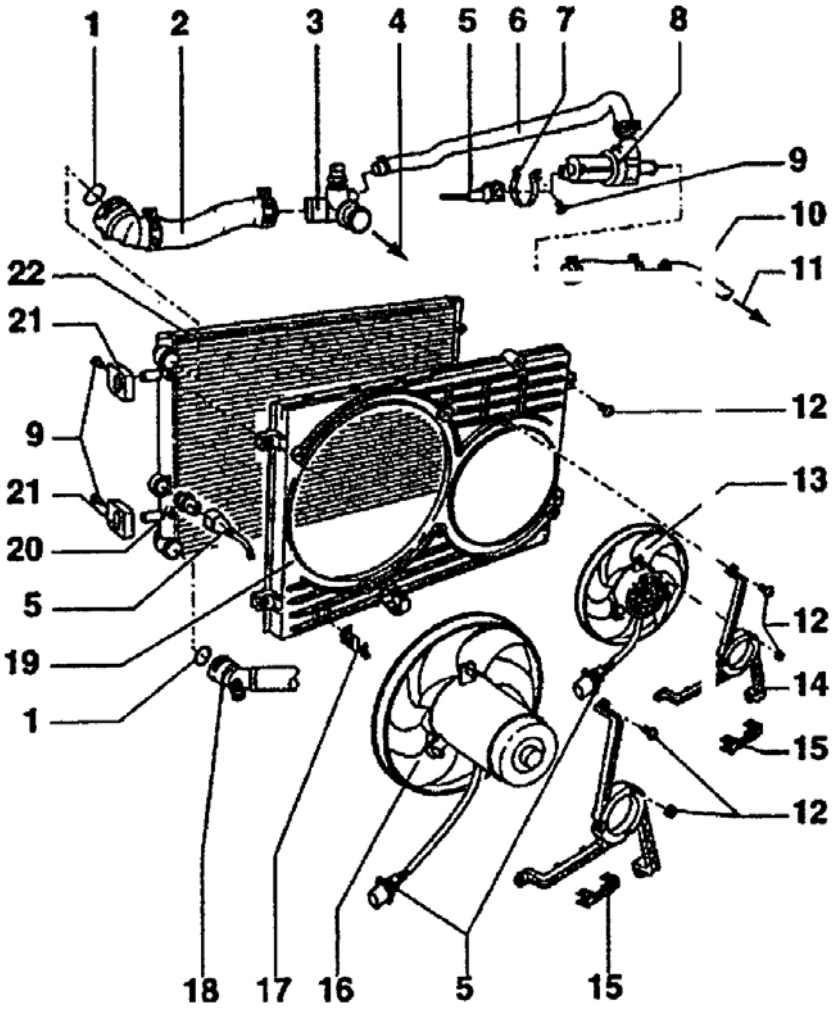
Fig. 11: Identifying Location Of Thermostat & Housing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

RADIATOR

NOTE: For help in identifying components and component locations, refer to illustrations. See Fig. 12 and Fig. 13 .

Removal & Installation

1. Drain coolant, see **DRAINING COOLING SYSTEM** . Remove front bumper. See **LOCK CARRIER** . Pull radiator hoses from radiator. Disconnect harness connectors from fan(s) and thermo switch. Remove tensioning element for ribbed belt. Remove radiator fasteners and take out radiator.
2. To install, reverse removal procedure. Tighten bolts to specification. See **TORQUE SPECIFICATIONS** . Fill and bleed cooling system. See **COOLING SYSTEM BLEEDING** .



1 - O-ring

- Replace if damaged

2 - Upper coolant hose

3 - Junction piece

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

6 - Upper coolant hose

- Secured to radiator with retaining clip

7 - Bracket

- Secured at intake air boot

8 - After-run coolant pump - V51-

- Continues to run up to 10 minutes after ignition is switched off

9 - 15 Nm(11 ft lbs)

10 - Coolant pipe

- Secured with retaining clamps at right long member

11 To - turbocharger

- Coolant hose connection

12 - 10 Nm

13 - Additional fan

14 - Fan ring

15 - Retaining clip

16 - Radiator fan

17 - Bracket

- For radiator fan connector

18 - Lower coolant hose

19 - Air ducting

20 - Coolar fan therm switch F18-, 3 Nm (25 ft lb

21 - Bracke

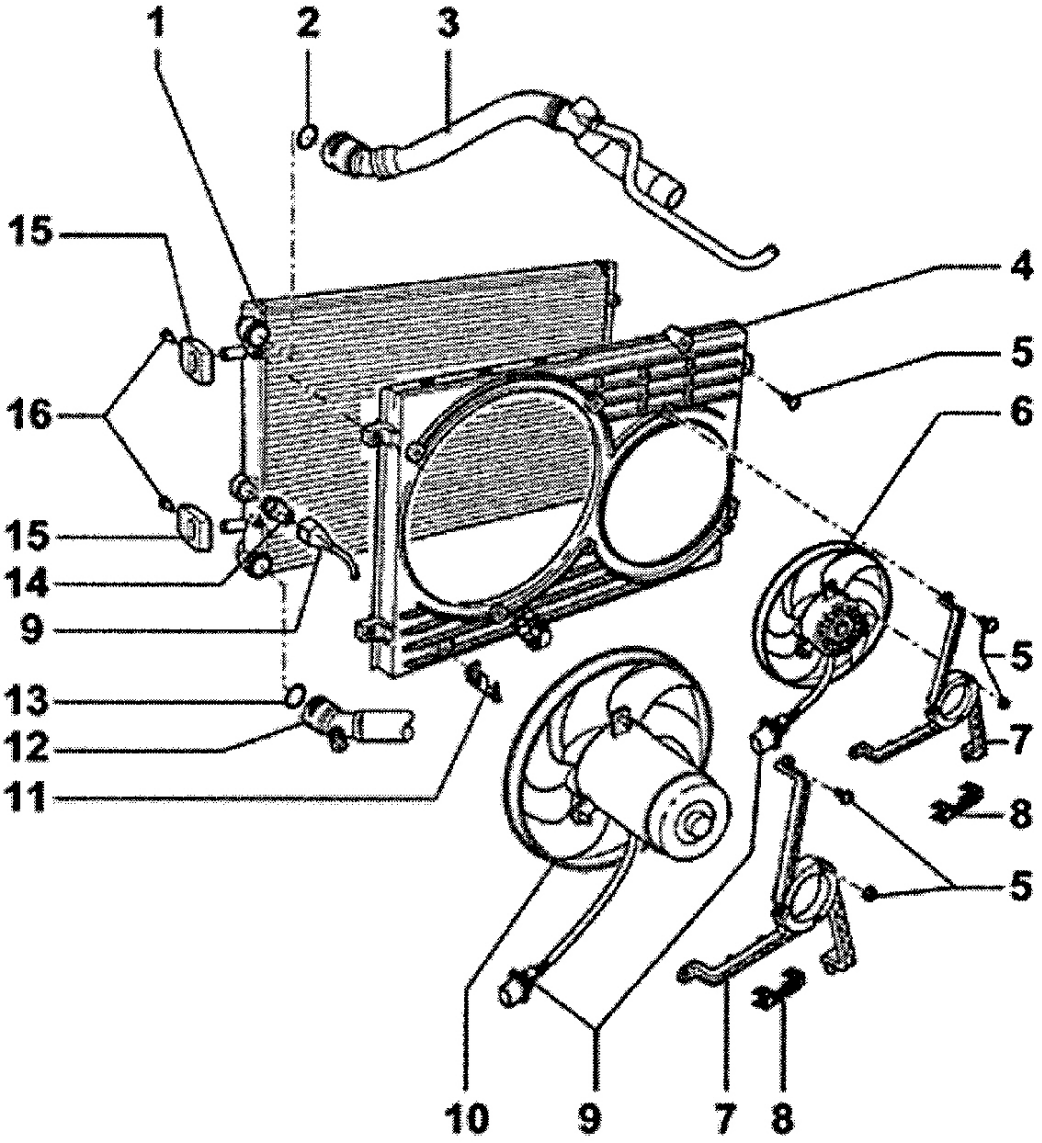
- For radiato

- Note fitting positio

22 - Coole (Radia

- After repla repla all coola

Fig. 12: Identifying Radiator & Related Components (Beetle)
Courtesy of VOLKSWAGEN UNITED STATES, INC.



1 - Radiator

2 - O ring

♦ Replace if damaged

3 - Upper coolant hose

4 - Air ducting

5 - 10 Nm (7 ft lbs)

6 - Additional

7 - Fan ring

8 - Retaining clip

9 - Connector

10 - Radiator fan

11 - Bracket

12 - Lower coolant hose

14 - Thermo-switch (F18), 35 Nm (25 ft lbs)

♦ For electric fan

♦ Switching temperatures:

- Stage 1 on: 92 to 97 ° C off: 84 to 91 ° C
- Stage 2 on: 99 to 105 ° C off: 91 to 98 ° C

Fig. 13: Identifying Radiator & Related Components (Golf, GTI & Jetta)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

CORE PLUG (CYLINDER HEAD)

CAUTION: Ensure core plug (sealing cap) is installed in cylinder head.

Removal

Removal procedure of core plug not provided by manufacturer.

Installation

Coat outside circumference of core plug (sealing cap) with Sealant (AMV 188 001 02). Using Needle Bearing Drift (VW295), drive in core plug until outside rim is flush with end of chamfer in cylinder head. See **Fig. 14** .

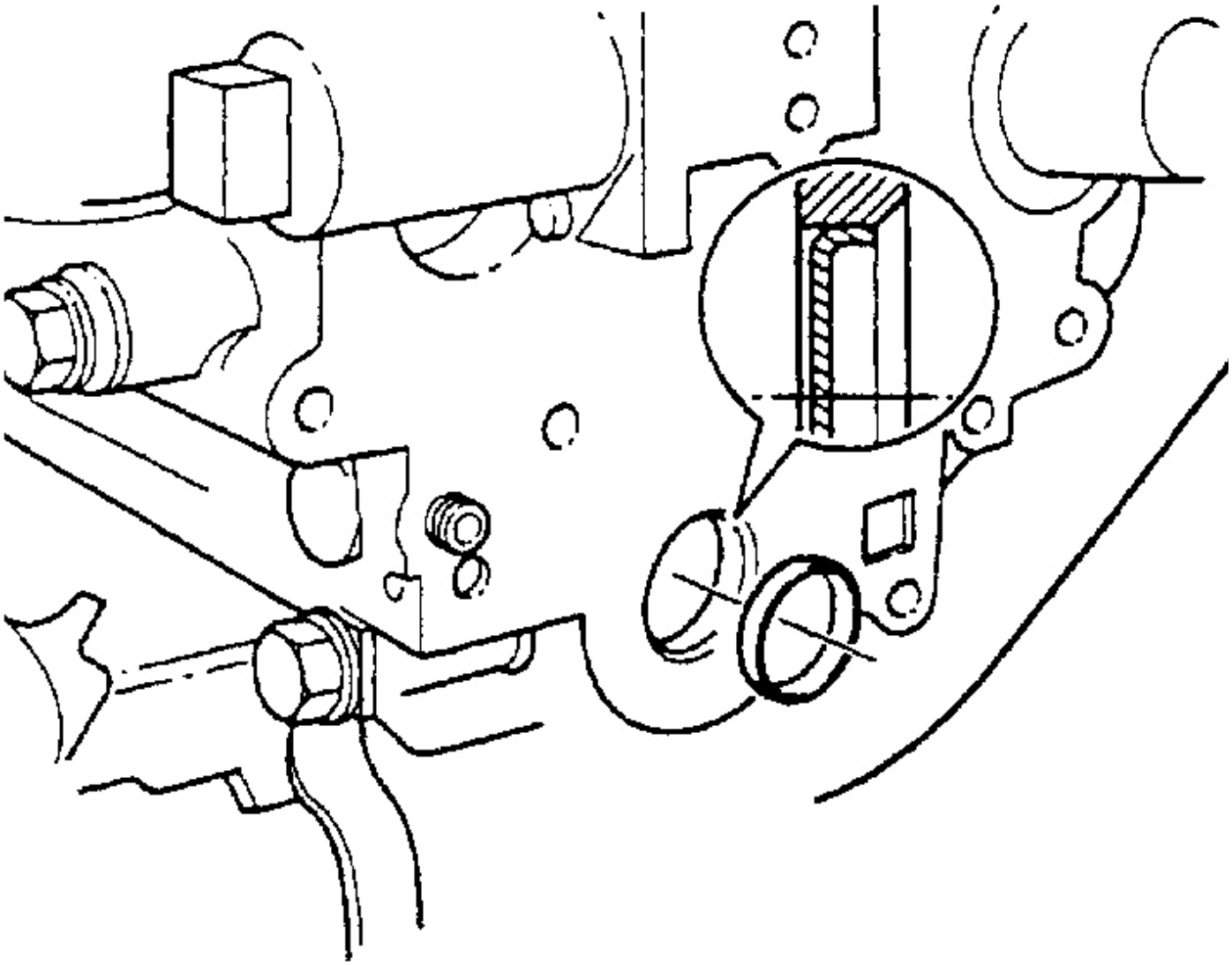


Fig. 14: Identifying Installed Depth Of Core Plug (Sealing Cap)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

LOCK CARRIER

Removal & Installation (Beetle)

1. Remove lower engine shield. Remove left and right side shield (noise insulators). Drain coolant from radiator. Remove front inner fenders. Remove fender bolts from inside of fender. See **Fig. 15** . Remove lower fender bolts. Remove screws from rear of fender. Remove 3 screws from under front of bumper cover. Remove 16 screws under hood attaching fenders and bumper cover to vehicle. With the aid of a helper, remove front fenders and bumper cover as an assembly.
2. Disconnect hood latch cable. Remove upper bumper bolt on each side and install Special Tools (3411). See **Fig. 16** and **Fig. 17** . Remove upper panel bolts and remaining bumper bolts. Slide entire lock carrier assembly out on special tools.
3. Disconnect radiator hoses. Disconnect radiator mounted switch harness connectors. Remove radiator mounting bolts. See **Fig. 18** . On vehicles equipped with A/C, remove A/C line retaining clamps. DO NOT disconnect A/C hoses. Fasten condenser to lock carrier before removing radiator. On all vehicles, remove radiator. To install, reverse removal procedure. Fill cooling system. See **COOLING SYSTEM BLEEDING** . Adjust headlights as necessary.

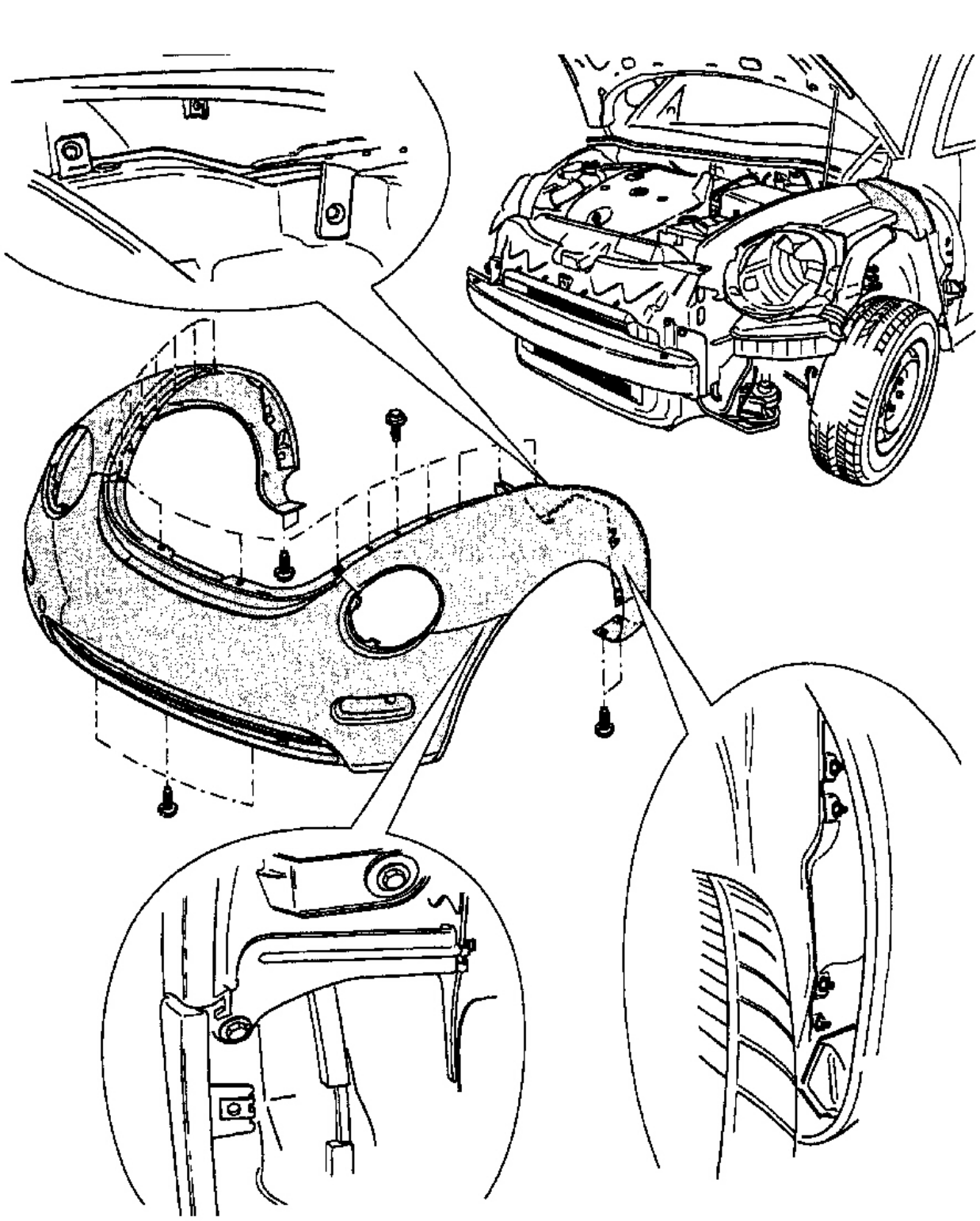


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Fig. 15: Removing Front Fenders & Bumper Cover (Beetle)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

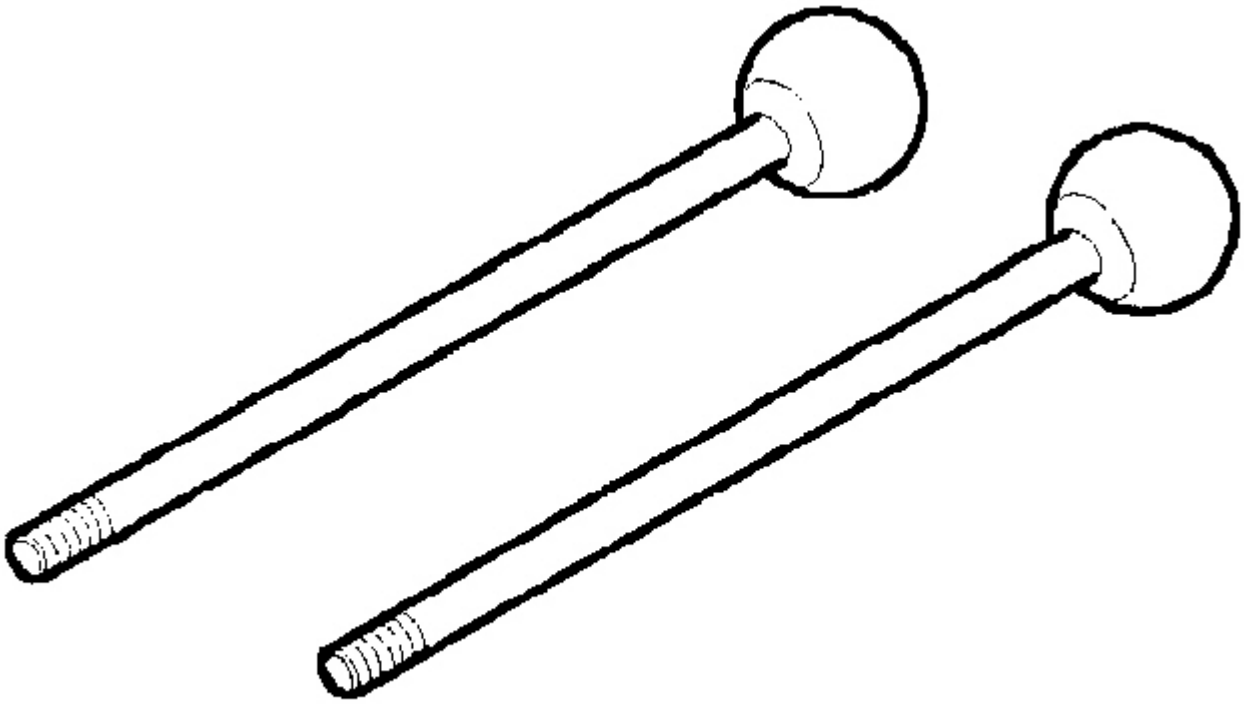

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Fig. 16: Identifying Guide Rods - Part No. 3411 (Beetle)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

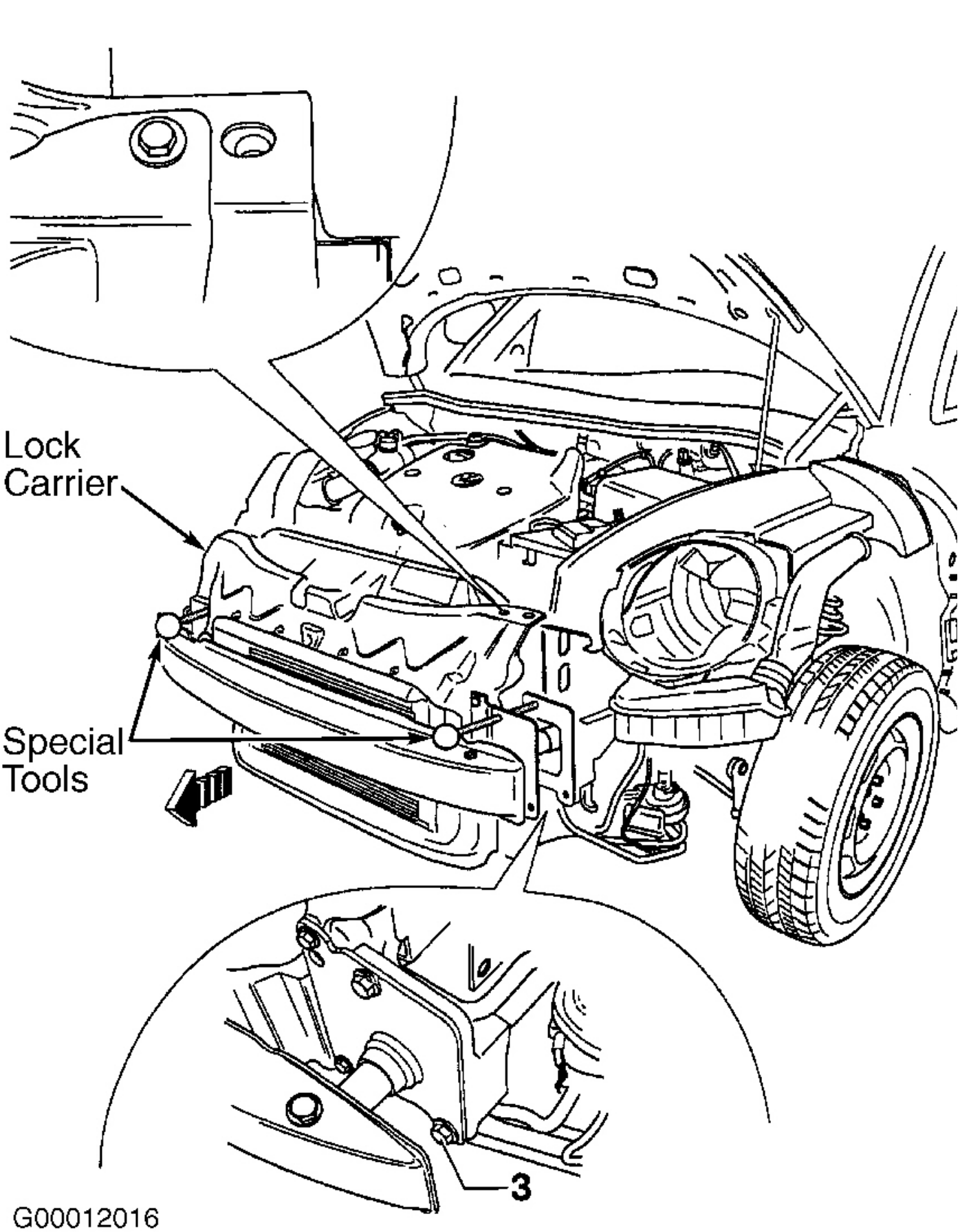


Fig. 17: Sliding Out Lock Carrier (Beetle)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

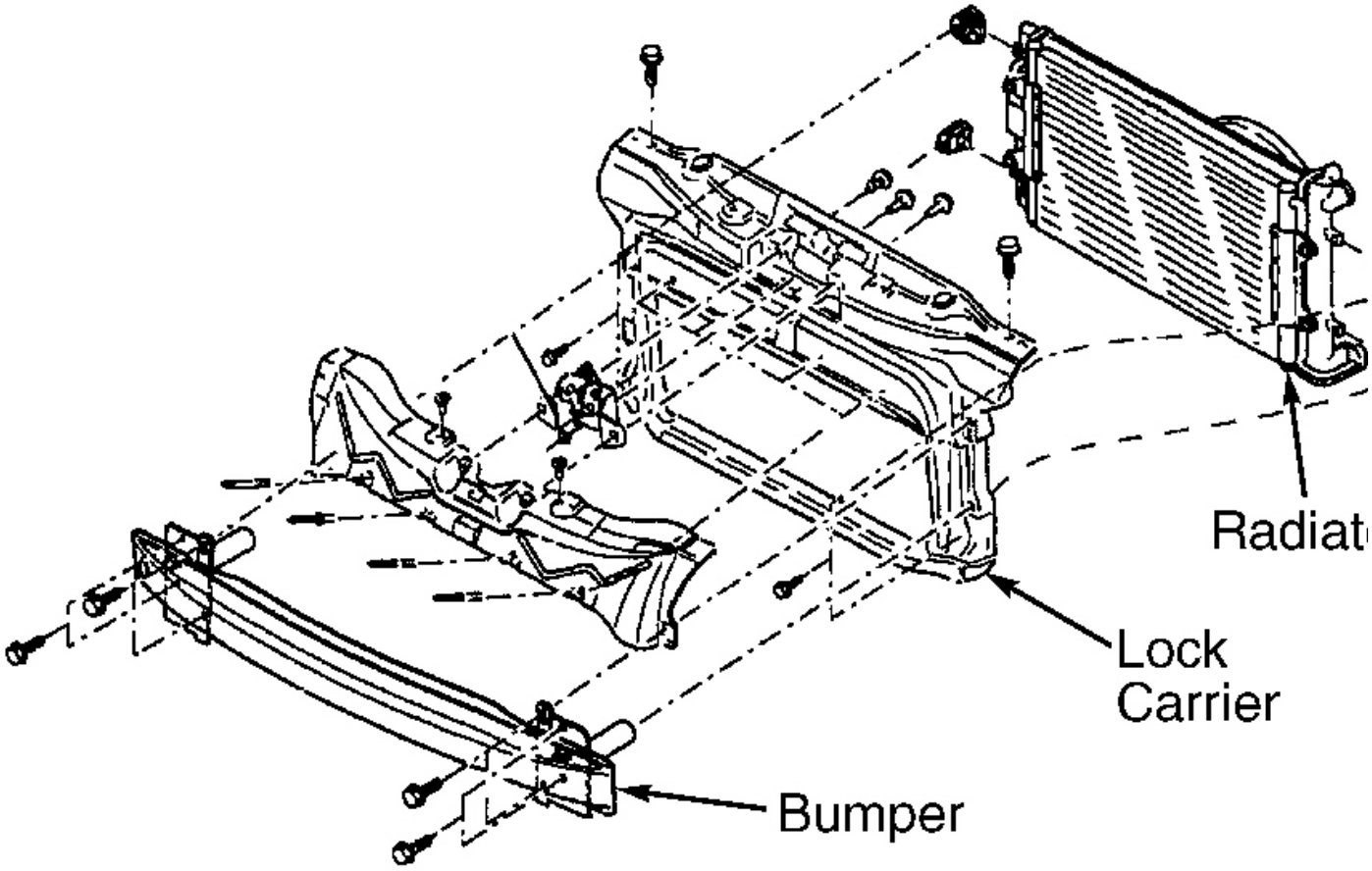
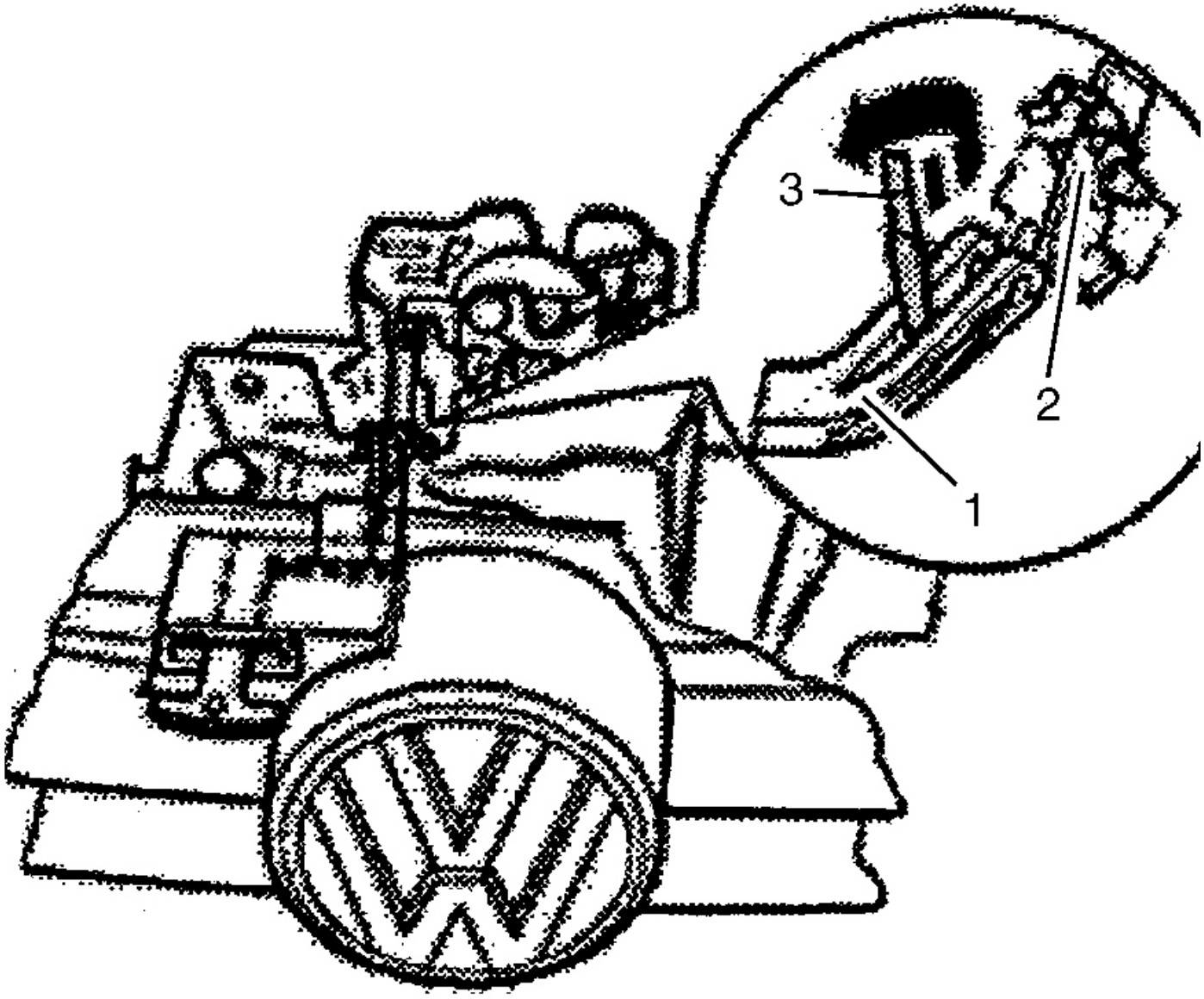


Fig. 18: Exploded View Of Lock Carrier (Beetle)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Removal & Installation (Jetta, Golf & GTI)

1. Remove lower engine shield (noise insulator). See **Fig. 10** . Drain coolant from radiator. Remove 16 screws under hood attaching fenders and bumper cover to vehicle. With a helper, remove front fenders and bumper cover as an assembly.
2. Disconnect hood latch cable and harness connector. Disconnect harness connectors at headlight housings.
3. Disconnect headlight washer system at "T" piece. Disconnect hood release lever, swing clip (2) downward. Pull release lever (1) with a screwdriver (3) and remove from hood lock. Pull release lever (1) with guide out of lock carrier. See **Fig. 19** .
4. Remove front grill trim piece. See **Fig. 20** . Remove front bumper and bumper carrier. See **Fig. 21** and **Fig. 22** .
5. Disconnect radiator hoses. Disconnect radiator mounted switch harness connectors. On vehicles equipped with A/C, remove A/C line retaining clamps. Remove radiator/condenser mounting bolts. See **Fig. 23** . DO NOT disconnect A/C hoses. Fasten condenser to lock carrier before removing radiator. To install, reverse removal procedure. Fill cooling system. See **COOLING SYSTEM BLEEDING** . Adjust headlights as necessary.



1. Release Lever
2. Clip
3. Screwdriver

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Fig. 19: Removing Hood Release Lever From Lock Carrier (Golf, GTI & Jetta)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

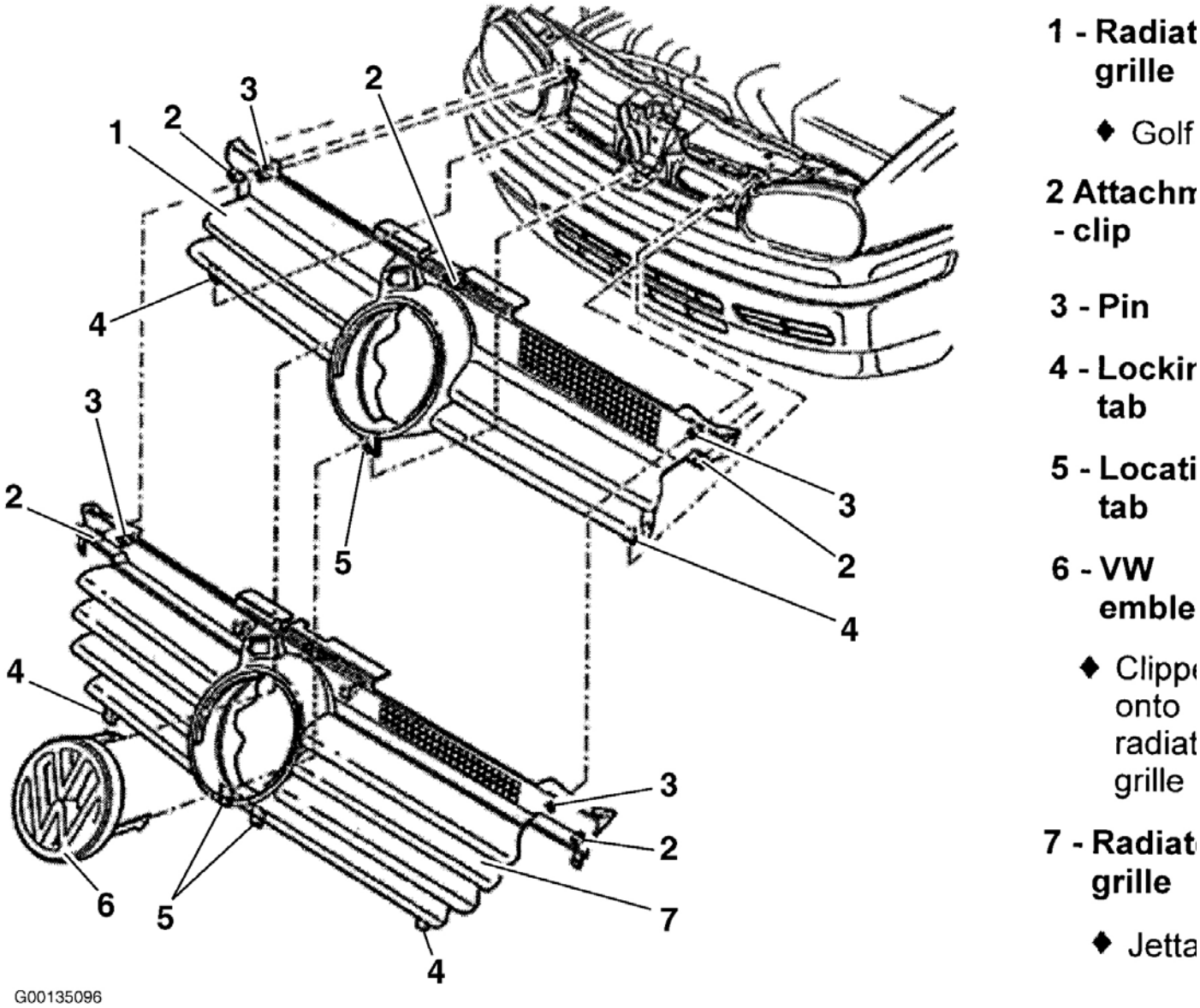
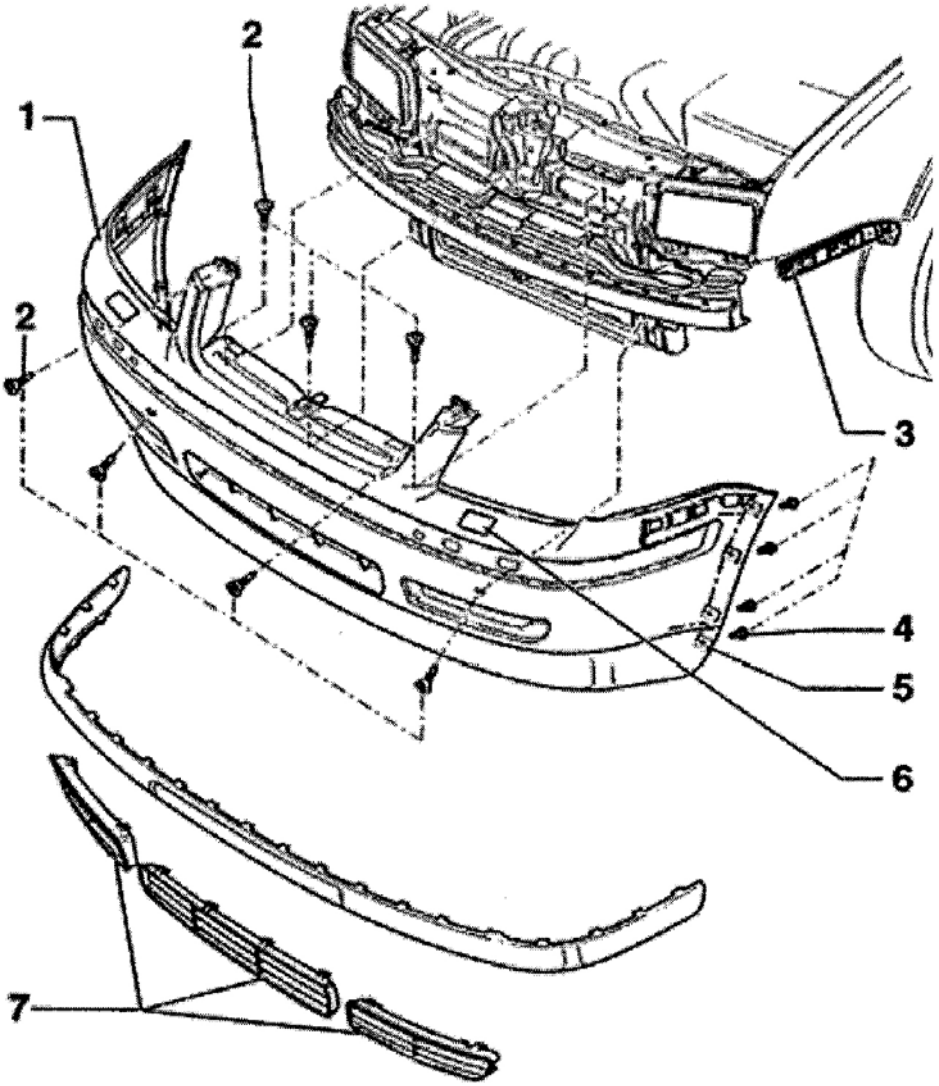


Fig. 20: Identifying Front Grill Trim Piece (Golf & Jetta Shown, GTI Similar)
Courtesy of VOLKSWAGEN UNITED STATES, INC.



1 - Cover

2 - Bolt

- Qty. 7
- 6.5 Nm (57 in. lbs.)

3 - Guide

- To remove/install bumper, pull out or push in parallel to guides at left and right

4 - Screw

- Qty. 4
- 2 Nm (17 in. lbs.)

5 - Spe nut

- Q pe si

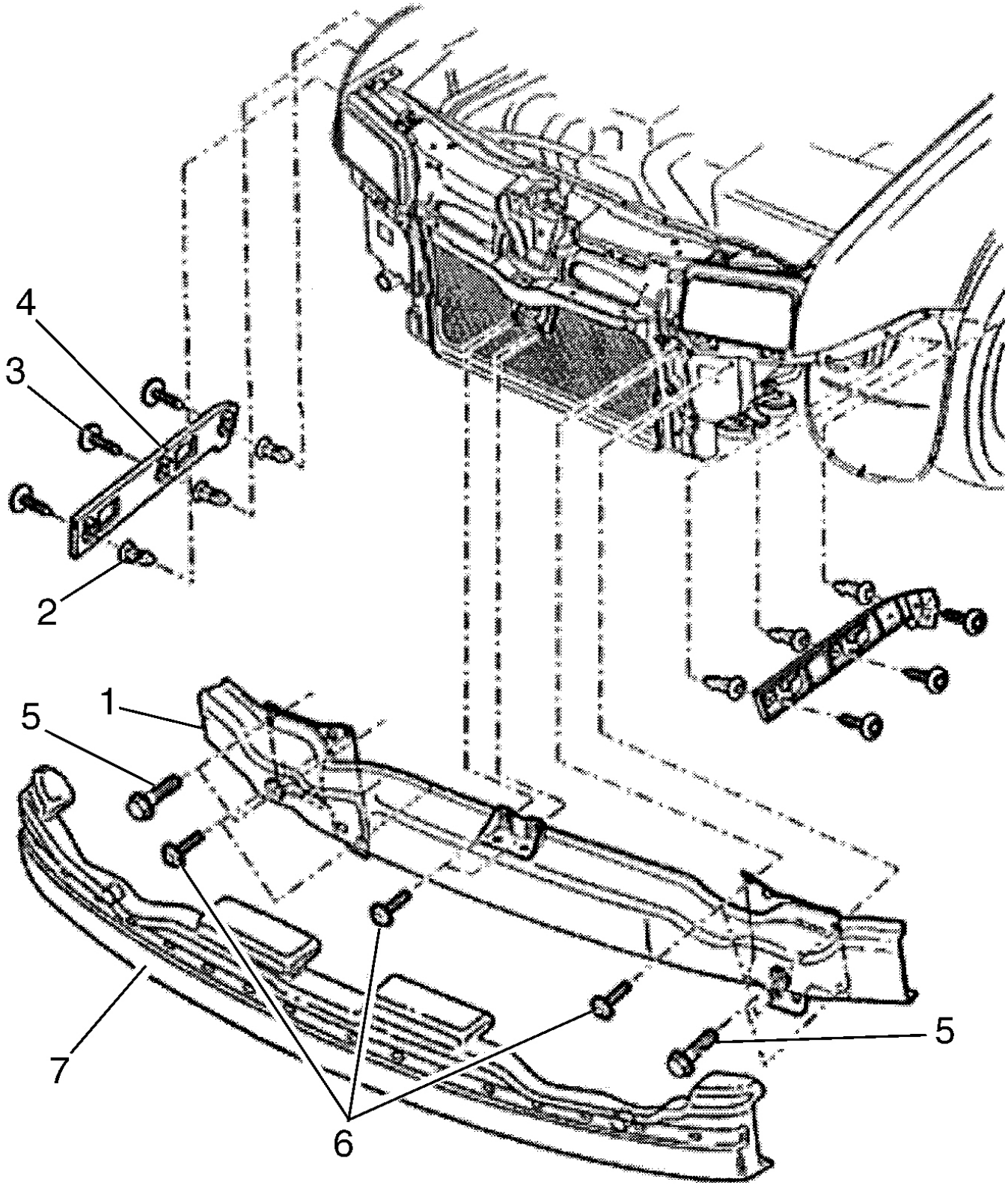
6 - Cove head wash

- Cove part head wash

7 - Air guid grill

- Clip to cov

Fig. 21: Front Bumper Assembly Overview (Golf & Jetta Shown, Differ In Style Only)
Courtesy of VOLKSWAGEN UNITED STATES, INC.



1 - Bumper beam

2 - Spreader nut

4 - Guide

- To remove/install bumper, pull

6 - Bolt

- Qty. 6
- 8 Nm

Fig. 22: Bumper Beam Assembly Overview (Golf, GTI & Jetta)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

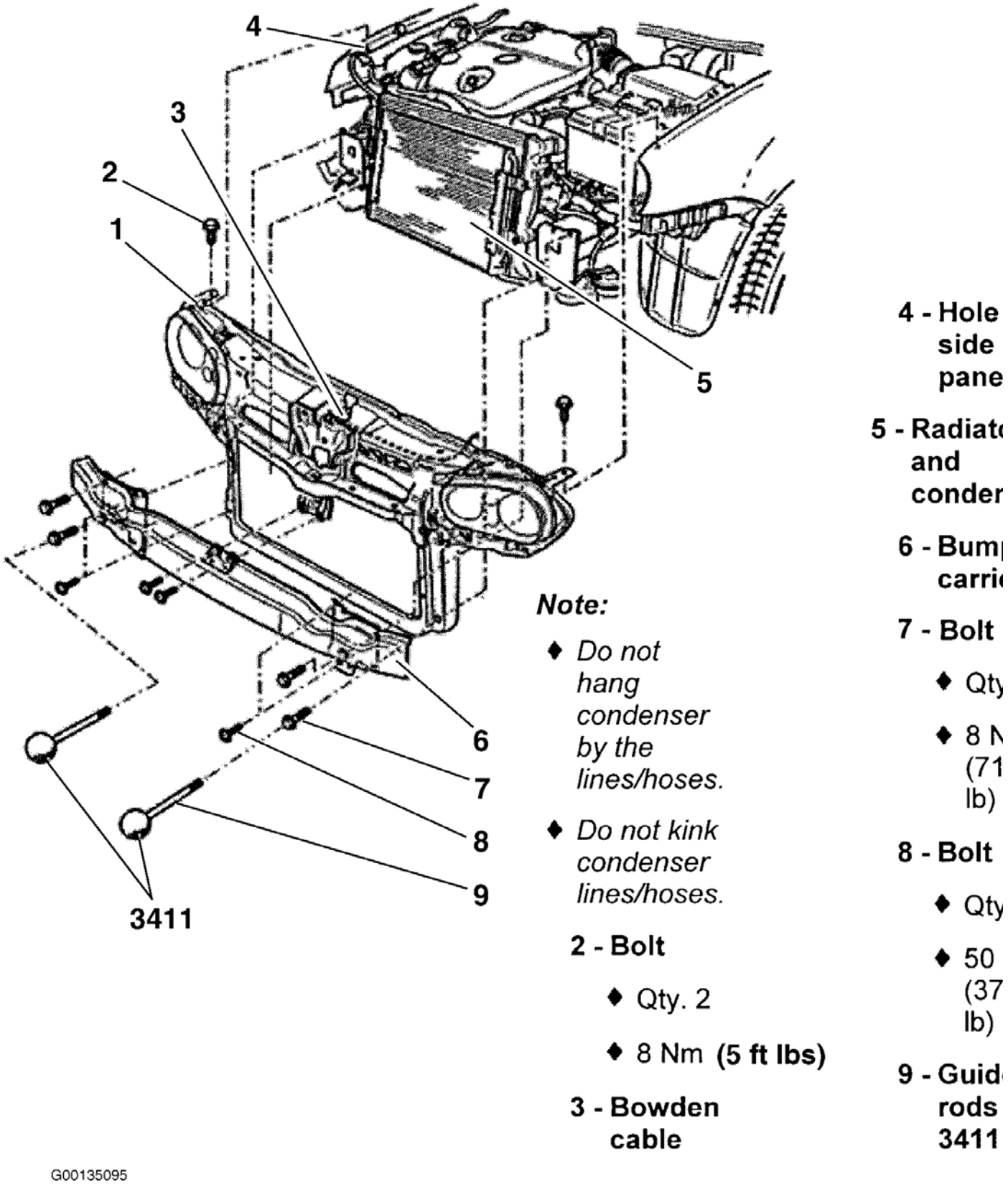


Fig. 23: Identifying Lock Carrier & Related Components (Golf, GTI & Jetta)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

ACCESSORY DRIVE BELT

CAUTION: If reusing old serpentine or other accessory drive belt(s), mark the running direction of belt with crayon or marker. Reinstalling a used belt in reversed direction could damage the belt, and cause component(s) or engine damage.

NOTE: Serpentine belt may also be referred to as ribbed belt or V-belt.

For help in identifying accessory drive belt(s) routing and component locations, refer to illustrations. See **Fig. 24** and **Fig. 25** .

Removal & Installation (Serpentine Belt)

1. Raise vehicle. Remove lower engine shield (noise insulator). See **Fig. 9** or **Fig. 10** . To loosen belt tensioner, install wrench on ear of belt tensioner.
2. Turn wrench in clockwise direction, release tension from belt and remove belt from pulley. See **Fig. 26** . Tool (3090) can be used to lock belt tensioner in released position. See **Fig. 27** .
3. To install, reverse removal procedure. Ensure pulleys are free of debris. Belt is automatically tensioned. Start engine and check belt running condition. Install lower engine shield (noise insulator).

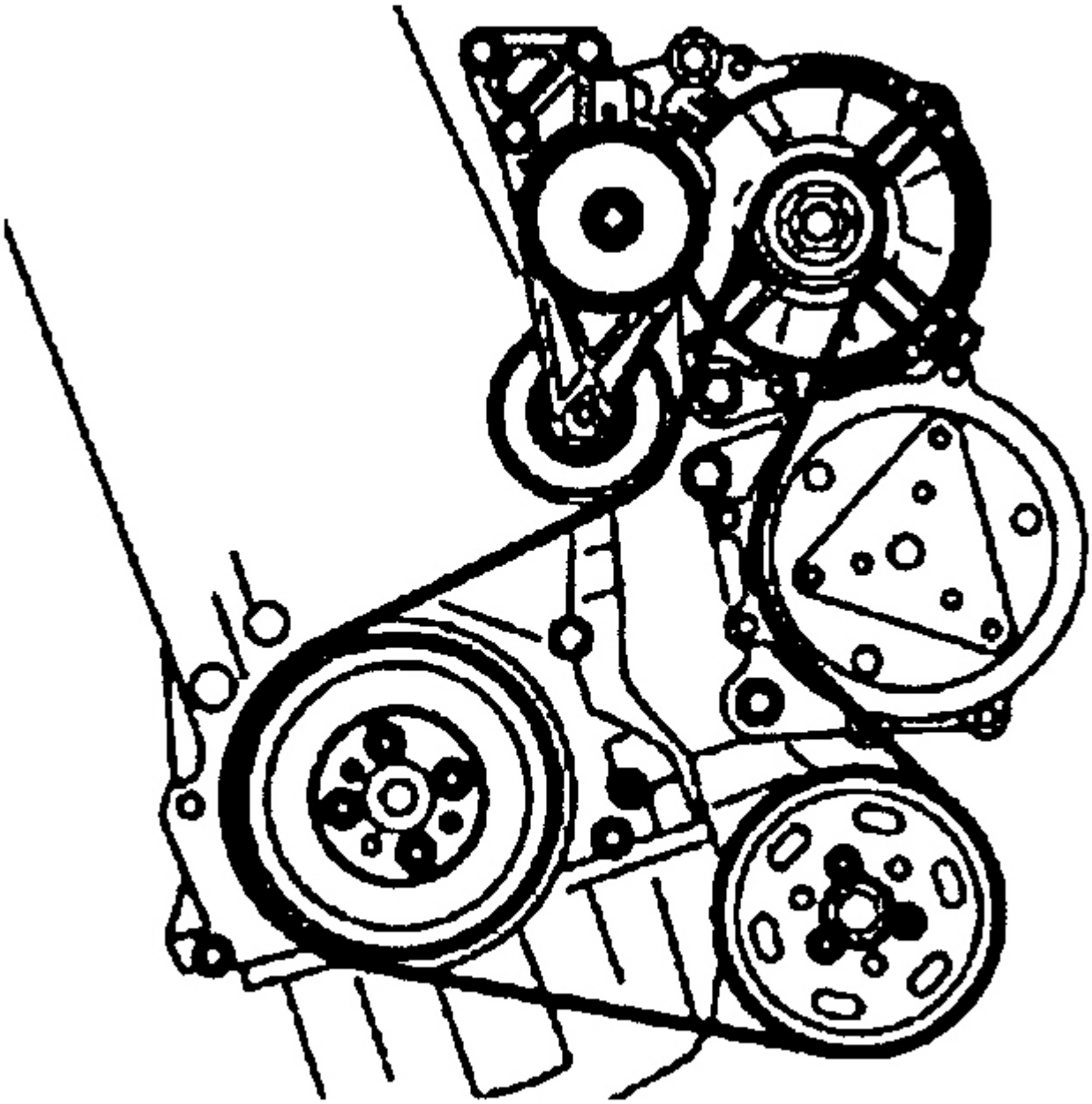


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Fig. 24: Serpentine Belt Routing With A/C Compressor
Courtesy of VOLKSWAGEN UNITED STATES, INC.

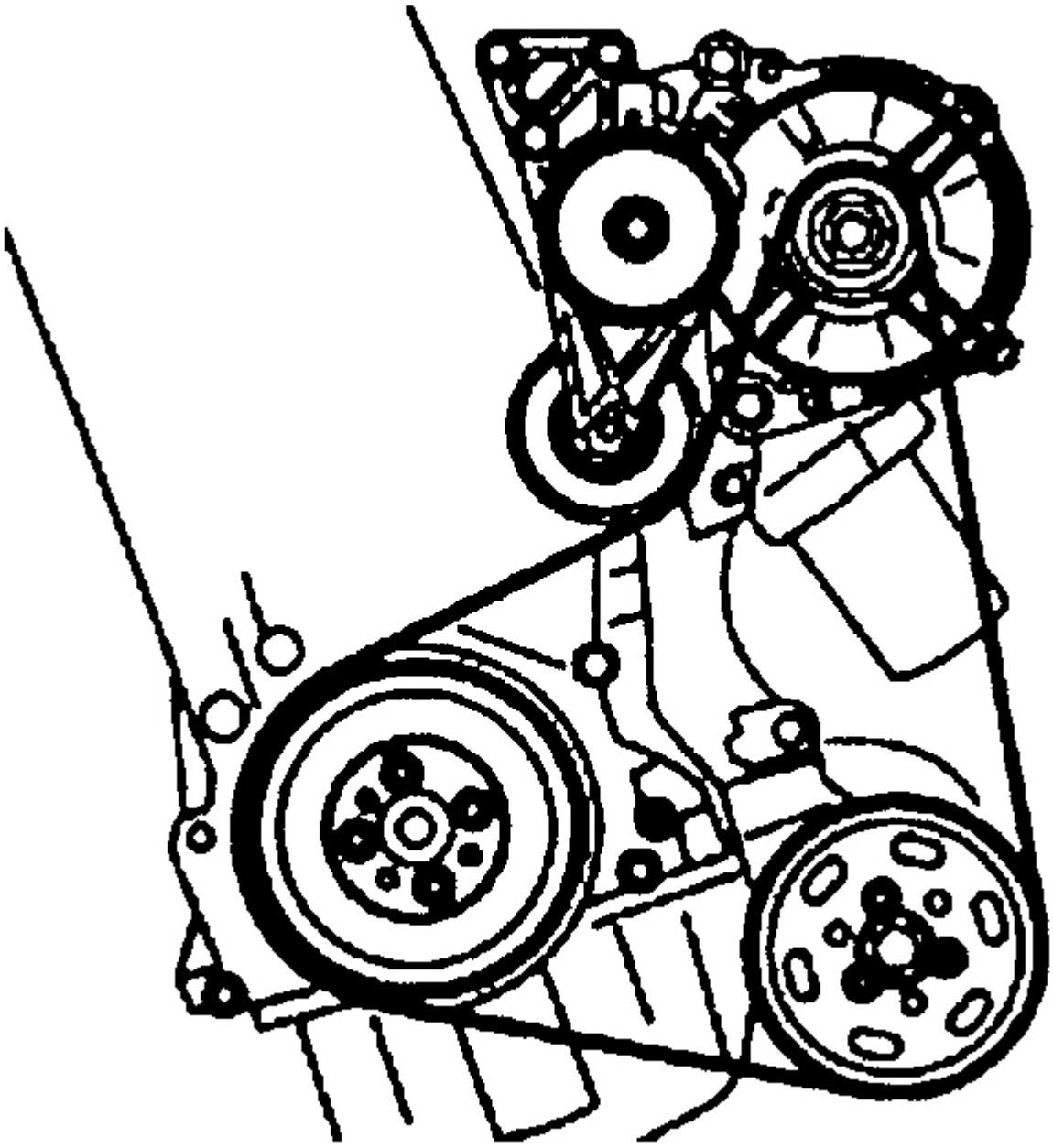

Fig. 25: Serpentine Belt Routing Without A/C Compressor
Courtesy of VOLKSWAGEN UNITED STATES, INC.

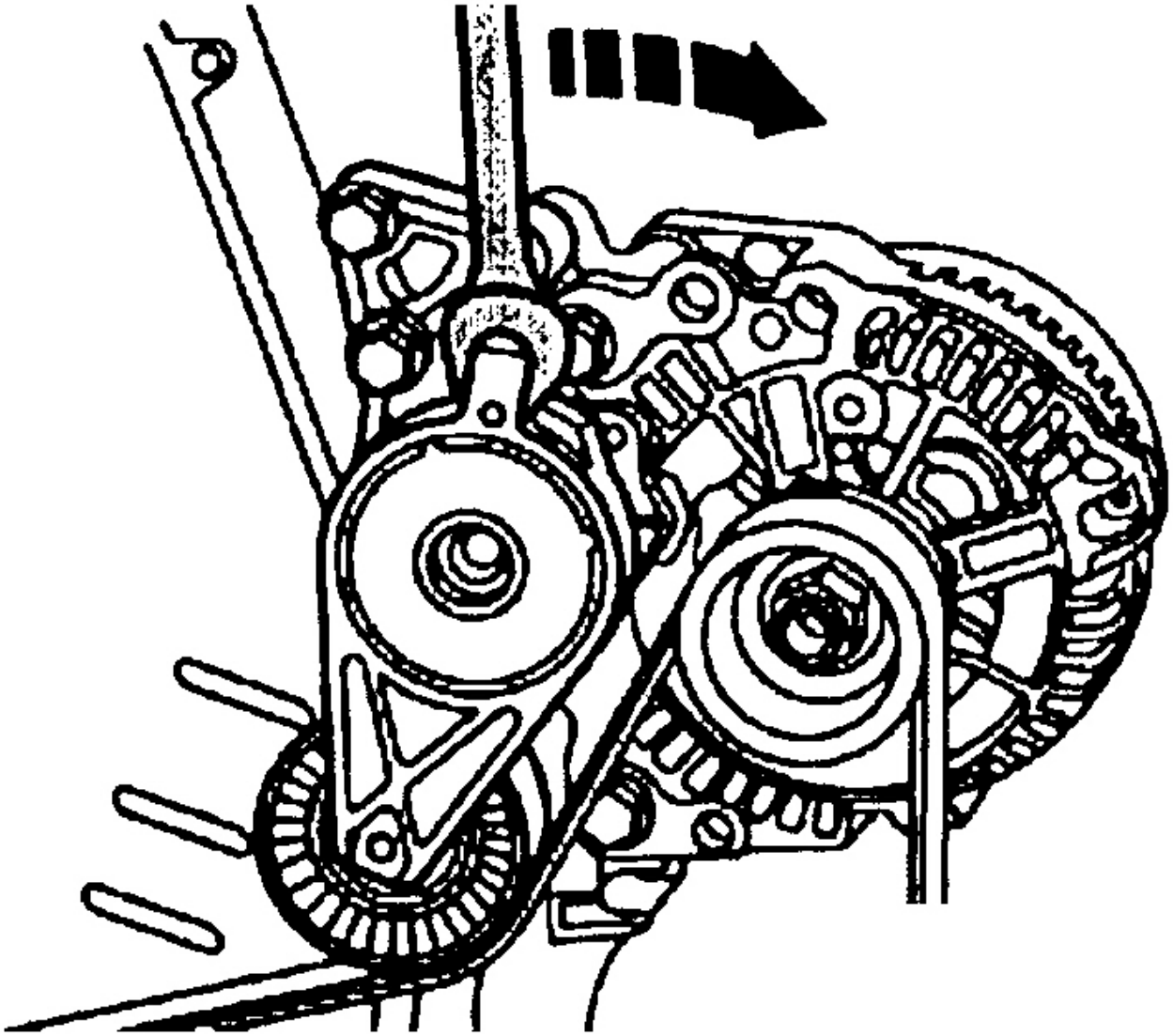

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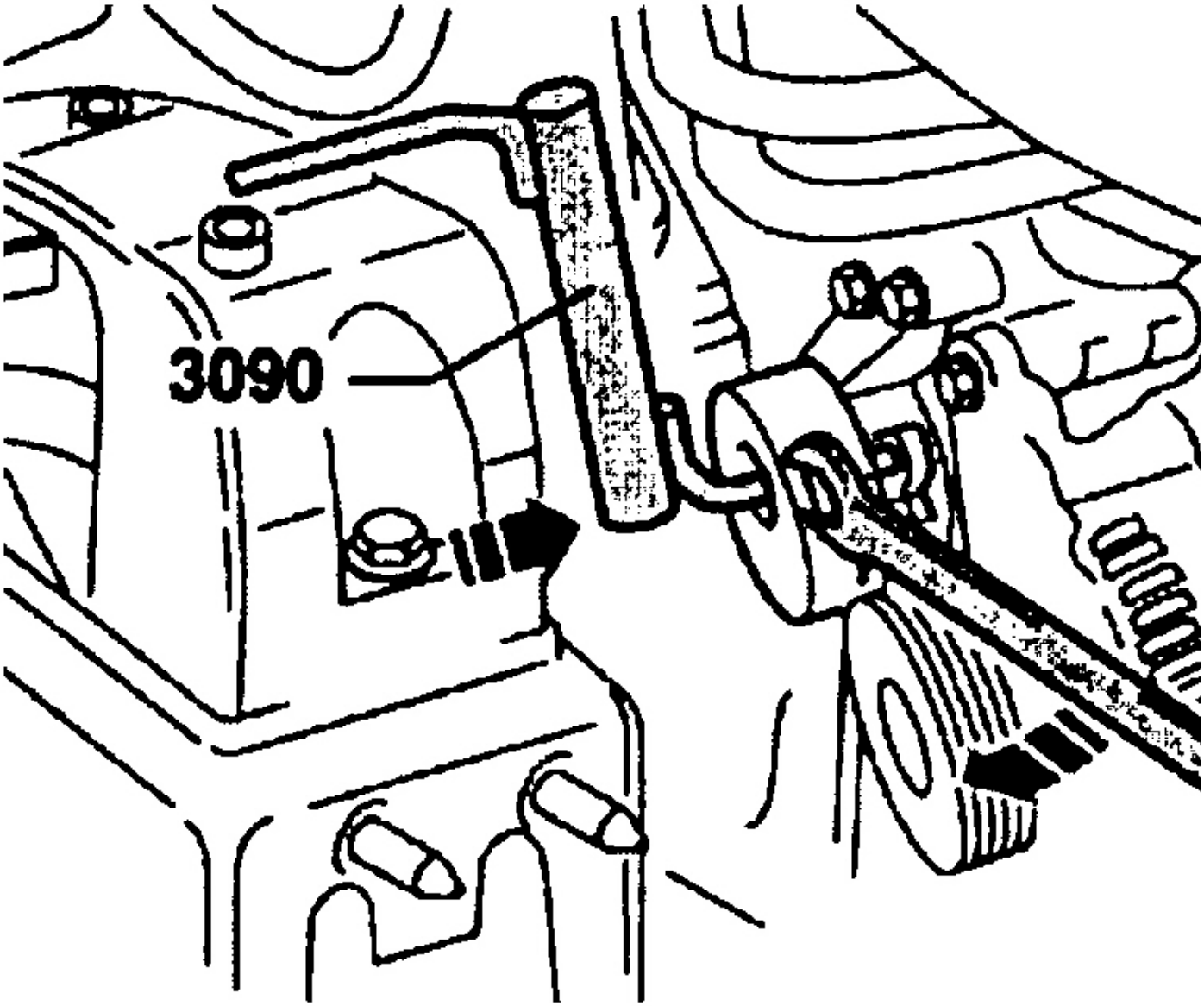
Fig. 26: Releasing Serpentine Belt Tensioner
Courtesy of VOLKSWAGEN UNITED STATES, INC.

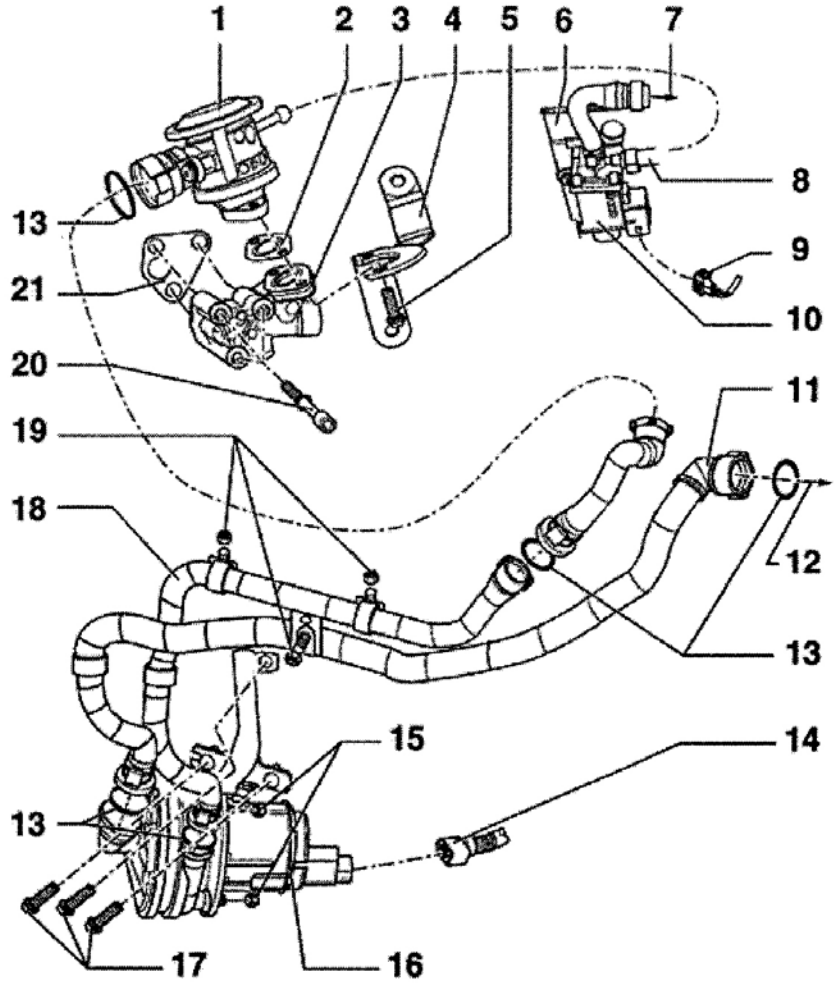


G00115617

Fig. 27: Locking Belt Tensioner In Released Positioned Using Tool (3090)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

SECONDARY AIR INJECTION SYSTEM

Removal and installation procedures are not available from manufacturer. For help in identifying components, refer to illustration. See **Fig. 28** . On installation, tighten bolts to specification. See **TORQUE SPECIFICATIONS** .



1 - Combi-valve

2 - Gasket

- Replace

3 - Connection

- Secured to cylinder head

4 - Bracket

5 - 10 Nm (7 ft. lbs.)

6 - Bracket

- Secured to intake manifold

7 - To vacuum reservoir

8 - Vacuum hose

9 - Connector

- 2 pin

10 Secondary - air intake valve (N112)

- Secured to bracket 6 Nm (4 ft. lbs.)
- Resistance: 21 to 24 Ω

11 - Intake hose

- For secondary air pump
- Make sure seated tightly
- Press together at front to release

12 - To air cleaner

13 - O-Ring

- Replace

14 - Connector

- 2 pin
- For secondary air pump motor

15 - 10 Nm (7 ft. l

16 Secondary - air pump motor (V101)

17 - 10 Nm (7 ft.

18 - Pressure hose

- Make sure seated tightly
- Press together at front to release

19 - 10 Nm (7 ft.

- Secured to bracket ⇒ item 6

20 - 10 Nm (7 ft.

21 - Gasket

- Replace

Fig. 28: Secondary Air Injection System Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

ENGINE

WARNING: ALWAYS release fuel pressure before disconnecting fuel injection related component. DO NOT allow fuel to contact engine or electrical components.

NOTE: The engine is removed from bottom, with transaxle attached. Obtain radio code before disconnecting battery.

NOTE: For help in identifying components and component locations, refer to illustrations. See Fig. 29 -Fig. 40 .

Removal (Beetle)

1. Release fuel pressure. See **FUEL PRESSURE RELEASE** . Remove lower engine shield (noise insulator). See **Fig. 9** . Drain engine oil. Drain coolant. See **DRAINING COOLING SYSTEM** .

   WARNING: The cooling system is pressurized when the engine is warm. When opening the expansion tank, wear gloves and other appropriate protection, cover the cap with a cloth and open carefully to relieve system pressure slowly.

2. **NOTE: Mark or tag vacuum lines to aid in reinstallation.**

   Disconnect battery, ground cable first. Remove both the battery and battery tray. Remove engine cover for fuel injectors. Disconnect vacuum lines and breather hoses from engine. Disconnect fuel supply and return lines at fuel rail. See **Fig. 30** . Disconnect intake air ducting located near radiator support. Remove air cleaner housing. Remove air ducting from intercooler. See **Fig. 31** . Disconnect harness connectors at horns. Disconnect coolant fan harness connectors. Remove fasteners and move P/S reservoir (DO NOT disconnect hoses). Secure reservoir to lock carrier.
3. Disconnect selector mechanism from transaxle. On Manual Transmissions (M/T), remove clutch slave cylinder. On all applications, disconnect all harness connectors from transaxle. Disconnect alternator (generator) harness connectors and remove alternator. On Automatic Transaxle (A/T), remove ATF lines from transaxle.
4. On all applications, disconnect turbocharger, air intake and throttle valve control module ducts. Remove electrical harness connector from fuel injectors. Disconnect connectors from ignition coils. Remove electrical connectors from throttle body and intake manifold. See **Fig. 32** . Disconnect Camshaft Position (CMP) sensor on front of cylinder head. See **Fig. 33** . Disconnect chassis grounds, disconnect all cables that would interfere with engine removal.
5. Unbolt vacuum canister from cylinder head cover and pull from bracket.
6. **NOTE: DO NOT open the air conditioning refrigerant circuit. Disconnect electrical connector to A/C compressor. Disconnect A/C refrigerant line brackets at support points only. After A/C compressor is removed from**

bracket, support with heavy wire and set A/C compressor carefully aside, avoid damage from bending or kinking refrigerant lines.

Remove right side air duct. Disconnect harness connector for A/C pressure switch.

7. **NOTE: Mark or tag vacuum lines to aid in reinstallation.**

   Disconnect Oxygen Sensor harness connector. Disconnect front exhaust pipe from exhaust manifold. Disconnect front exhaust pipe from catalytic converter. Remove front catalytic converter from turbocharger. Disconnect Leak Detection Pump (LDP) vacuum lines. Remove harness connector from starter.
8. Disconnect all coolant and heater hoses. Remove coolant system expansion reservoir and set aside. Remove securing clamps for power steering pressure pipe. Remove power steering pump with bracket and set aside. DO NOT disconnect hoses from pump.
9. Remove protective cover from right-side inner constant velocity joint. Remove right and left driveshaft from there flanges at the transaxle.
10. Remove pendulum support. See **Fig. 34** . Fit Engine Support Bracket (T 10012) onto cylinder block. Using a M10 X 25/8.5 bolt and a securing nut, fasten Engine Support Bracket to block and tighten to approximately 40 N.m (30 ft. lbs). See **Fig. 35** .
11. **NOTE: Mount bolts are removed from top side.**

    Unbolt engine side of assembly mount from engine carrier at top. See **Fig. 36** . Unbolt transaxle side of assembly mount from transaxle carrier at top. See **Fig. 37** .
12. Carefully lower engine/transaxle assembly. Power steering pressure line will need to be guided around transaxle as assembly is lowered. Ensure not to damage bodywork. If assembly gets caught up, stop and inspect for cause. After assembly is free, continue with lowering the assembly.
13. Move assembly to a suitable workbench and remove transaxle from engine. See **Fig. 38** . On A/T, ensure torque converter does not separate from transaxle. Secure torque converter.
14. **NOTE: Ensure lift tackle is installed properly.**

    Install Engine Support Bracket (2024 A) and Hooks (3180) to engine. Install at front of engine (pulley side), 3rd hole in hook at position 1. At flywheel side, 2nd hole in hook at position 5. See **Fig. 39** . Lift engine off of Jack (VAG 1283).

    WARNING: Ensure hooks and locating pins are secured with locking pins.

15. Install engine to Support Clamp (VW 313) using Engine/Transmission Bracket (VW 540). See **Fig. 40** .

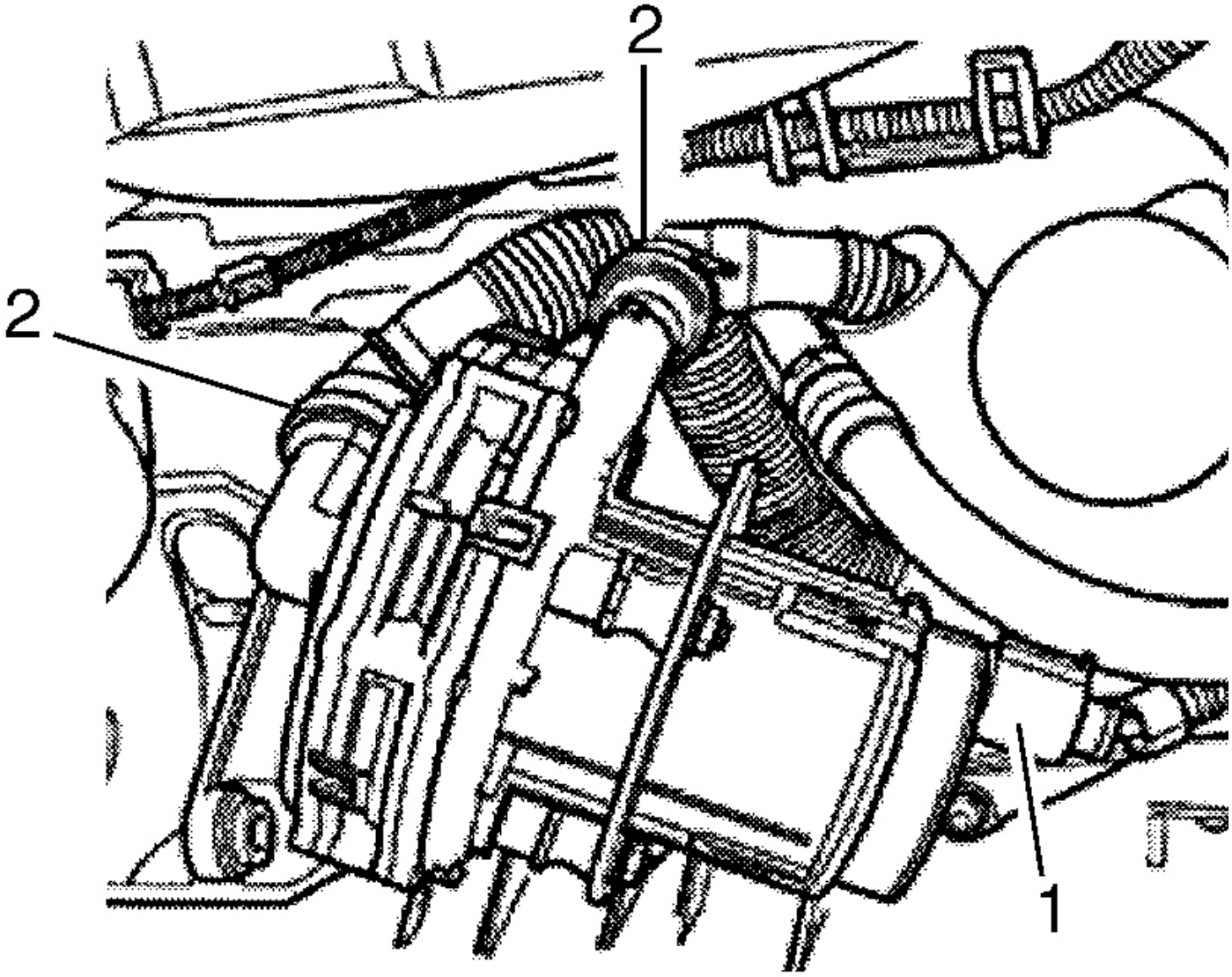
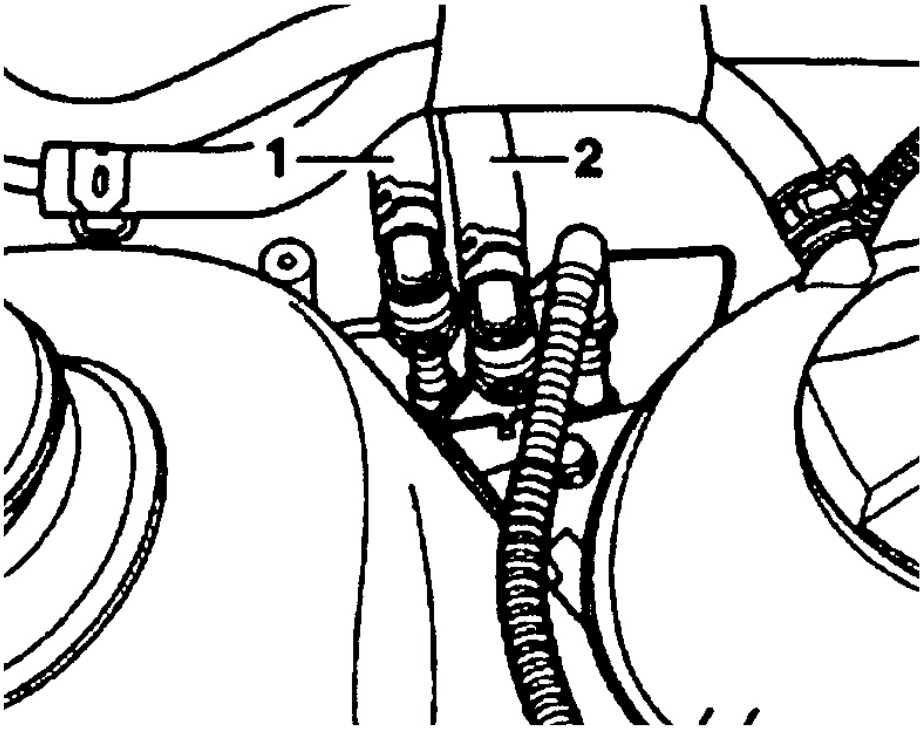


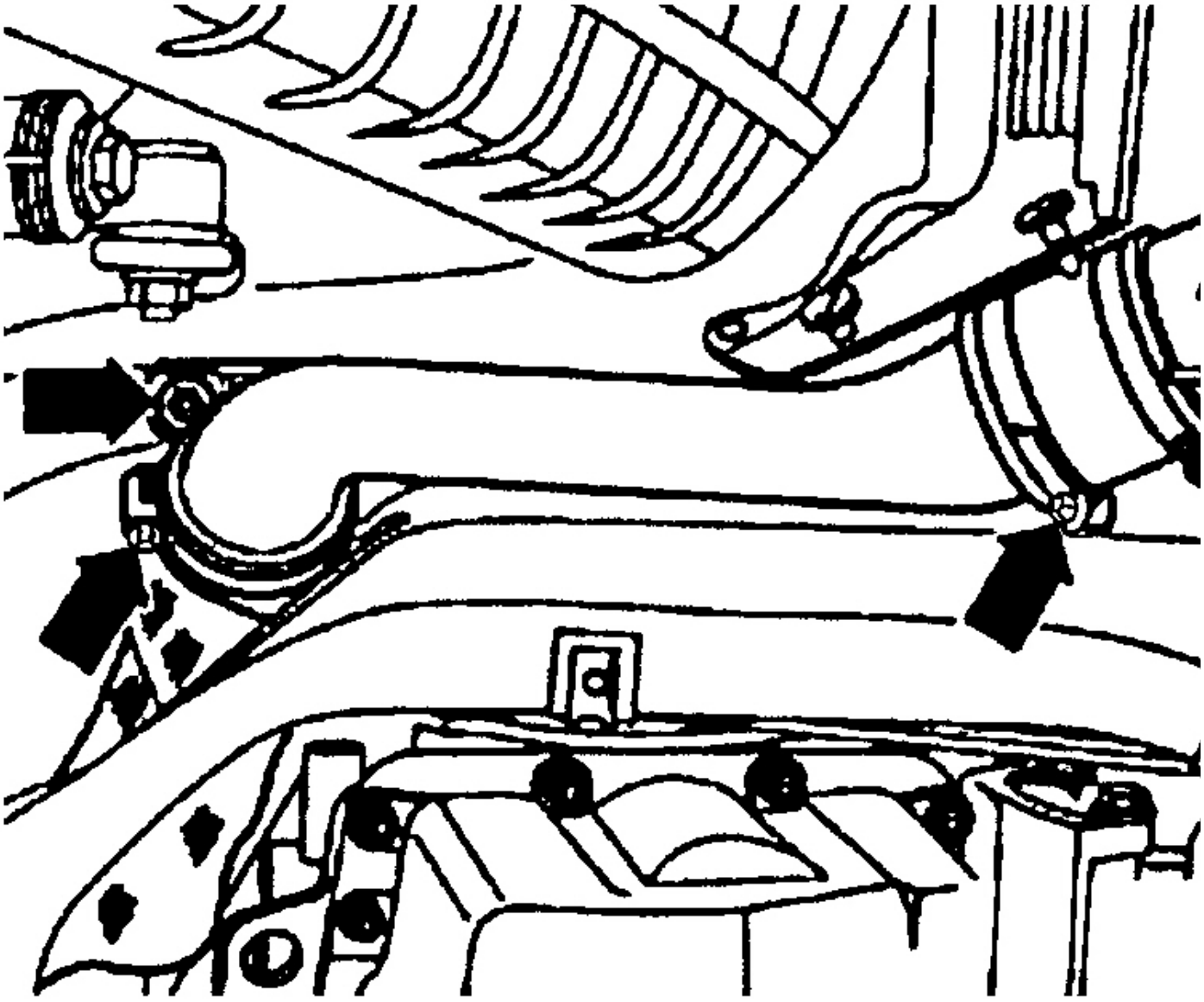
Fig. 29: Identifying Secondary Air Pump Combination Valve
Courtesy of VOLKSWAGEN UNITED STATES, INC.



1. Fuel Supply
2. Fuel Return

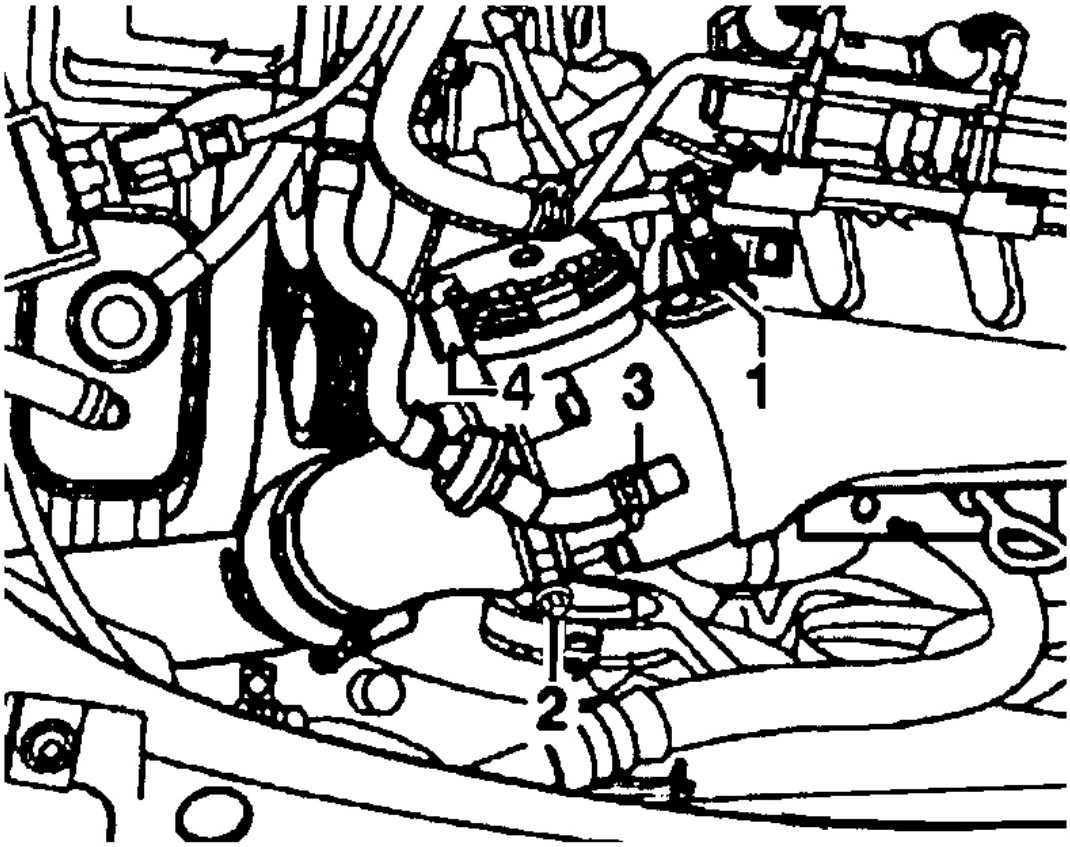
G00115619

Fig. 30: Identifying Fuel Supply & Fuel Return Lines
Courtesy of VOLKSWAGEN UNITED STATES, INC.



G00115621

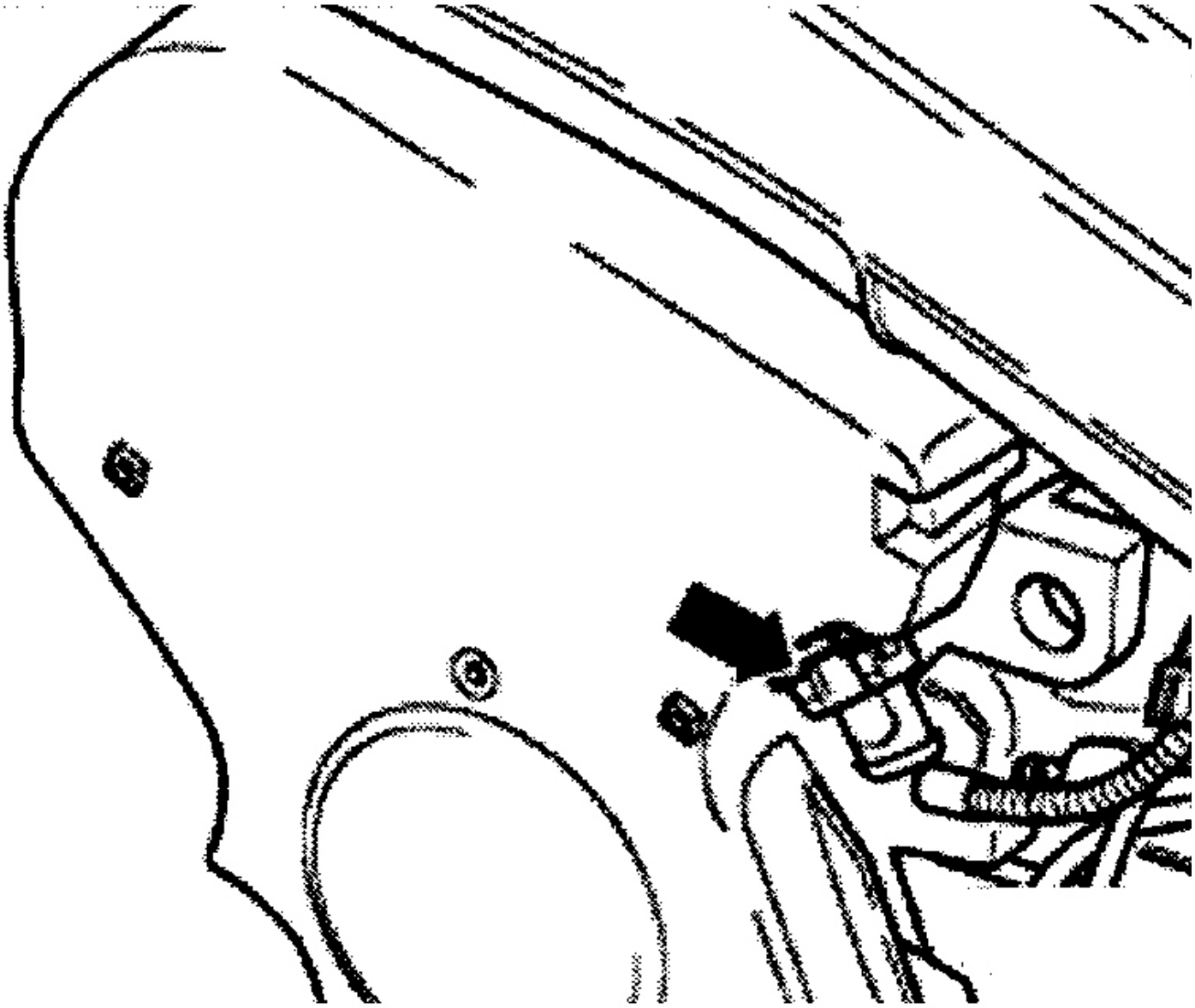
Fig. 31: Identifying Air Duct To Charge Air Cooler
Courtesy of VOLKSWAGEN UNITED STATES, INC.



1. Intake Air Temp (IAT) Sensor
2. Clamp
3. Hose Clamp
4. Throttle Valve Control Module

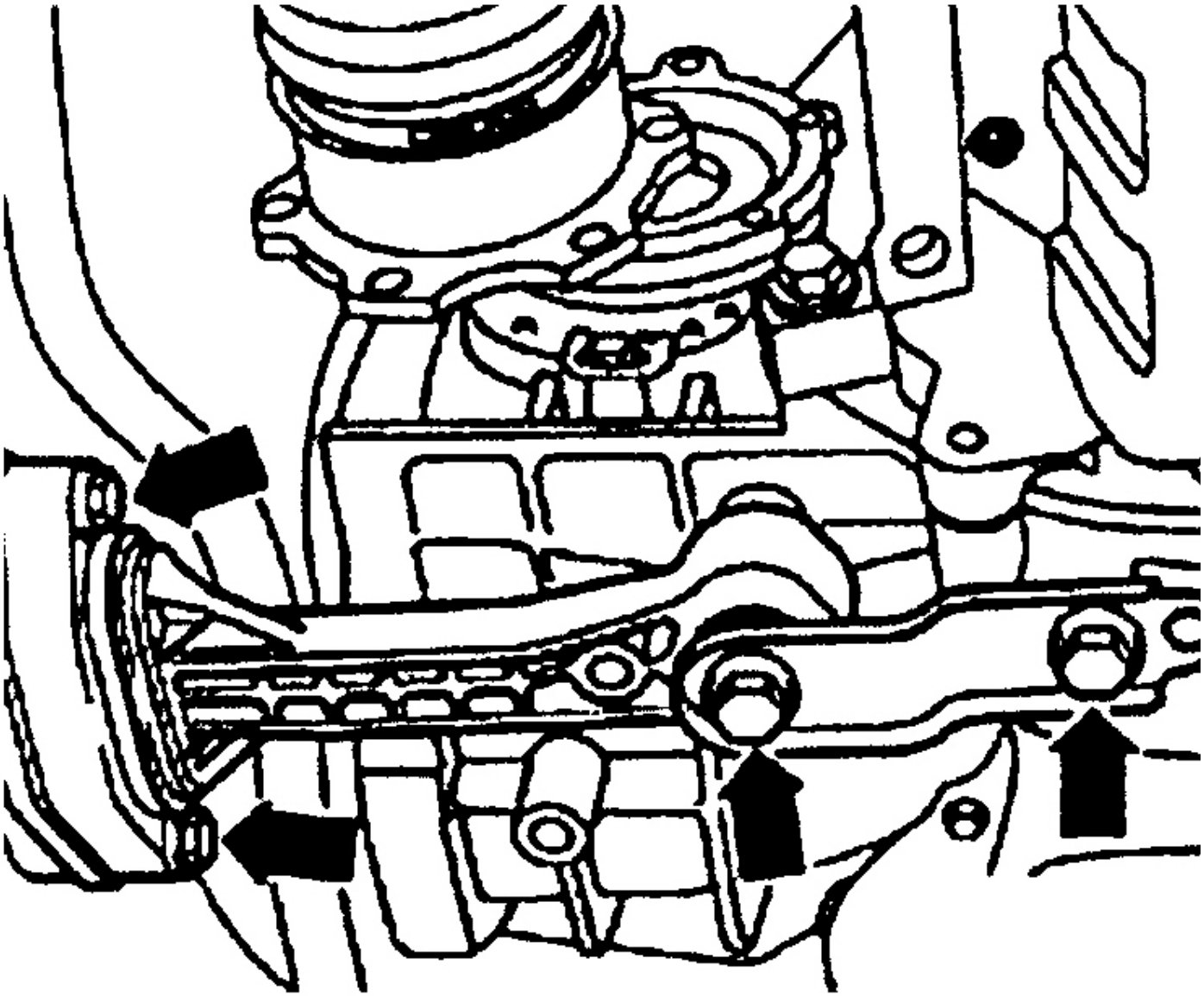
G00115620

Fig. 32: Identifying Throttle Body Connection Components
Courtesy of VOLKSWAGEN UNITED STATES, INC.



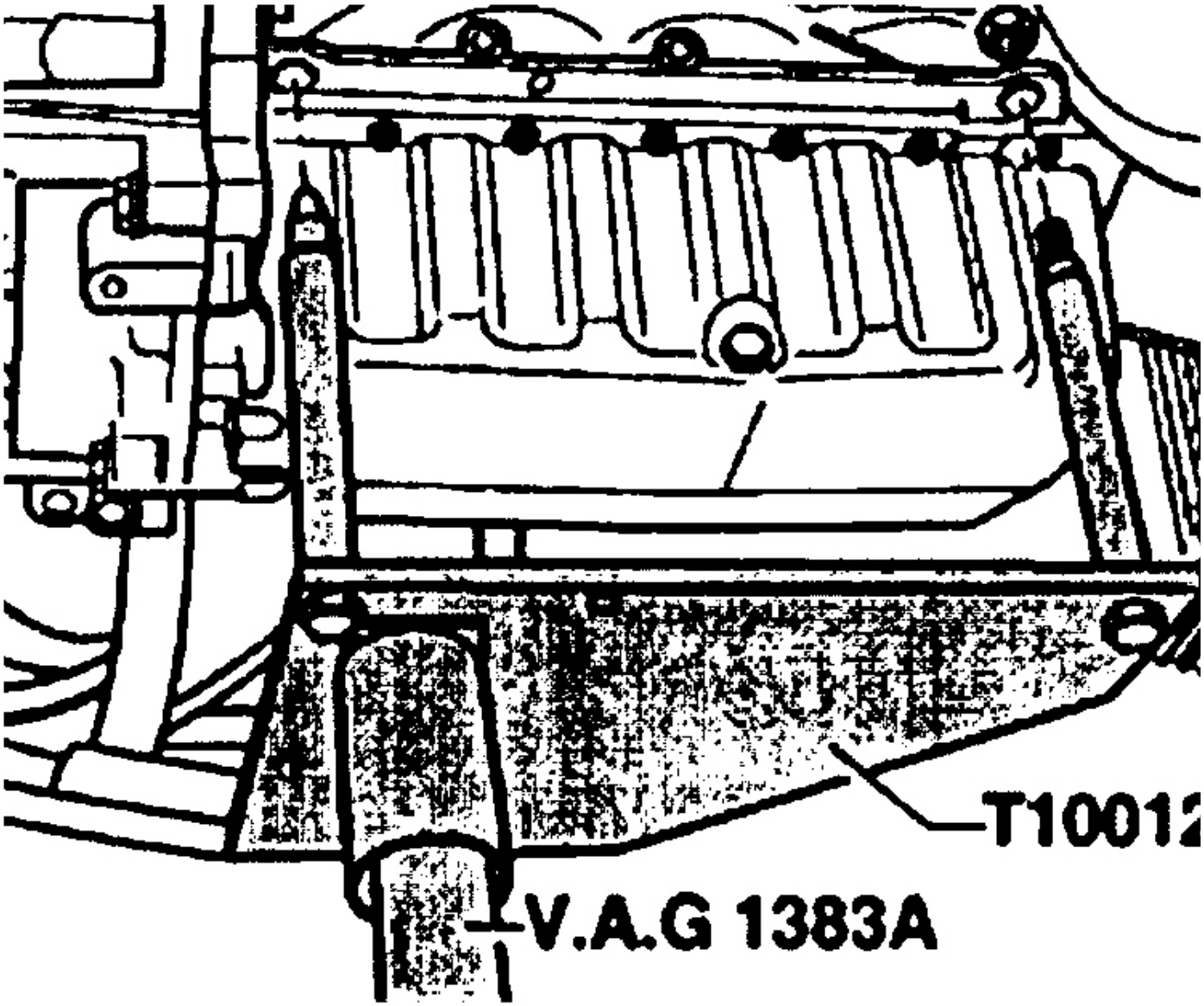
G00115514

Fig. 33: Identifying Camshaft Position Sensor Harness Connector
Courtesy of AUDI OF AMERICA, INC.



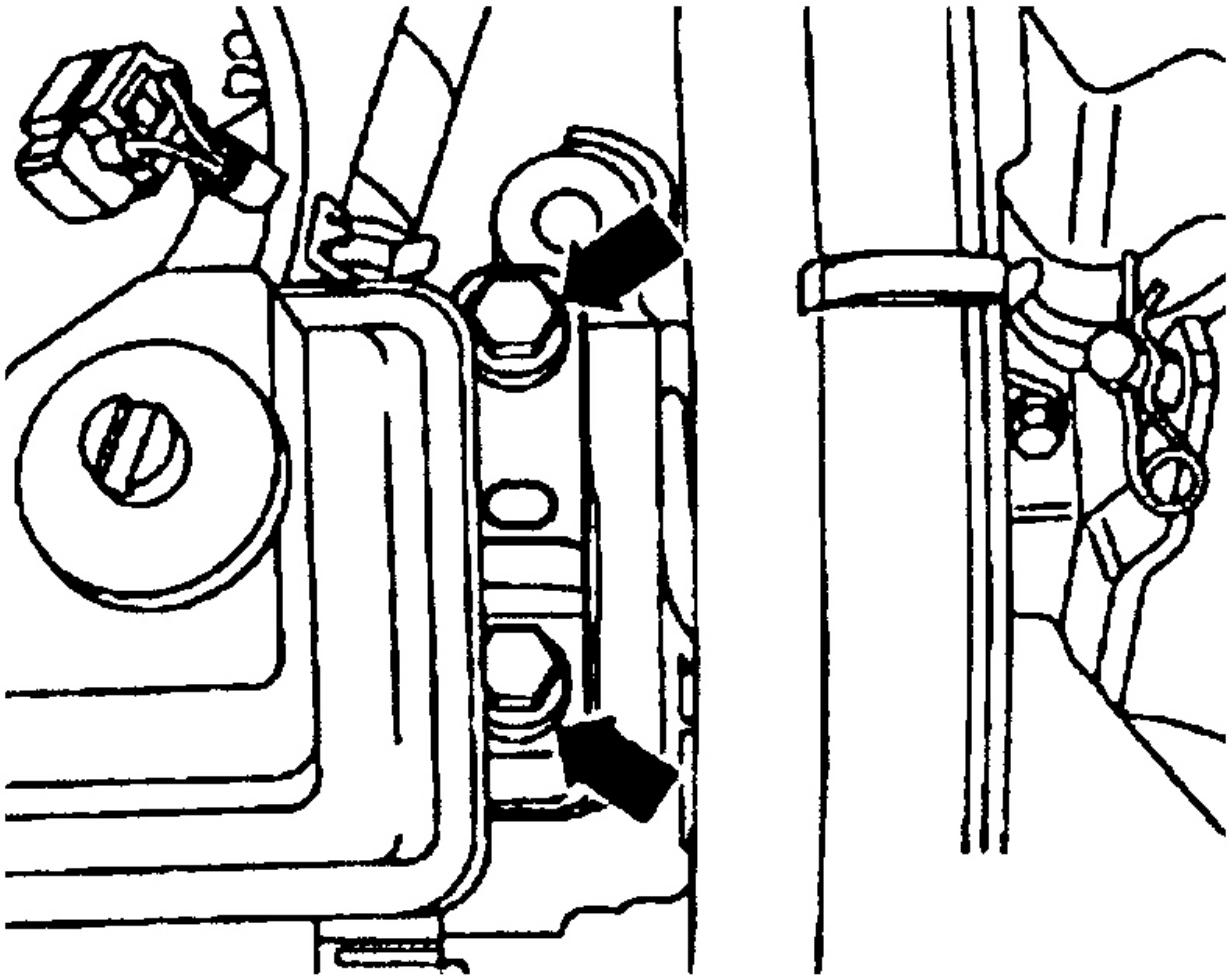
G00115622

Fig. 34: Identifying Pendulum Support
Courtesy of VOLKSWAGEN UNITED STATES, INC.



G00115623

Fig. 35: Installing Engine Support Bracket (T 10012) & Jack (VAG 1383 A)
Courtesy of VOLKSWAGEN UNITED STATES, INC.



G00115624

Fig. 36: Unbolting Engine Side Mount Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

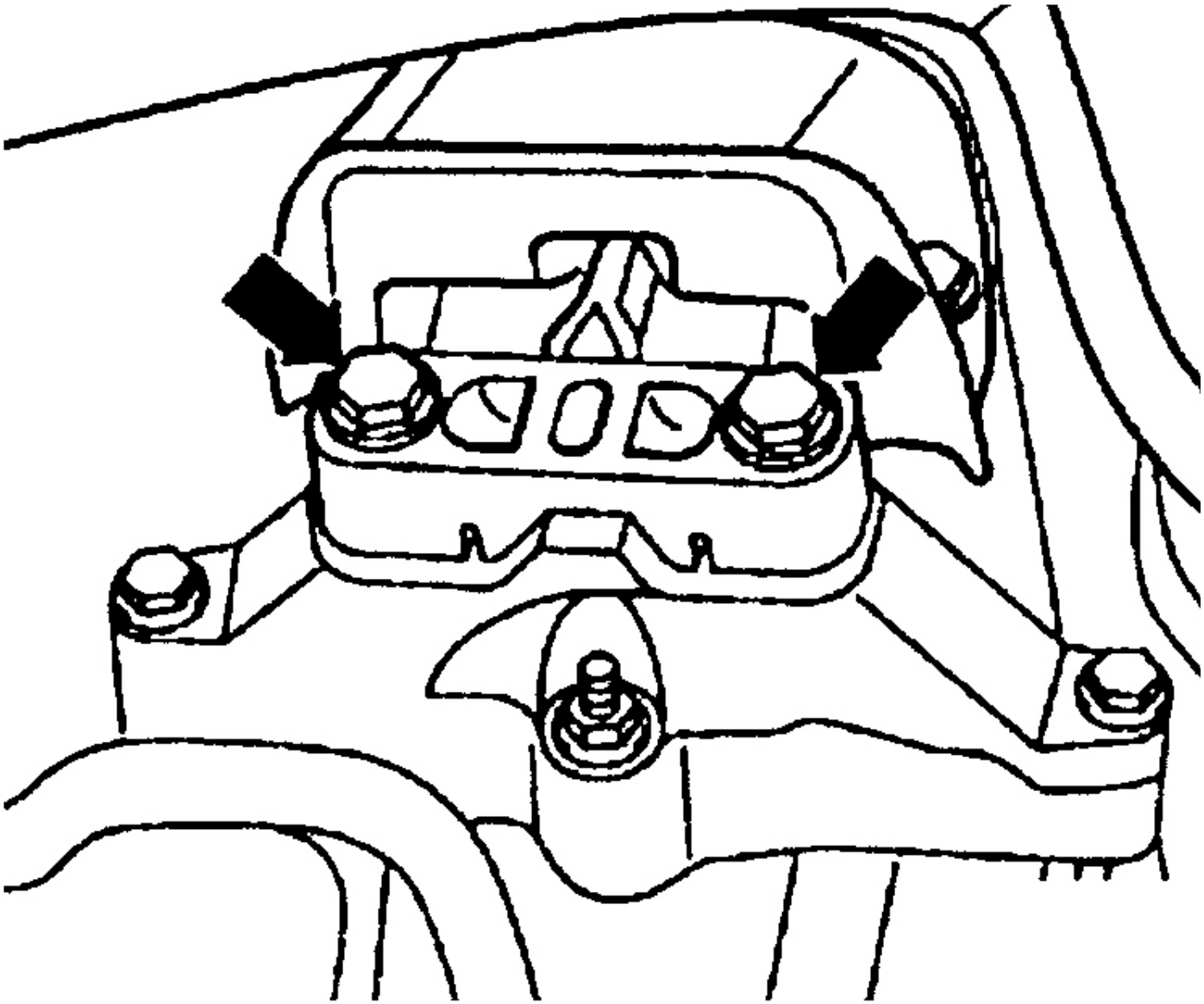
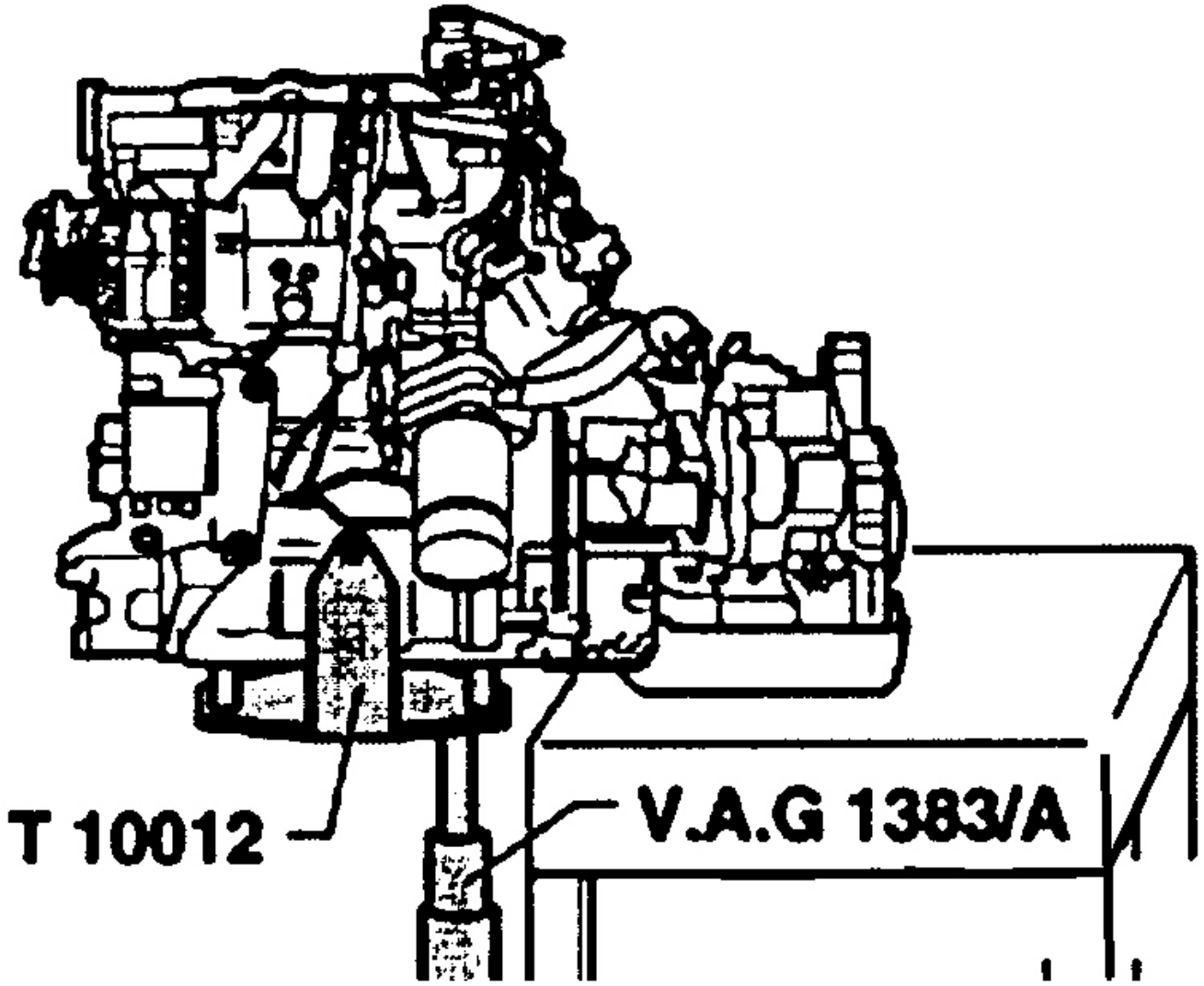


Fig. 37: Unbolting Transaxle Side Mount Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.



G00115626

Fig. 38: Supporting Transaxle On Workbench Prior To Removal
Courtesy of VOLKSWAGEN UNITED STATES, INC.

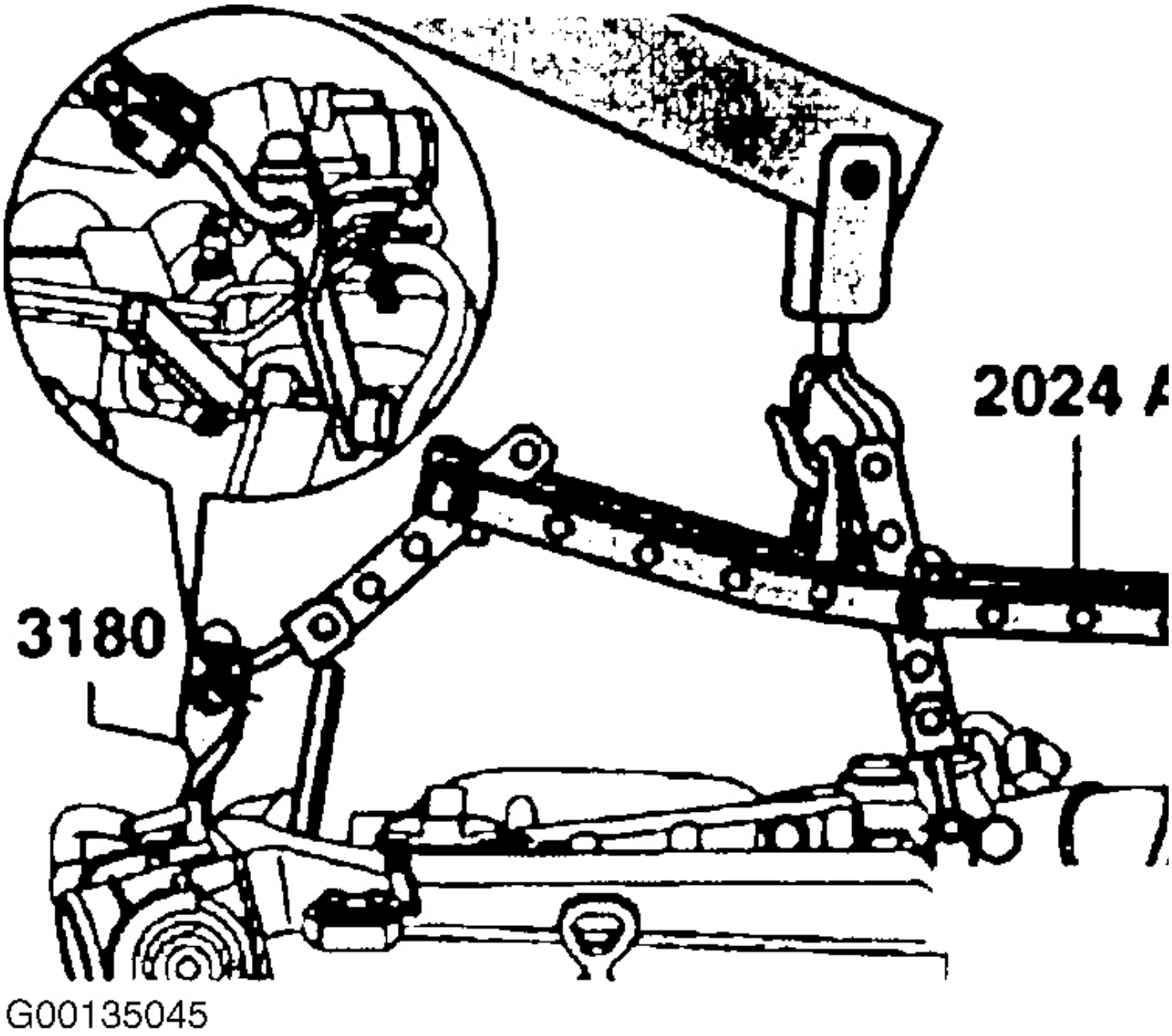


Fig. 39: Attaching Lifting Tackle (2024A) With Bracket (3180)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

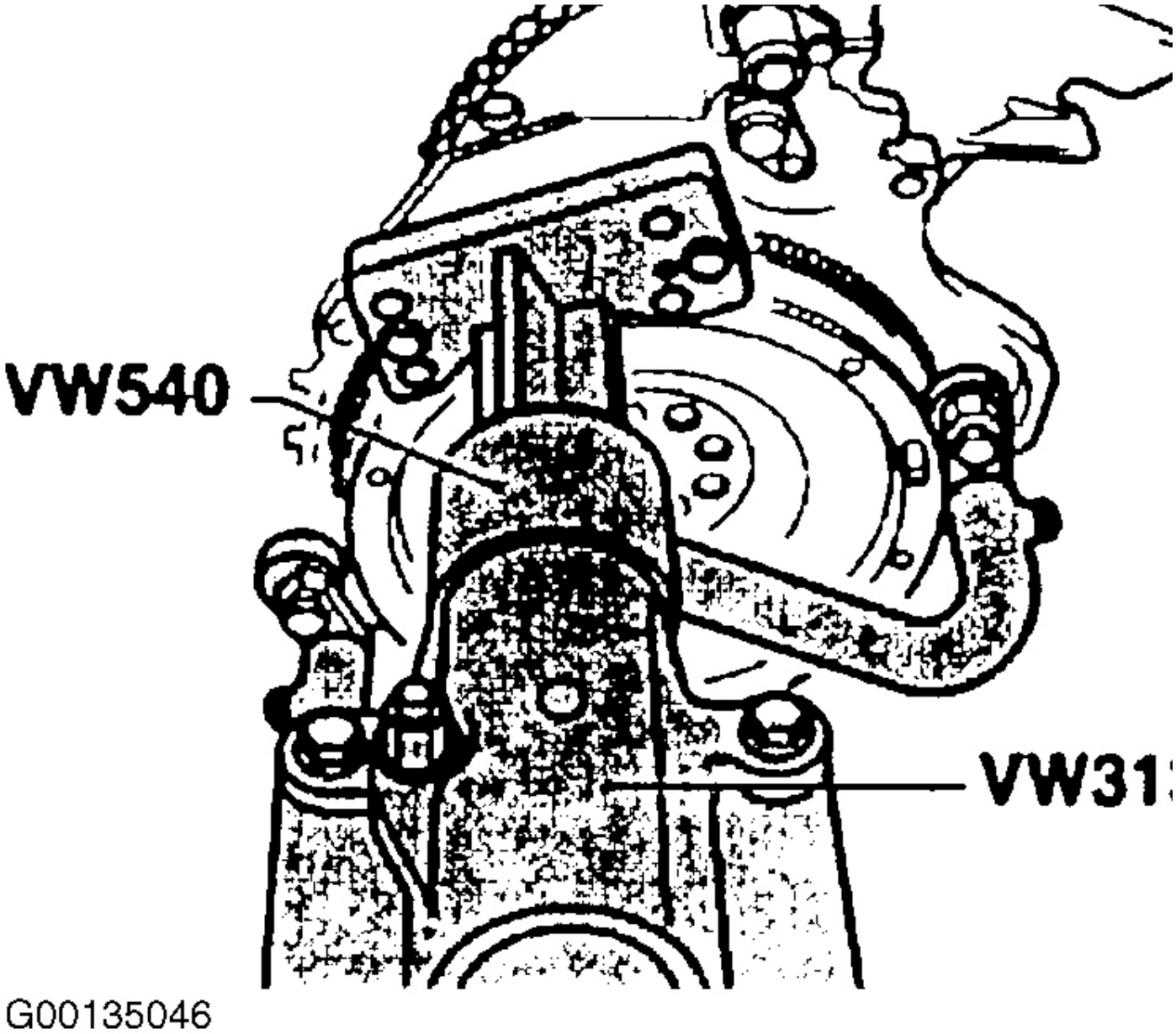


Fig. 40: Installing Engine To Engine/Transaxle Support (VW 313) & Bracket (VW 540)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Removal (Golf, GTI & Jetta)

1. Release fuel pressure. See **FUEL PRESSURE RELEASE** . Remove lower engine shield (noise insulator). See **Fig. 10** . Drain engine oil. Drain coolant. See **DRAINING COOLING SYSTEM** .

   WARNING: The cooling system is pressurized when the engine is warm. When opening the expansion tank, wear gloves and other appropriate protection, cover the cap with a cloth and open carefully to relieve system pressure slowly.

2. **NOTE: Mark or tag vacuum lines to aid in reinstallation.**

Disconnect battery, ground cable first and remove both the battery and battery tray. Remove engine cover. Remove connecting hoses between the secondary air pump combination valve and secondary air pump/air cleaner. Pull harness connector (1) off secondary air pump. See **Fig. 29** . Remove air cleaner. Disconnect vacuum lines and breather hoses from engine. Disconnect fuel supply and return lines at fuel rail. See **Fig. 30** .

3. Disconnect intake air ducting between the turbocharger and Mass Air Meter, remove air ducting. Remove intake air ducting between the charge air cooler (intercooler) and throttle body. Remove air ducting from intercooler. See **Fig. 31** . Disconnect harness connectors at horns. Disconnect coolant fan harness connectors. Remove securing clips for P/S pressure lines. Remove the P/S pump with bracket, remove P/S reservoir (DO NOT disconnect any of these hoses). Secure P/S pump and reservoir off to the side.
4. Remove electrical harness connector from fuel injectors. Disconnect connectors from ignition coils. Remove electrical connectors from throttle body and intake manifold. See **Fig. 32** . Disconnect Camshaft Position (CMP) sensor connector at front of cylinder head. See **Fig. 33** . Disconnect chassis grounds, disconnect all cables that would interfere with engine removal.
5. Disconnect selector mechanism and remove selector cable from transaxle. On Manual Transaxle (M/T), remove clutch slave cylinder. On all applications, remove all harness connectors from transaxle. Disconnect alternator (generator) harness connectors. Remove alternator. On Automatic Transaxle (A/T), remove ATF lines from transaxle.
6. On all applications, unbolt vacuum canister from cylinder head cover and pull from bracket.
7. **NOTE: DO NOT open the air conditioning refrigerant lines. Disconnect electrical connector to A/C compressor. Disconnect A/C refrigerant line brackets at support points only. After A/C compressor is removed from bracket, support with heavy wire and set A/C compressor carefully aside, avoid damage from bending or kinking refrigerant lines.**

   Remove right side air duct. Disconnect harness connector for A/C pressure switch.
8. **NOTE: Mark or tag vacuum lines to aid in reinstallation.**

   Disconnect Oxygen Sensor harness connect, disconnect front exhaust pipe from exhaust manifold. Disconnect front exhaust pipe from catalytic converter. Remove front catalytic converter from turbocharger. Disconnect Leak Detection Pump (LDP) vacuum lines. Remove harness connector from starter.
9. Disconnect all coolant and heater hoses. Remove coolant system expansion reservoir and set aside.
10. Remove protective cover from right-hand inner constant velocity joint. Remove right and left driveshaft from there flanges at the transaxle.
11. Remove pendulum support. See **Fig. 34** . Fit Engine Support Bracket (T 10012) onto cylinder block. Using M10 X 25/8.5 bolt and a securing nut, fasten to block and tighten to approx. 40 N.m (30 ft. lbs). See **Fig. 35** .
12. **NOTE: Mount bolts are removed from top side.**

    Unbolt engine side of assembly mount from engine carrier at top. See **Fig. 36** . Unbolt transaxle side of assembly mount from transaxle carrier at top. See **Fig. 37** .
13. Carefully lower engine/transaxle assembly. Power steering pressure line will need to be guided around transaxle as assembly is lowered. Ensure not to damage bodywork. If assembly gets caught up, stop

and inspect for cause. After assembly is free, continue with lowering the assembly.

14. Move assembly to a suitable workbench. Remove transaxle from engine. See **Fig. 38** . On A/T, ensure torque converter does not separate from transaxle. Secure torque converter.
15. **NOTE: Ensure lift tackle is installed properly.**

    On all applications, when working on the engine, it should be secured to the assembly stand support clamp Install Engine Support Bracket (2024 A) and Hooks (3180) to engine. Install at front of engine (pulley side), 3rd hole in hook at position 1. At flywheel side, 2nd hole in hook at position 5. See **Fig. 39** . Lift engine off of Jack (VAG 1283).

    WARNING: Ensure hooks and locating pins are secured with locking pins.

16. Install Engine-To-Support Clamp (VW 313) using Engine/Transmission Bracket (VW 540). See **Fig. 40** .

Installation

1. Ensure dowel sleeves and intermediate plate are installed on block before installing transaxle. See **Fig. 41** . Check centering of clutch drive plate, check condition of release bearing, replace if necessary. Lightly grease clutch release bearing, guide sleeve and splines on input shaft with (G000 100). To complete installation, reverse removal procedure.
2. **WARNING: Before loosening engine and transaxle mount bolts, the assembly must be secured with Engine Support Bar and Stands (10-222A). See Fig. 42 .**

   Engine alignment adjustment is necessary whenever engine is removed or mounts are loosened. To adjust, loosen through-bolts on engine mount and back bolts out 1 to 2 turns, do the same for transaxle mount bolts. Remove the bolts that need replacement. DO NOT reuse torque-to-yield bolts. Install NEW bolts. Lightly rock engine and transaxle to shift position as necessary. See **Fig. 45** -**Fig. 49** .
3. Evenly tighten mount bolts in reverse order of loosening. Align exhaust so components are free of stress. Tighten all bolts and nuts to specification. See **TORQUE SPECIFICATIONS** .
4. Verify engine fluid levels are filled to proper levels. Adjust clutch pedal (if equipped).
5. Perform a test drive and check memory for Diagnostic Trouble Codes (DTC). See appropriate SELF-DIAGNOSTICS article in ENGINE PERFORMANCE.
6. Perform Adapting Throttle Valve Control Module (J338) To ECM (J220) procedure. See **THROTTLE VALVE CONTROL MODULE (J338)** in appropriate SELF-DIAGNOSTICS article in ENGINE PERFORMANCE.
7. Read Readiness Codes. See appropriate SELF-DIAGNOSTICS article in ENGINE PERFORMANCE.
8. If DTC memory has been erased or engine control module separated from permanent positive, readiness code must be generated again. See appropriate SELF-DIAGNOSTICS article in ENGINE PERFORMANCE.

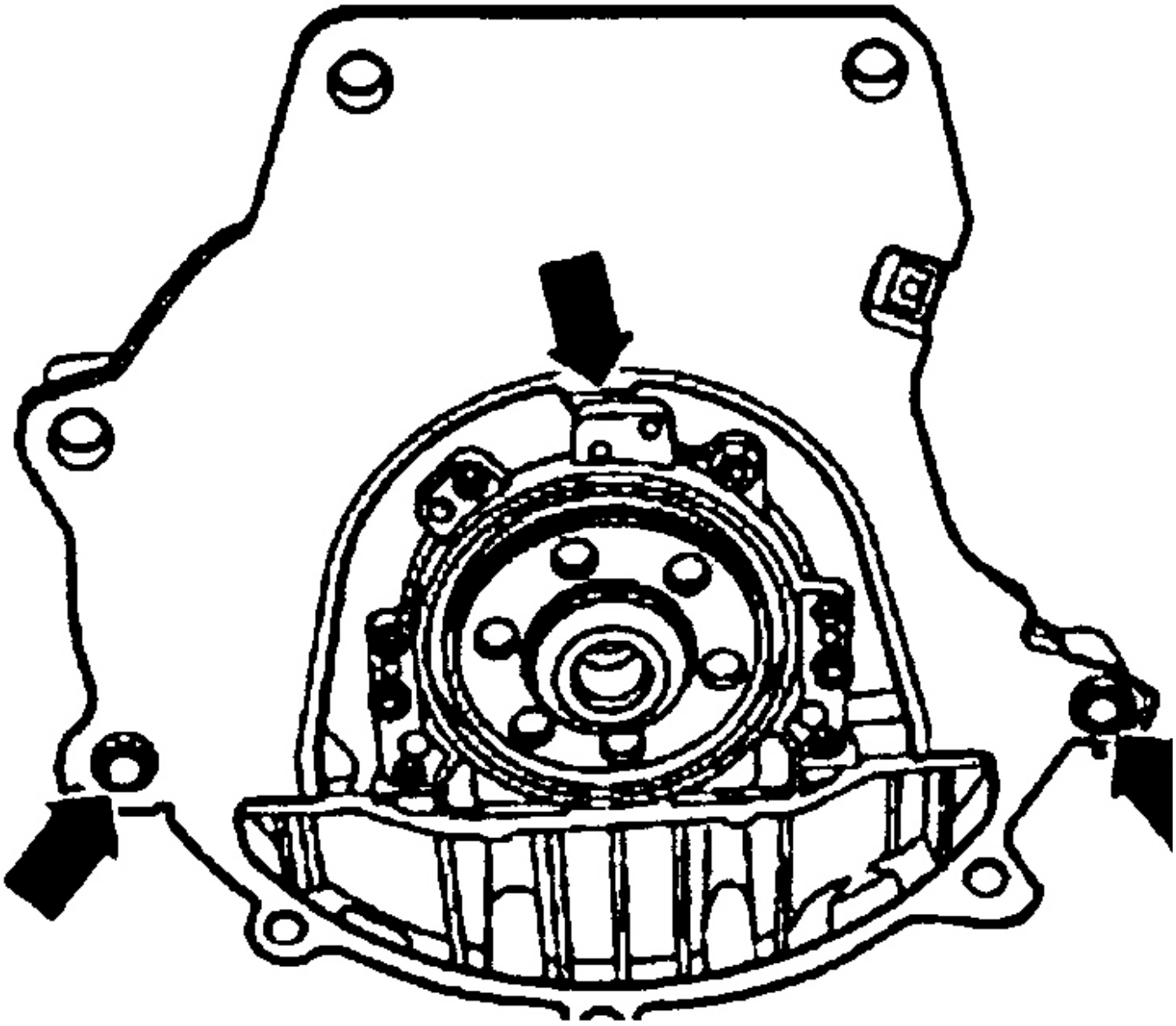


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Fig. 41: Identifying Dowel Sleeves & Intermediate Plate Installation
Courtesy of VOLKSWAGEN UNITED STATES, INC.

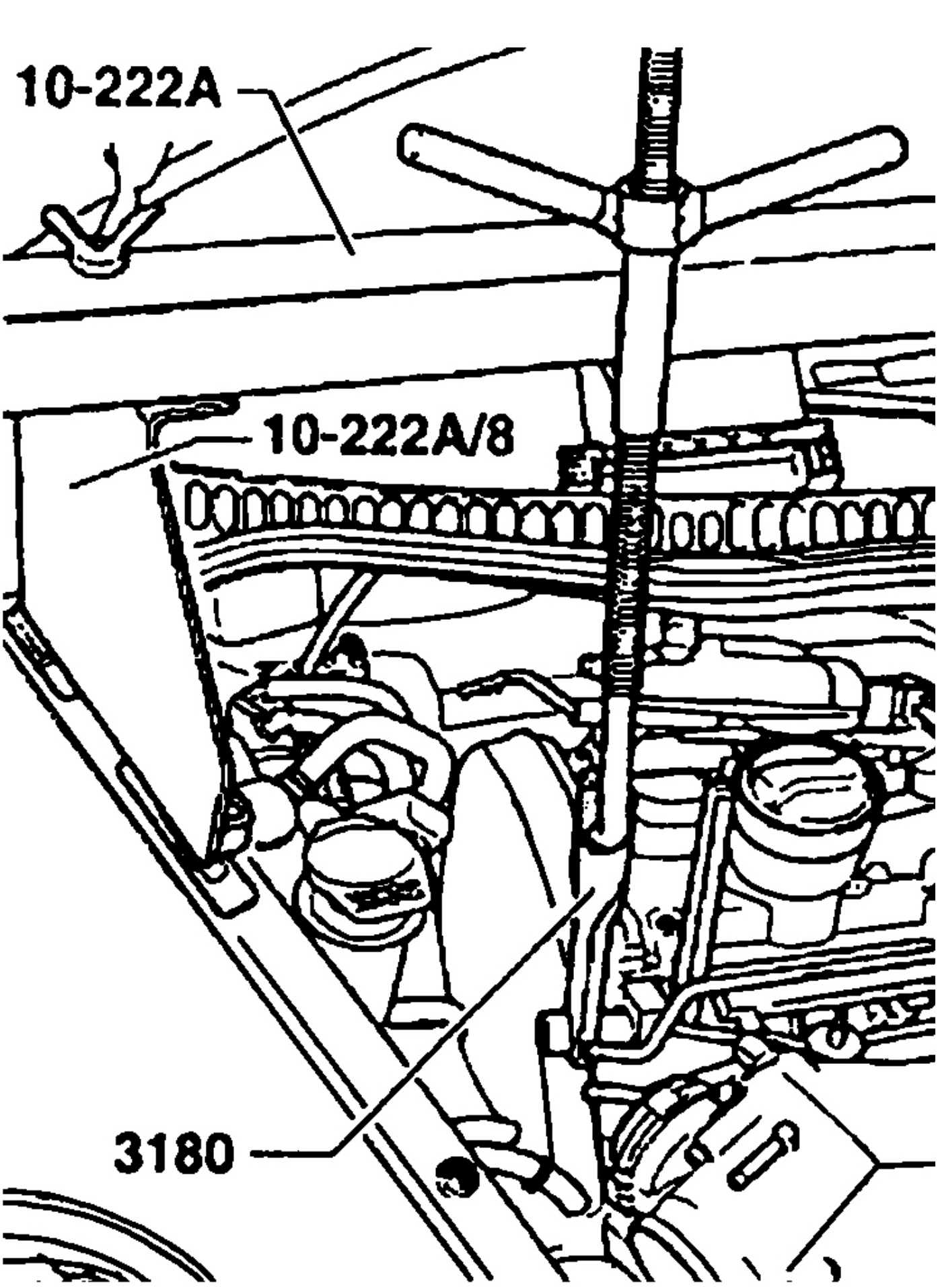


Fig. 42: Identifying Engine Support Bracket (10-222A, 10-222A/8 & 3180) Installation (Beetle)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

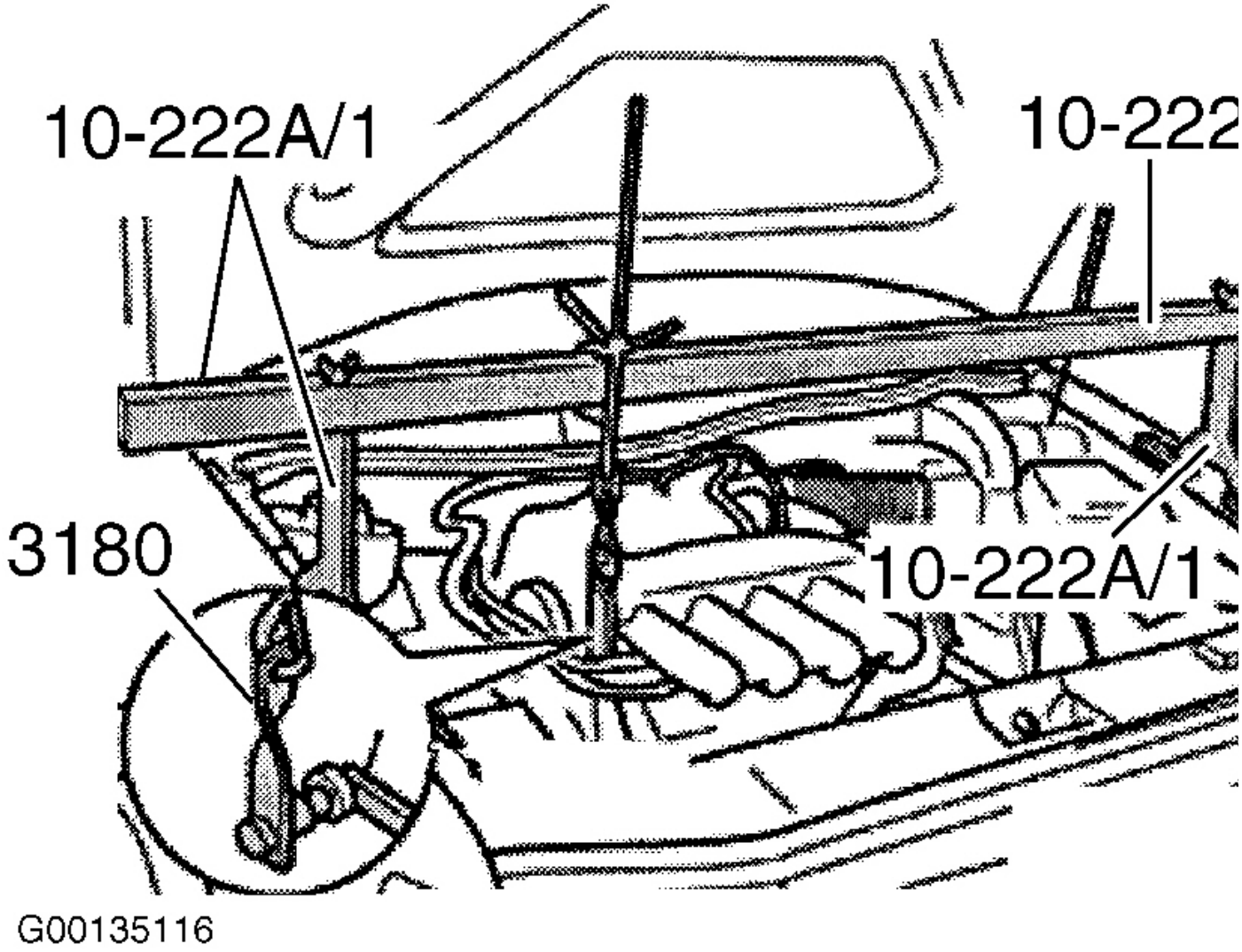
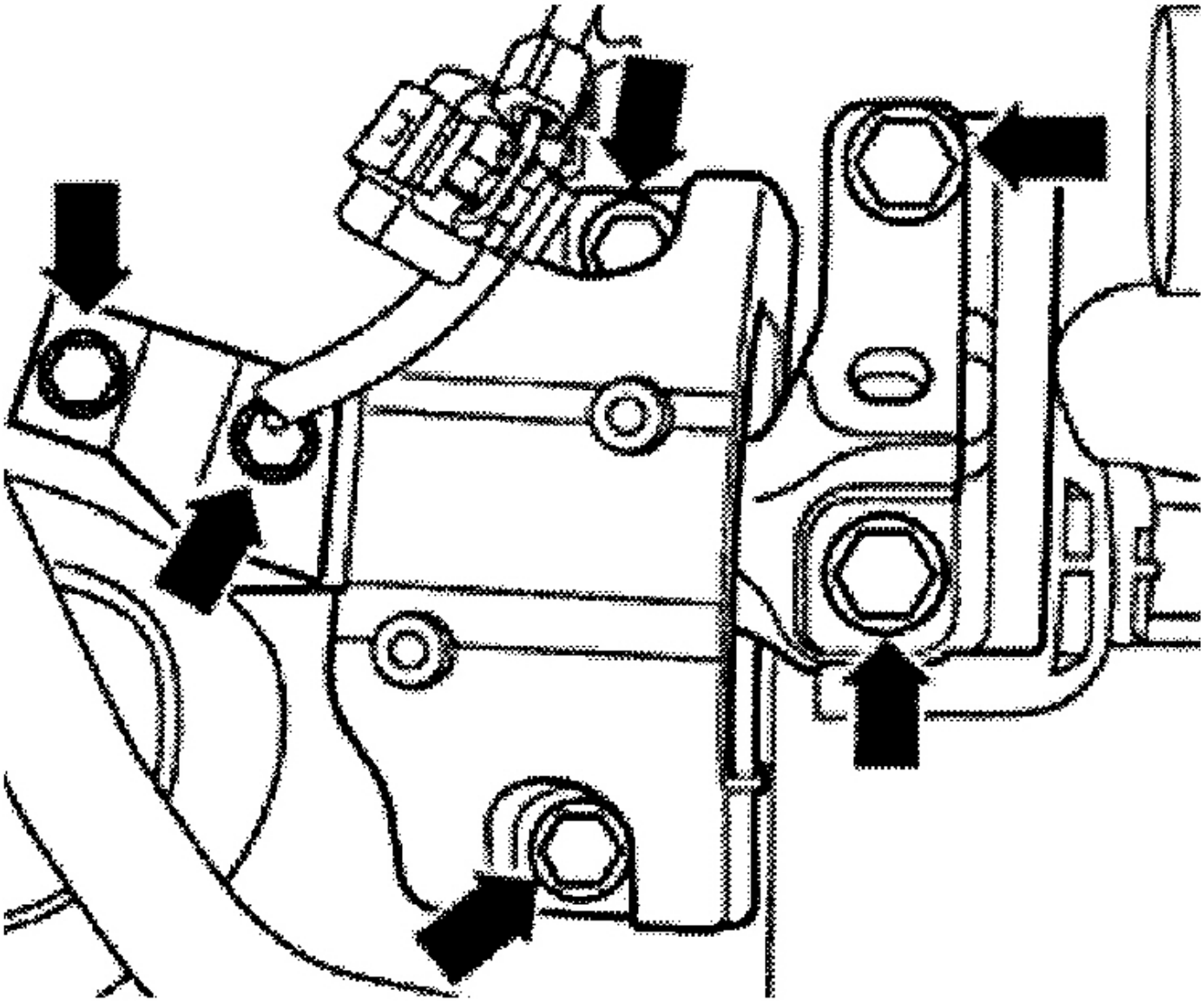
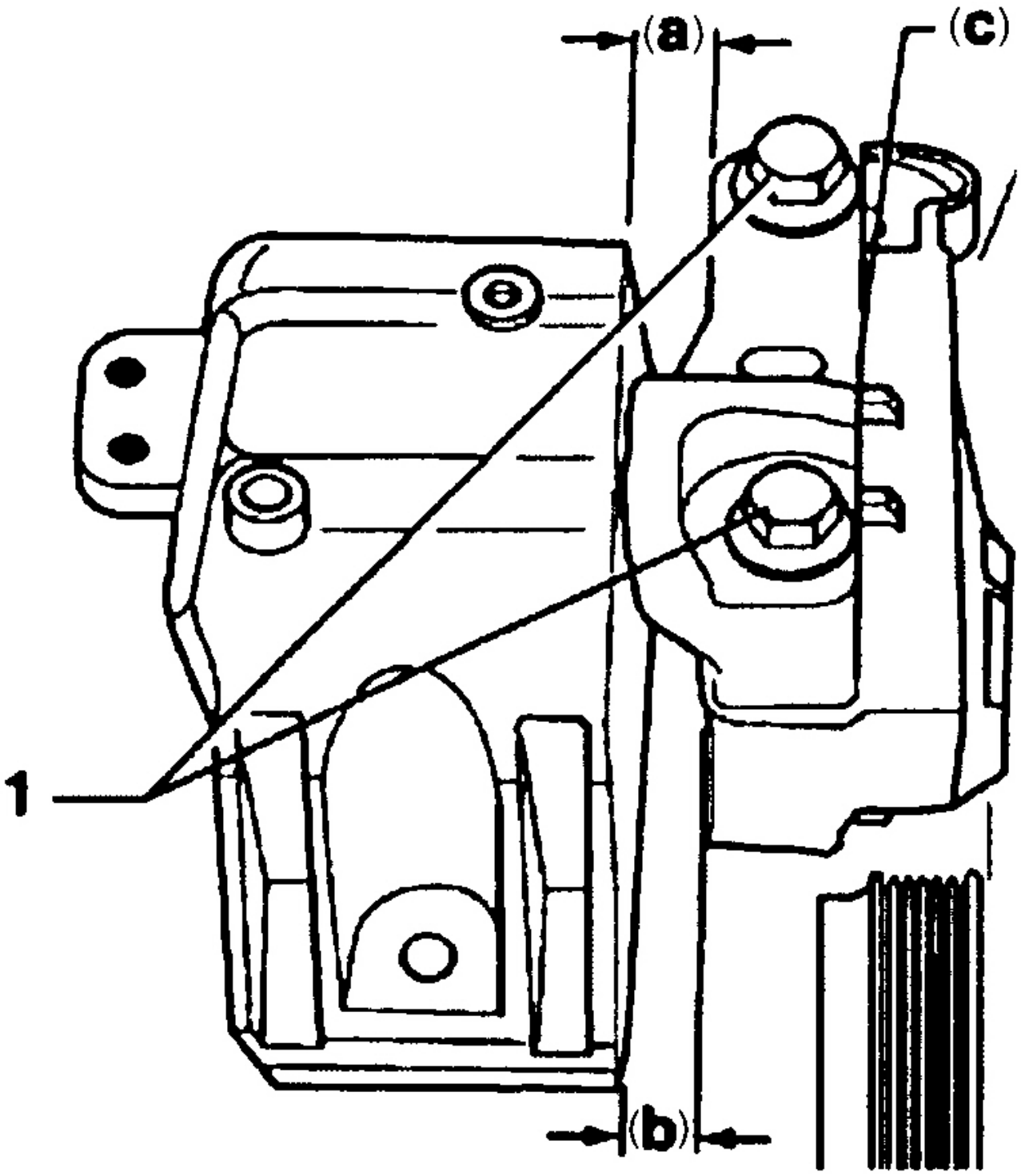


Fig. 43: Identifying Engine Support Bracket (10-222A, 10-222A/1 & 3180) Installation (Golf, GTI & Jetta)
Courtesy of VOLKSWAGEN UNITED STATES, INC.



G00135117

Fig. 44: Identifying Assembly Mount/Engine Mount & Cylinder Block Engine Mount
Courtesy of VOLKSWAGEN UNITED STATES, INC.



a = 14.0 mm

b = at least 10.0 mm

Fig. 45: Engine Mount Alignment Specifications
Courtesy of VOLKSWAGEN UNITED STATES, INC.

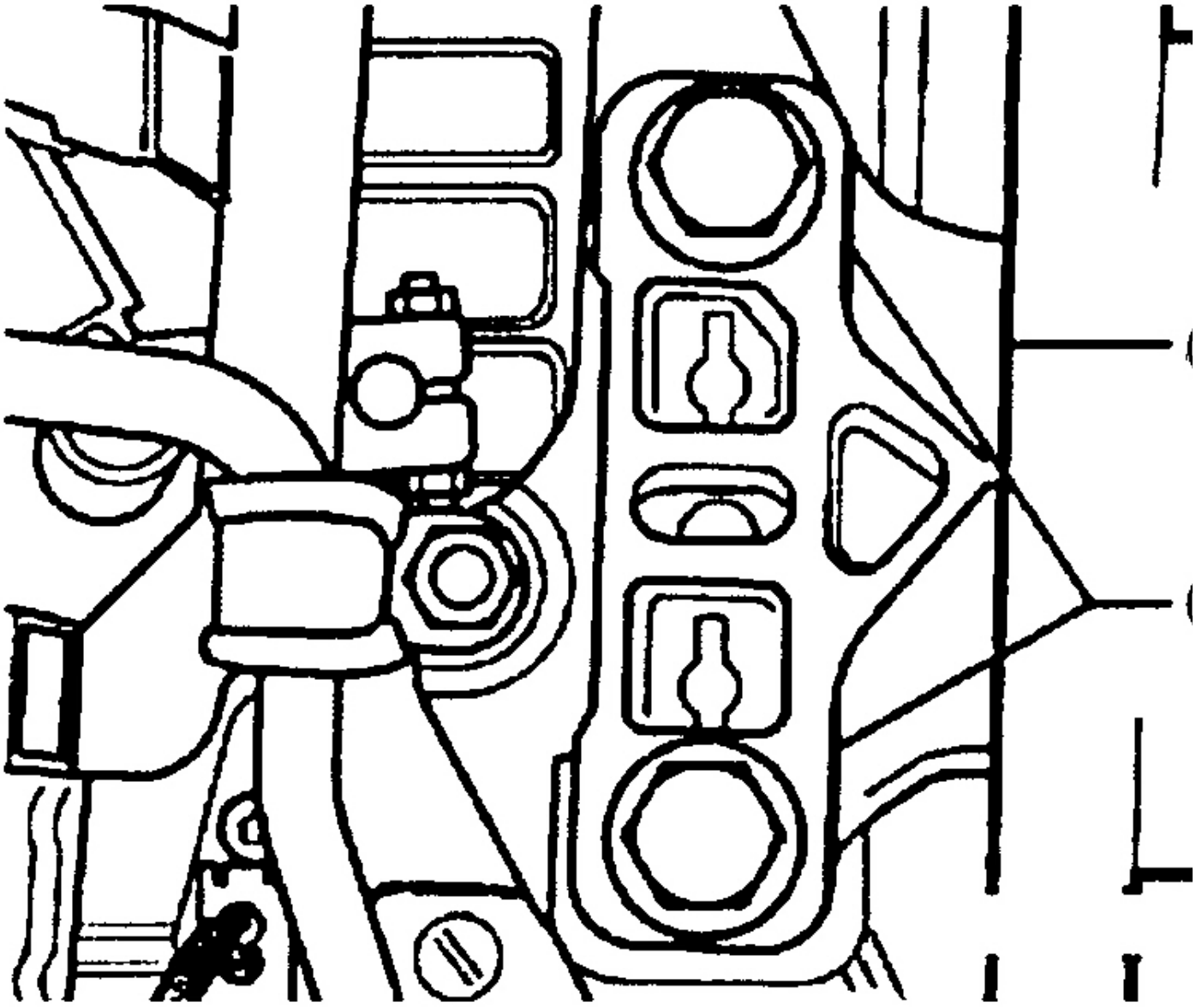
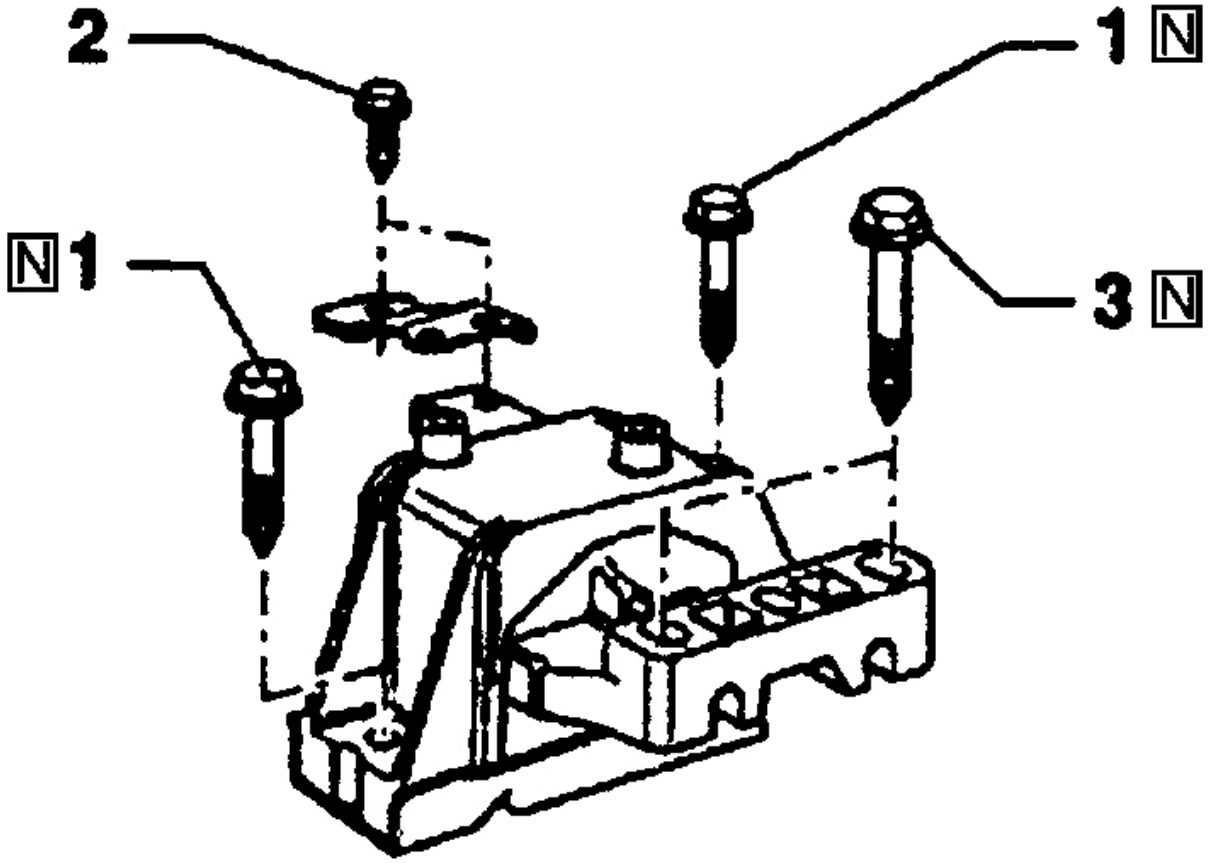


Fig. 46: Transaxle Mount Alignment Specifications
Courtesy of VOLKSWAGEN UNITED STATES, INC.



1 Mount to body 40 Nm + 90° (1/4 tur

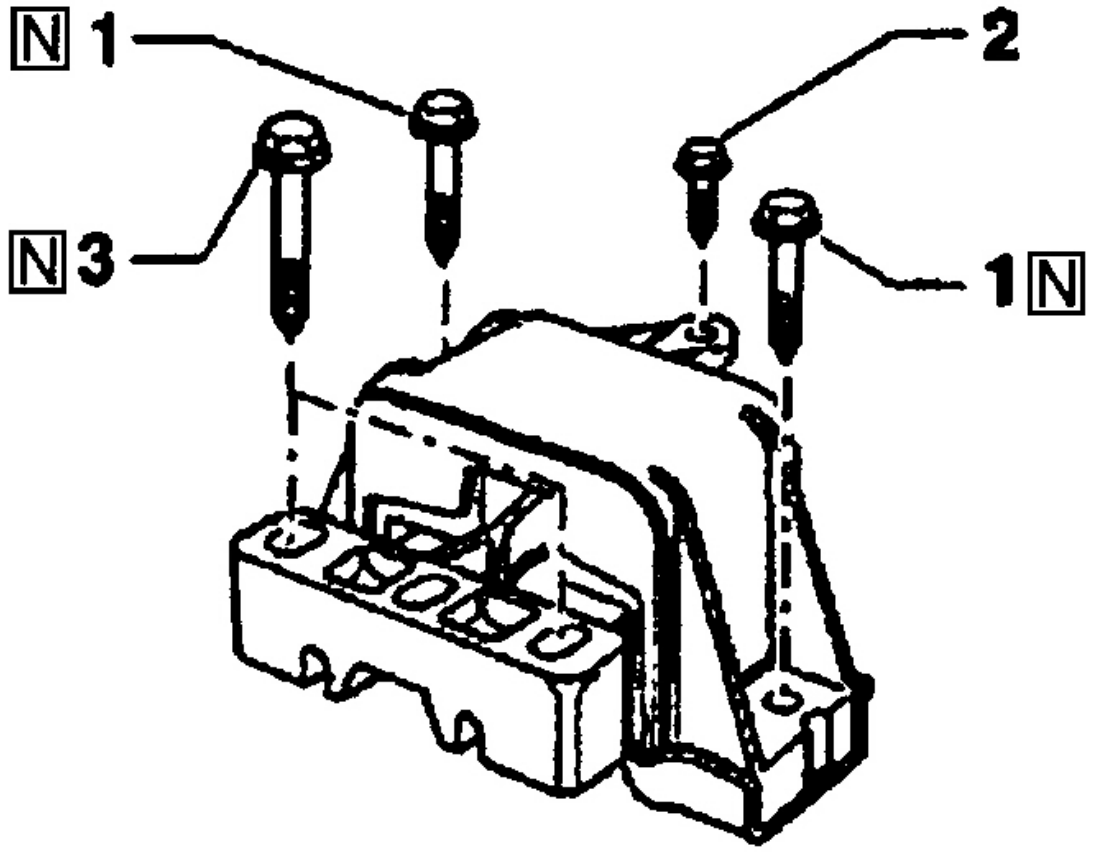
2 Mount/bracket to body: 25 Nm

3 Mount to engine bracket 60 Nm + 90° (1/4 turn)

N Replace bolts

G00135050

Fig. 47: Engine Mount Bolts Tightening Sequence & Torque Specification
Courtesy of VOLKSWAGEN UNITED STATES, INC.



1 Mount to body 40 Nm + 90° (1/4 tur

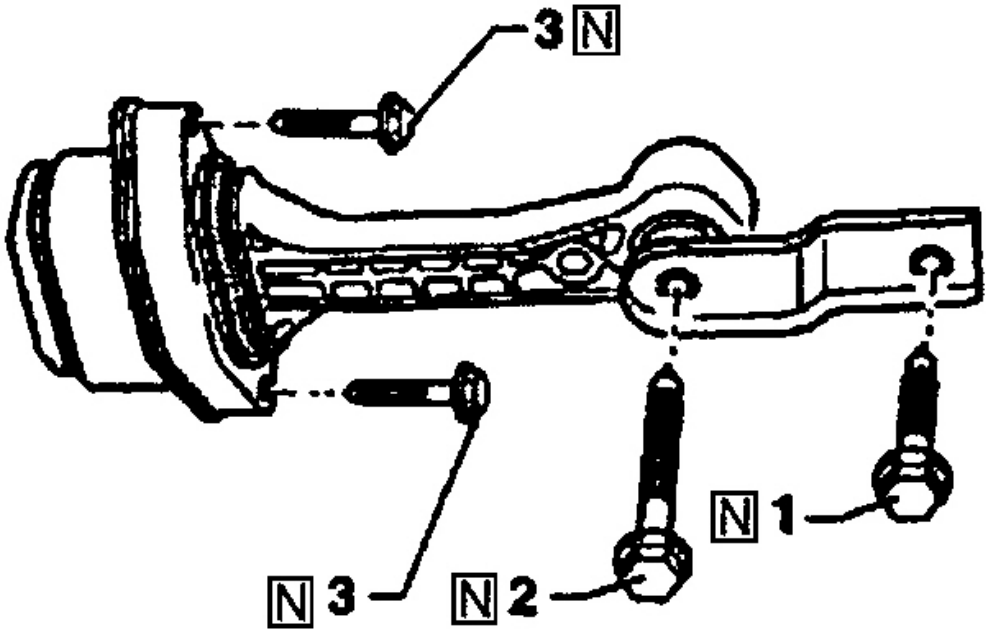
2 Mount to body: 25 Nm

3 Mount to transmission console 60 Nm + 90° (1/4 tur

N Replace bolts

G00135051

Fig. 48: Transaxle Mount Bolts Tightening Sequence & Torque Specifications
Courtesy of VOLKSWAGEN UNITED STATES, INC.



1	Pendulum support to transmission	40 Nm + 90° (1/4 tu
2	Pendulum support to transmission	40 Nm + 90° (1/4 tu
3	Pendulum support to subframe	20 Nm + 90° (1/4 tu

N Replace bolts

G00135052

Fig. 49: Pendulum Support Bolts Tightening Sequence & Torque Specifications
Courtesy of VOLKSWAGEN UNITED STATES, INC.

DRIVE PLATE

Removal

NOTE: **The following procedure is given assuming the transaxle has been removed or the engine has been removed for servicing.**

Mark the position of the drive plate (A/T), also marking the positions of the packing plate (1) and the shim (2) between the drive plate and the crankshaft flange. See **Fig. 50** . Loosen the bolts in a cross pattern and remove drive plate or flywheel.

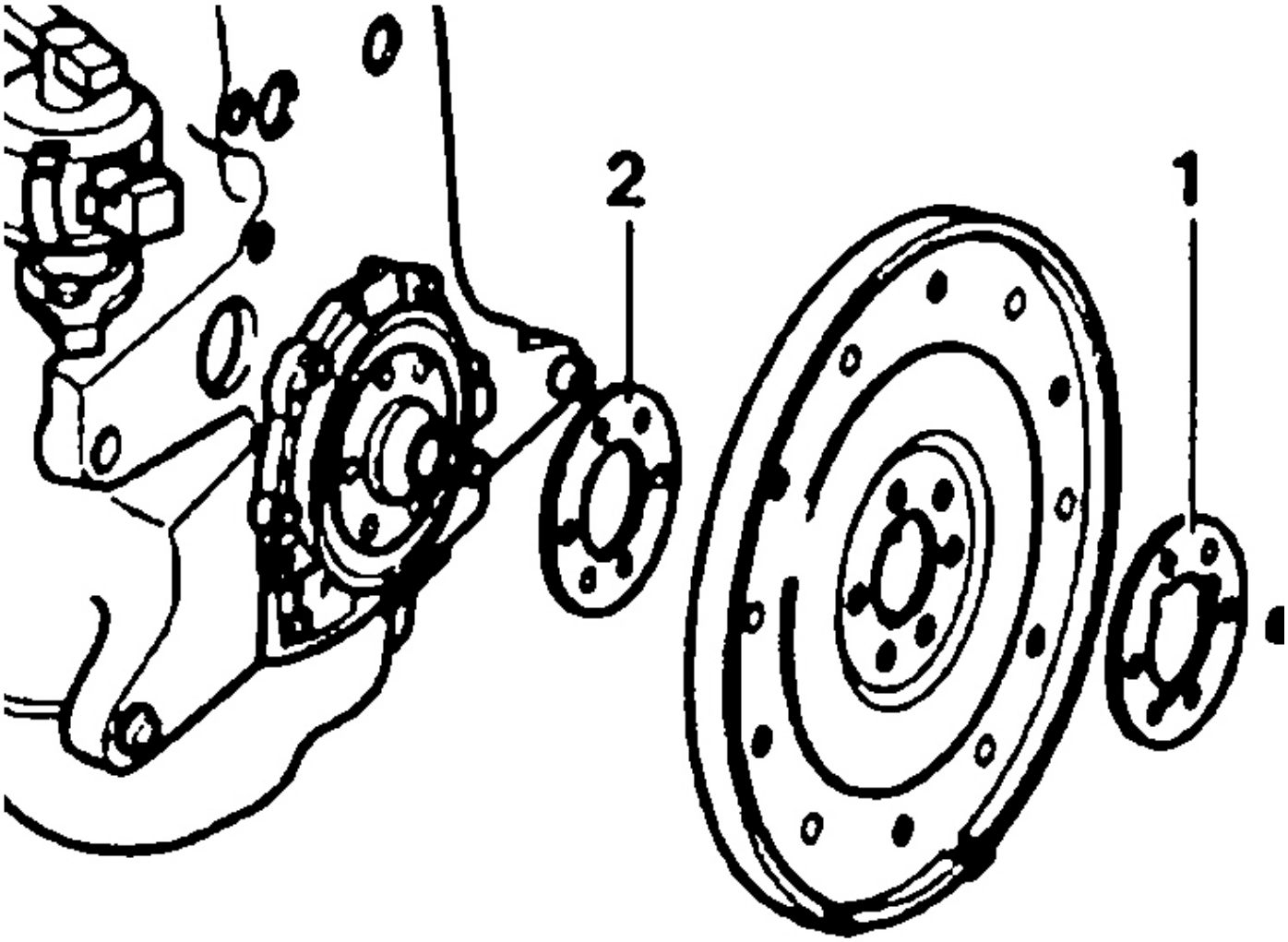


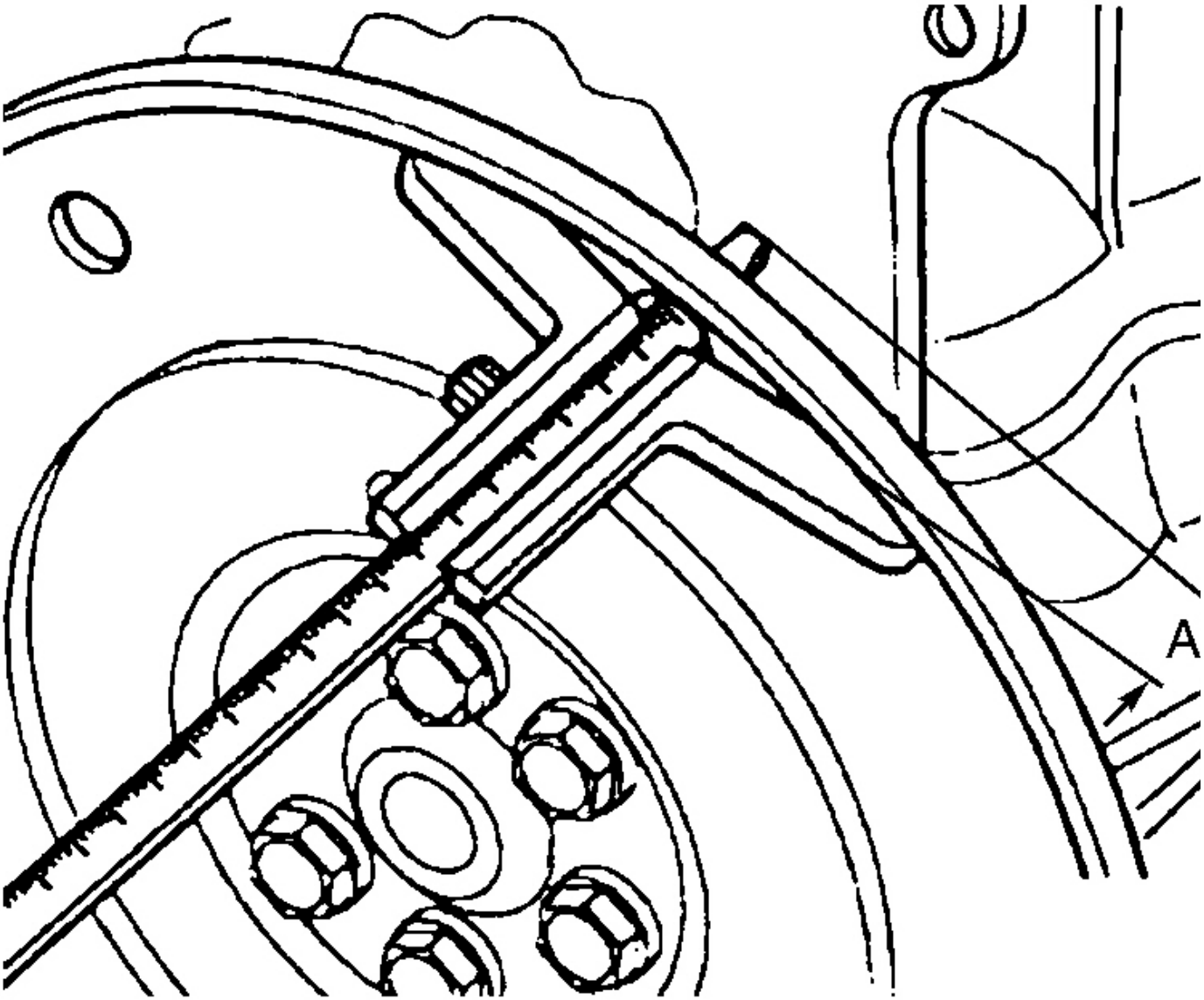
Fig. 50: Identifying Drive Plate & Related Components
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Installation

1. Install drive plate or flywheel. See **Fig. 50** . Using 3 new bolts inserted into flange, tighten the bolts evenly to 30 N.m (22 ft. lbs.). Measuring through the hole in drive plate, check dimension "A" at 3 points and calculate the average. See **Fig. 51** . Specification should be approximately 0.767-0.830" (19.5-21.1 mm).
2.

NOTE: Only one shim of the proper size may be used. Tighten flange bolts in a cross-cross pattern.

If specification is incorrect, remove the drive plate and install a shim to obtain proper dimension. Once specification is attained, install bolts and tighten in a criss-cross pattern to specification. See **TORQUE SPECIFICATIONS** .



G00135068

Fig. 51: Calculating Dimension "A" Distance Between Drive Plate & Cylinder Block
Courtesy of VOLKSWAGEN UNITED STATES, INC.

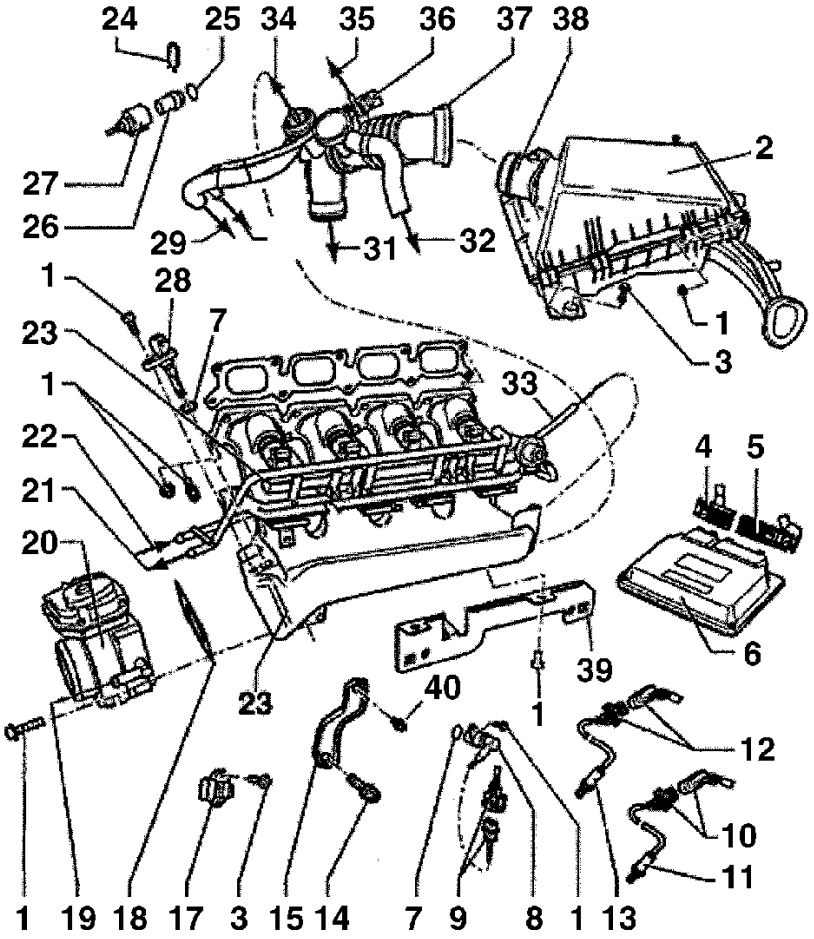
INTAKE MANIFOLD

NOTE: Obtain radio code before disconnecting battery.

Removal & Installation

Removal and installation procedures are not available from manufacturer. For help in identifying

components and component locations, refer to illustrations. See **Fig. 52** or **Fig. 53** . On installation, tighten bolts to specification. See **TORQUE SPECIFICATIONS** .



1 - 10 Nm (7 ft lbs)

2 - Air cleaner

3 - 6 Nm (4 ft lbs)

4 - 40-pin connector

5 - 81-pin connector

6 - Engine Control Module (ECM)

7 - O ring

- Replace

8 - Engine speed sensor (G28)

9 - 3 pin connector

- Grey

10 - 4-pin connector

- Brown

11 - Oxygen sensor 2 after catalyst (G130), 50 Nm (37 ft lbs)

12 - 6-pin connector

- Black
- For oxygen sensor 1 before catalyst (G39) and Heated oxygen sensor

13 - Oxygen sensor 1 before catalyst (G39), 50Nm (37 ft lbs)

- Grease only the threads with G 052 112 A3

14 - 20 Nm (15 ft lbs)

15 - Support

- Between intake manifold and engine block

16 - Intake manifold

17 - Charge

- For

19 - From activated charcoal filter solenoid valve 1 (N80)

- Activated charcoal filter system

20 - Throttle valve control module (J338)

- 6 pin connector

21 - Return pipe

- Secure with spring-type clips

22 - Supply pipe/hose

- Secure with spring-type clips

23 - Fuel rail with injectors

24 - Retaining clip

25 - O ring

- Replace if damaged

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

- Blue

28 Intake air - temperature sender (G42)

- 2 pin connector

29 To pipe - between turbocharge and charge air cooler

- Large connectior

30 To pipe - between turbocharge and charge air cooler

- Small connectior

31 To intake - hose at turbocharge

32 - From crankcase breather

33 - From intake hose

34 To - recirculating valve for turbocharge -N249-

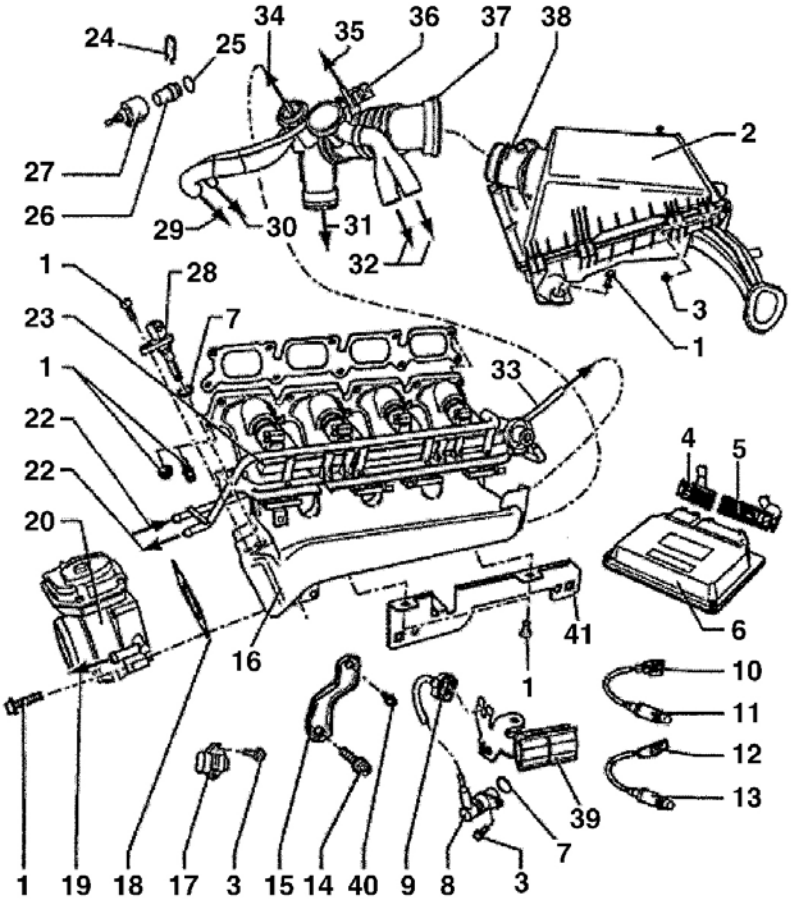
35 To pressure - unit on turbocharge

36 - Charge pressure limitation solenoid valve (N75)

37 - Intake hose

- Note

Fig. 52: Identifying Fuel Injection & Intake Manifold Components (AWD Engine)
Courtesy of VOLKSWAGEN UNITED STATES, INC.



1 - 10 Nm (7 ft lbs)

2 - Air cleaner

3 - 6 Nm (4 ft lbs)

4 - 40-pin connector

5 - 81-pin connector

6 - Engine Control Module (ECM)

7 - O ring

- Replace

8 - Engine speed sensor (G28)

9 - 3 pin connector

- Grey
- Above oil filter bracket
- For engine speed sensor

10 - 4-pin connector

- Brown

11 - Oxygen sensor 2 after catalyst (G130), 50 Nm (37 ft lbs)

12 - 6-pin connector

- Black
- For oxygen sensor 1 before catalyst (G39) and Heated oxygen sensor (Z19)

13 - Oxygen sensor 1 before catalyst (G39), 50Nm (37 ft lbs)

- Grease only the threads with "G" 052 112 A3

14 - 20 Nm (15 ft lbs)

15 - Support

- Between intake manifold and engine block

16 - Intake manifold

17 - Charge air pressure sensor - G31-

18 - Gasket

19 - From activated charcoal filter solenoid valve 1 (N80)

- Activated charcoal filter system

20 - Throttle valve control module (J338)

- 6 pin connector

21 - Return pipe

- Secure with spring-type clips

22 - Supply pipe/hose

- Secure with spring-type clips

23 - Fuel rail with injectors

24 - Retaining clip

25 - O ring

- Replace if damaged

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

- Blue
- For engine control module

27 - Connector

- Black, 4

28 Intake air - temperature sender (G42)

- 2 pin connector

29 To pipe - between turbocharger and charge air cooler

- Large connection

30 To pipe - between turbocharger and charge air cooler

- Small connection

31 To intake - hose at turbocharger

32 - From crankcase breather

33 - To intake hose

34 To - recirculating valve for turbocharge -N249-

35 To pressure - unit on turbocharger

36 - Wastegate Bypass Regulator Valve (N75)

37 - Intake hose

- Note installation position

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

- 5 pin connector

39 Su Bra

- F

40 20 (15

41 - Br

Fig. 53: Identifying Fuel Injection & Intake Manifold Components (AWW & AWP Engine)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

EXHAUST MANIFOLD

Removal and installation procedures are not available from manufacturer. See **TURBOCHARGER** . On installation, tighten bolts to specification. See **TORQUE SPECIFICATIONS** .

TURBOCHARGER

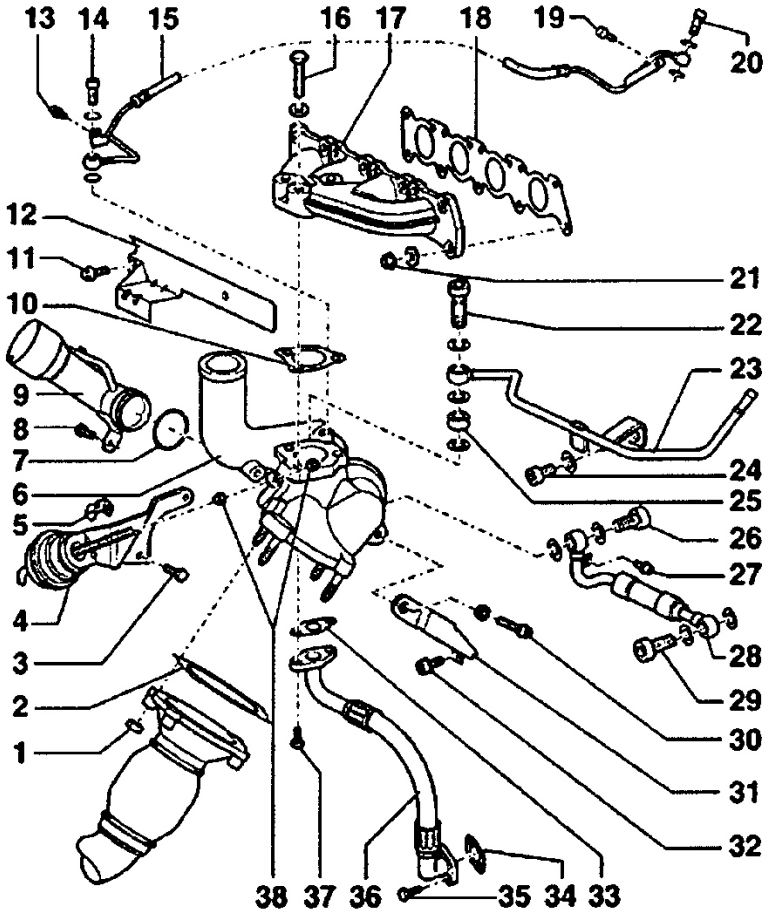
WARNING: The cooling system is pressurized when the engine is warm. When opening the expansion tank, wear gloves and other appropriate protection, cover the cap with a cloth and open carefully to relieve system pressure slowly.

NOTE: Obtain radio code before disconnecting battery. Always replace gaskets and self locking nuts.

Removal & Installation

NOTE: Specific removal and installation procedures are not available from manufacturer. A general procedure is given here, all steps may not apply. However, more steps may be required.

1. Disconnect battery. Remove engine cover(s). Raise vehicle, remove lower engine shield (noise insulator). See **Fig. 9** or **Fig. 10** . Drain coolant, see **DRAINING COOLING SYSTEM** .
2. Unbolt turbo support bracket (31), disconnect oil return line (36) from turbo and move aside. Remove ducting from turbo.
3. Unbolt catalytic converter from turbo, remove bolts (16) from exhaust manifold. Position turbo to gain access to coolant supply line banjo fitting and remove. Remove turbocharger. See **Fig. 54** .
4. To install, reverse removal procedure. Tighten turbocharger-to-exhaust manifold bolts to specification. See **TORQUE SPECIFICATIONS** . For help in identifying intake ducting components, vacuum line routing and component locations, refer to illustrations. See **Fig. 54** -**Fig. 57** . Also see **Fig. 60** . Fill and bleed cooling system. See **COOLING SYSTEM BLEEDING** .



1 - 40 Nm (30 ft lbs)
- Coat threads with G 052 112 A3

2 - Seal
- Always replace

3 - 10 Nm (7 ft lbs)
- Must not be loosened

4 - Pressure unit

5 - Circlip

8 - 10 Nm (7 ft lbs)

9 - Intake pipe

10 - Gasket
- Always replace
- Note installation position

11 - 20 Nm

12 - Heat shield

13 - 10 Nm (7 ft lbs)

14 - Banjo

16 - 30 Nm (22 ft lbs)
- Always replace
- Coat threads and bolt head seating surface with(G 052 112 A3)

17 - Exhaust manifold

18 - Gasket
- Always

19 - 20 Nm (15 ft lbs)

20 - Banjo bolt, 30 Nm (22 ft lbs)

21 - 25 Nm (18 ft lbs)
- Always replace
- Coat threads with G 052 112 A3

22 - Banjo bolt, 35 Nm (26 ft lbs)

23 - Coolant return pipe

24 - 25 Nm (18 ft lbs)

25 - Spacer sleeve

26 - Banjo bolt, 35 Nm (26 ft lbs)

27 - 10 Nm (7 ft lbs)

28 - Coolant supply pipe

30 - 30 Nm (22 ft
- Only use genu bolt from parts cata

31 - Retair
- Between turbocha and cylin block

32 - 25 Nm (18 ft

33 - Gaske
- Alwa repl

34 - Gaske
- Alwa repl

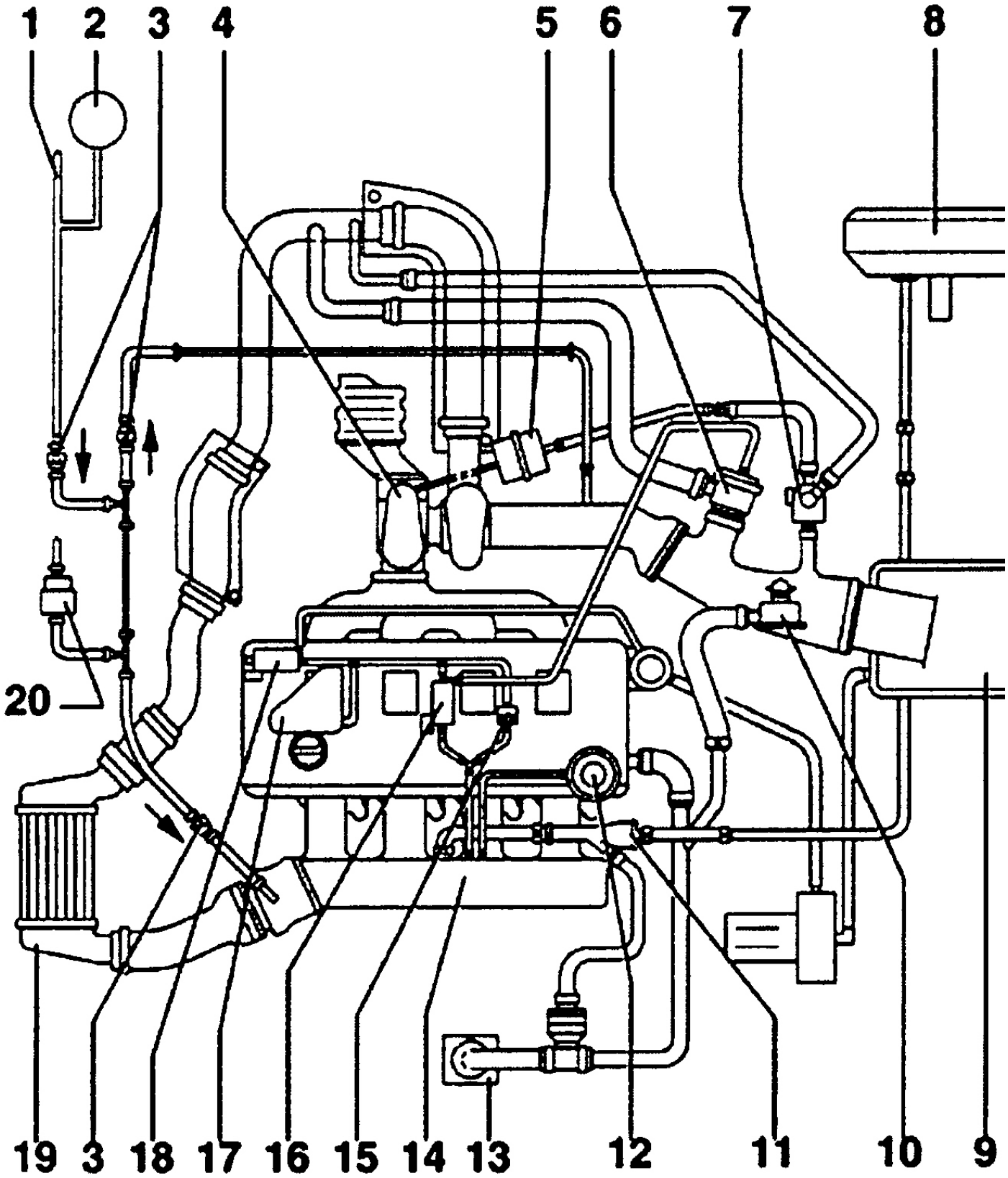
35 - 10 Nm (7 ft l

36 - Oil returr pipe
- To pan

37 - 10 Nm (7 ft l

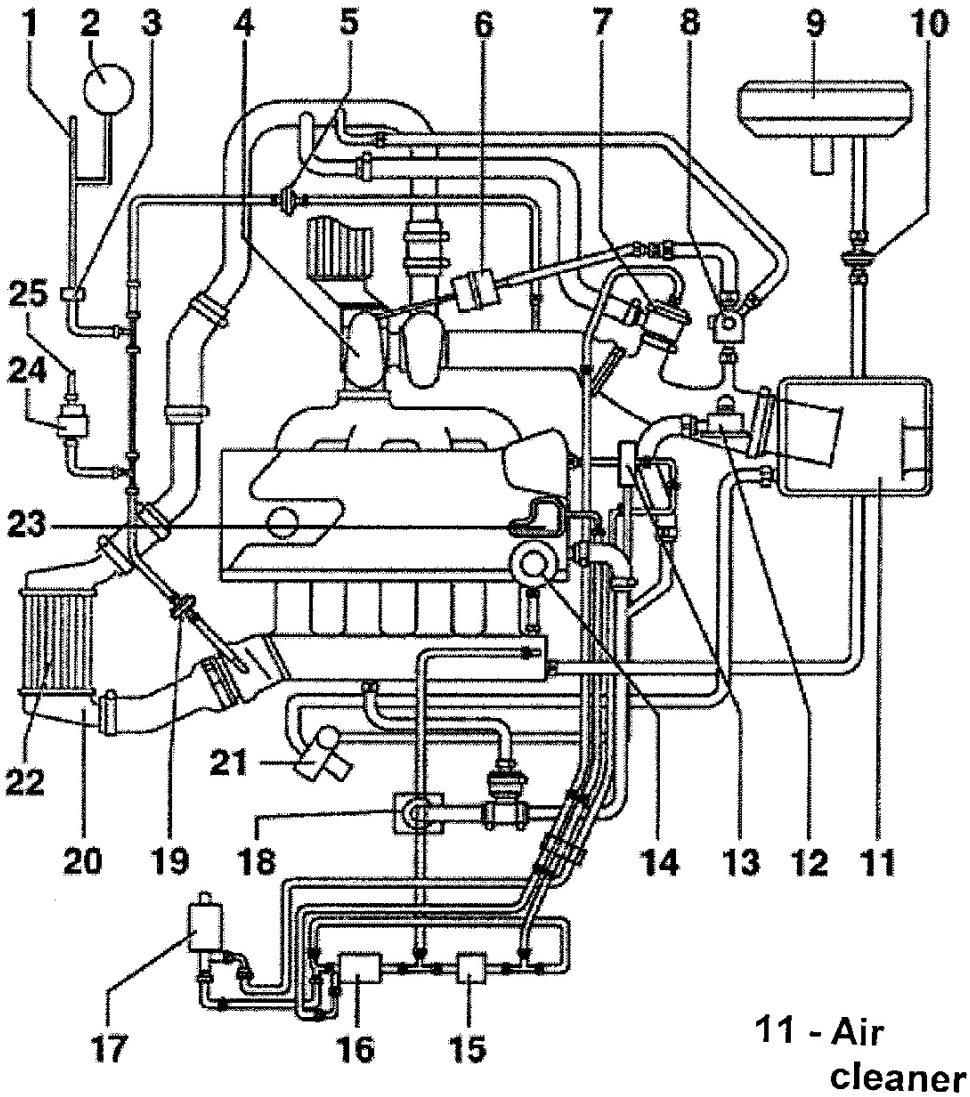
38 - 10 Nm (7 ft l
- Do

Fig. 54: Identifying Turbocharger & Related Components
Courtesy of GENERAL MOTORS CORP.



1. Vent Line (Fuel Tank)
2. Vacuum Reservoir
3. Non - Return Valve (EVAP)
4. Turbocharger
5. Pressure Unit (Actuator)
6. Charge Pressure Bypass Valve
11. Vacuum Booster
12. Fuel Pressure Regulator
13. Crankcase Breather
14. Intake Pipe
15. Non-Return Valve
16. Recirculating Valve For Turbochar

Fig. 55: Turbocharger System Overview (APH Engine)
Courtesy of VOLKSWAGEN UNITED STATES, INC.



1 - Connecting pipe/hose

- from Leak detection pump (LDP) - V144-)

2 - Vacuum reservoir

- below wheelhousing liner at front right

3 - Non-

6 - Pressure unit

7 - Overrun shut-off valve

8 Wastegate - bypass regulator valve - N75-

9 - Brake servo

10 - Non-return

11 - Air cleaner with air mass meter - G70-

12 Cylinder - block breather pressure regulating valve

13 - Combi-valve

- For secondary air system

16 Recircula - valve for turbocha -N249-

17 - Seconc air intal valve (N112)

18 - Cylinde block breathe

19 - Non-ret valve

20 - Charge pressu sensor (G31)

- Repla O ring dama

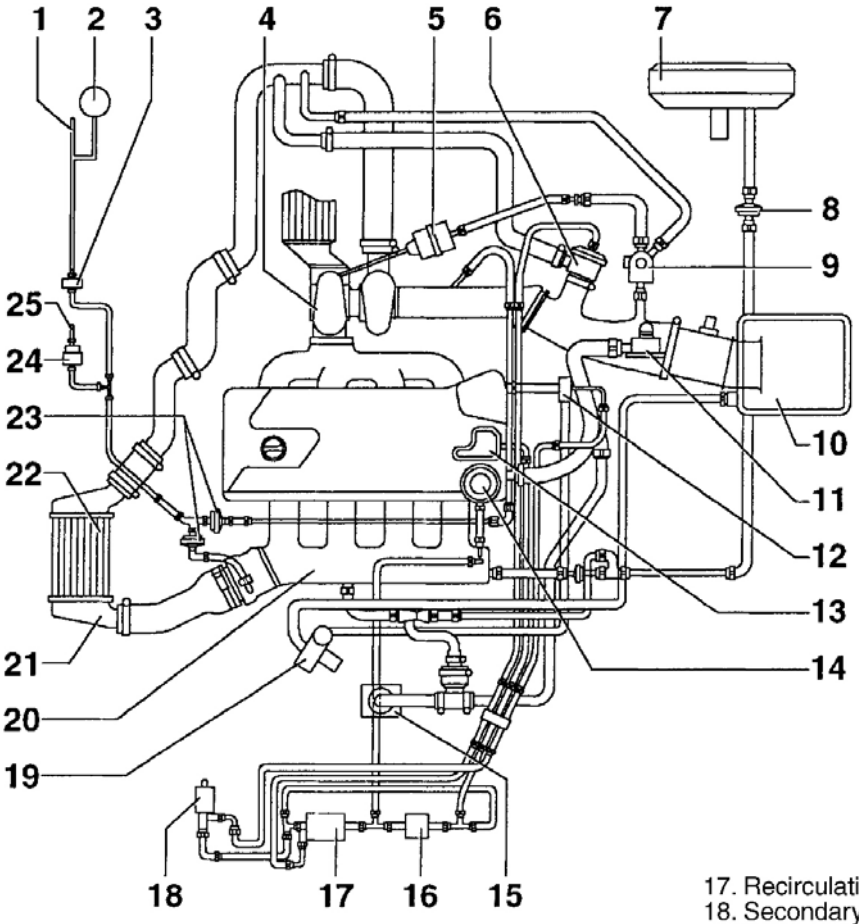
21 - Seconc air pum motor (V101)

22 - Charge cooler

23 - Vacuun reservc

24 Evaporat - Emission (EVAP) canister purge regulator valve (N8

Fig. 56: Turbocharging System Overview (AWD Engine)
Courtesy of VOLKSWAGEN UNITED STATES, INC.



1. Connecting Hose
2. Vacuum Reservoir
3. Check Valve
4. Turbocharger
5. Turbocharger Pressure Unit
6. Deceleration Shut Off Valve
7. Brake Booster
8. Check Valve
9. Wastegate By-Pass Regulator Valve
10. Air Cleaner With MAF Sensor
11. PCV Valve
12. Combination Valve (Secondary Air Injection)
13. Vacuum Reservoir
14. Fuel Pressure Regulator
15. Crankcase Breather
16. Check Valve
17. Recirculating Valve For Turboch
18. Secondary Air Injection Valve
19. Vacuum Booster
20. Secondary Air Pump
21. Intake Pipe
22. Charge Air Pressure Sensor
23. Charge Air Cooler
24. Non-Return Valve
25. EVAP Canister Purge Regulato
26. Connector Hose

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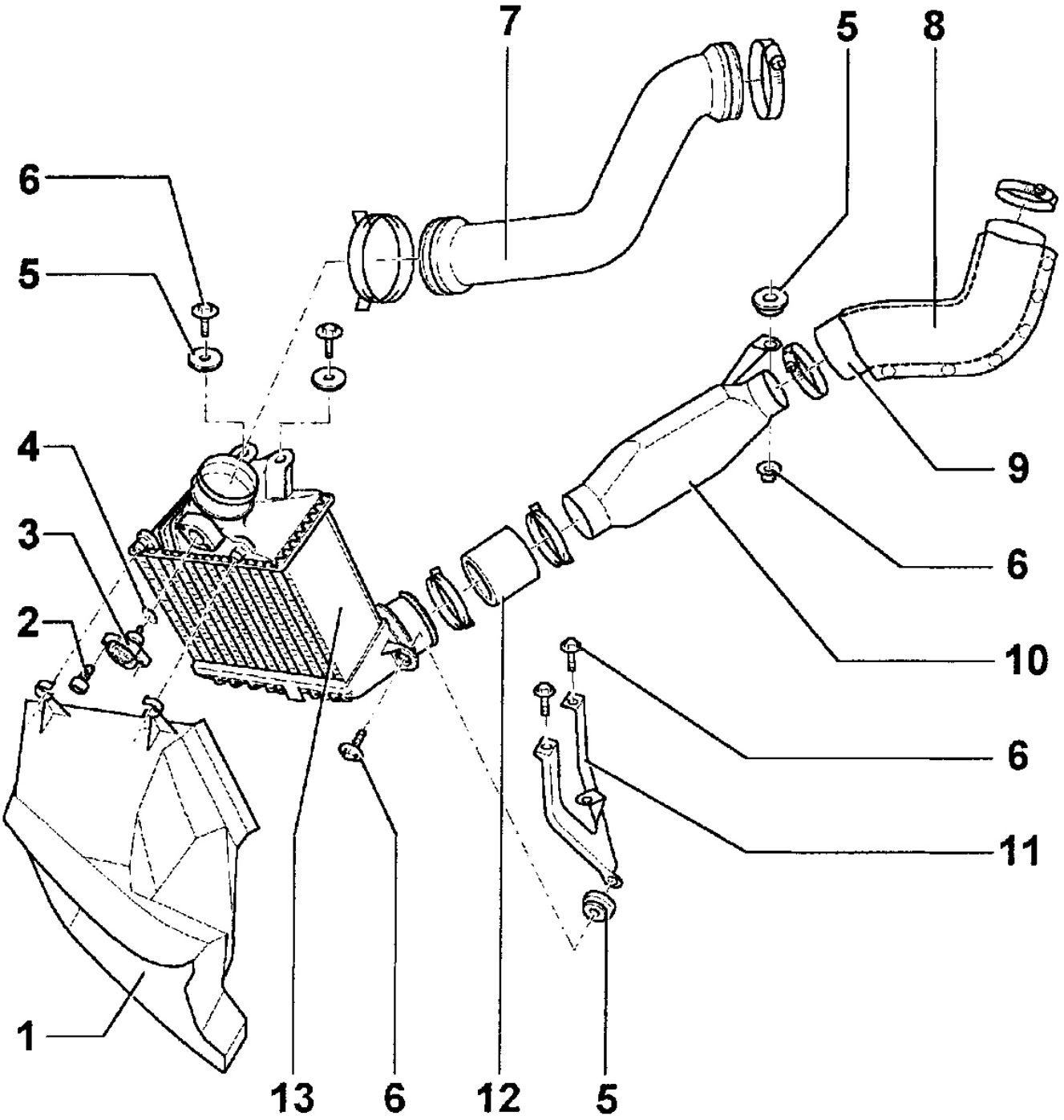
Fig. 57: Turbocharging System Overview (AWP & AWW Engine)
Courtesy of VOLKSWAGEN UNITED STATES, INC.



1. Air Ducting
2. Bolt
3. Charge Air Pressure Sensor (Engine Codes APH & AWV)
4. "O" Ring
5. Rubber Grommet
6. Bolt
7. Intake Hose
8. Heat Shield
9. Connecting H
10. Air Pipe
11. Bracket
12. Connecting H
13. Charge Air Co

G00064781

Fig. 58: Identifying Turbocharger Charge Air Cooling System Components
Courtesy of VOLKSWAGEN UNITED STATES, INC.

CYLINDER HEAD

CAUTION: DO NOT start engine for about 30 minutes after installing camshafts. Hydraulic valve lifters must settle or valves may strike pistons. Rotate crankshaft by hand 2 revolutions before starting engine to ensure valves do not strike pistons.

NOTE: Obtain radio code before disconnecting battery. Always replace gaskets and self locking nuts.

NOTE: Replace cylinder head bolts with new bolts. DO NOT reuse torque-to-yield bolts For installation reference, label all disconnected electrical connectors and vacuum hoses.

Removal (Beetle)

1. Release fuel pressure. See **FUEL PRESSURE RELEASE** . With ignition off, disconnect negative battery cable. Drain coolant. See **DRAINING COOLING SYSTEM** .
2. Remove secondary air pump motor and bracket. Remove cover for fuel injectors, wrap a shop towel around fuel supply and fuel return lines. Disconnect fuel lines at fuel rail connectors. Seal fuel line to prevent dirt entry.
3. Disconnect coolant hose connection from on cylinder head, remove interconnecting, coolant, vacuum and intake hoses on engine.
4. Disconnect ignition coils harness connectors and remove coils. Disconnect all other electrical connectors as necessary from engine bay and lay to the side.
5. Remove intake air hose from connection of exhaust turbocharger as follows: Pull off hose at pressure regulator valve of crankshaft ventilation. Disconnect harness connector at wastegate bypass regulator valve. Pull off hose at wastegate regulator bypass valve. Disconnect hose from solenoid valve to turbocharger.
6. Disconnect hose between EVAP canister and exhaust turbocharger at bulkhead. Pull out securing buckle at connector of exhaust turbocharger and remove air intake hose.
7. Remove heat protection pad (1) from air guide duct (2). Note position of pad for installation. See **Fig. 59** . Remove air guide duct. Loosen 2 bolts from bracket of upper air guide duct. See **Fig. 60** .
8. Remove upper heat protection pad from air guide duct (3). Note position of pad for installation. Remove fasteners (1 and 4) for heat shield behind cylinder head. Also loosen fasteners (2 and 5). See **Fig. 61** . Remove air guiding hose, hose to turbocharger and heat shield.
9. Remove 3 exhaust gas turbocharger/exhaust manifold securing bolts See **Fig. 62** .
10. Remove timing belt. See **TIMING BELT** .
11. **NOTE: When valve cover has been removed, take note of oil deflector positioning.**

    NOTE: On Polydrive cylinder head bolts, use Tool (3452).

    Remove ignition coils, remove cylinder head valve cover, remove cylinder head bolts using sequence. Loosen head bolts a little at a time, till all bolts are loose. See **Fig. 63** . Remove cylinder head from vehicle.

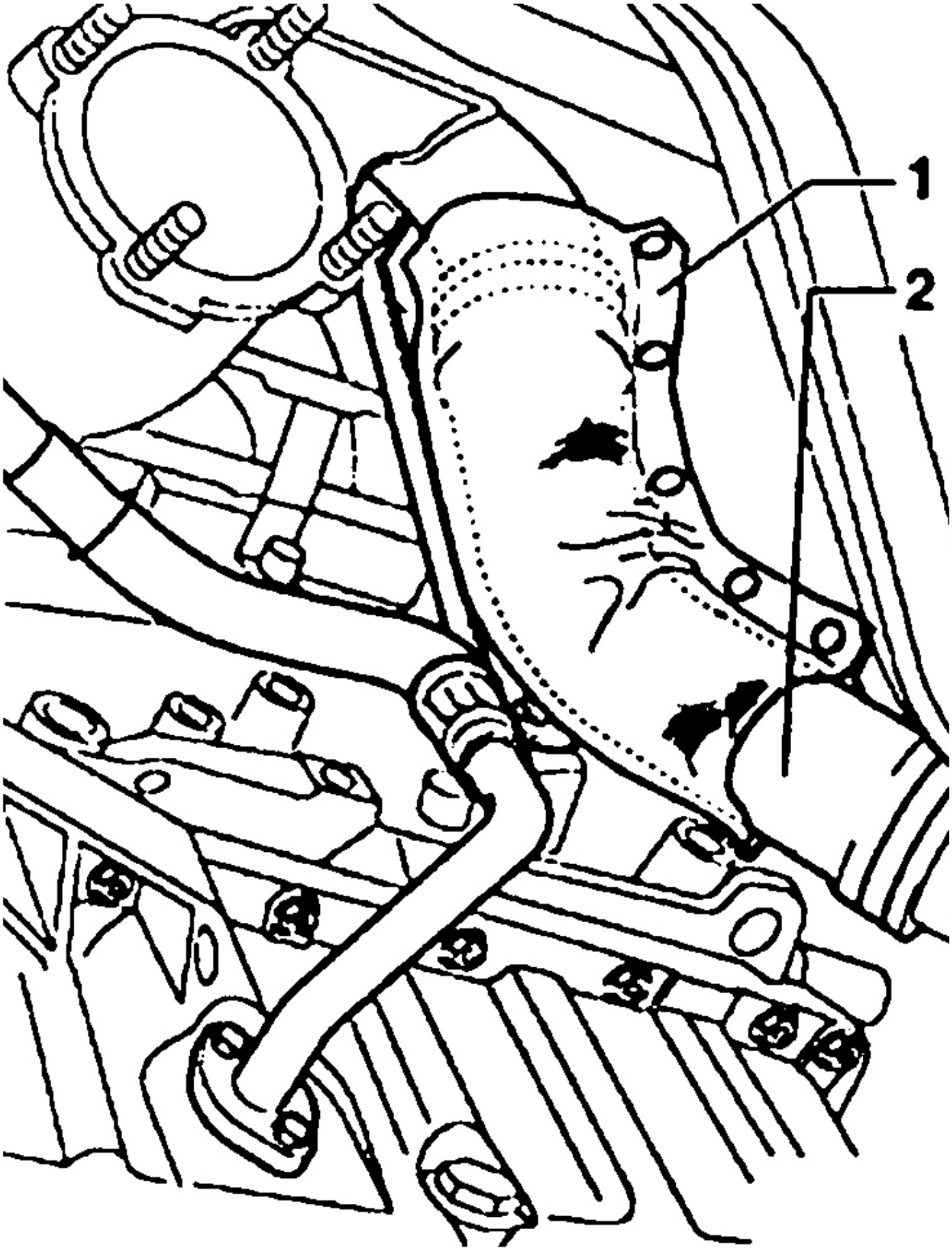
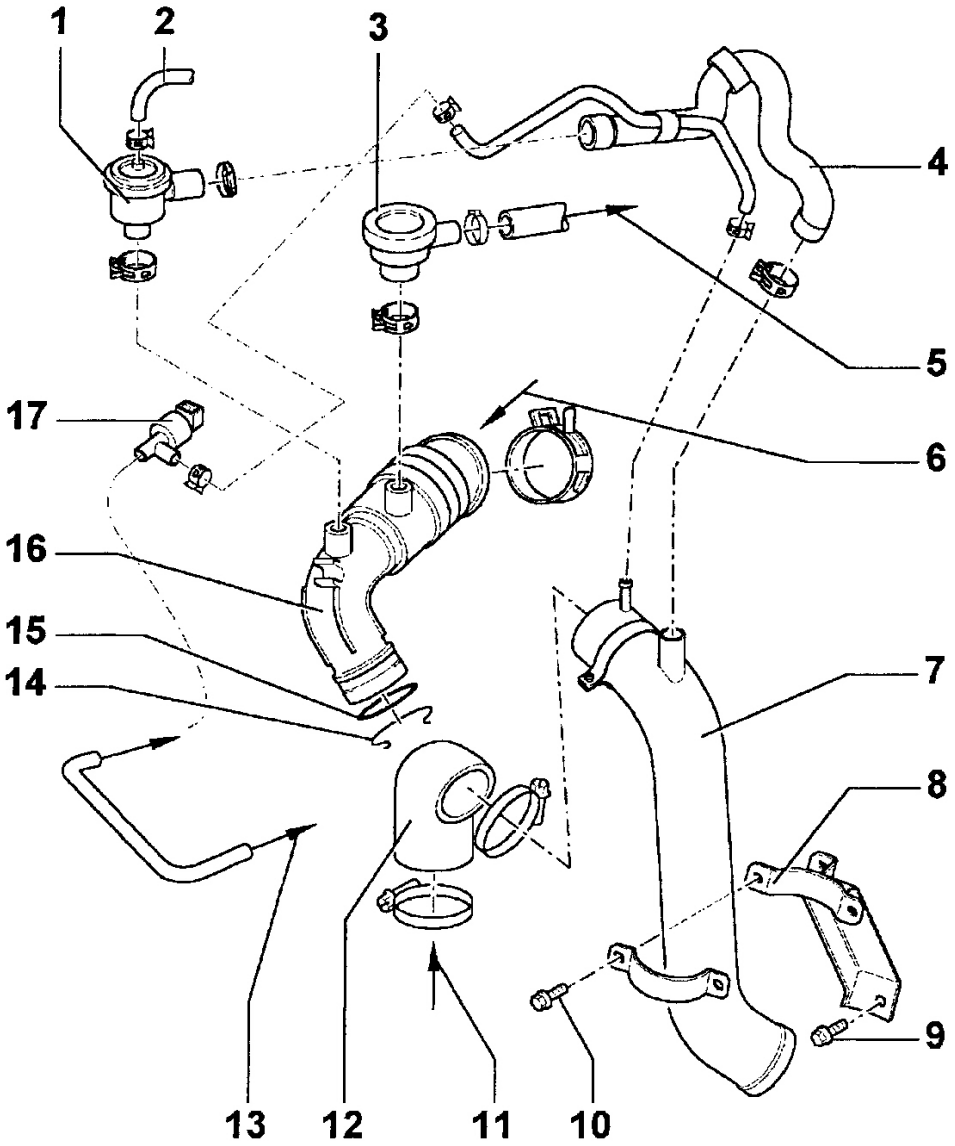


Fig. 59: Identifying Location Of Heat Protection Pad On Air Guide Duct
Courtesy of VOLKSWAGEN UNITED STATES, INC.



1. Deceleration Shut Off Valve
2. Connecting Hose
3. PCV Valve
4. Connecting Hose
5. To Crankcase Ventilation
6. From Air Cleaner
7. Upper Air Duct
8. Bracket
9. Bolt
10. Bolt
11. From Air Outlet (Boost Pressure) Side Of Turbocharger
12. Connecting Hose
13. Connecting Hose
14. Circlip
15. "O" Ring
16. Intake Hose
17. Wastegate By-Pass Regulator

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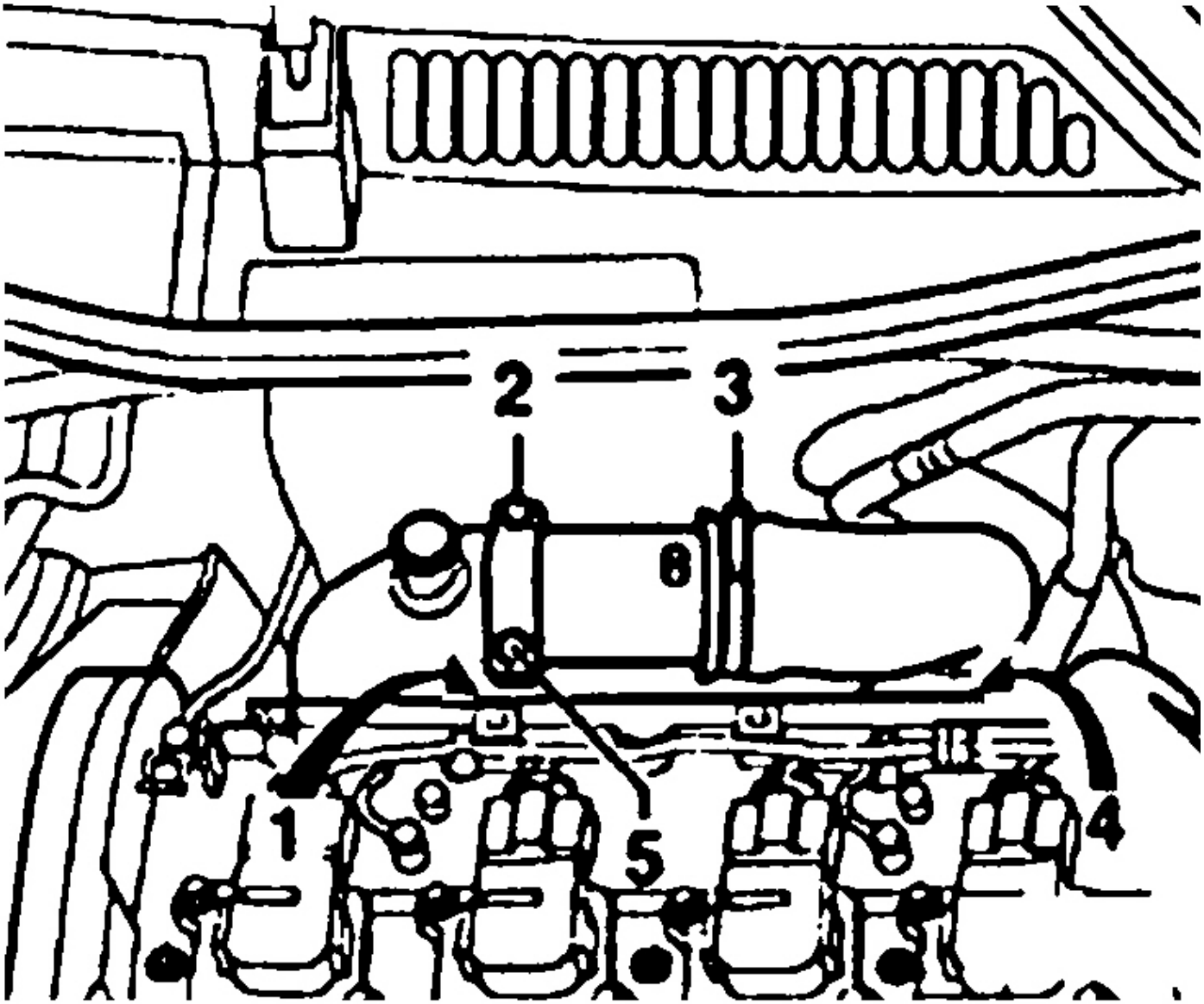
Fig. 60: Identifying Air Induction Components & Control Valves
Courtesy of VOLKSWAGEN UNITED STATES, INC.



1. Fastener For Heat Shield
2. Fasteners
3. Hose Clamp
4. Fastener For Heat Shield

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Fig. 61: Identifying Location Of Upper Heat Protection Pad For Air Duct
Courtesy of VOLKSWAGEN UNITED STATES, INC.

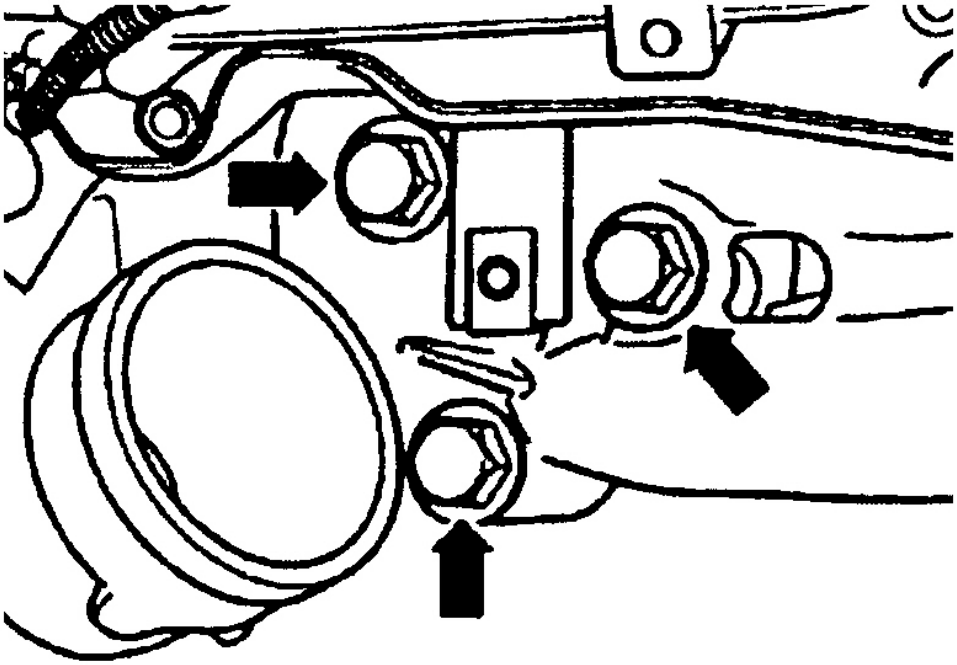

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Fig. 62: Identifying 3 Exhaust Gas Turbocharger/Exhaust Manifold Securing Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

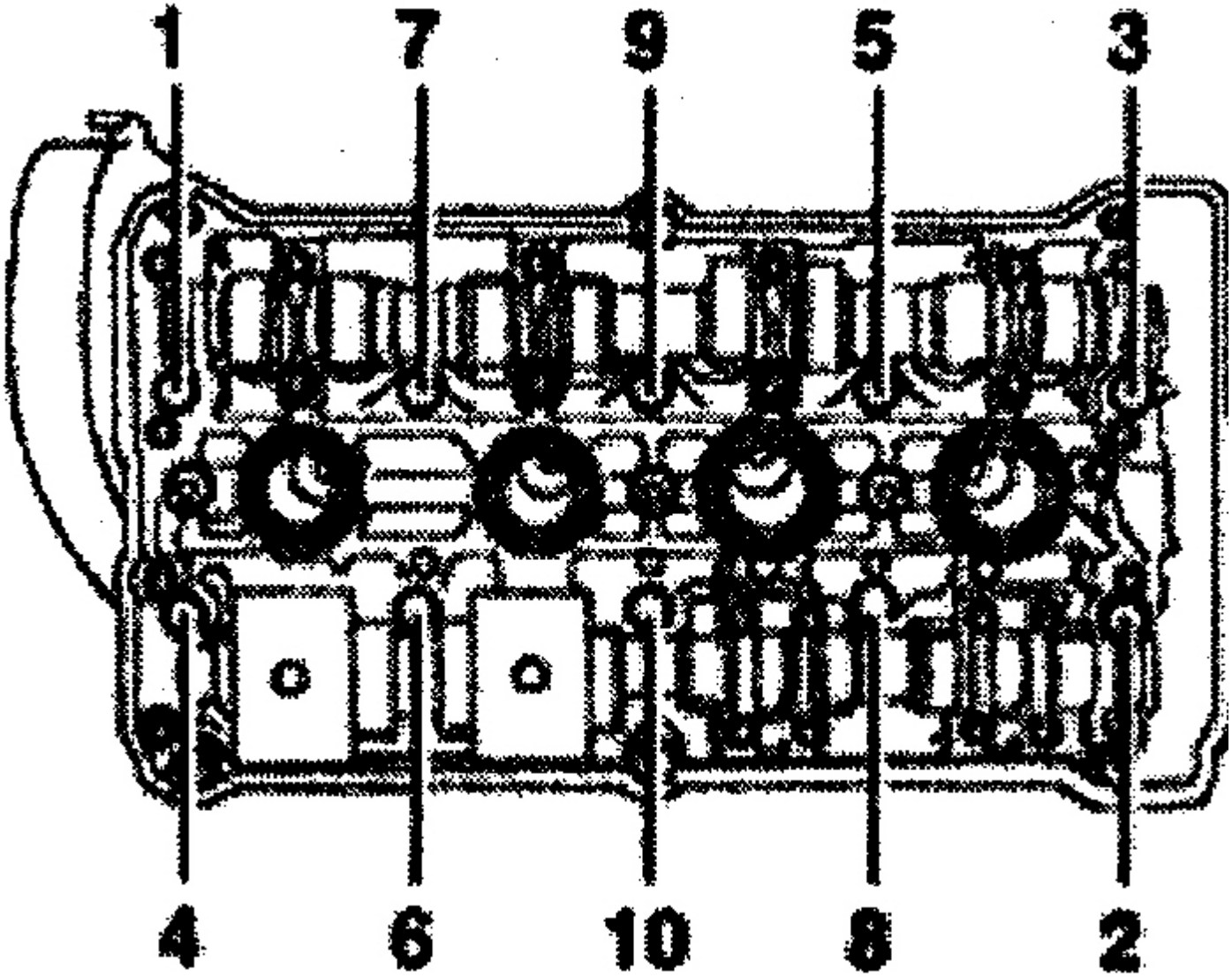

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Fig. 63: Cylinder Head Bolt Loosening Sequence
Courtesy of AUDI OF AMERICA, INC.

Removal (Jetta, Golf & GTI)

1. Release fuel pressure. See **FUEL PRESSURE RELEASE** . With ignition off, disconnect negative battery cable. Drain coolant. See **DRAINING COOLING SYSTEM** .
2. Disconnect front exhaust pipe from turbocharger.
3. Remove engine cover. Disconnect ignition coils harness connectors and remove coils. Disconnect all other electrical connectors as necessary from engine bay and lay to the side.
4. Wrap a shop towel around fuel supply and fuel return lines. Disconnect fuel lines at fuel rail connectors. Seal fuel line to prevent dirt entry.
5. Disconnect coolant hose connections from on cylinder head, remove interconnecting, coolant, vacuum and intake hoses on engine.
6. Remove secondary air pump motor and bracket.
7. Remove turbocharger and intake system induction hoses as necessary.

8. Disconnect EVAP canister hoses between canister and engine.
9. Remove timing belt. See **TIMING BELT** .
10. **NOTE: When valve cover has been removed, take note of oil deflector positioning. On Polydrive cylinder head bolts, use Tool (3452).**

    Remove ignition coils, remove cylinder head valve cover, remove cylinder head bolts using loosening sequence. Loosen head bolts a little at a time, until all bolts are loose. See **Fig. 63** . Remove cylinder head from vehicle.

Inspection

Thoroughly clean all gasket mating surfaces. Check cylinder head for warpage. Maximum warpage is .004" (.100 mm). Check minimum cylinder head height and replace cylinder head (if necessary). See **CYLINDER HEAD** under OVERHAUL. Also see **CYLINDER HEAD** table under ENGINE SPECIFICATIONS.

Installation (All Models)

CAUTION: If cam followers or camshaft have been removed and followers are charged with oil, allow 30 minutes for followers to bleed down before starting engine. Pistons may strike valves, resulting in bent valves.

CAUTION: DO NOT position cylinder No. 1. piston at Top Dead Center (TDC) when placing cylinder head on block.

NOTE: Replace cylinder head bolts with a NEW bolts. DO NOT reuse torque-to-yield bolts.

NOTE: DO NOT reuse antifreeze after replacing cylinder block, cylinder head, head gasket, radiator and/or heater core.

1. Ensure part number on cylinder head gasket faces up. Install gasket on cylinder block. DO NOT use any type of sealant. Align camshaft timing marks and position crankshaft at TDC. See **TIMING BELT** .
2. **NOTE: Ensure no oil or coolant has collected in cylinder head bolt holes, remove as necessary.**

   Install Guide Pins (VAG 3070 tool set) in head bolt holes No. 8 and 10. Carefully position cylinder head on cylinder. Install remaining NEW head bolts finger tight. Remove guide pins with guide pin removal tool from (VAG 3070) and install remaining bolts. Tighten cylinder head bolts in 3 steps, in sequence to specification. See **Fig. 64** . Also see **TORQUE SPECIFICATIONS** . Before installation of valve cover apply a thin layer of Sealer (D 454 300 A2) at the points of valve cover where leakage may occur. See **Fig. 65** .
3. Bolt together turbocharger and exhaust manifold. Install support bracket to cylinder head. Tighten bolts at support bracket between turbocharger and block. See **TORQUE SPECIFICATIONS** . To complete installation, reverse removal procedure. See **TIMING BELT** installation.

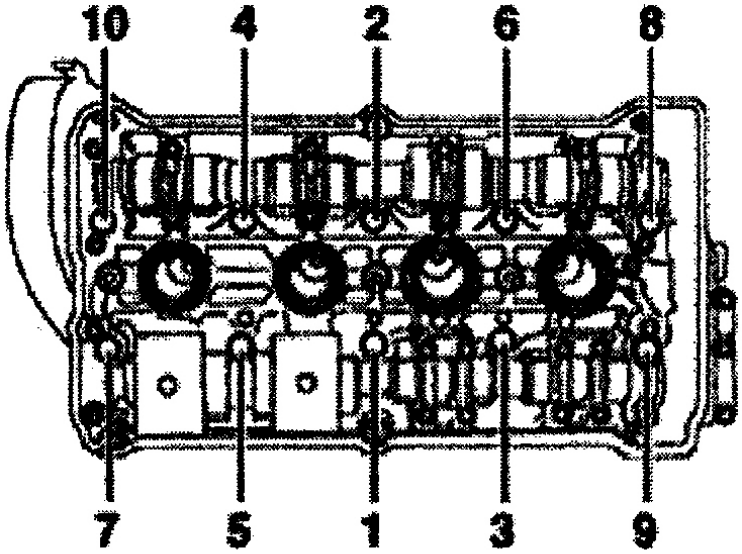

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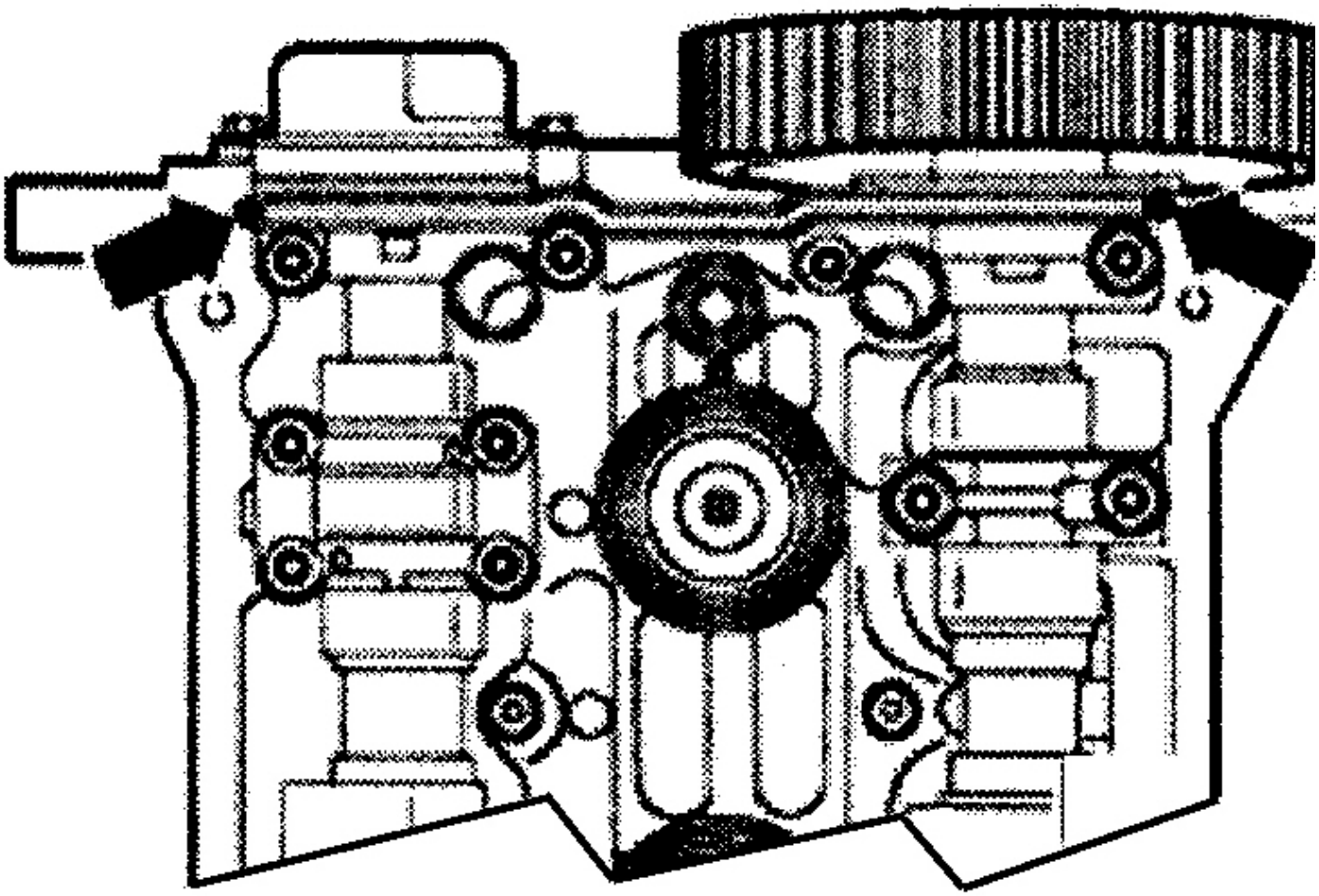
Fig. 64: Cylinder Head Bolt Tightening Sequence
Courtesy of AUDI OF AMERICA, INC.



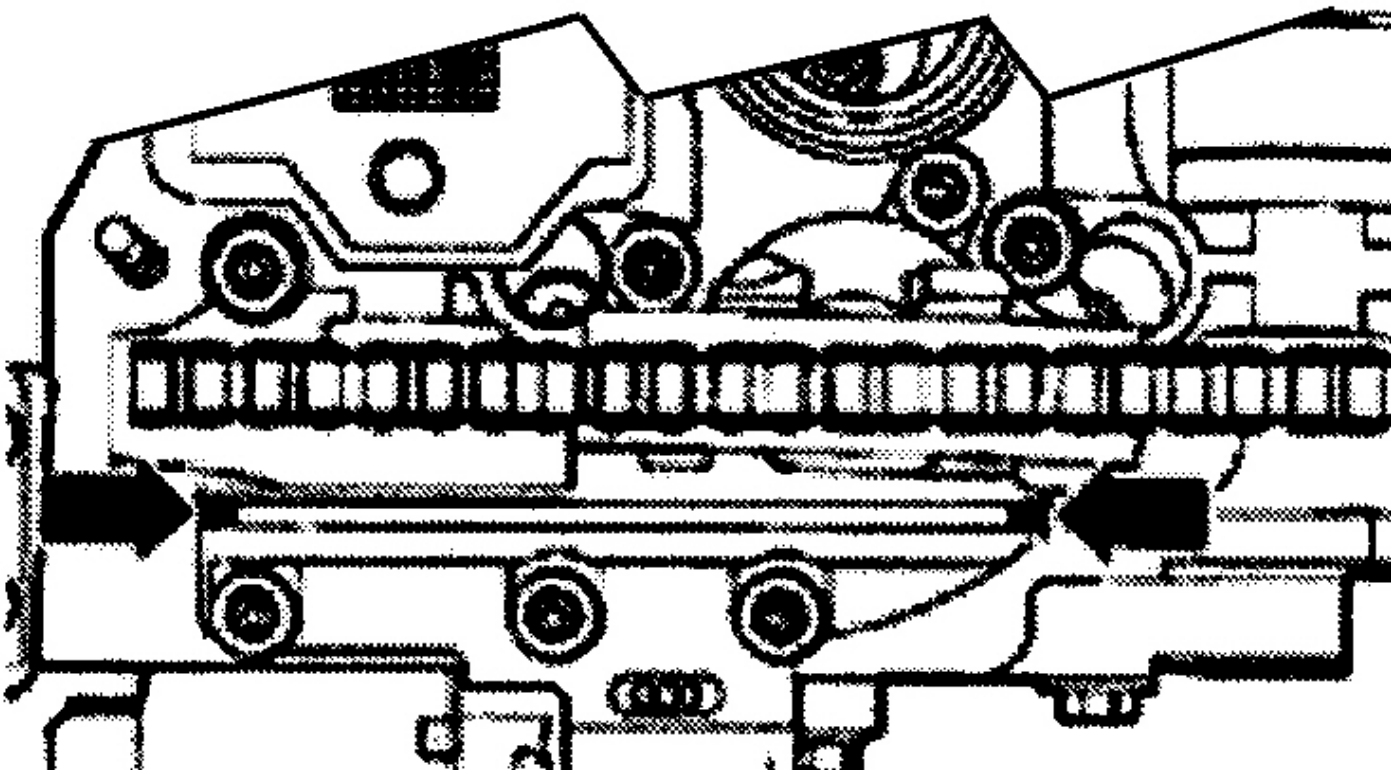


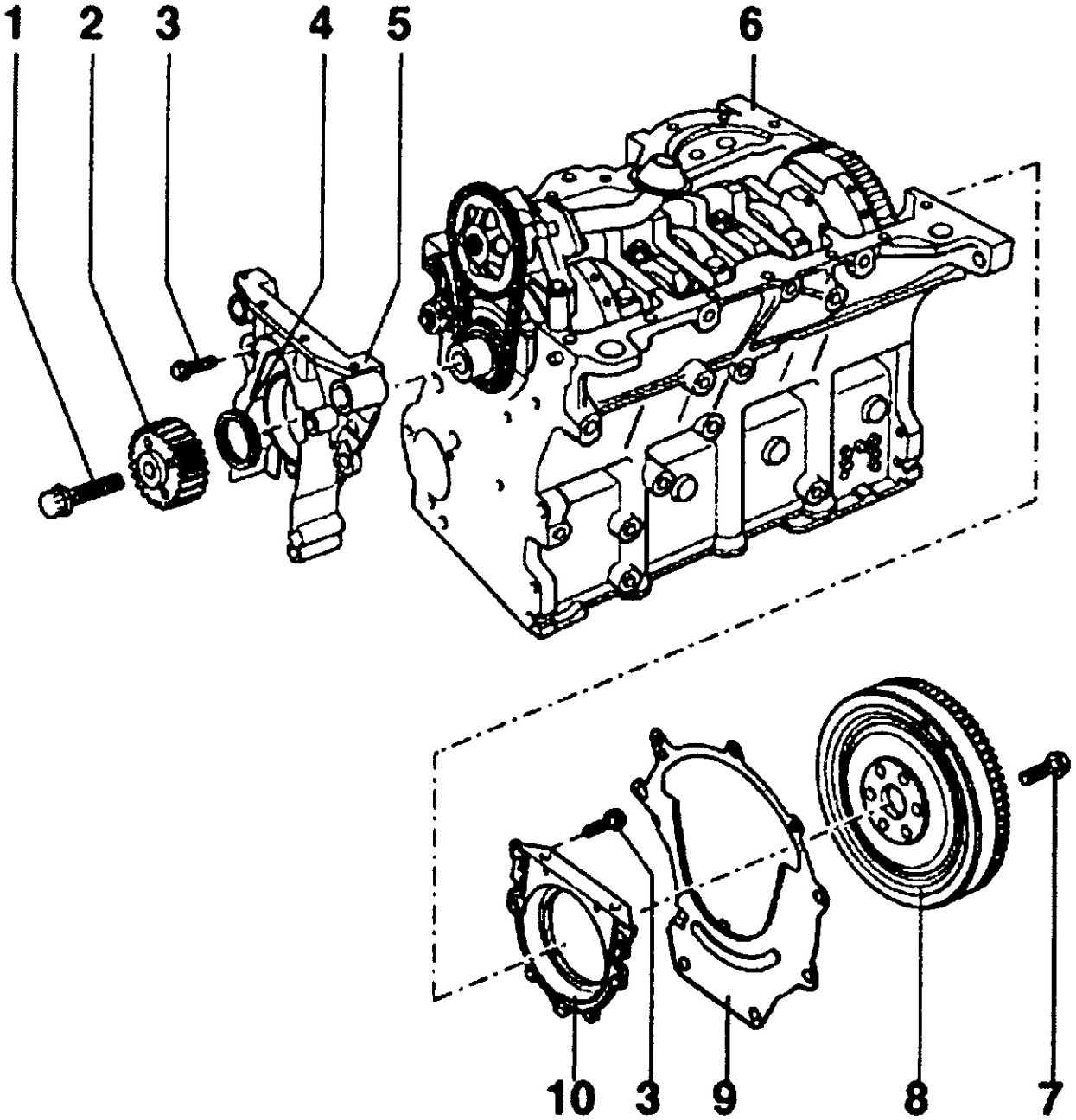
Fig. 65: Identifying Location To Apply Sealer Before Valve Cover Installation
Courtesy of AUDI OF AMERICA, INC.

CRANKSHAFT FRONT OIL SEAL

NOTE: For help in identifying components and component locations, refer to illustration. See Fig. 66 .

Removal

1. Remove timing belt. See **TIMING BELT** .
2. Remove crankshaft timing belt sprocket, by counter-holding sprocket with Locking Fixture (3415). See **Fig. 67** . To guide oil seal extractor, screw center bolt in as far into crankshaft as possible, by hand. See **Fig. 68** .
3. Unscrew inner part of oil seal extractor 9 turns (approx. 20 mm) out of the outer section and lock with knurled screw. Lubricate threaded head of oil seal extractor, place in position and while exerting firm pressure, screw as far as possible into oil seal. See **Fig. 69** .
4. Loosen knurled screw and turn inner part against crankshaft until oil seal is pulled out.



1. Crankbolt 90 Nm + 1/4 Turn ♦Must Replace
2. Timing Bolt Sprocket
3. Flange Bolts 15 Nm (11ft lbs)
4. Oil Seal ♦Replace
5. Front Sealing Flange
6. Cylinder Block
7. Flywheel Bolts 60 Nm + 1/4 Turn ♦Replace
8. Flywheel Or Driveplace
9. Intermediate Plate ♦Ensure Dowel Sleeves In Place
10. Sealing Flange With Seal ♦Replacement Fl Comes With Seal

G00135062

Fig. 66: Identifying Crankshaft Oil Seals & Front & Rear Sealing Flanges
Courtesy of VOLKSWAGEN UNITED STATES, INC.

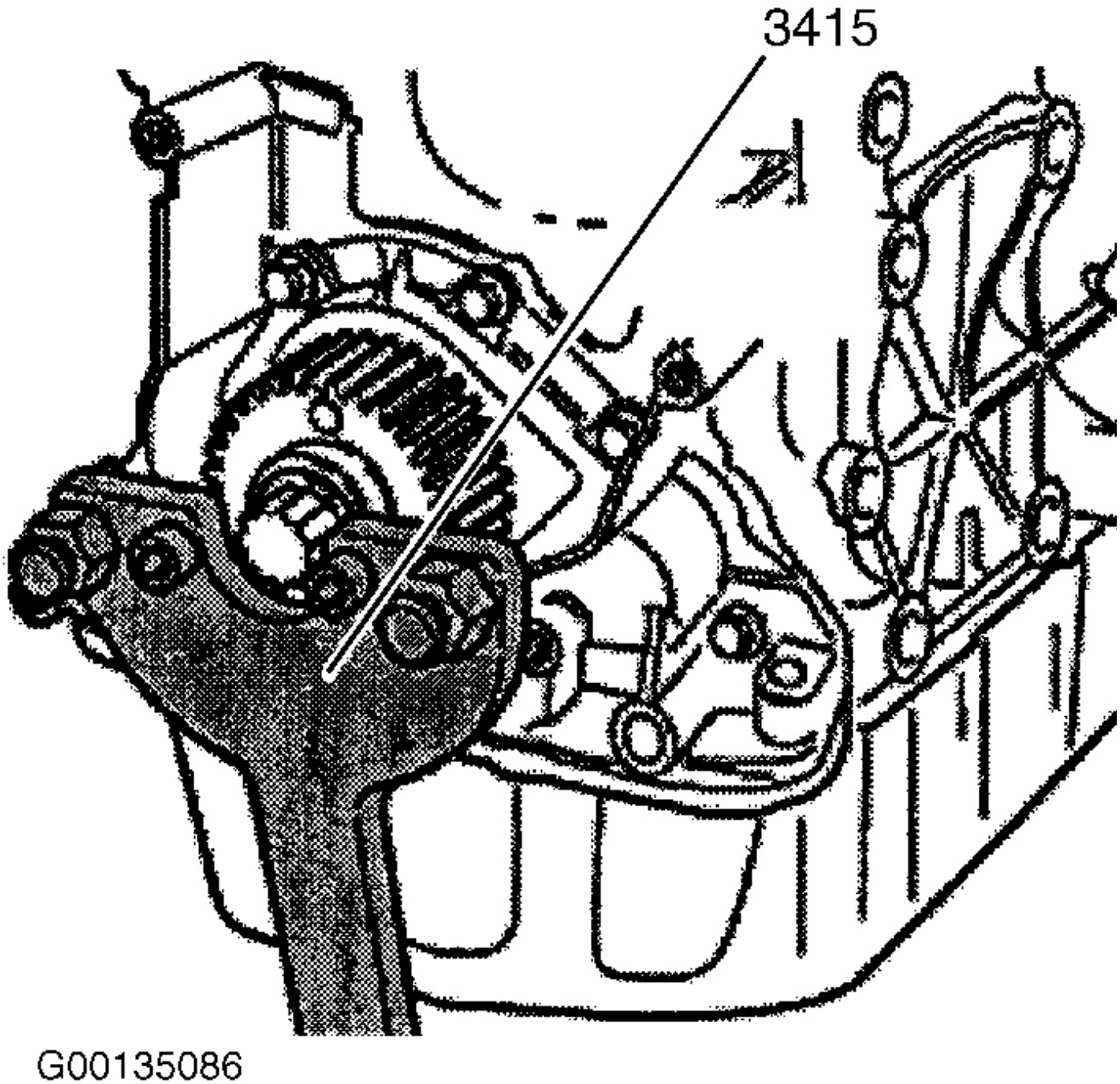


Fig. 67: Removing Crankshaft Timing Belt Sprocket Using Tool (3415)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

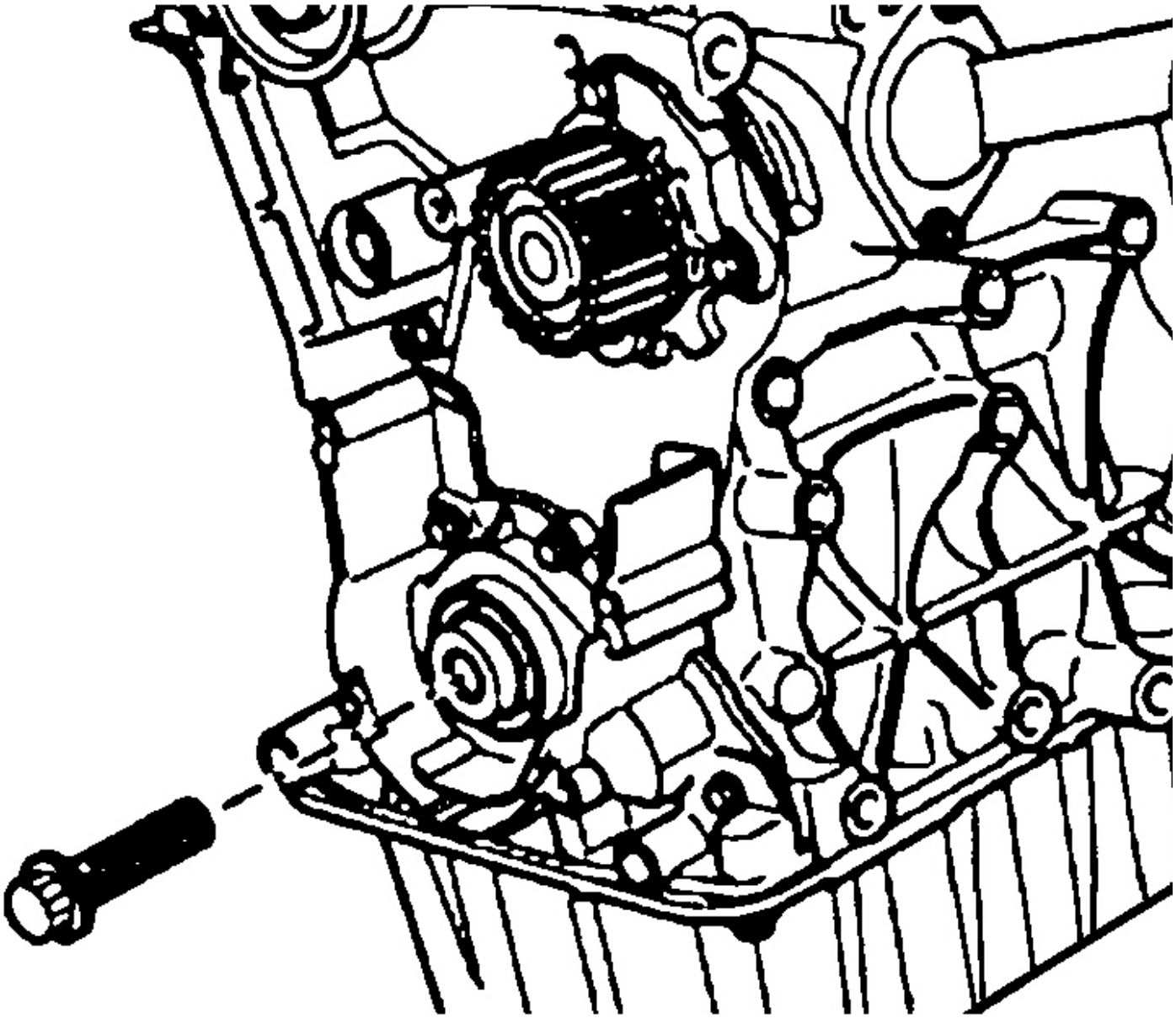


Fig. 68: Installing Crankshaft Center Bolt Into Crank With Belt Sprocket Removed
Courtesy of VOLKSWAGEN UNITED STATES, INC.

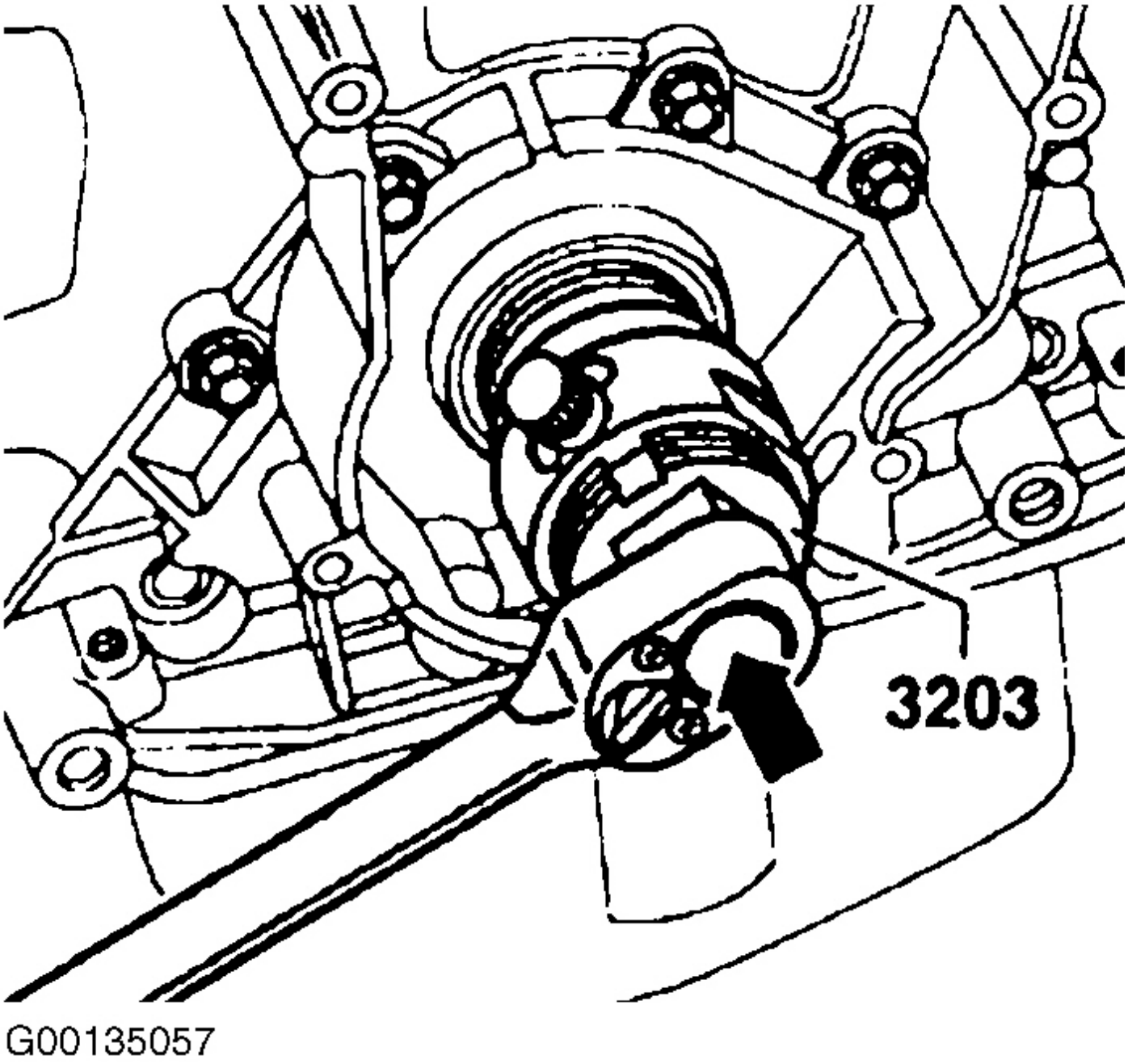


Fig. 69: Removing Front Crankshaft Seal Using Seal Extractor (3203)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Installation

NOTE: Replace crankshaft center bolt with a new bolt. DO NOT reuse torque-to-yield bolt.

NOTE: DO NOT lube threads or shoulder of new bolt, install dry.

NOTE: DO NOT lubricate lip of new PTFE oil seal.

Place Guide Sleeve (T10053/1) onto crankshaft journal. Push oil seal over guide sleeve. Using Center Bolt (T10053/2 - M16 X 1.4 X 60), press seal completely into position with Press Sleeve (T10053). See **Fig. 70**

and **Fig. 71** . Reinstall crankshaft timing belt sprocket, by holding sprocket with 3415 tool. Tighten NEW bolt to specification. See **Fig. 67** . See **TORQUE SPECIFICATIONS** . To complete installation, reverse removal procedure.

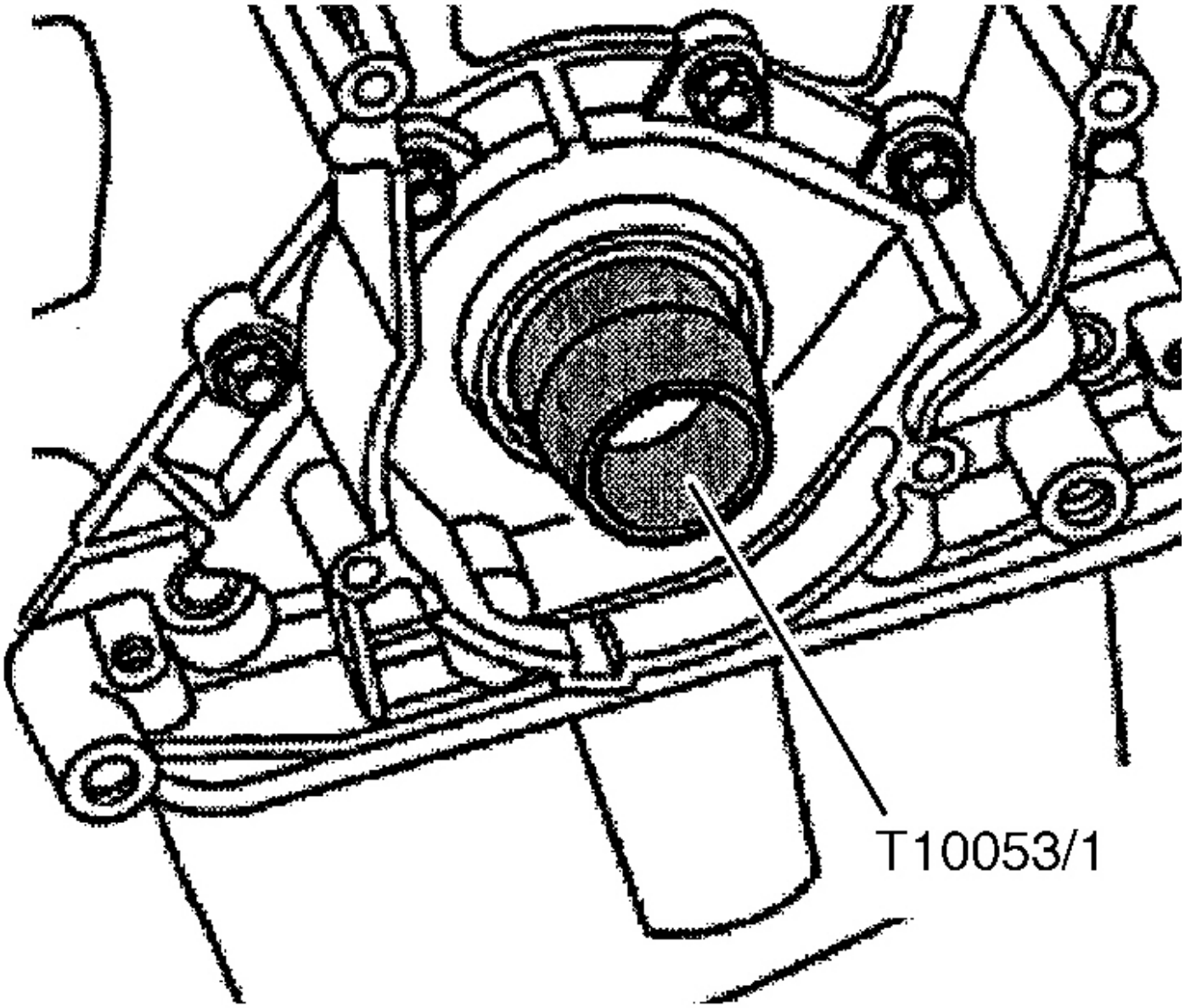


Fig. 70: Installing Guide Sleeve (T10053/1) Over Crank Journal
Courtesy of VOLKSWAGEN UNITED STATES, INC.

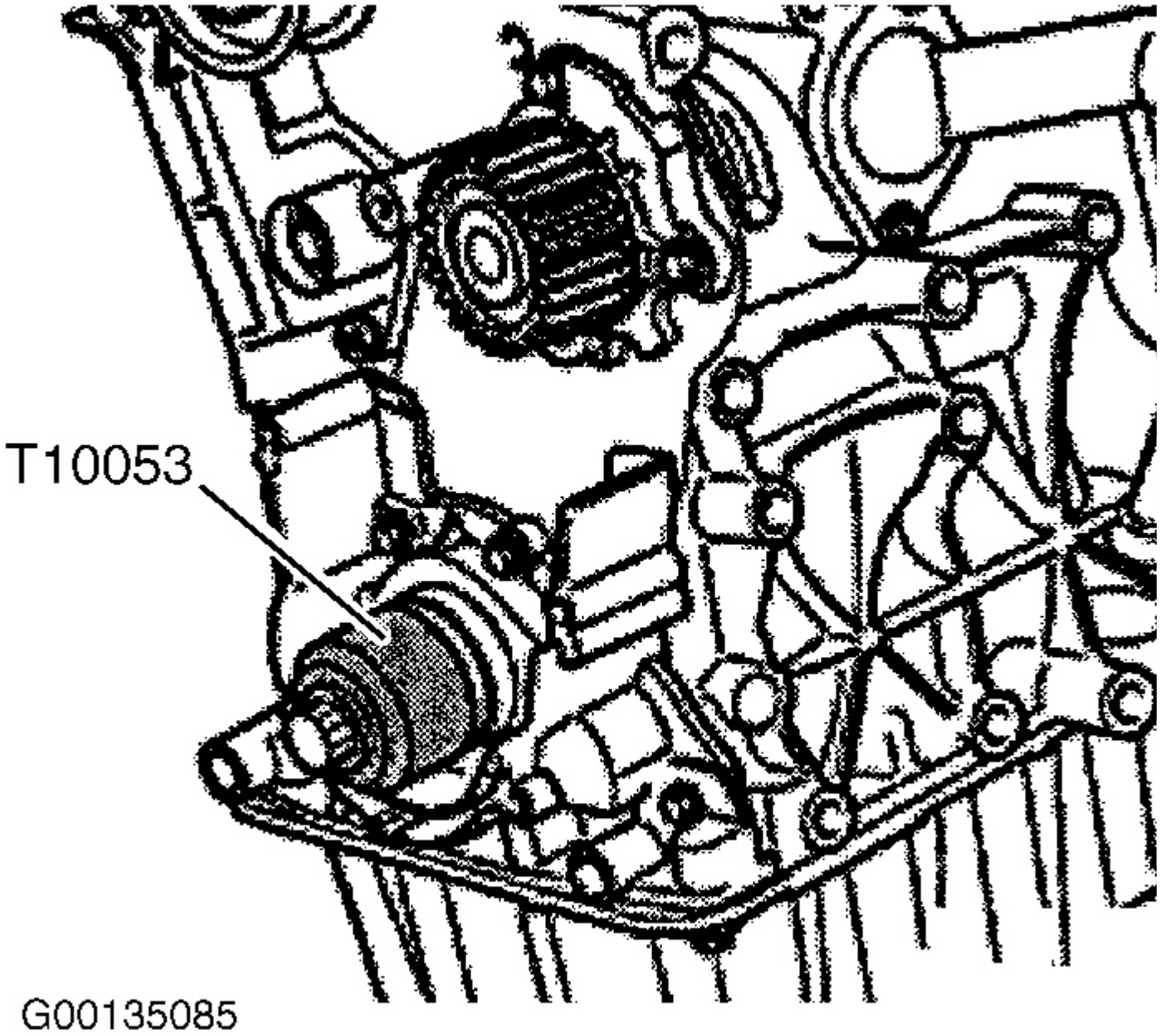


Fig. 71: Installing Crankshaft Front Oil Seal With Press Sleeve From Tool Kit (T10053)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

CRANKSHAFT FRONT OIL SEAL FLANGE

Removal

1. Remove timing belt. See **TIMING BELT** . Drain engine oil. Remove oil pan. See **OIL PAN** . Remove flange from block. To loosen flange, lightly tap flange with a rubber hammer.
2. Remove old sealant from block using a flat scraper. Using a plastic wheel, remove old sealant from flange mating surface. See **Fig. 72** . Ensure mating surface is not damaged during cleaning.

Installation

1. Apply silicone sealant in a 0.1" (3 mm) bead along flange mating surface. See **Fig. 73** .
2. If seal is not installed in flange, go to step 3 . With seal already installed in flange, DO NOT lubricate

lip of NEW seal. Place guide sleeve (T10053/1) onto crankshaft journal. See **Fig. 70** . Push oil seal over guide sleeve. Slide flange over crank journal, lightly tighten all flange bolts by hand. Using a criss-cross pattern, tighten bolts to specification. See **TORQUE SPECIFICATIONS** . Go to step 4 .

3. If oil seal is not installed in flange, install flange and in a criss-cross pattern and tighten bolts to specification. See **TORQUE SPECIFICATIONS** . Install crankshaft front oil seal. See **CRANKSHAFT FRONT OIL SEAL** . Go to next step.
4. Allow 30 minutes for sealant on flange to dry before adding oil to engine. To complete installation, reverse removal procedure.

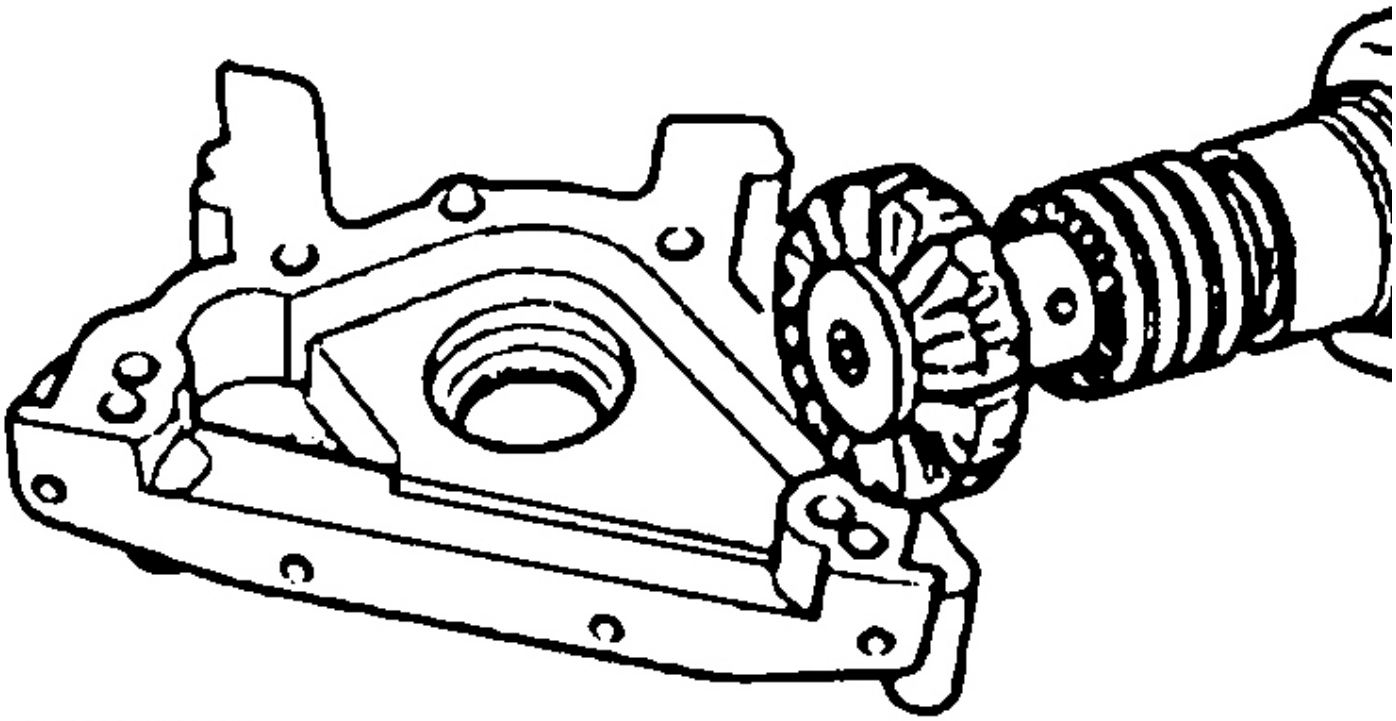


Fig. 72: Cleaning Flange Mating Surface Using Plastic Wheel
Courtesy of VOLKSWAGEN UNITED STATES, INC.

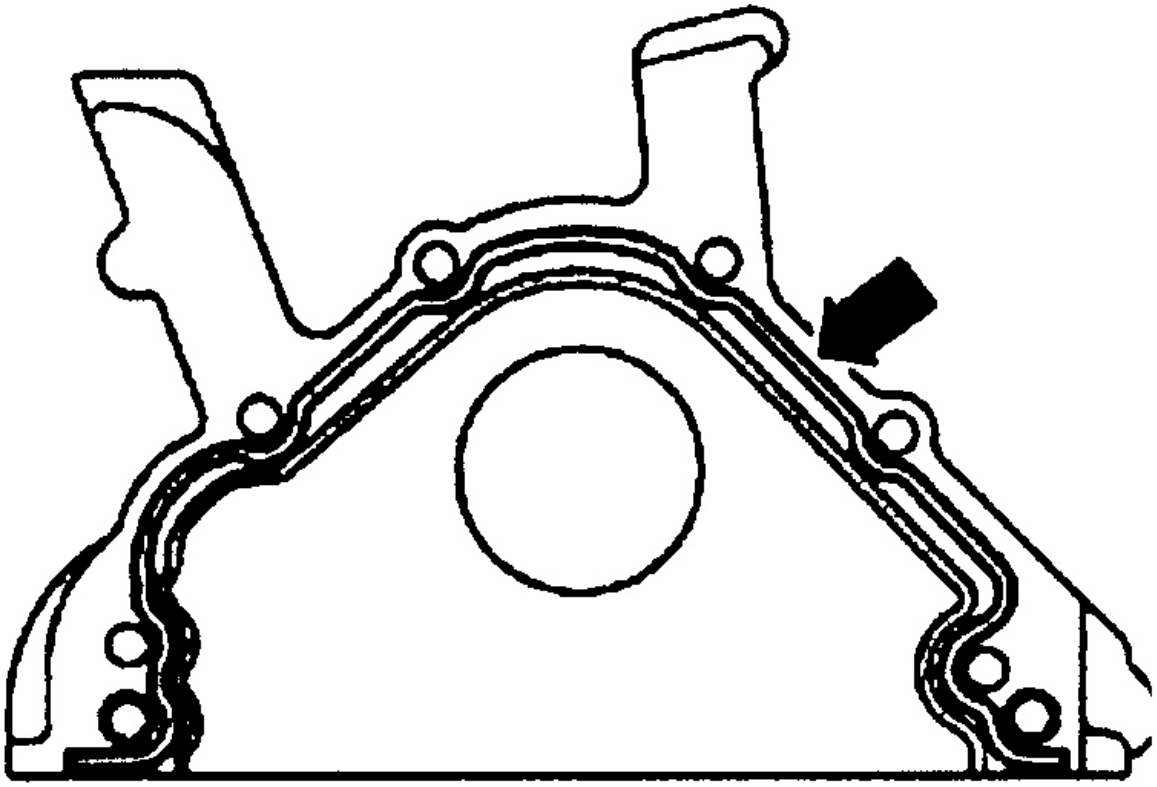


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Fig. 73: Apply Silicone Sealant To Flange Mating Surface As Shown
Courtesy of VOLKSWAGEN UNITED STATES, INC.

TIMING BELT

CAUTION: DO NOT turn crankshaft or camshaft with timing belt removed. Valve damage may result.

Removal (Beetle)

1. Disconnect negative battery cable. Remove lower engine shield (noise insulator). See **Fig. 9** . Remove accessory drive belts. See **ACCESSORY DRIVE BELTS** .
2. **NOTE: Certain engine mount bolts must be replaced. DO NOT reuse torque-to-yield bolts.**

   Remove engine cover. Raise vehicle. Remove lower shield and right side shield (insulators). Remove the air duct between the air charge cooler and the turbocharger. Lower vehicle. Install Engine Support Bar with Stands (10-222A). See **Fig. 42** . Remove vibration dampener. Remove bolts from assembly mount/engine mount. Remove assembly mount/engine mount. Remove engine mount from cylinder block. See **Fig. 44** . Slightly raise engine and remove engine bracket from engine block.
3. Remove upper timing belt cover. Place crankshaft at TDC with No. 1 cylinder on compression stroke. See **Fig. 74** . Ensure timing mark on flywheel is aligned with mark on transaxle casing. If timing belt is to be reused, mark direction of rotation on belt. Release tensioner, using tool (T10092) or a threaded stud. Screw (T10092), or threaded stud M5 X 55 (1) into timing belt tensioner.
4. If using threaded stud M5 X 55, fit hexagon nut (2) with large washer (3) onto threaded stud (1). Align pressure piston using pointed pliers or wire before tensioning (turning piston to match hole in

tensioner housing). Tension the lever so holes in the piston line up with hole in housing. Install Locking Pin (T40011) or a suitable pin through hole to lock piston in place. See **Fig. 75** . Remove timing belt. Carefully rotate crankshaft slightly backwards to take No. 1 piston off Top Dead Center (DTC).

Removal (Jetta, Golf & GTI)

1. Disconnect negative battery cable. Remove lower engine shield (noise insulator). See **Fig. 10** . Remove accessory drive belts. See **ACCESSORY DRIVE BELTS** .
2. **NOTE: Certain engine mount bolts must be replaced. DO NOT reuse torque-to-yield bolts.**

   Remove engine cover. Remove coolant reservoir tank and place to the side. Remove power steering reservoir and place to the side. Remove vacuum lines at charcoal filter and at throttle body. Raise vehicle. Remove lower engine shield (noise insulators). Remove right-side head lamp. Remove the air duct between the air charge cooler and the turbocharger. Lower vehicle.
3. Install Engine Support Bar with Stands (10-222A). See **Fig. 43** . Remove vibration dampener. Remove bolts from assembly mount/engine mount. Remove assembly mount/engine mount. Remove engine mount from cylinder block. See **Fig. 44** . Slightly raise engine and remove engine bracket from engine block.
4. Remove upper timing belt cover. Place crankshaft at TDC with No. 1 cylinder on compression stroke. See **Fig. 74** . Ensure timing mark on flywheel is aligned with mark on transaxle casing. If timing belt is to be reused, mark direction of rotation on belt. Release tensioner, using tool (T10092) or a threaded stud. Screw (T10092), or threaded stud M5 X 55 (1) into timing belt tensioner.
5. If using threaded stud M5 X 55, fit hexagon nut (2) with large washer (3) onto threaded stud (1). Align pressure piston using pointed pliers or wire before tensioning (turning piston to match hole in tensioner housing). Tension the lever so holes in the piston line up with hole in housing. Install locking pin (T40011) or a suitable pin through hole to lock piston in place. See **Fig. 75** . Remove timing belt. Carefully rotate crankshaft slightly backwards to take No. 1 piston off Top Dead Center (DTC).

Installation (All Models)

1. Align mark on camshaft sprocket with mark on cylinder head cover and/or timing belt guard. See **Fig. 74** . Install timing belt on timing belt sprocket. Put crankshaft at DTC mark. Pull timing belt around water pump and up around camshaft sprocket (taking up slack in belt). DO NOT let crankshaft rotate as belt is installed.
2. With timing marks aligned, and very little slack on the water pump side of the belt, remove slack at back side of belt by removing locking pin from auto-tensioner, than removing the nut, washer and stud assembly. See **Fig. 75** . Allow tensioner to stabilize for 1 minute. Turn crankshaft 2 full revolutions and check that camshaft and crankshaft reference marks align. Repeat timing belt procedure if marks are out of alignment. Once again, rotate crankshaft 2 revolutions in running direction and stop on TDC and recheck.
3. Install timing belt covers. Install vibration damper pulley and tighten to specification. See **TORQUE SPECIFICATIONS** . Install aggregate mount and engine mount. Install accessary drive belt tensioner and tighten to specification. Install accessary drive belt. See **ACCESSORY DRIVE BELT** . To complete installation, reverse removal procedure.

CAMSHAFTS

CAUTION: DO NOT turn crankshaft or camshaft with timing belt removed. Valve damage may result.

NOTE: For help in identifying components and component locations, refer to illustration. See Fig. 76 .

Removal

1. **NOTE: Certain engine mount bolts must be replaced. DO NOT reuse torque-to-yield bolts.**

   Remove engine cover. Raise vehicle. Remove lower shield and right side shield (noise insulators). Remove the air duct between the air charge cooler and the turbocharger. Lower vehicle. Install Engine Support Bar with Stands (10-222A). See **Fig. 42** . Remove vibration dampener. Remove engine mount. Slightly raise engine, and remove engine bracket from engine block.
2. Remove upper timing belt cover. Place crankshaft at TDC with No. 1 cylinder on compression stroke. See **Fig. 74** . If timing belt is to be reused, mark direction of rotation on belt. Release tensioner, using Tool (T10092) or a threaded stud. Screw (T10092), or threaded stud M5 X 55 (1) into timing belt tensioner. If using threaded stud M5 X 55, fit hexagon nut (2) with large washer (3) onto threaded stud (1). Align pressure piston using pointed pliers or wire before tensioning (turning piston to match hole in tensioner housing). Tension the lever so holes in the piston line up with hole in housing. Install Locking Pin (T40011) or a suitable pin through hole to lock piston in place. See **Fig. 75** .
3. Remove timing belt. Carefully rotate crankshaft slightly backwards to take No. 1 piston off Top Dead Center (DTC).
4. Using Camshaft Holder (3036), remove camshaft sprocket bolt. Remove camshaft sprocket. Remove Woodruff key. Install camshaft sprocket bolt and washer until washer is tight against camshaft. On intake cam, remove Camshaft Position (CMP) sensor housing. Remove the CMP sensor shutter wheel (hood) bolt and washer. Remove CMP sensor shutter wheel.
5. Clean camshaft drive chain and chain sprockets. Moving only the cams align the marks on the cam sprocket with arrows on the bearing caps. Using paint, mark chain and sprockets opposite arrows on bearing caps. Distance between both arrows (and between paint markings) is 16 rollers on the chain. See **Fig. 78** . If a new chain is being installed, distance between Notch "A" and "B" must equal 16 drive chain rollers. Notch "A" is slightly off set inward toward drive chain roller (1). See **Fig. 79** .
6. Remove camshaft position sensor housing. Mark installation position on bearing caps with a colored marker. Secure chain tensioner, install Chain Tensioner (3366) and tighten to keep slight pressure on chain between camshafts. DO NOT overtighten chain tensioner. See **Fig. 80** . Remove camshaft caps as follows:
   - Remove camshaft intake and exhaust bearing caps No. 3 and 5. Loosen bolts in small amounts evenly in a criss-cross sequence. See **Fig. 77** .
   - Remove double bearing cap.
   - Remove both bearing caps at chain sprockets on intake and exhaust camshafts.
   - Remove chain tensioner securing bolts.
   - Remove intake and exhaust camshaft 2nd and 4th bearing caps using alternate and cross-over sequence.
7. Remove intake and exhaust camshafts with chain tensioner and retainer for Chain Tensioner (3366) from cylinder head.

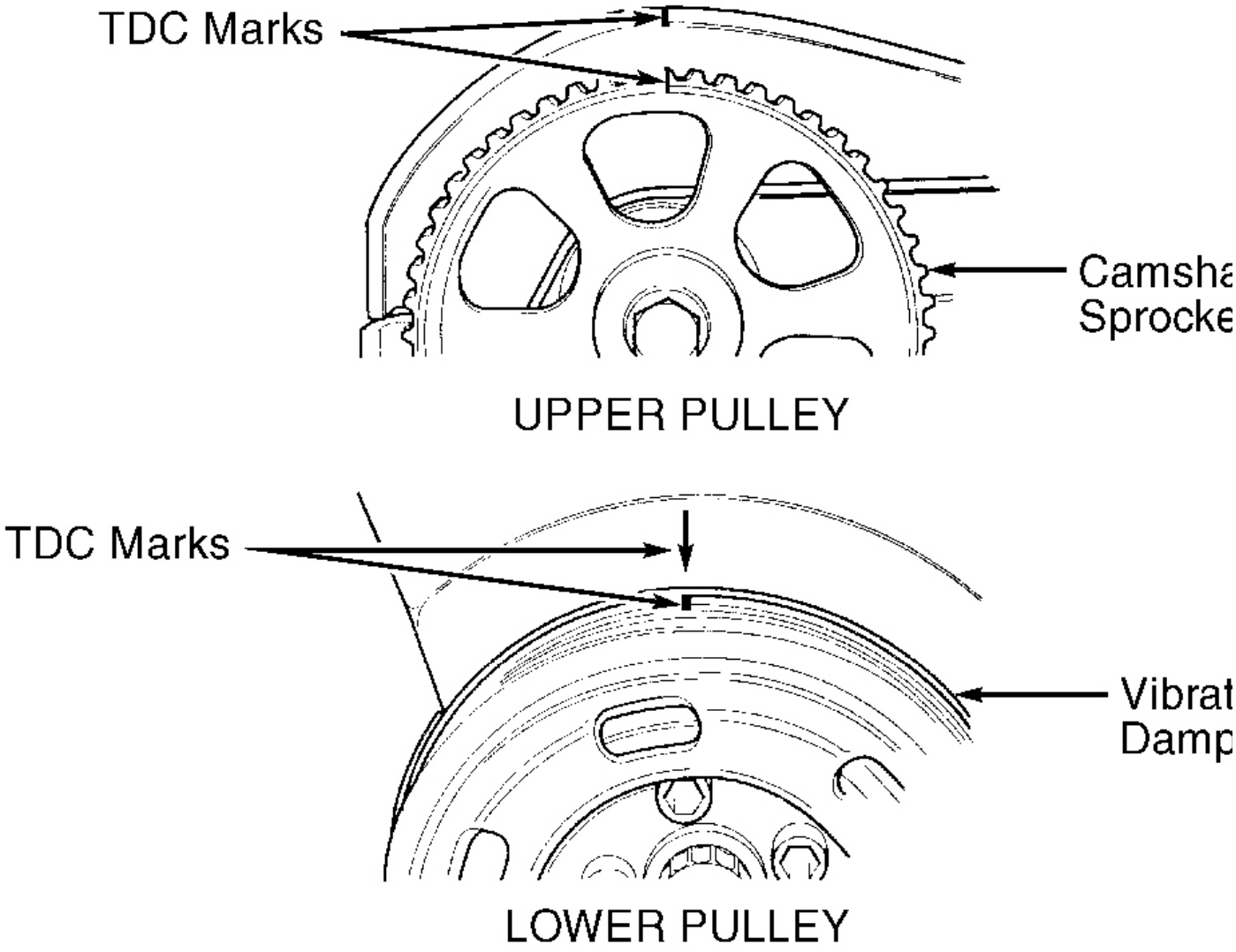
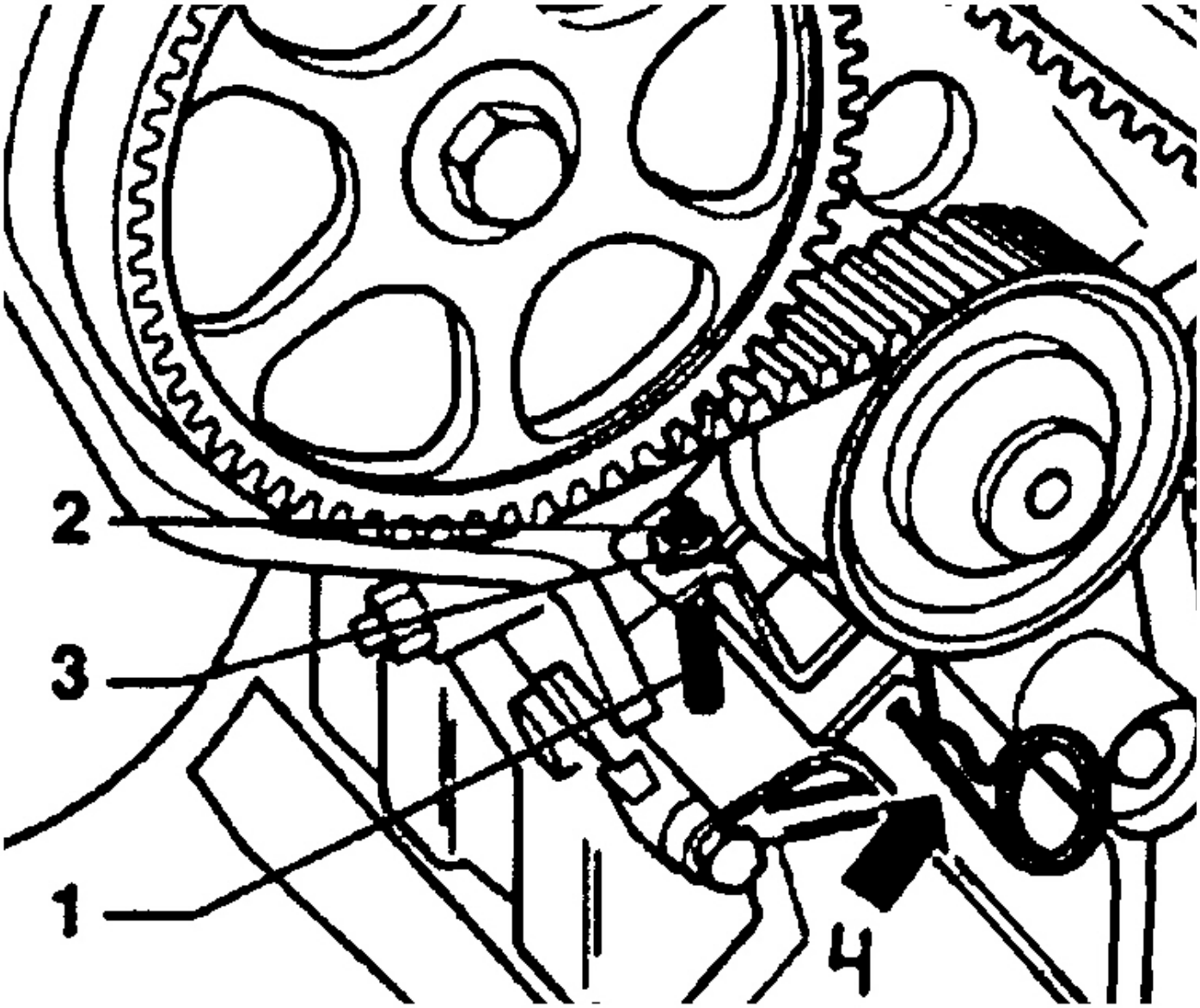


Fig. 74: Aligning Camshaft & Crankshaft Timing Mark To Top Dead Center (TDC)
Courtesy of AUDI OF AMERICA, INC.



1. M5 x 55 Stud
2. Hexagon Nut
3. Large Wash
4. Piston Locke

G00135054

Fig. 75: Releasing Tension Off Timing Belt & Locking Tensioner Piston In Place
Courtesy of VOLKSWAGEN UNITED STATES, INC.

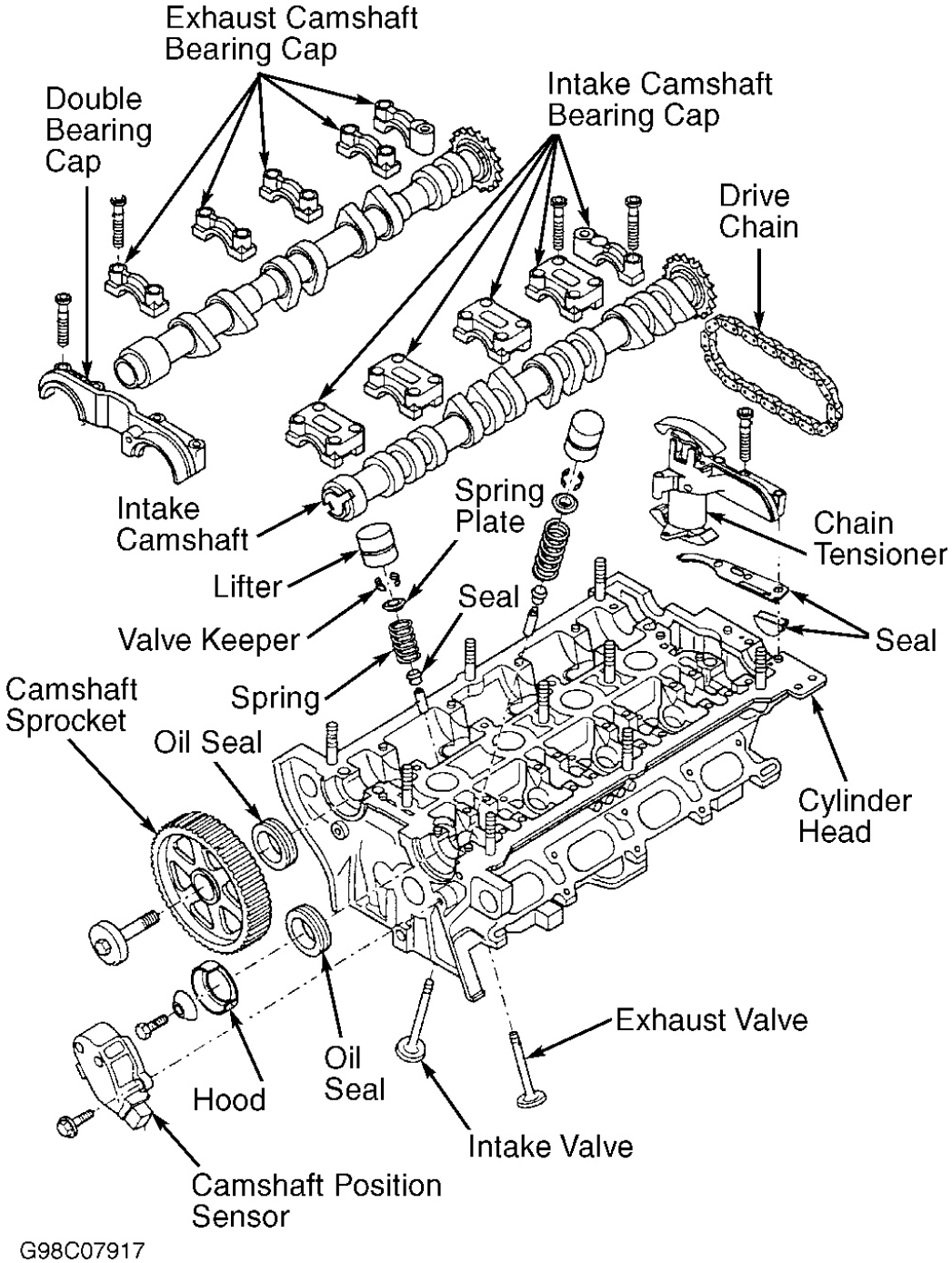


Fig. 76: Identifying Cylinder Head Components
Courtesy of VOLKSWAGEN UNITED STATES, INC.

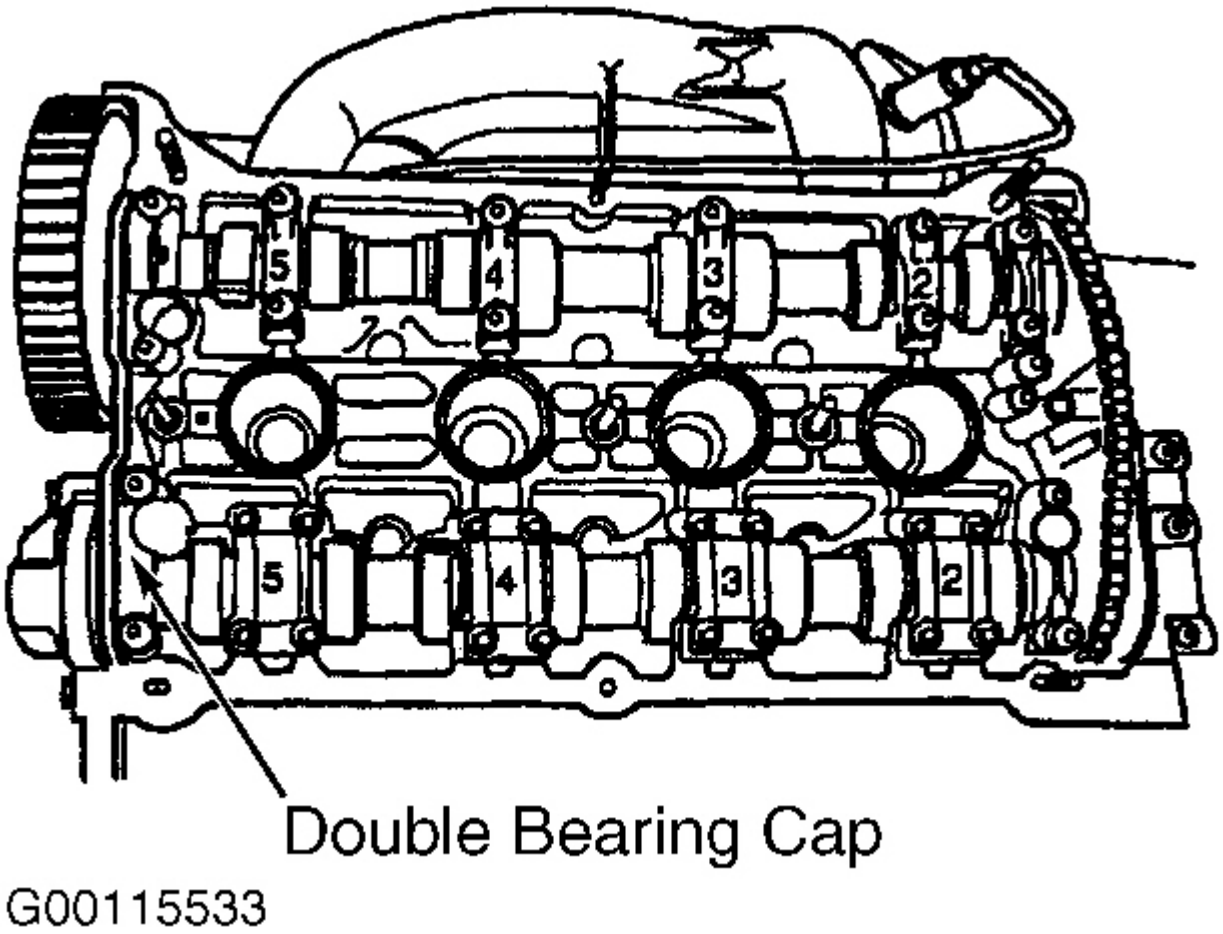


Fig. 77: Identifying Camshafts Bearing Caps 1-5 & Double Bearing Cap
Courtesy of VOLKSWAGEN UNITED STATES, INC.

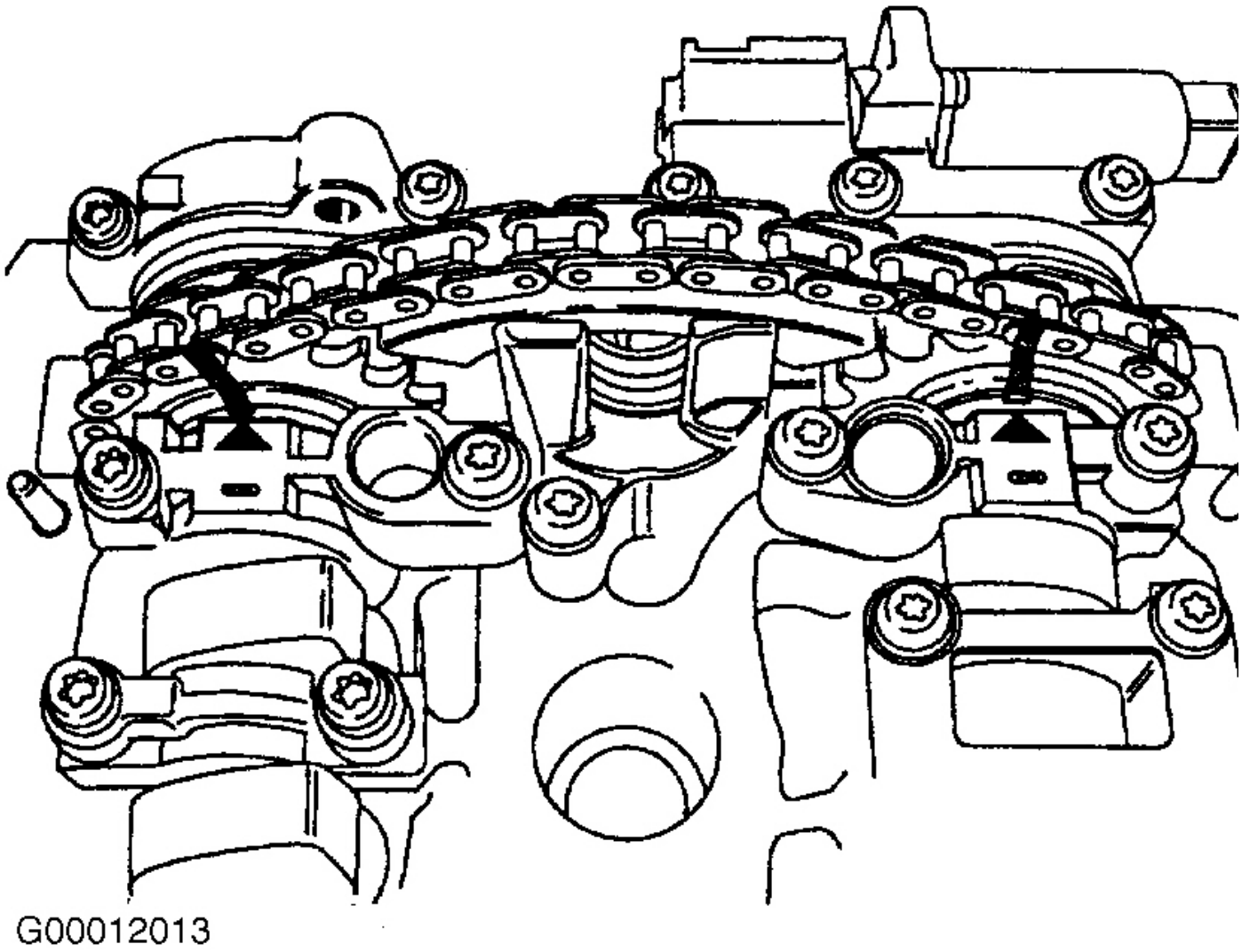


Fig. 78: Identifying Marks On Cam Chain Gears & Arrows On Cam Caps
Courtesy of VOLKSWAGON UNITED STATES INC.

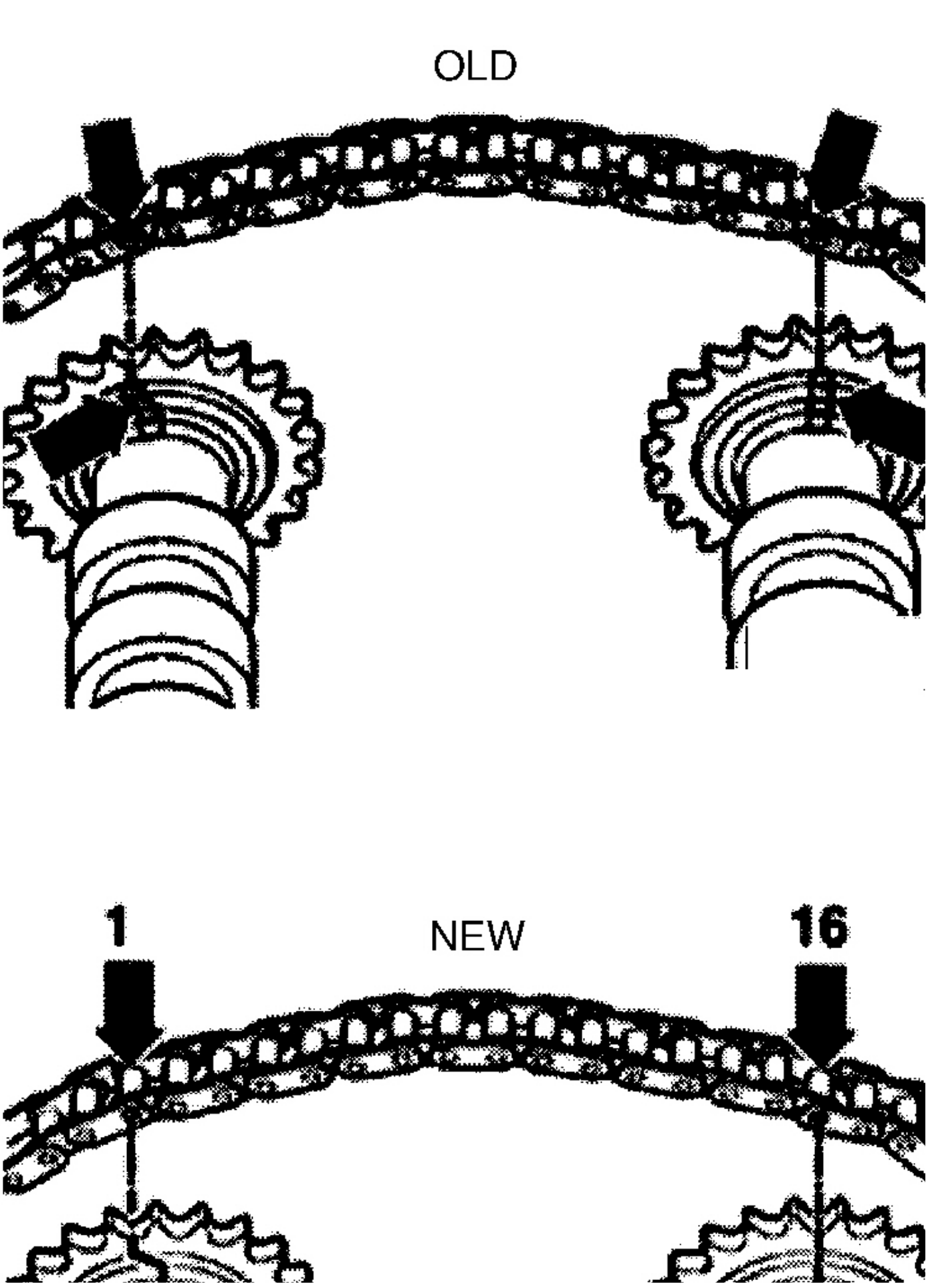


Fig. 79: New Camshaft Drive Chain Install Dimensions
Courtesy of AUDI OF AMERICA, INC.

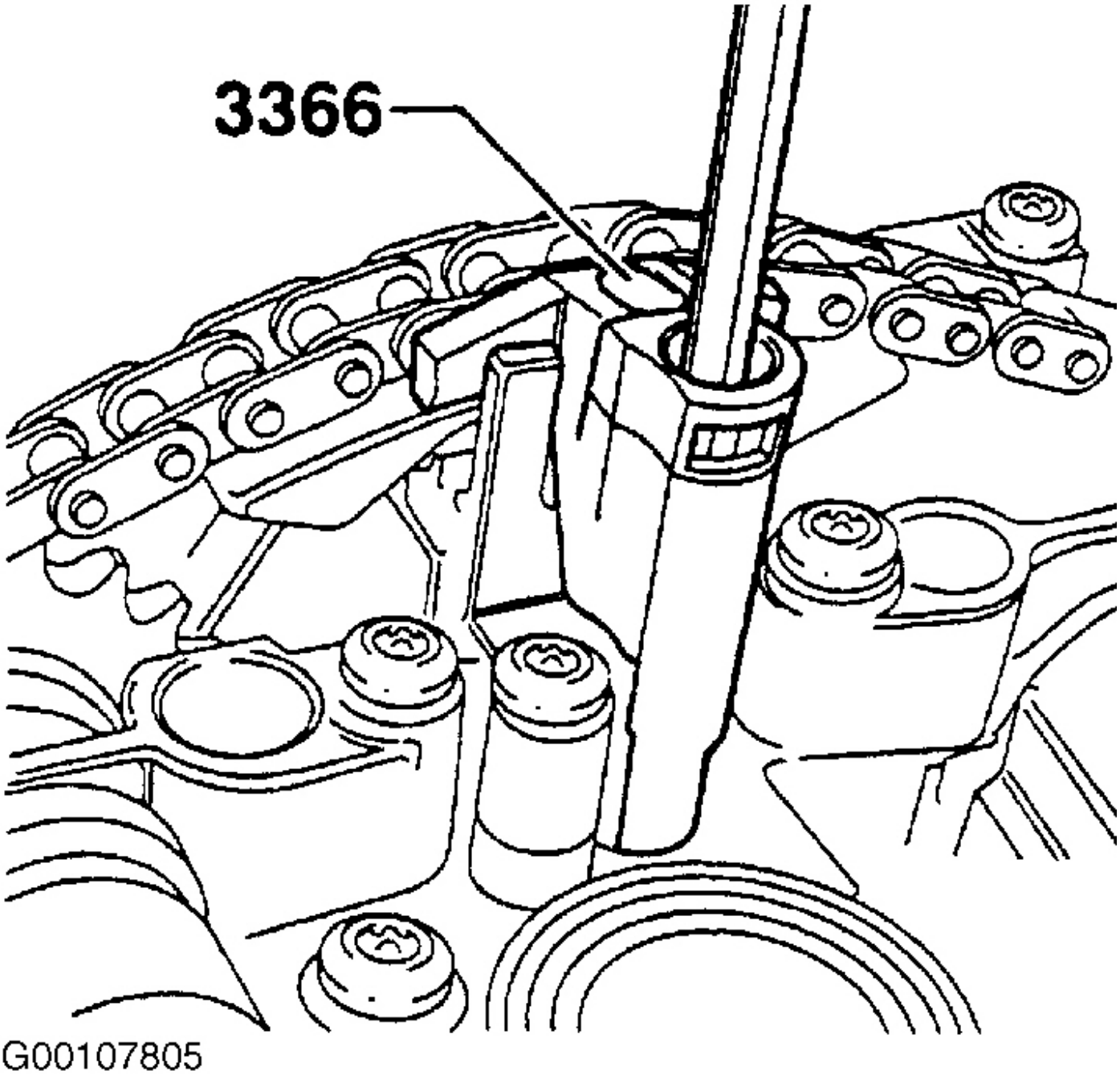


Fig. 80: Identifying Usage Of Camshaft Chain Adjuster Retainer Tool
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Inspection

Check camshaft bearing oil clearance. See **CAMSHAFT** table under ENGINE SPECIFICATIONS. If oil clearance is not within specification, install new camshaft and recheck clearance. If clearance still exceeds specification, replace cylinder head. Check camshaft end play. See **VALVE TRAIN** under OVERHAUL.

CAUTION: If cam followers are charged with oil, allow 30 minutes for followers to bleed down before starting engine. Pistons may strike valves, resulting in bent

valves.

Installation

1. **NOTE: When installing the bearing caps, ensure that the cap markings can be read from the intake side of the cylinder head.**

   Place camshafts in cylinder head. Ensure lobes for No. 1 cylinder are pointed upward. See **Fig. 76** . Fit drive chain onto both camshafts relative to the marks. Replace chain tensioner rubber/metal gasket and coat shaded area lightly with Sealant (D 454 300 A2). See **Fig. 81** . Slide chain tensioner between drive chain.

2. **NOTE: Take note of dowel sleeves locations.**

   Lightly lubricate oil running surfaces of camshafts. Place camshafts with drive chain in cylinder head. Tighten chain tensioner to specification. See **TORQUE SPECIFICATIONS** . Tighten camshaft bearing caps No. 2 and 4 evenly to specification. Install both bearing caps at chain sprockets for intake and exhaust camshafts. Ensure camshafts are positioned correctly. Tighten bearing caps to specification. Remove retainer for chain tensioner (3366).

3. Lightly coat hatched area of double bearing cap with Sealant (D 454 300 A2). See **Fig. 82** . Install double bearing cap and tighten to specification (remember dowel sleeves).
4. Install remaining bearing caps and tighten to specification (remember dowel sleeves). Check position of marks made on camshafts sprockets relative to one another. Position of marks should be close to marks prior to removal. See **Fig. 78** . If a new chain is being installed, distance between Notch "A" and "B" must equal 16 drive chain rollers. Notch "A" is slightly off set inward toward drive chain roller (1). See **Fig. 79** .
5. To complete installation, reverse removal procedure. If cam followers are charged with oil, allow 30 minutes for followers to bleed down before starting engine.

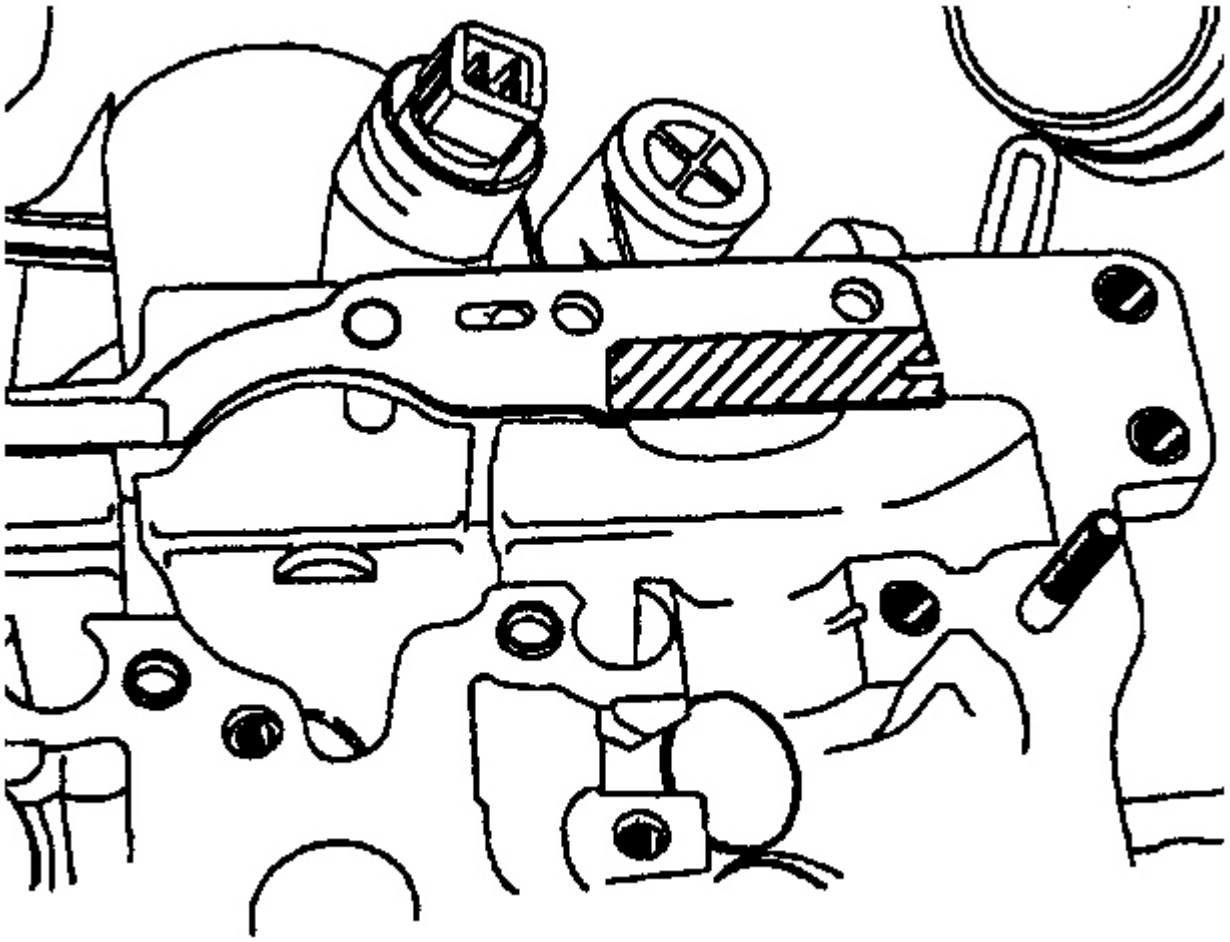


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Fig. 81: Applying Sealant (D 454 300 A2) To Chain Tensioner Mounting Surface
Courtesy of VOLKSWAGEN UNITED STATES, INC.

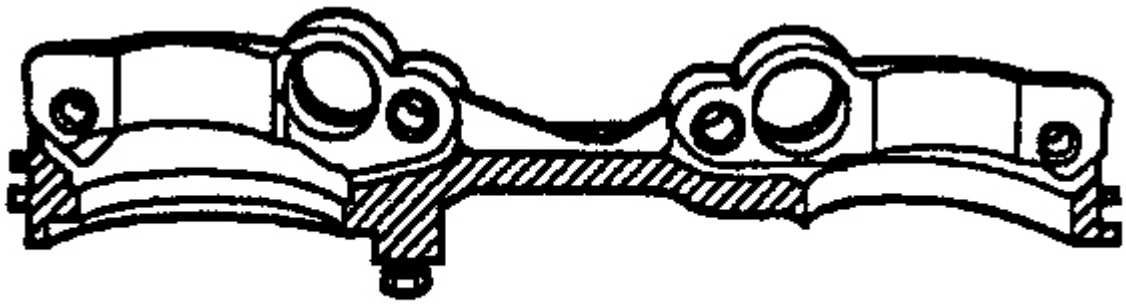

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Fig. 82: Applying Sealant (D 454 300 A2) To Double Bearing Cap
Courtesy of VOLKSWAGEN UNITED STATES, INC.

CAMSHAFT OIL SEALS

CAUTION: DO NOT turn crankshaft or camshaft with timing belt removed. Valve damage may result. DO NOT allow camshaft to turn when removing camshaft sprocket bolt.

Removal (Exhaust Cam)

1. Remove upper timing belt cover. Place crankshaft at TDC with No. 1 cylinder on compression stroke. See **Fig. 74** . If timing belt is to be reused, mark direction of rotation on belt. Release tensioner, using Tool (T10092) or a threaded stud. Screw (T10092), or threaded stud M5 X 55 (1) into timing belt tensioner. If using threaded stud M5 X 55, fit hexagon nut (2) with large washer (3) onto threaded stud (1). See **Fig. 75** . Align pressure piston using pointed pliers or wire before tensioning (turning piston to match hole in tensioner housing). Tension the lever so holes in the piston line up with hole in housing. Install Locking Pin (T40011) or a suitable pin through hole to lock piston in place.
2. Remove timing belt. Very carefully rotate crankshaft backwards to take pistons off Top Dead Center (DTC). Using Camshaft Holder (3036), remove camshaft sprocket bolt. Remove camshaft sprocket. Reinstall camshaft sprocket bolt and washer until bolt comes to a stop (hand tight) against camshaft. See **Fig. 83** .
3. Unscrew inner part of Oil Seal Extractor (2085) 2 turns (approx. 3 mm) out of the outer section and lock with knurled screw. Lubricate threaded head of oil seal extractor. Place in position and while exerting firm pressure, screw oil seal extractor in as far as possible into oil seal. See **Fig. 84** .
4. Loosen knurled screw and turn inner part against crankshaft until oil seal is pulled out.

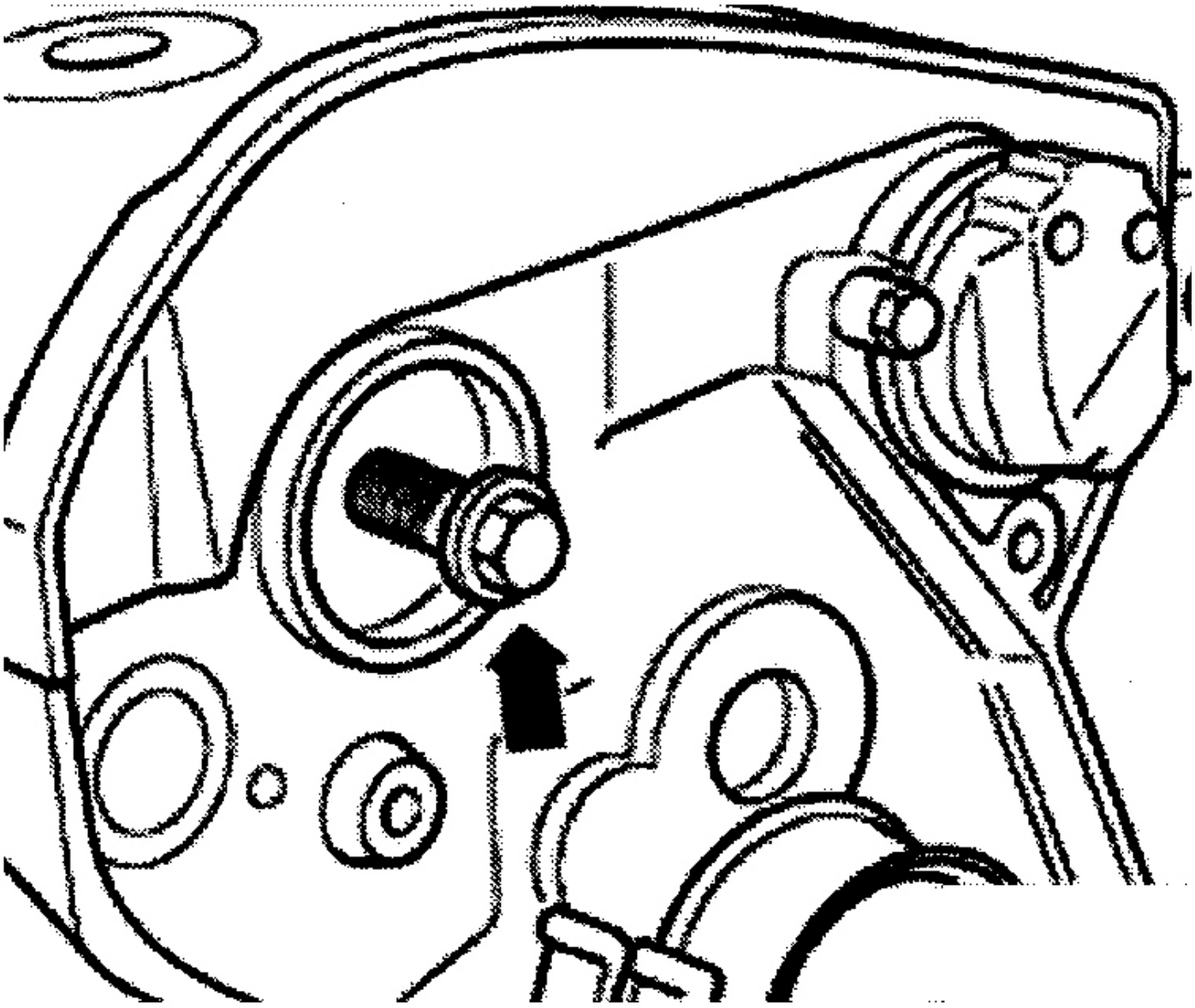

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Fig. 83: Camshaft Sprocket Bolt Installed In Camshaft
Courtesy of AUDI OF AMERICA, INC.

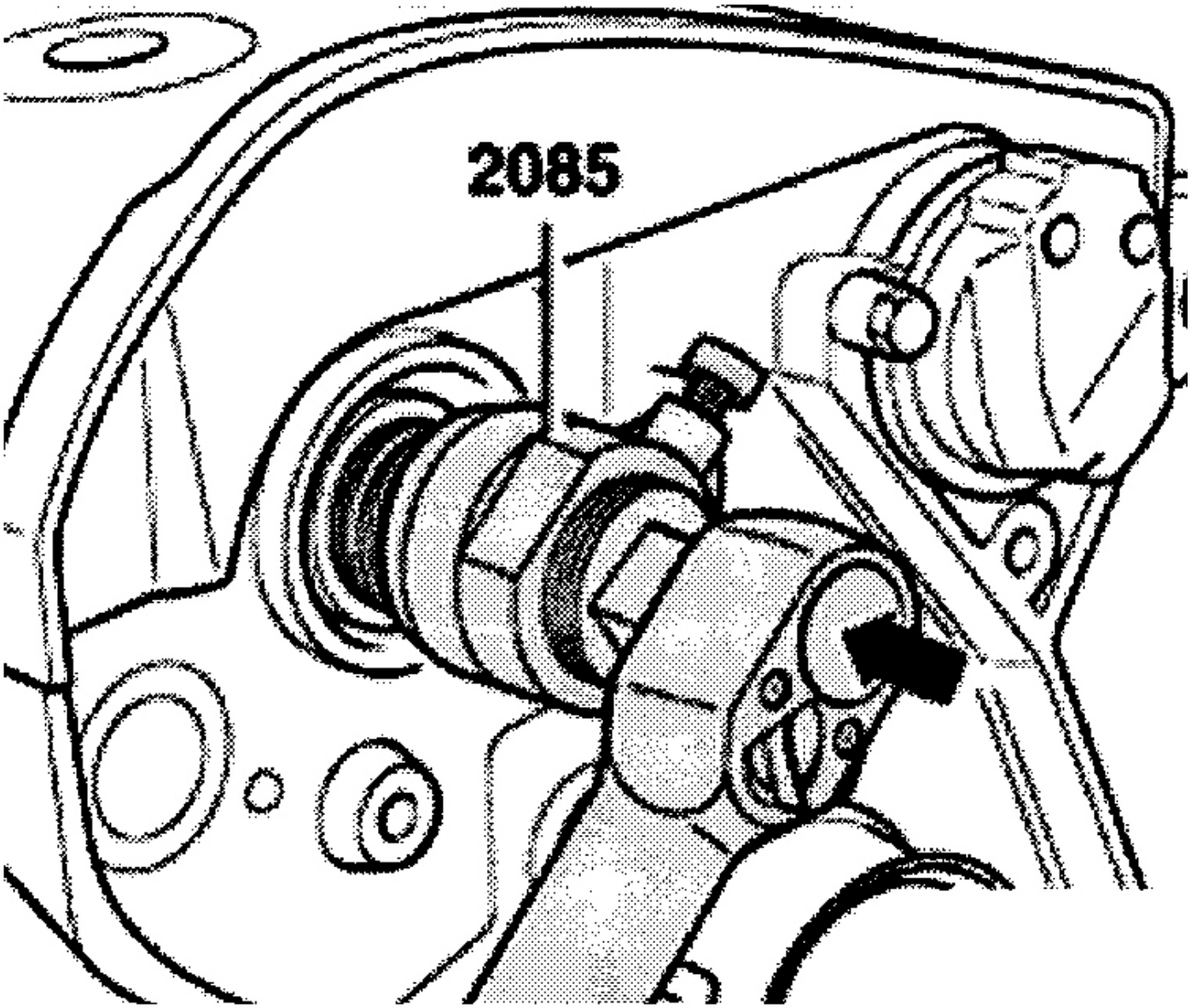

Fig. 84: Installing Seal Puller (2085)
Courtesy of AUDI OF AMERICA, INC.

Installation

NOTE: Gradual introduction of PTFE oil seal (identifying characteristics: no annular spring and sealing lip is wider). The sealing lip of this oil ring must not be oiled or lubricated. A plain encased seal of older construction (with annular spring) may be replaced with a PTFE oil seal, but not vice versa.

DO NOT lubricate new PTFE seal lip. DO NOT oil outer circumference of oil seal. Using Guide Sleeve (T10071/1), slide seal until flush with head. See **Fig. 85** . Using Seal Installer with Press Sleeve (T10071/3) and Bolt (T10071/4), install new camshaft oil seal flush into cylinder head. See **Fig. 86** . To complete installation, reverse removal procedure. See **TIMING BELT** .

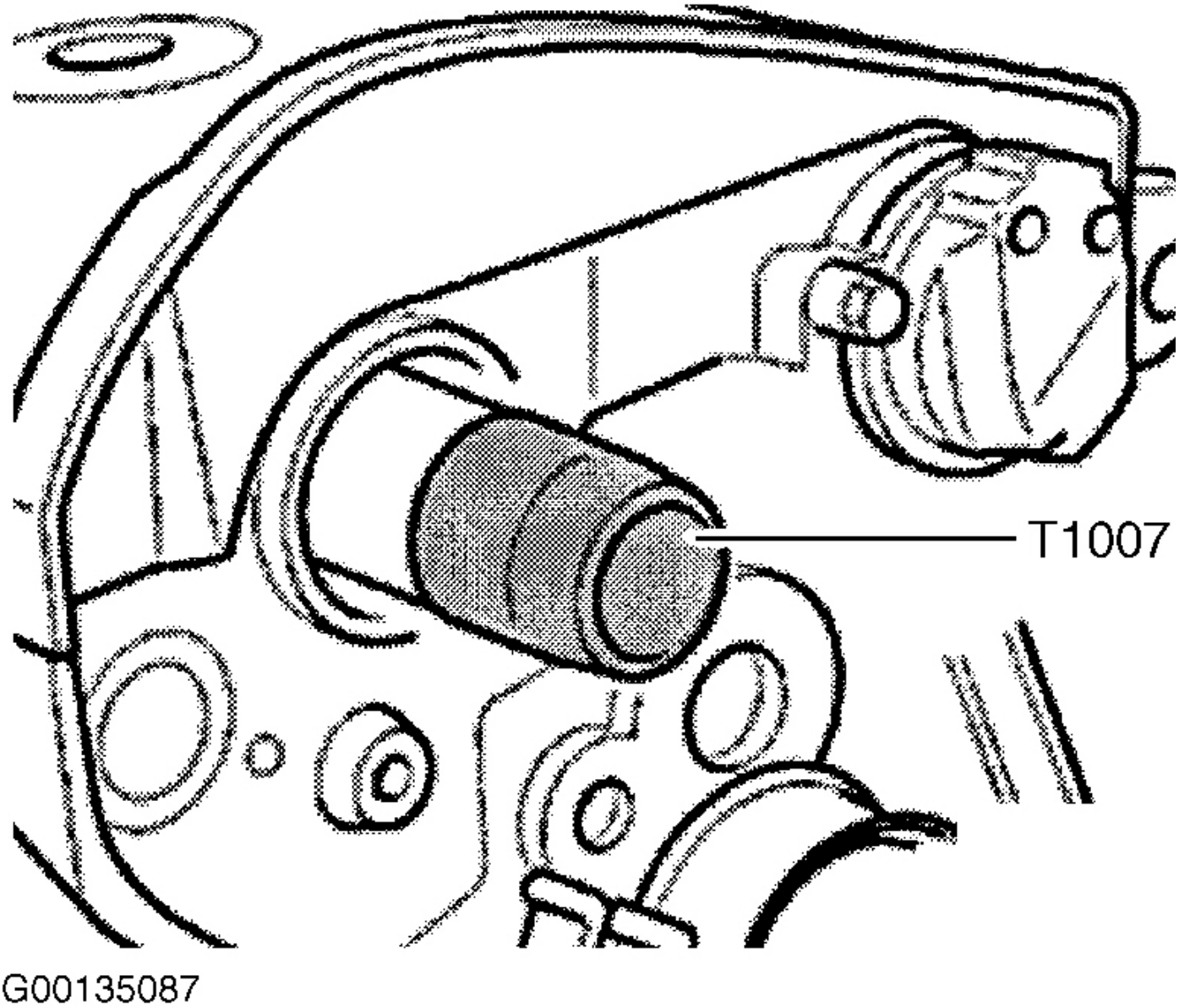

Fig. 85: Installing Guide Sleeve Tool (T10071/1) Over Camshaft Journal
Courtesy of VOLKSWAGEN UNITED STATES, INC.

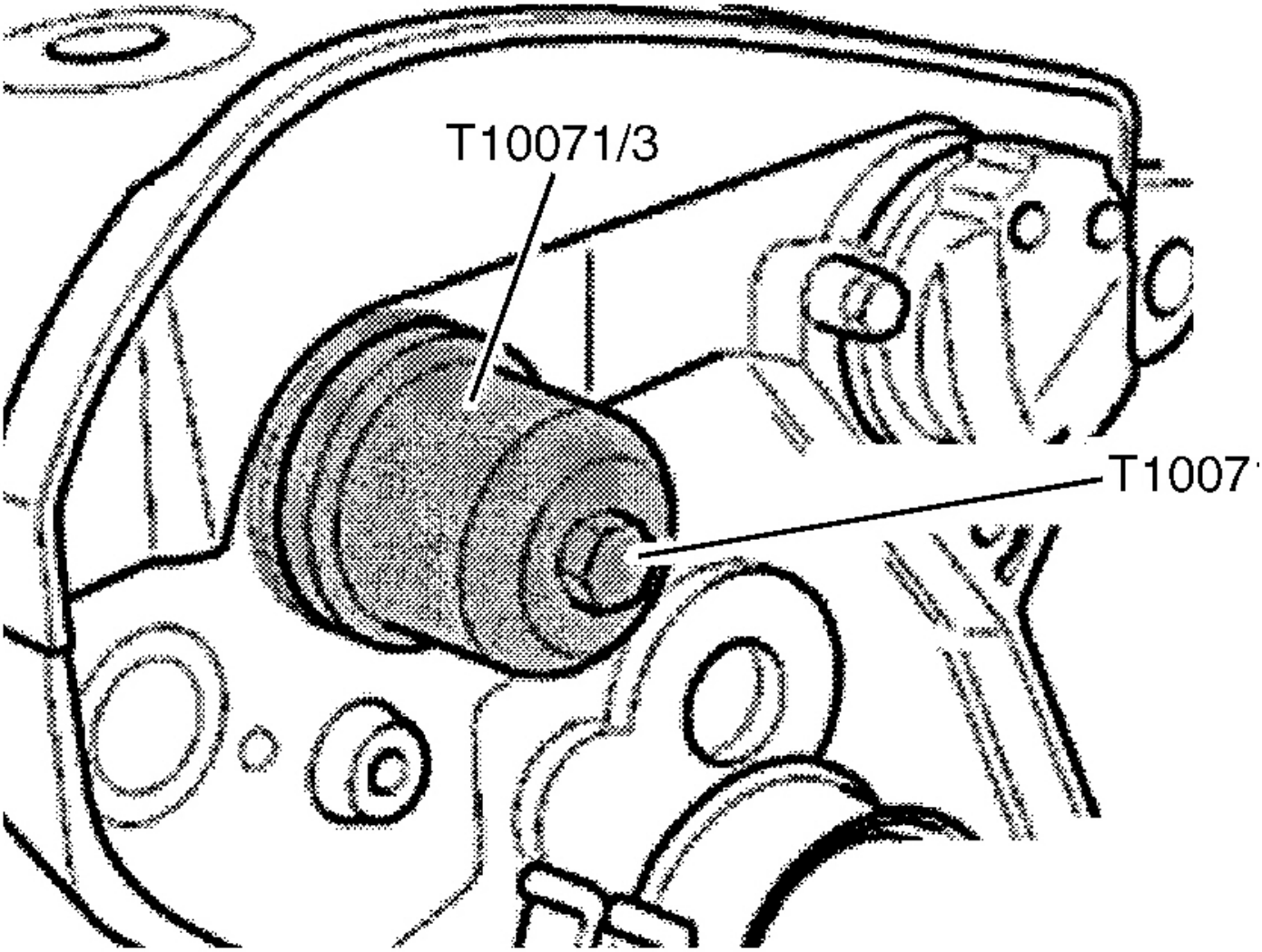

Fig. 86: Installing Cam Oil Seal Using Press Sleeve (T10071/3) & Bolt (T10071/4)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Removal (Intake Cam)

1. Remove upper timing belt cover. Disconnect Camshaft Position (CMP) sensor connector. See **Fig. 33** . Remove CMP sensor. Remove the CMP sensor shutter wheel (hood) bolt and washer. Remove CMP sensor shutter wheel.
2. Screw Adaptor (2058/1 bolt) into camshaft. See **Fig. 87** . Unscrew inner part of Oil Seal Extractor (2058) 2 turns (approx. 3 mm) out of outer part and lock with knurled screw. See **Fig. 88** .
3. Lubricate thread head of oil seal extractor, place it in position while applying firm pressure screw it as far as into oil seal. Loosen knurled screw and turn inner part of extractor against camshaft until oil seal has been extracted.

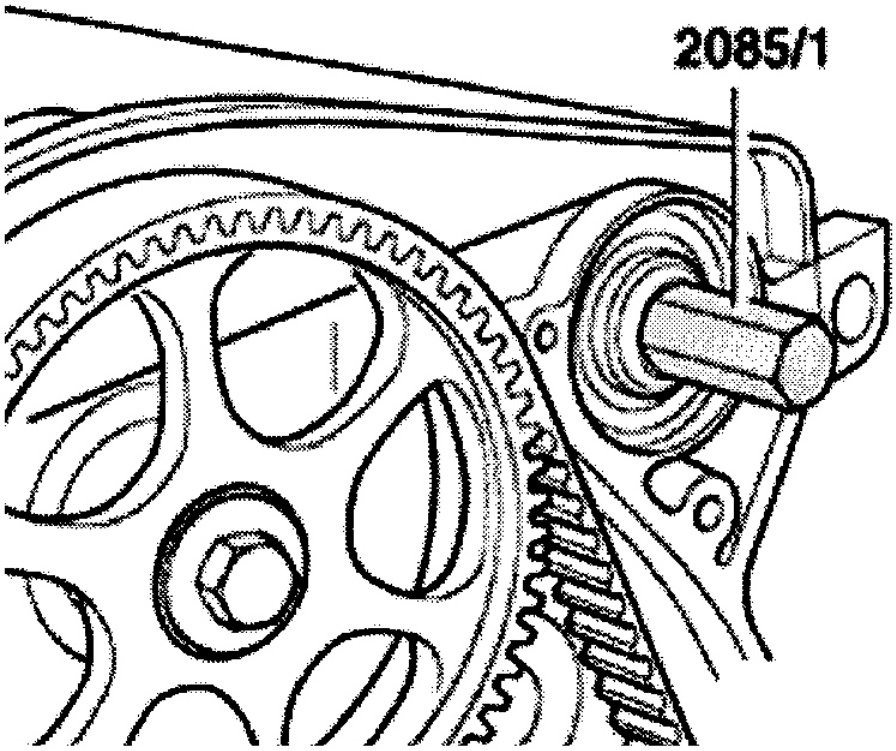

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Fig. 87: Installing Adaptor (2085/1) Into Intake Camshaft
Courtesy of AUDI OF AMERICA, INC.

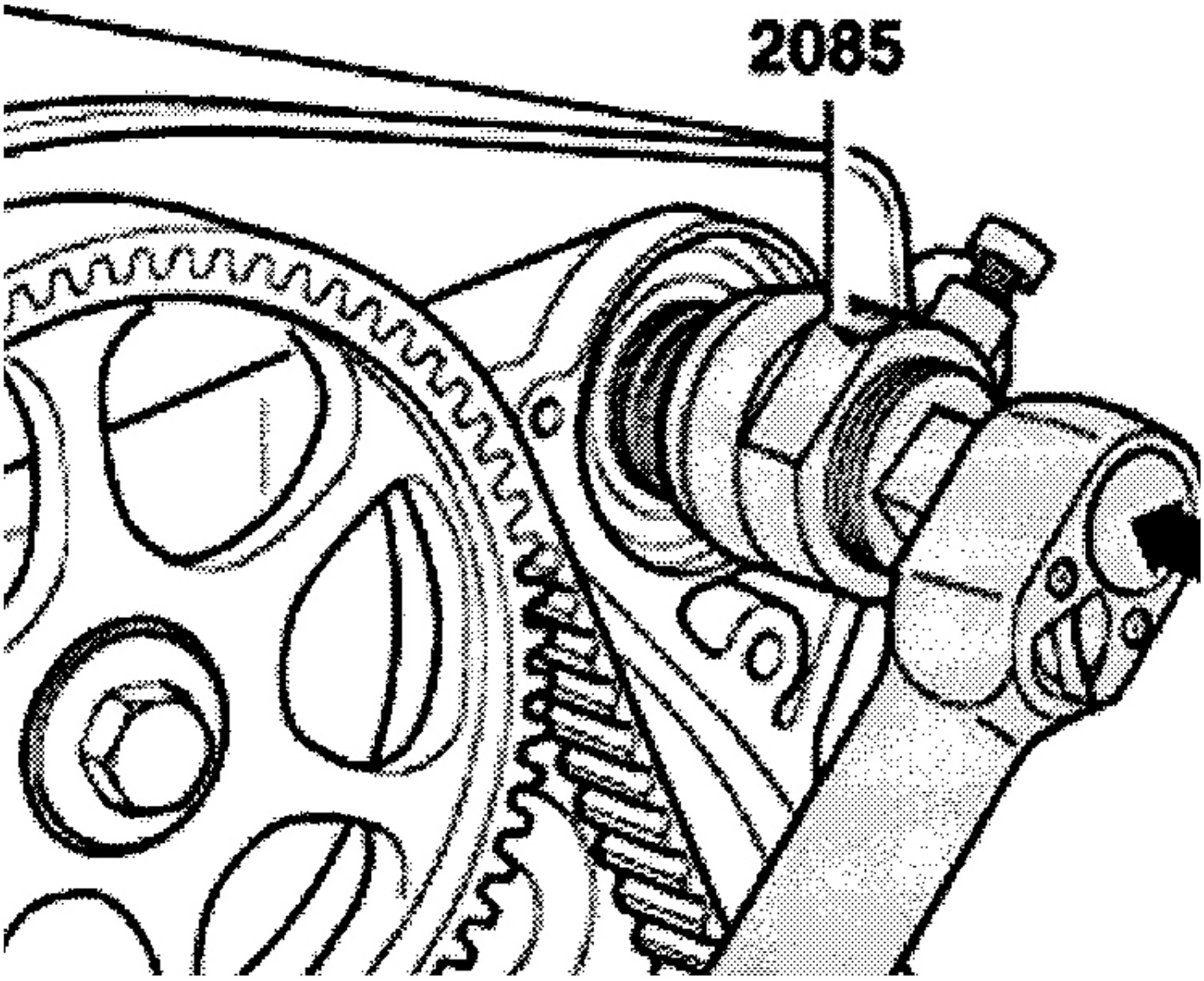

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Fig. 88: Installing Seal Puller (2085)
Courtesy of AUDI OF AMERICA, INC.

Installation (Annular Spring Seal Type)

NOTE: Gradual introduction of PTFE oil seal (identifying characteristics: no annular spring and sealing lip is wider). The sealing lip of this oil ring must not be oiled or lubricated. A plain encased seal of older construction (with annular spring) may be replaced with a PTFE oil seal, but not vice versa.

1. Coat new seal lip lightly with engine oil. DO NOT oil outer circumference of oil seal. Using Guide Sleeve (3241/2), slide seal until flush with head. See **Fig. 89** . Using Seal Installer with Press Sleeve (3241/1) and Bolt (3241/3), install new camshaft oil seal flush into cylinder head. See **Fig. 90** .
2. Install CMP sensor shutter wheel, washer and bolt. Ensure washer is installed with taper facing outward. Tighten shutter wheel bolt to specification. See **TORQUE SPECIFICATIONS** . Install CMP sensor and tighten CMP sensor bolts to specification. To complete installation, reverse removal procedure.

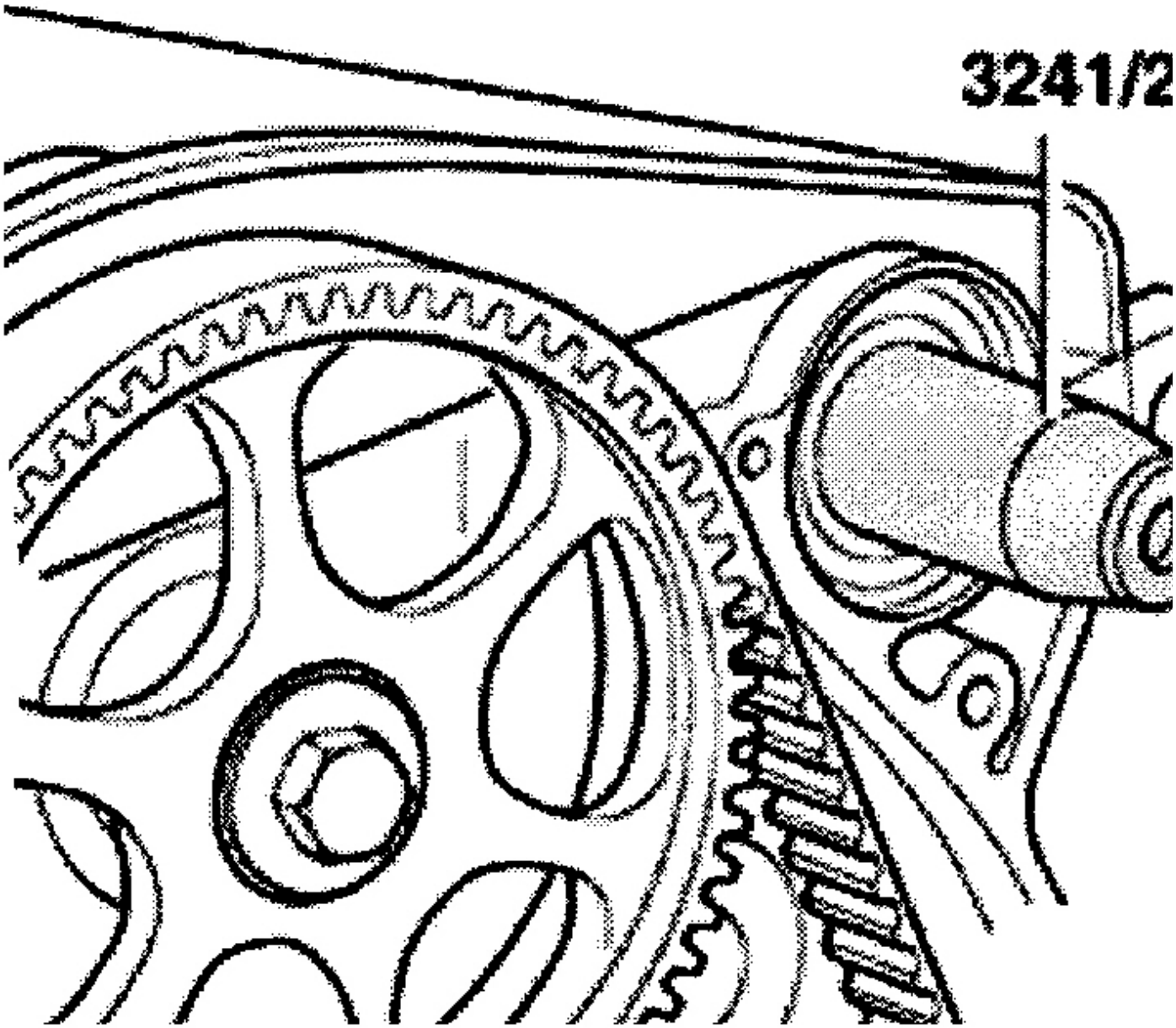

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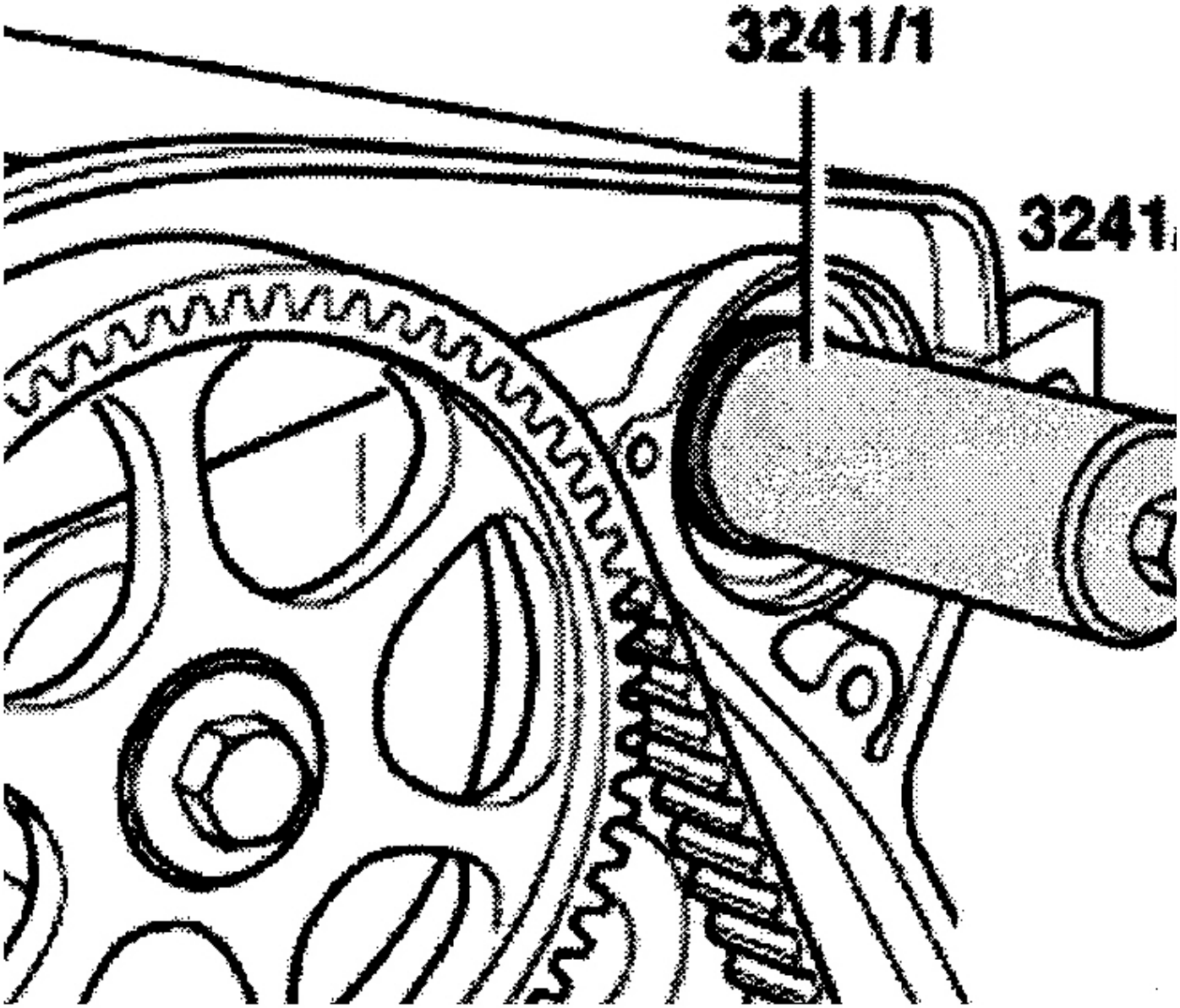
Fig. 89: Installing Guide Sleeve (3241/2) Over Intake Cam
Courtesy of AUDI OF AMERICA, INC.



G00115551

Fig. 90: Installing Seal Using Press Sleeve (3241/1) & Bolt (3241/3)
Courtesy of AUDI OF AMERICA, INC.

Installation (PTFE Seal Type)

NOTE: Gradual introduction of PTFE oil seal (identifying characteristics: no annular spring and sealing lip is wider). The sealing lip of this oil ring must not be oiled or lubricated. A plain encased seal of older construction (with annular spring) may be replaced with a PTFE oil seal, but not vice versa.

1. DO NOT lubricate NEW seal lip (install dry). DO NOT oil outer circumference of oil seal. Using Guide Sleeve (T10071/5), slide seal until flush with head. See **Fig. 91** . Using Seal Installer with Press Sleeve (T10071/3) and bolt (bolt size, M8 X 60), install new camshaft oil seal flush into cylinder head. See **Fig. 92** .
2. Install CMP sensor shutter wheel, washer and bolt. Ensure washer is installed with taper facing

outward. Tighten shutter wheel bolt to specification. See **TORQUE SPECIFICATIONS** . Install CMP sensor and tighten CMP sensor bolts to specification. To complete installation, reverse removal procedure.

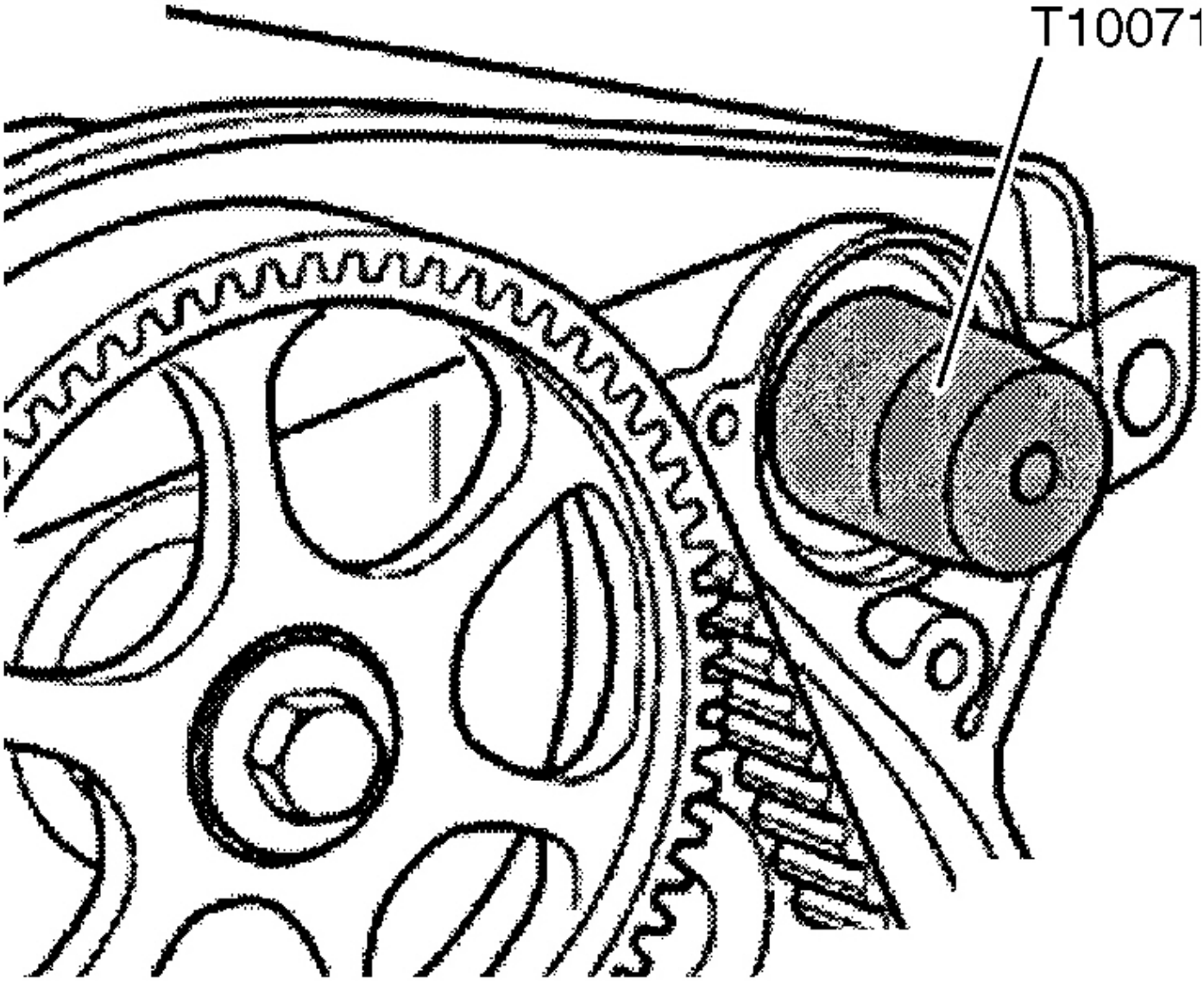


Fig. 91: Installing Guide Sleeve (T10071/5) Over Intake Camshaft Journal
Courtesy of VOLKSWAGEN UNITED STATES, INC.

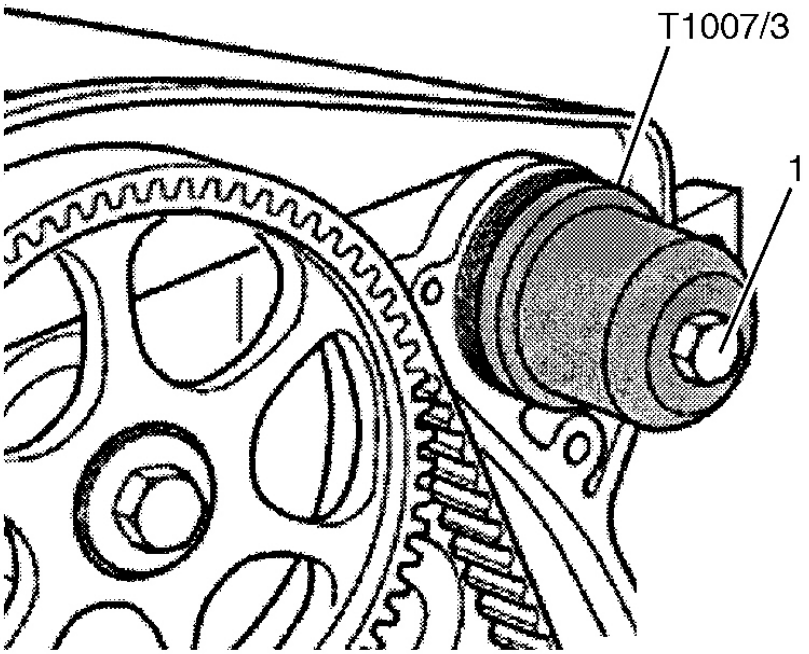


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Fig. 92: Installing Seal Using Press Sleeve (T10071/3) & Bolt (Bolt Size, M8 X 60)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

CRANKSHAFT REAR OIL SEAL

NOTE: Crankshaft rear oil seal cannot be serviced separately. Crankshaft rear oil sear and flange are serviced as an assembly.

NOTE: For help in identifying components and component locations, refer to illustration. See Fig. 66 .

Removal & Installation

1. Remove transaxle. For M/T, see appropriate article in CLUTCHES. For A/T, see appropriate TRANSMISSION REMOVAL & INSTALLATION article in TRANSMISSION SERVICING. Remove drive plate (A/T) or dual-mass flywheel (M/T).
2. Remove oil pan. See **OIL PAN** . Remove crankshaft oil seal flange bolts and remove flange with oil seal. Lightly oil lip with clean engine oil. Install NEW oil seal with flange using supplied sleeve. Tighten crankshaft oil seal flange bolts to specification. See **TORQUE SPECIFICATIONS** .

WATER PUMP

Removal & Installation

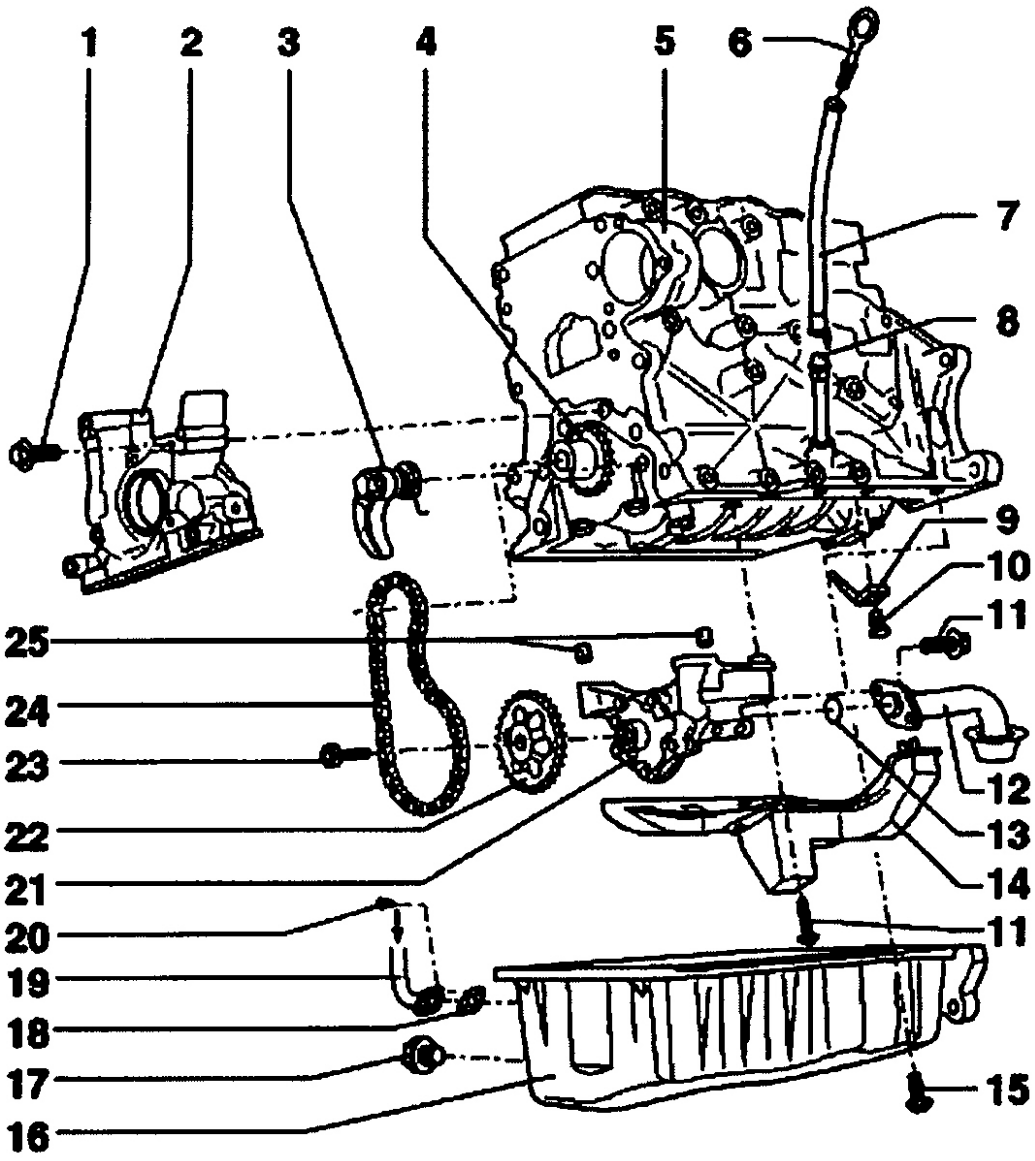
Removal of water pump requires removal of timing belt. See **TIMING BELT** . With timing belt removed from water pump, remove fasteners and pull water pump (21) away from block. Clean sealing surface. Install NEW seal (O-ring). See **Fig. 11** . To complete installation, reverse removal procedure. Tighten bolts to specification. See **TORQUE SPECIFICATIONS** . Fill and bleed cooling system. See **COOLING SYSTEM BLEEDING** .

OIL PAN

NOTE: For help in identifying components and component locations, refer to illustration. See Fig. 93 .

Removal & Installation

1. Remove center engine shield and right insulation tray (noise insulators). See **Fig. 9** or **Fig. 10** . Drain engine oil. Remove oil pan bolts. Remove oil pan, to loosen pan, tap lightly with a rubber hammer. Remove old sealant from block using a flat scraper. Using a plastic wheel remove old sealant from oil pan mating surface, ensure mating surfaces is not damaged during cleaning. See **Fig. 94** .
2. Apply Silicone Sealant (D 176 404 A2) in a 0.1" (3 mm) bead along flange mating surface. See **Fig. 95** . Place oil pan against block, ensure pan is flush with block. Tighten oil pan bolts to specification. See **TORQUE SPECIFICATIONS** .
3. Allow 30 minutes for sealant on oil pan to dry before adding oil to engine. To complete installation, reverse removal procedure.



1. 15 Nm (11 ft lbs)

2. Sealing Flange
   - ◆Insert With Silicone Sealant D 176 404 A2

3. Chain Tensioner With Tensioning Rail, 15 Nm (11 ft lbs)
   - ◆When Installing, Pretension Spring And

5. Cylinder Block

6. Dipstick

7. Guide
   - ◆Pull off to extract oil

8. Guide Tube

9. Oil Spray Jet

10. Pressure Relief Valve, 27 Nm (19 ft lbs)

11. 15 Nm (11 ft lbs)

13. O-Ring

14. Baffle Plate

15. 15 Nm (11 ft lbs)
   - ◆Loosen and tighten with T-bar and socket 10 mm (3185)
   - ◆Remove With Hexagon

16. Oil Pan
   - ◆Install with silicone sealant D 176 404 A2

17. Oil Drain Plug, 30 Nm (22 ft lb

18. Seal
   - ◆Replace

19. Oil Return Pipe
   - ◆From turbocharg

20. 10 Nm (7 ft lbs

21. Oil Pump
   - ◆With positive pressure valve, 12 bar
   - ◆Before installing, check that both dowe sleeves fo centering pump/ cyl head are installed
   - ◆Replace if running surfaces and gears are scored

22. Chain Sprocket

23. 25 Nm (18 ft l

24. Chain
   - ◆Mark direction of

Fig. 93: Identifying Location Of Oil Pan & Oil Pump With Related Components
Courtesy of VOLKSWAGEN UNITED STATES, INC.

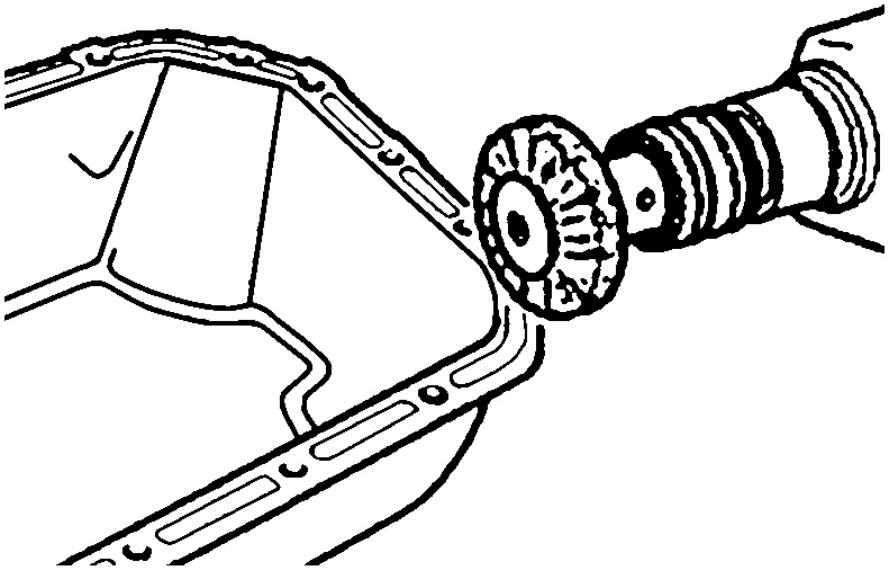


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Fig. 94: Cleaning Sealing Mating Surface Using Plastic Wheel
Courtesy of VOLKSWAGEN UNITED STATES, INC.

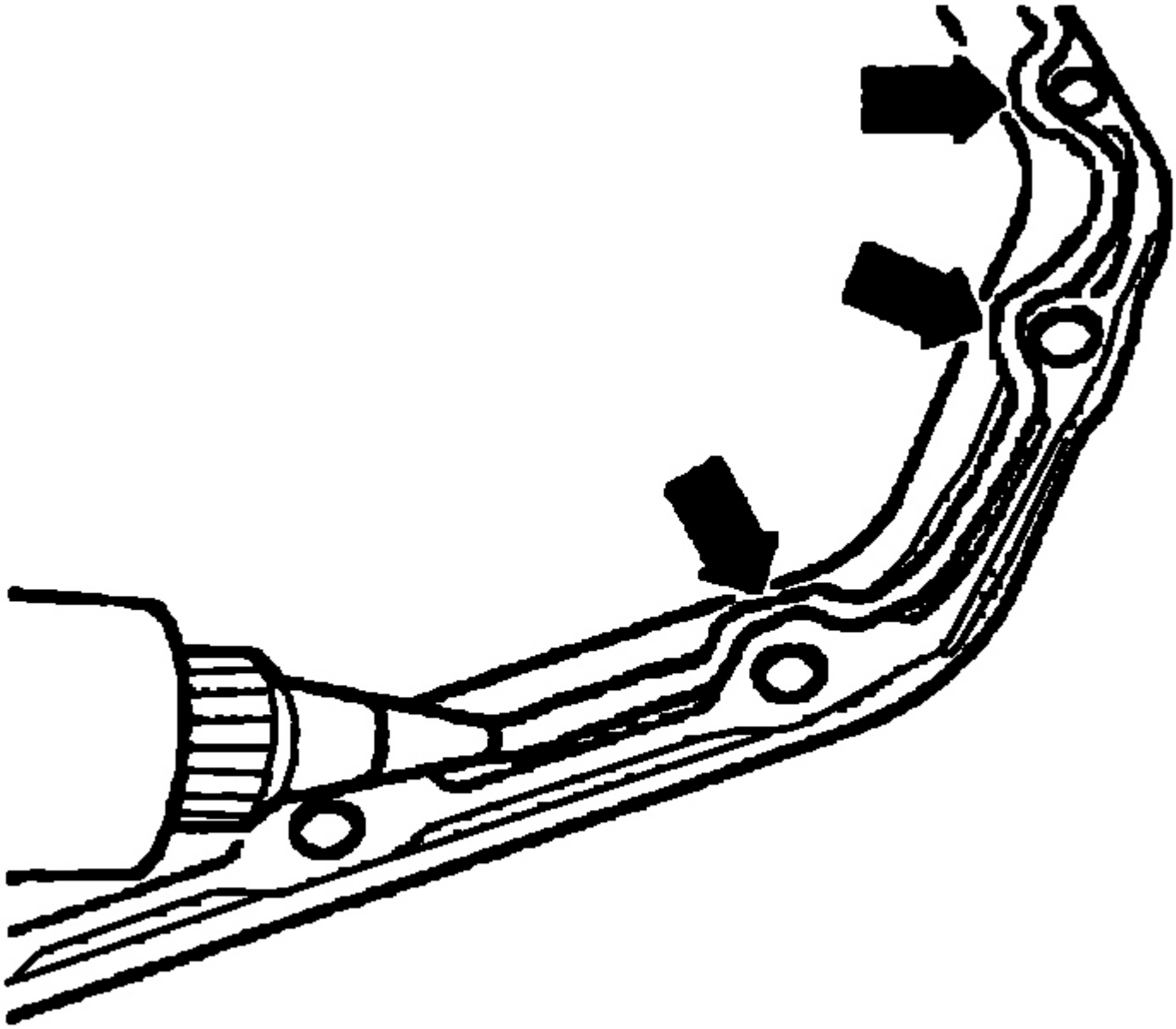

Fig. 95: Apply Sealant (D 176 404 A2) To Oil Pan
Courtesy of VOLKSWAGEN UNITED STATES, INC.

OVERHAUL

CAUTION: DO NOT start engine for about 30 minutes after installing camshafts. Hydraulic valve lifters must bleed down or valves may strike pistons. Rotate crankshaft by hand 2 full revolutions before starting engine to ensure valves do not strike pistons.

CYLINDER HEAD

Cylinder Head Resurfacing

Measure cylinder head warpage, measure at several points along gasket surface using straight edge and feeler gauge. See **Fig. 96** . If warpage exceeds specification, machine cylinder head. See **CYLINDER**

HEAD table under ENGINE SPECIFICATIONS. If machining causes cylinder head height to be less than specification, replace cylinder head. When checking dimensions for cylinder head height, measure at (A) through the holes for the head bolts. See **Fig. 97** .

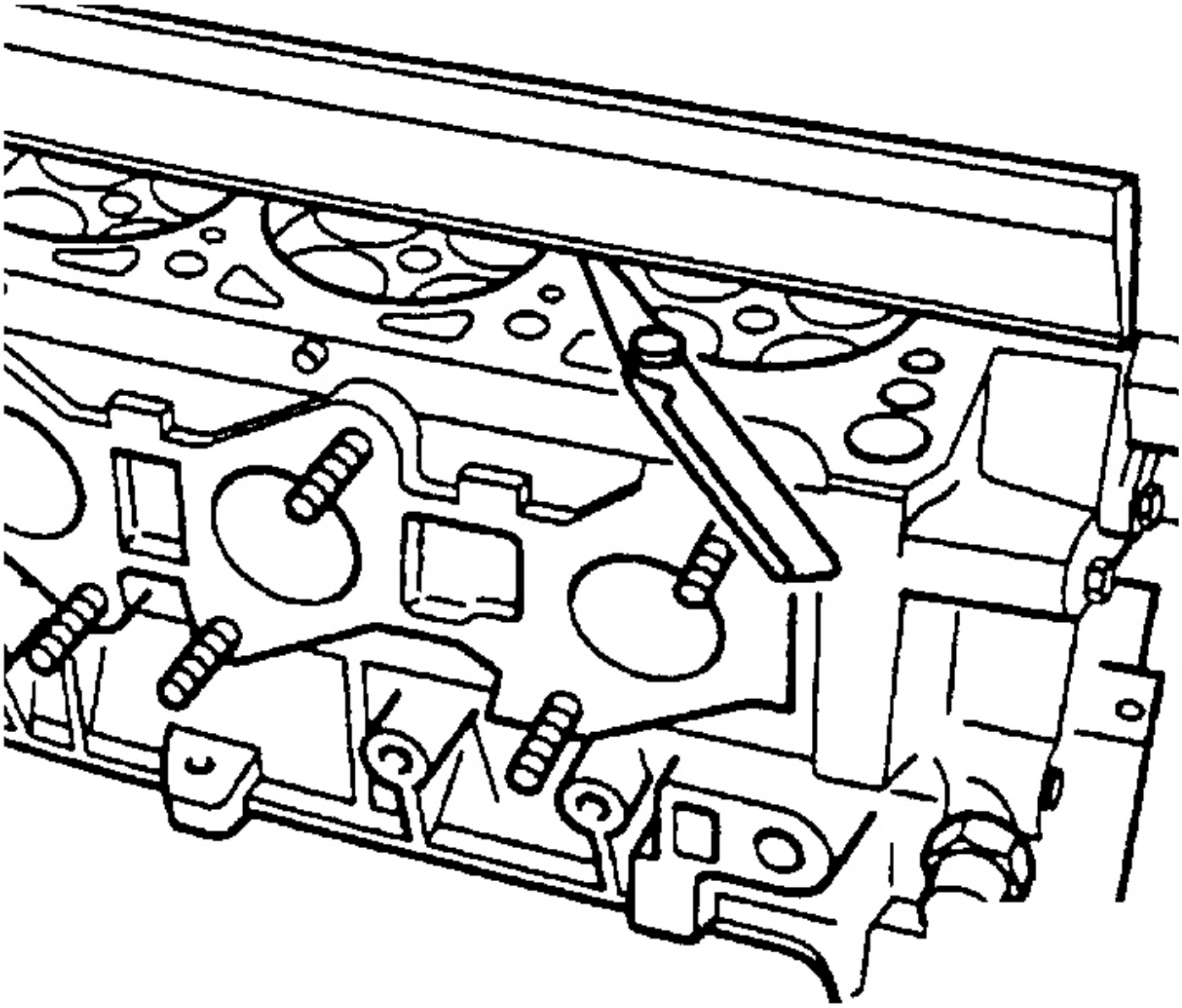

Fig. 96: Checking Cylinder Head For Warpage
Courtesy of VOLKSWAGEN UNITED STATES, INC.

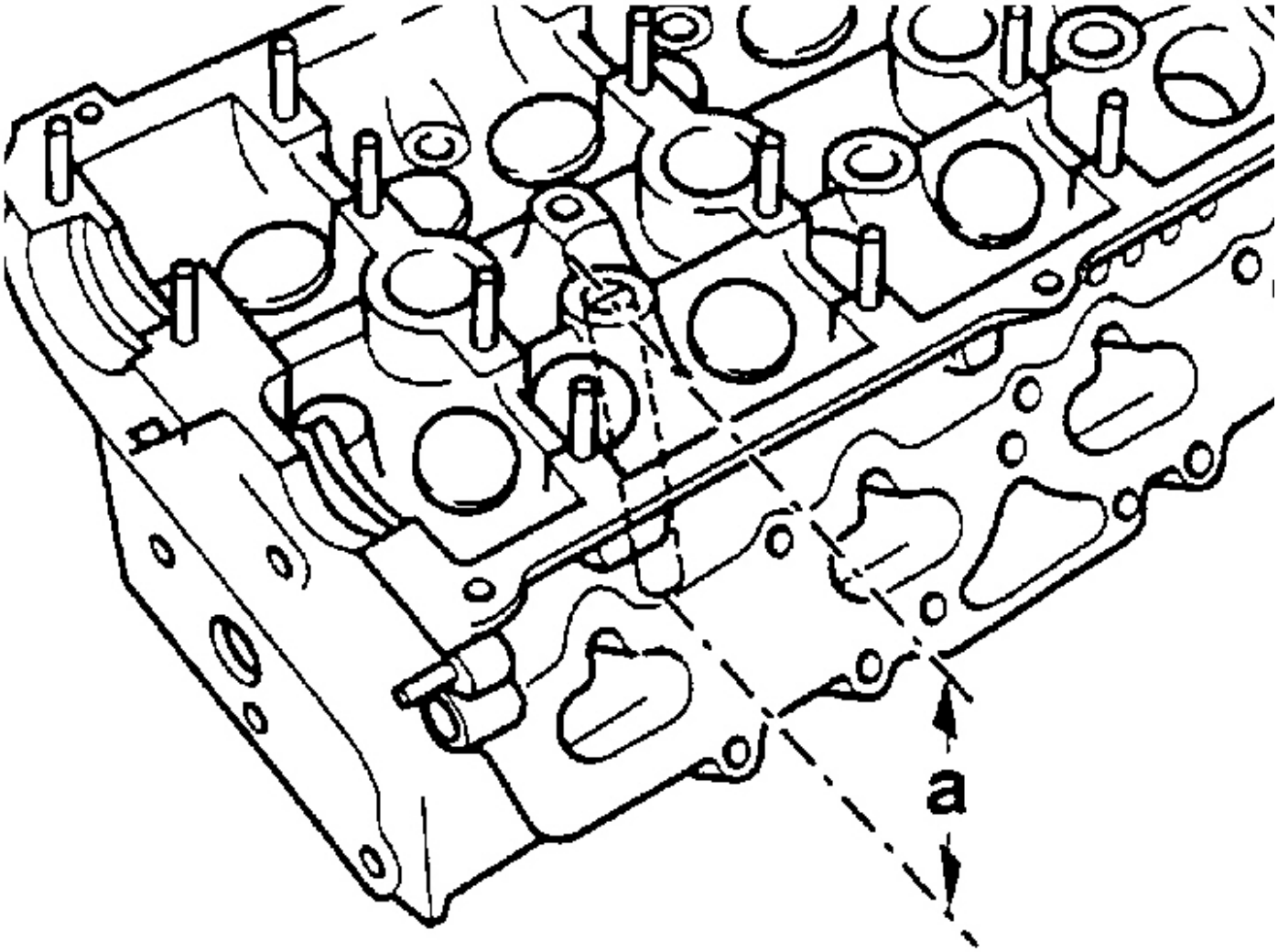

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Fig. 97: Checking Cylinder Head Height
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Valve Guide Checking

NOTE: Intake valve stem diameter differs from exhaust valve stem diameter. Use appropriate valve when measuring valve guide wear.

1. To measure valve guide wear, attach dial indicator to cylinder head. Insert valve into guide until valve stem tip is even with top end of guide.
2. Lightly push edge of valve head against dial indicator tip. Zero dial indicator. Push valve away from dial indicator, in direction opposite of camshaft axis. Note dial indicator reading.
3. If deflection does not exceed specification, guide is okay. See **CYLINDER HEAD** table under ENGINE SPECIFICATIONS. If deflection exceeds specification, recheck using new valve. If deflection still exceeds specification, replace cylinder head. See **Fig. 98** .

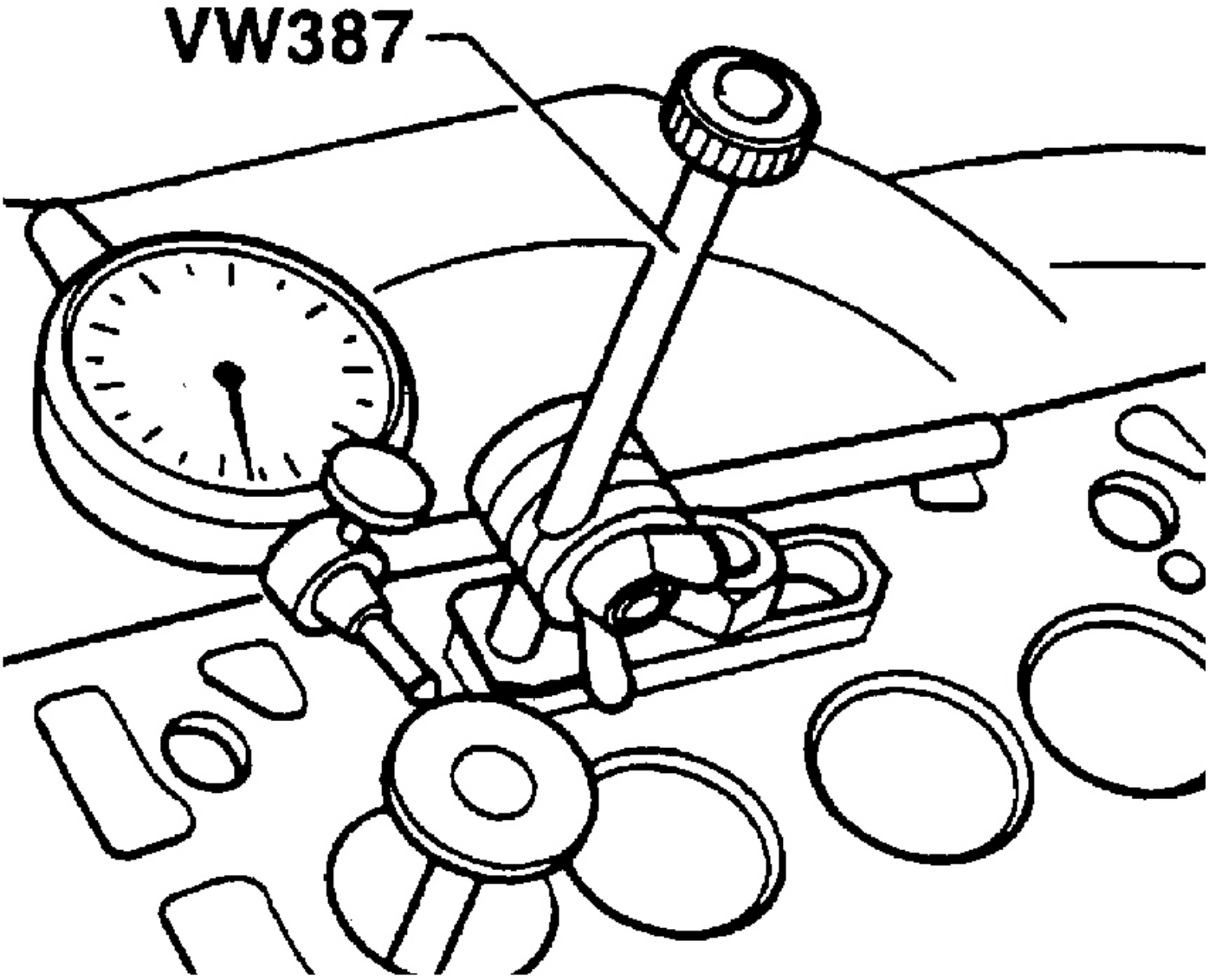

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Fig. 98: Checking Valve Guide Wear
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Valve Guide Removal

Hand lap valves and check sealing. Also check cylinder head sealing surface can be refaced. If a problem is found in either case, valve guides should not be replaced. See **VALVE GUIDE CHECKING** . After checking valve guide wear, if deflection still exceeds specification, replace cylinder head.

Valves Stem Seals Replacement (Head Installed)

1. Remove camshafts. See **CAMSHAFTS** under REMOVAL & INSTALLATION.
2. Remove valve lifters and place them with contact surface downward. During removal make sure lifters are not interchanged.
3. Remove spark plugs with Spark Plug Removal Tool (3122B).
4. Set piston of relevant cylinder to Bottom Dead Center (BDC).

5. Screw VW Pressure Hose (653/3) into spark plug thread. See **Fig. 99** .
6. **NOTE: DO NOT remove valve springs at this time.**

   Secure (3362) valve spring compressor to cylinder head with tool securing bolt and position installing tool for compressing valve springs to following positions. Outer intake valves to the lower position, center intake valve to the upper position and exhaust valve to the lower position. See **Fig. 99** .
7. Connect pressure hose to compressed air system supplying at least 6 bar (87 psi) and remove valve springs.
8. Remove valve stem seals with Puller (3364) for valve shaft seal. See **Fig. 100** .

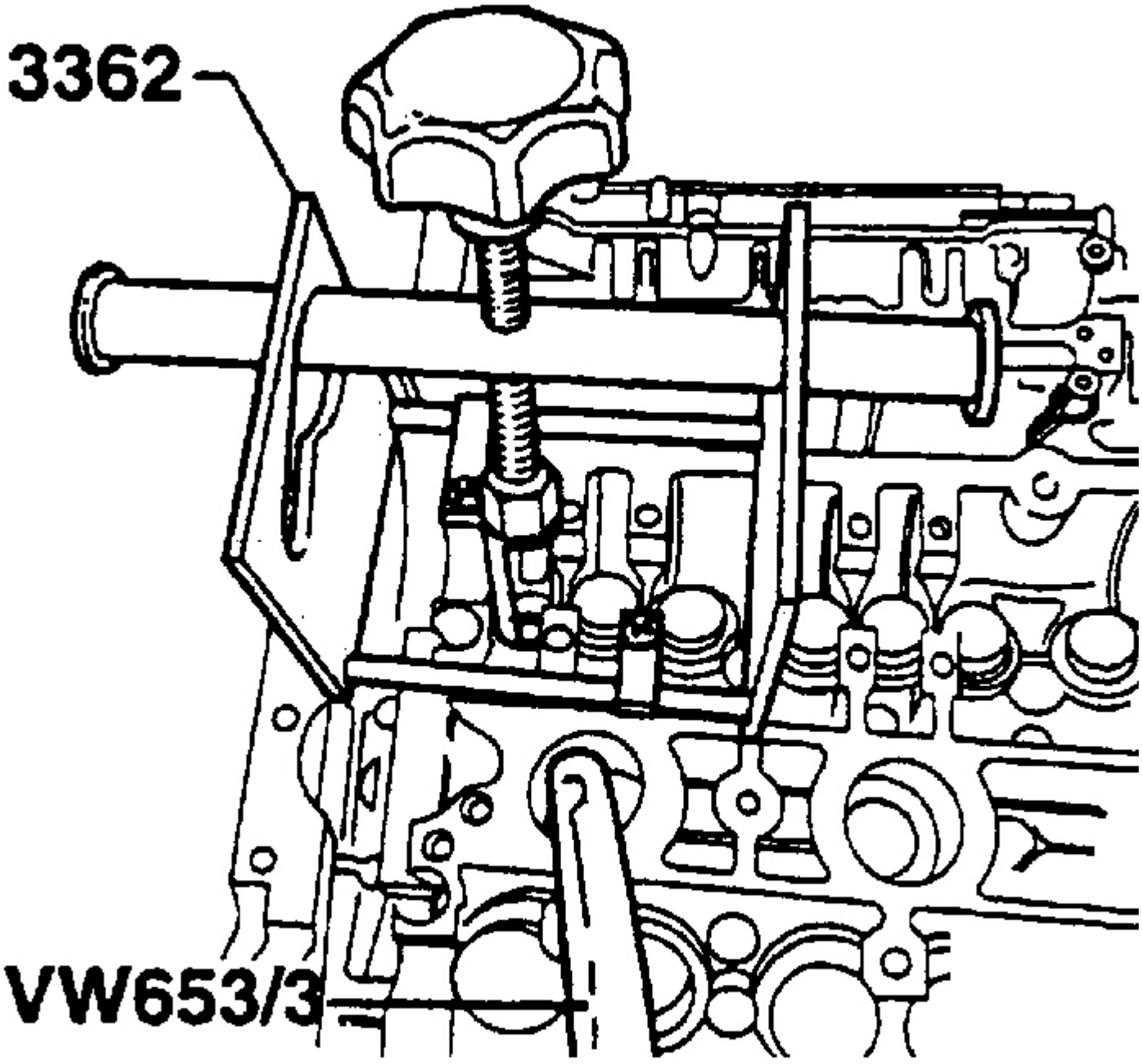

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Fig. 99: Installing Air Pressure Hose (653/3) Into Spark plug Hole & Valve Spring Compressor (3362) Onto Cylinder Head
Courtesy of VOLKSWAGEN UNITED STATES, INC.

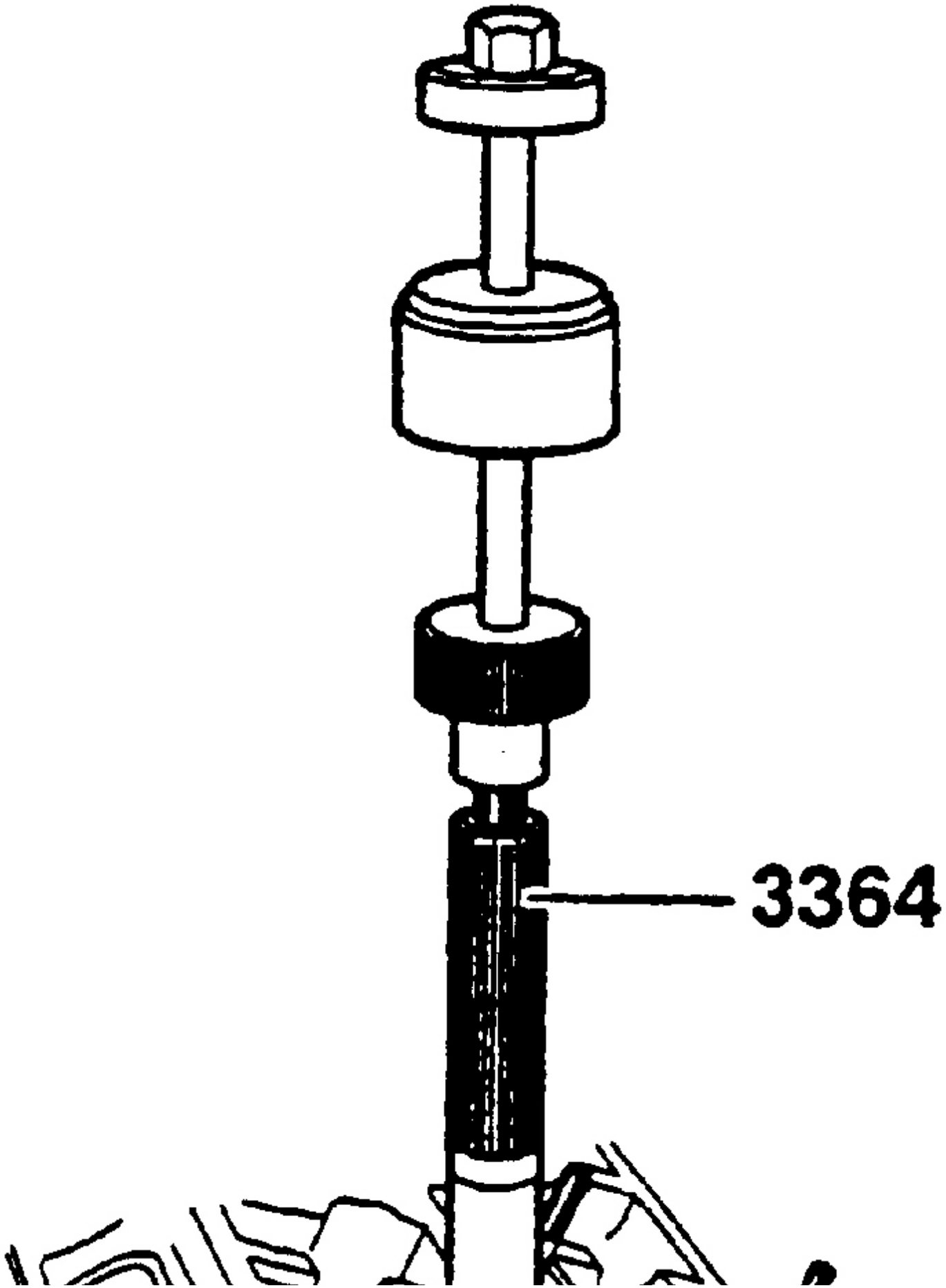

Fig. 100: Identifying Valve Stem Seal Puller (3364)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Installing Valves Stem Seals

1. Slide plastic sleeve (A) supplied over relevant valve stem. This will prevent the new valve stem seal (B) from being damaged. See **Fig. 101** .
2. Place new valve stem seal into Installation Tool (3365).
3. Oil valve stem seal sealing lip and press carefully onto the valve guide. See **Fig. 101** . The assembly is basically a reverse of the dismantling sequence.

CAUTION: DO NOT start engine for about 30 minutes after installing camshafts. Hydraulic valve lifters must bleed down or valves may strike pistons. Rotate crankshaft by hand 2 full revolutions before starting engine to ensure valves do not strike pistons.

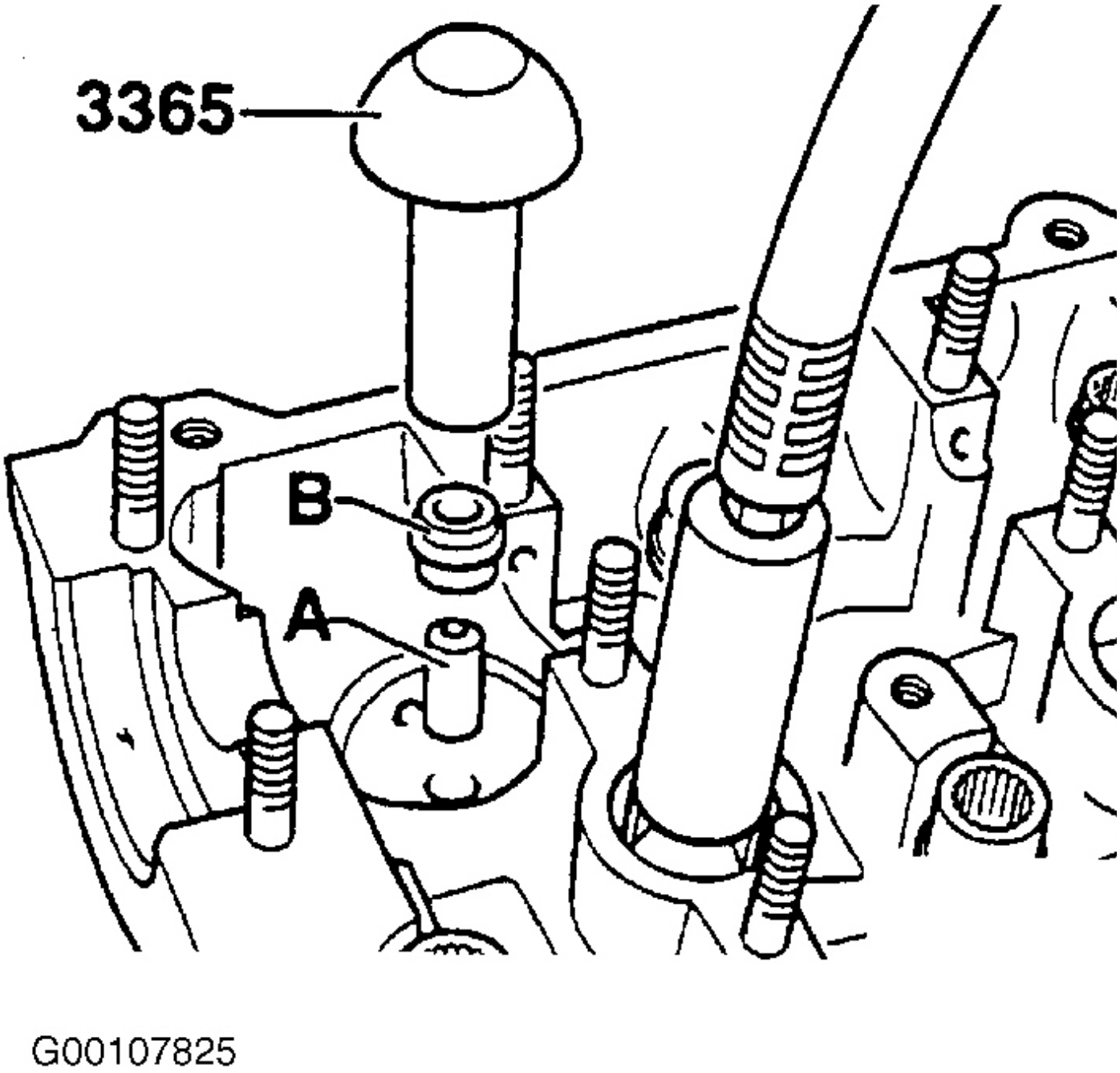

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Fig. 101: Identifying Plastic Sleeve Placement, Valve Stem Seal & Installation Tool (3365)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Valve Seats

When repairing engines with leaking valves, it is not sufficient to replace or renew valve seats and valves. It is also necessary to check the valve guides for wear. This is particularly important on high mileage engines. The valve seats should only be refaced just enough to produce a perfect seating pattern. The maximum permissible refacing dimension must be calculated before beginning refacing. If the refacing dimension is exceeded, the function of the hydraulic valve lifters can no longer be guaranteed and the cylinder head should be replaced. If the valve is to be replaced as part of a repair, use a new valve for the calculation.

1. Insert valve into guide. Press valve tightly against valve seat. Lay a straightedge across top of cylinder head. Measure distance between valve stem tip and bottom of straightedge. See **Fig. 102** . This is

valve installed height. If a new valve is going to be installed, use new valve to make this measurement.

2. This measurement determines installed valve height. Subtract measured distance from minimum specification. See **MINIMUM VALVE INSTALLED HEIGHT** table. If valve installed height is too low or too high, cam followers will not work correctly. If valve stem height is less than 31.339" (4.0 mm) on intake valve (outer), 31.327" (3.7 mm) intake valve (center), or 1.354" (34.4 mm) on the exhaust valve, install a new valve and measure again. See **Fig. 103** .
3. If valve stem height measurement is still less than specification, replace cylinder head. If valve stem height exceeds specification, seat can be machined; however, DO NOT machine enough material away from seat to cause valve stem height to be less than minimum specification.

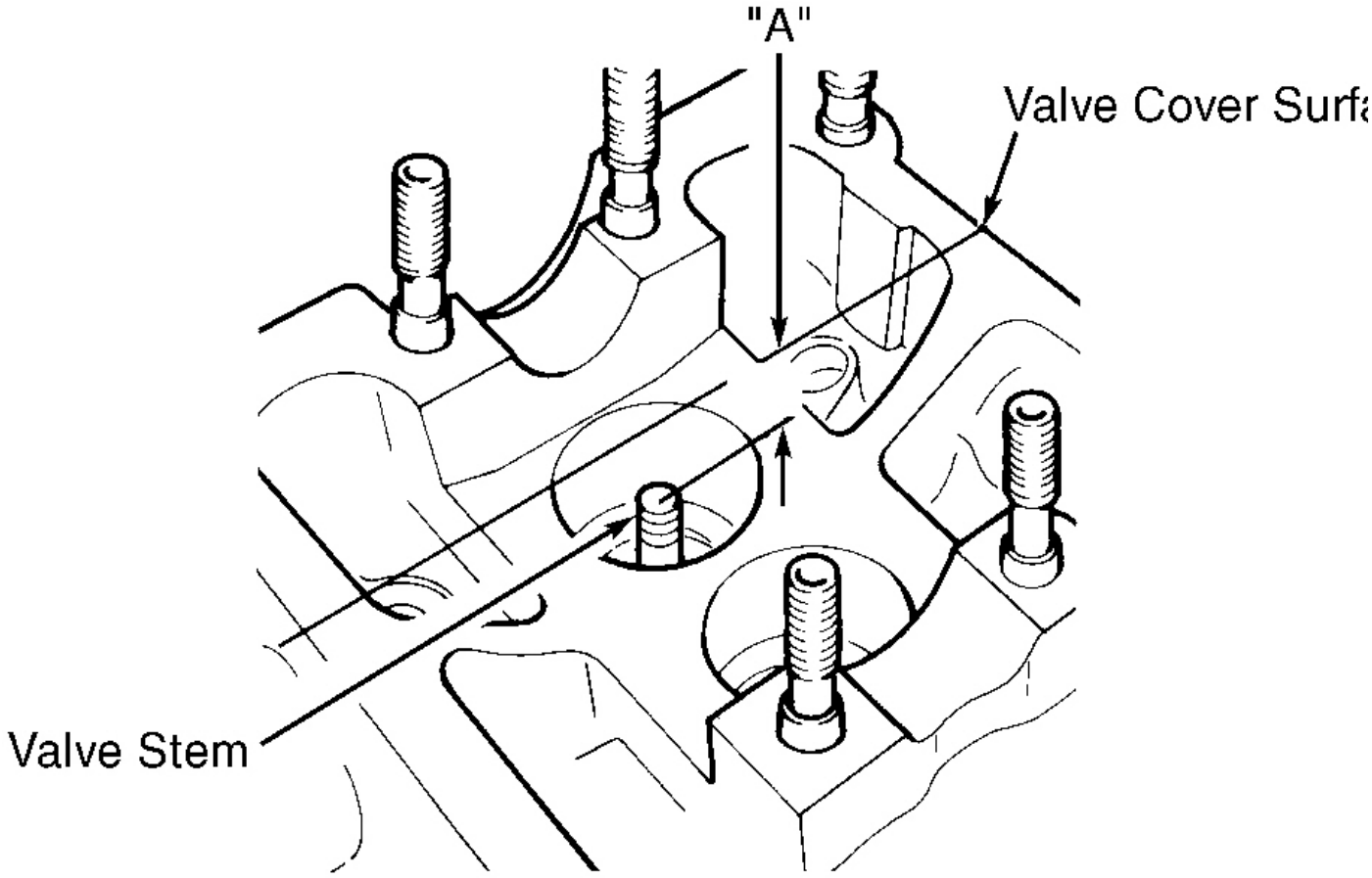
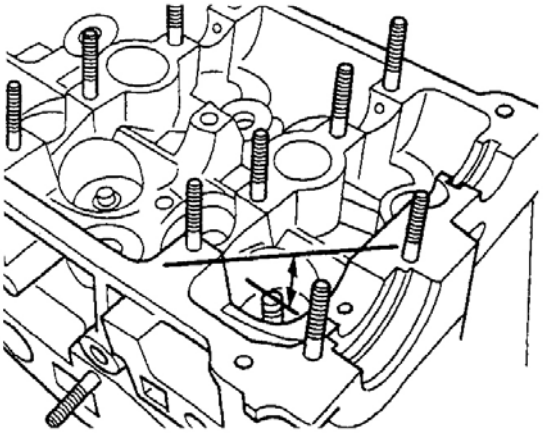


Fig. 102: Measuring Valve Installed Height
Courtesy of VOLKSWAGEN UNITED STATES, INC.

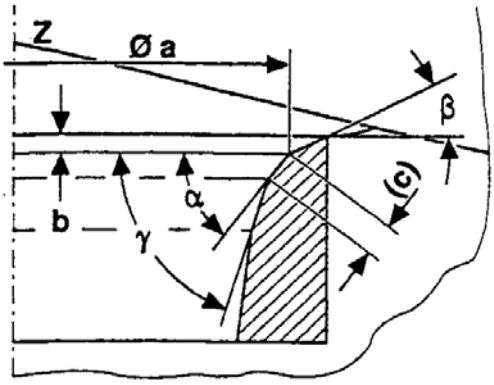


Measured distance minus minimum dimension = max. permissible refacing dimension.

Example:

Measured distance	mm (in.)	34.4 (1.354)
– Minimum dimension	mm (in.)	34.0 (1.339)
= max. perm. reface dimension*	mm (in.)	0.4 (0.016)

*) The max. permissible refacing dimension is shown on illustrations for reworking valve seats as dimension "b".



◄ **Refacing inlet valve seat**

a = 26.2 mm (1.031 in.) diameter
b = Max. permissible refacing dimension*
c = 1.5–1.8 mm (0.0394–0.1063 in.)
Z = Cylinder head lower edge
α = 45° valve seat angle
β = 30° upper correction angle
γ = 60° lower correction angle

Refacing exhaust valve seat

a = 29.0 mm (1.142 in.) diameter
b = Max. permissible refacing dimension*
c = Approx. 1.8 mm (0.1063 in.)
Z = Cylinder head lower edge
α = 45° valve seat angle
β = 30° upper correction angle
γ = 60° lower correction angle

*) Calculating max. permissible refacing dimen
See Example:

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Fig. 103: Calculating Stem Height & Valve Seat Refacing Dimension
Courtesy of VOLKSWAGEN UNITED STATES, INC.

MINIMUM VALVE INSTALLED HEIGHT

Application	In. (mm)
Intake Valve	
Outer	1.370 (34.0)
Center	1.326 (33.70)
Exhaust Valve	1.354 (34.40)

VALVE TRAIN

Lifters (Cam Followers)

CAUTION: If lifters are charged with oil, allow 30 minutes to bleed down before starting engine. Pistons may strike valves, resulting in bent valves.

CAUTION: DO NOT start engine for about 30 minutes after installing camshafts. Hydraulic valve lifters must bleed down or valves may strike pistons. Rotate crankshaft by hand 2 full revolutions before starting engine to ensure valves do not strike pistons.

Test lifters, see **HYDRAULIC VALVE ADJUSTERS** under ADJUSTMENTS. If lifter(s) can be pushed down more than .008" (.20 mm), replace lifters.

Camshaft Axial Play

Measure camshaft axial play (intake and exhaust) with lifter and camshaft chain removed. Camshaft bearing caps No. 2. and No. 4. installed. Remove all other caps, note their locations for reassemble. See **Fig. 104** . Maximum wear limit .008" (.20 mm). See **Fig. 105** .

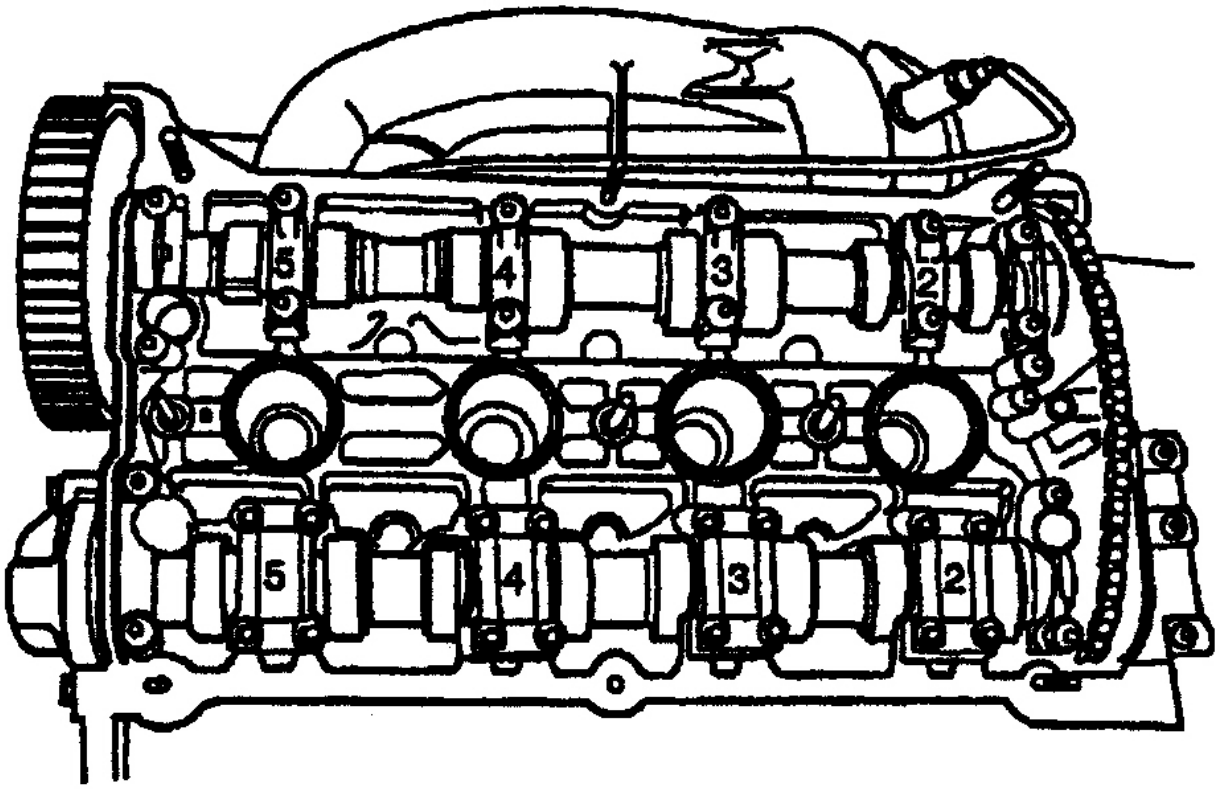

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Fig. 104: Identifying Camshaft Bearing Caps
Courtesy of VOLKSWAGEN UNITED STATES, INC.

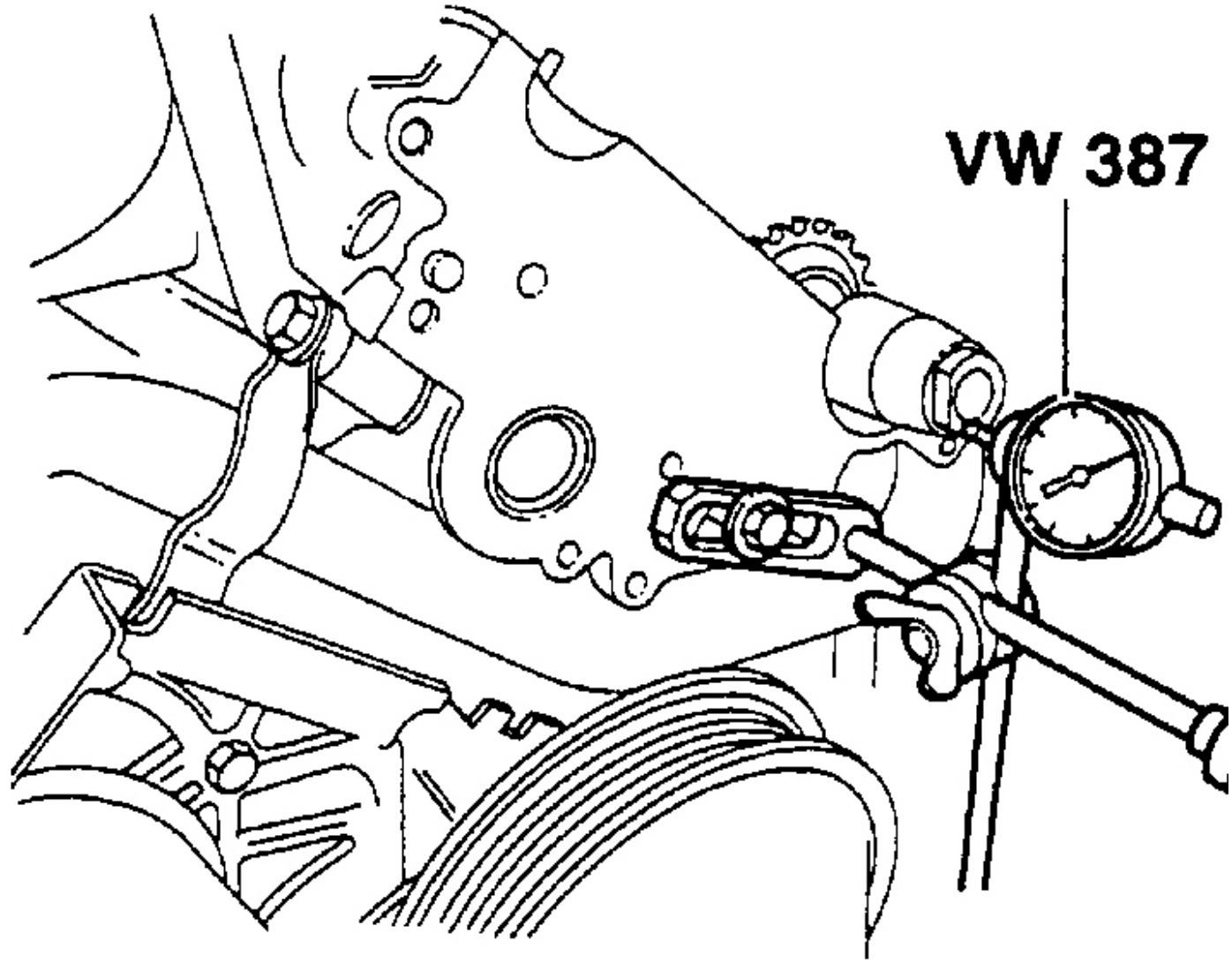

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Fig. 105: Checking Camshaft Axial Play
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Valves

WARNING: Sodium-filled exhaust valves must not be disposed of until they have been properly treated as follows: By HAND (no air tools), saw the valves into two sections using a metal saw at a point between the center of the valve stem and the valve head. The valves must not come into contact with water when this is done. Throw the valves into a bucket of water (not more than ten at a time) and step back. A sudden chemical reaction will occur during which the sodium filling burns. After this treatment the valves can be disposed of as normal scrap.

Measure valve stem diameter and valve margin. If not within specification, replace valves. Replace as necessary. See **VALVES & VALVE SPRINGS** table under ENGINE SPECIFICATIONS.

Valves must not be refaced by grinding. Hand lap only. If lapping does not produce proper sealing, check

valve seat. See **VALVE SEATS** .

Valve Springs

Information is not available from manufacturer.

CYLINDER BLOCK ASSEMBLY

Piston & Rod Assembly

1. Ensure piston, connecting rod and rod caps are marked with matching cylinder number prior to removal. Ensure engine front arrow is marked on top of piston and front mark "A" exists on rod and cap. See **Fig. 106** . Pistons and rods are to be replaced in sets of 4. Rod cap bolts and nuts must be replaced after removing or loosening.

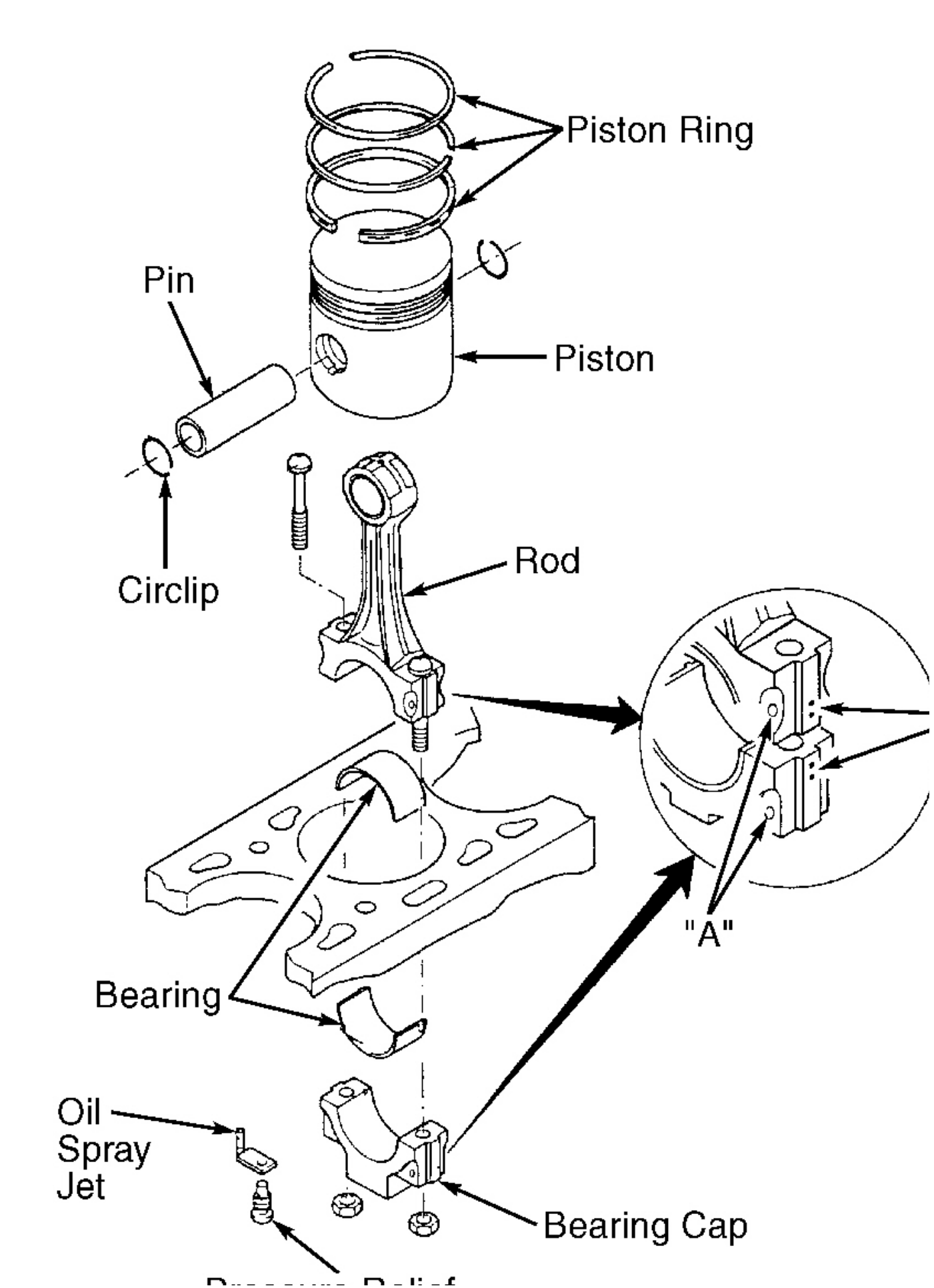

Fig. 106: Assembling Piston & Rod
Courtesy of VOLKSWAGEN UNITED STATES, INC.

2. Mark piston in relation to pin. Remove circlips from ends of pin bore. Use Piston Pin Replacer/Installer (VW 222A) to remove and install piston pin. If pin is too tight, heat piston to 140°F (60°C). Ensure rod is properly positioned with piston. See **Fig. 106** .

Fitting Pistons

Measure clearances with cylinder block supported on work bench. Check clearance of piston-to-cylinder bore. Piston diameter is stamped on top of piston in millimeters. See **PISTON-TO-CYLINDER BORE DIMENSIONS** .

PISTON-TO-CYLINDER BORE DIMENSIONS

Size	Piston Diameter (1)	Cylinder Bore
Standard	3.187" (80.96 mm)	3.189" (81.01 mm)
1st Oversize	3.207" (81.46 mm)	3.209" (81.51 mm)

(1) Measurement does not include graphite coating, thickness of .0008" (.02 mm). Graphite coating wears away.

Piston Rings

Install piston ring with TOP mark (if present) facing upward. Insert ring from bottom of cylinder block to a depth of about .591" (15 mm) and measure ring end gap. See **Fig. 107** . Measure ring side clearance with piston. See **Fig. 108** . If not within specification, replace as necessary. See **PISTONS, PINS & RINGS** table under ENGINE SPECIFICATIONS. Install rings on piston with TOP mark facing upward. Recessed edge on outside of center ring must face piston pin (down). Position ring gaps on piston at 120 degree intervals. See **Fig. 106** .

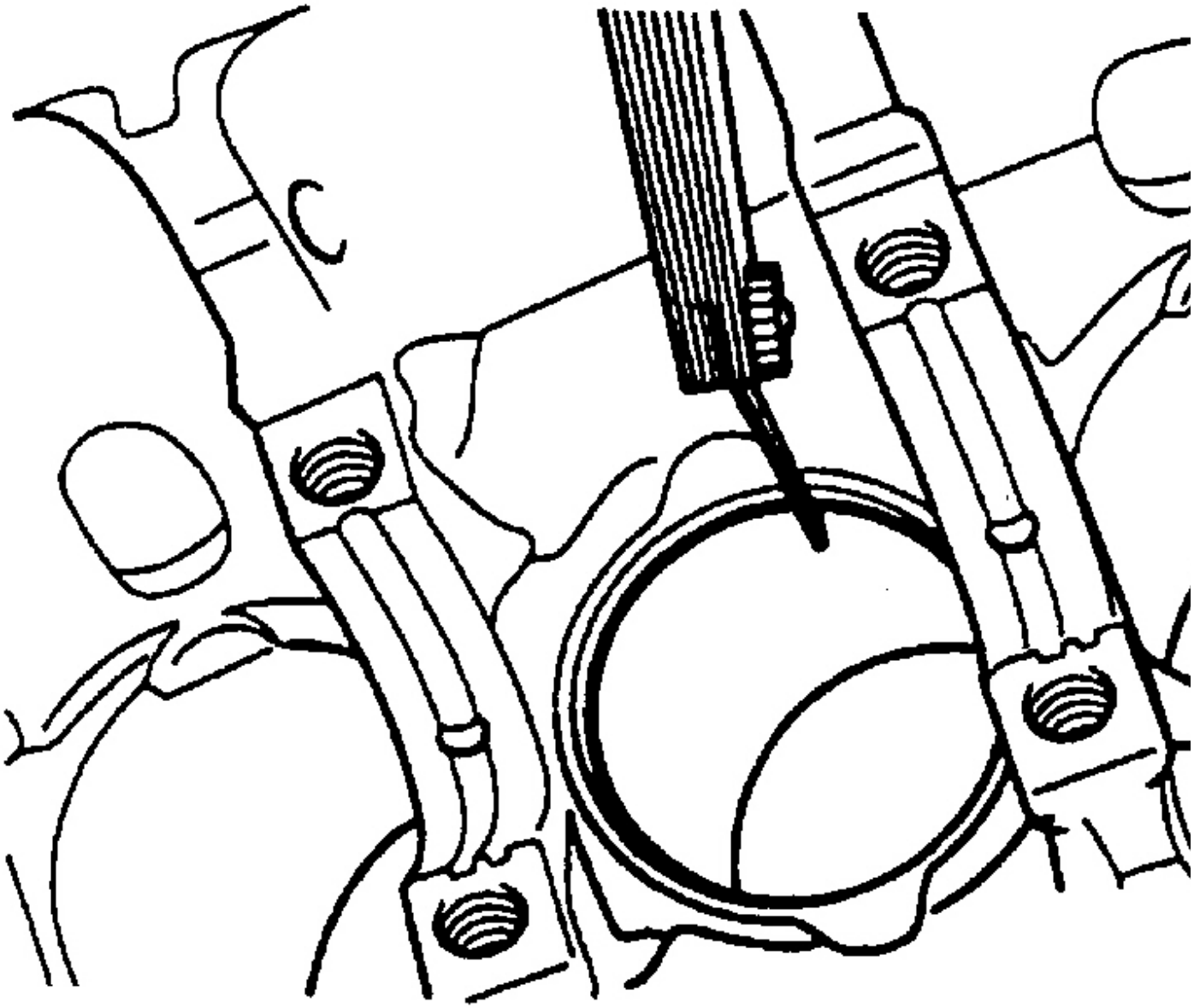

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Fig. 107: Checking Piston Ring End Gap
Courtesy of VOLKSWAGEN UNITED STATES, INC.

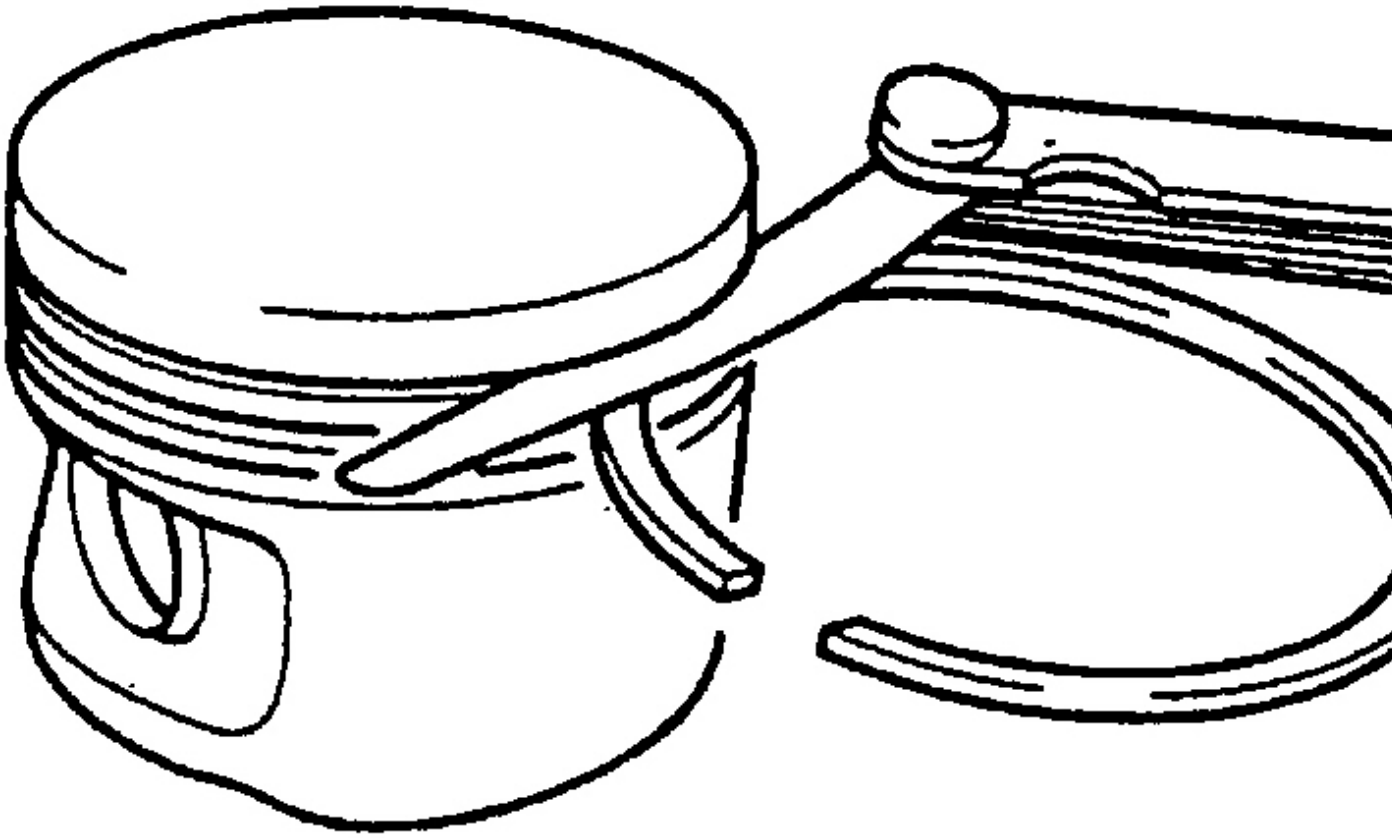

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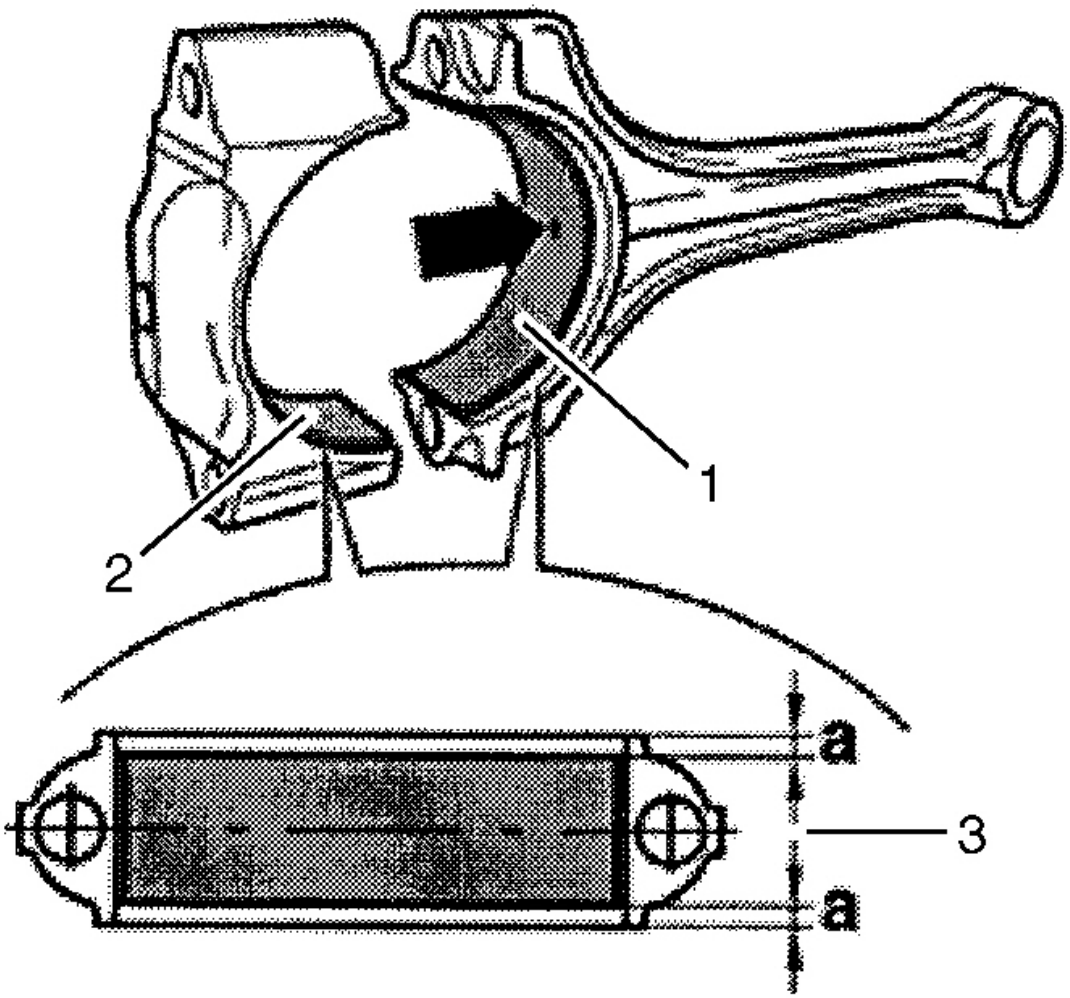
Fig. 108: Checking Piston Ring Side Clearance
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Rod Bearings

NOTE: For help in identifying rod bearing installation, refer to illustration. See Fig. 109 .

Mark rod caps for reinstallation. Use Plastigage to measure bearing oil clearance. DO NOT turn additional 90 degrees. Measure connecting rod side play. Replace or machine as necessary. See **CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS** table under ENGINE SPECIFICATIONS. Ensure oil hole is properly positioned and bearing shell is centered (dimension "A") when installed. Lubricate bolt threads when installing connecting rod caps. Tighten evenly to specification in several steps. See **TORQUE SPECIFICATIONS** .



1. Connecting Rod Bearing Shell
2. Connecting Rod Bearing Cap Bearing Shell
3. Bearing Shell Centered

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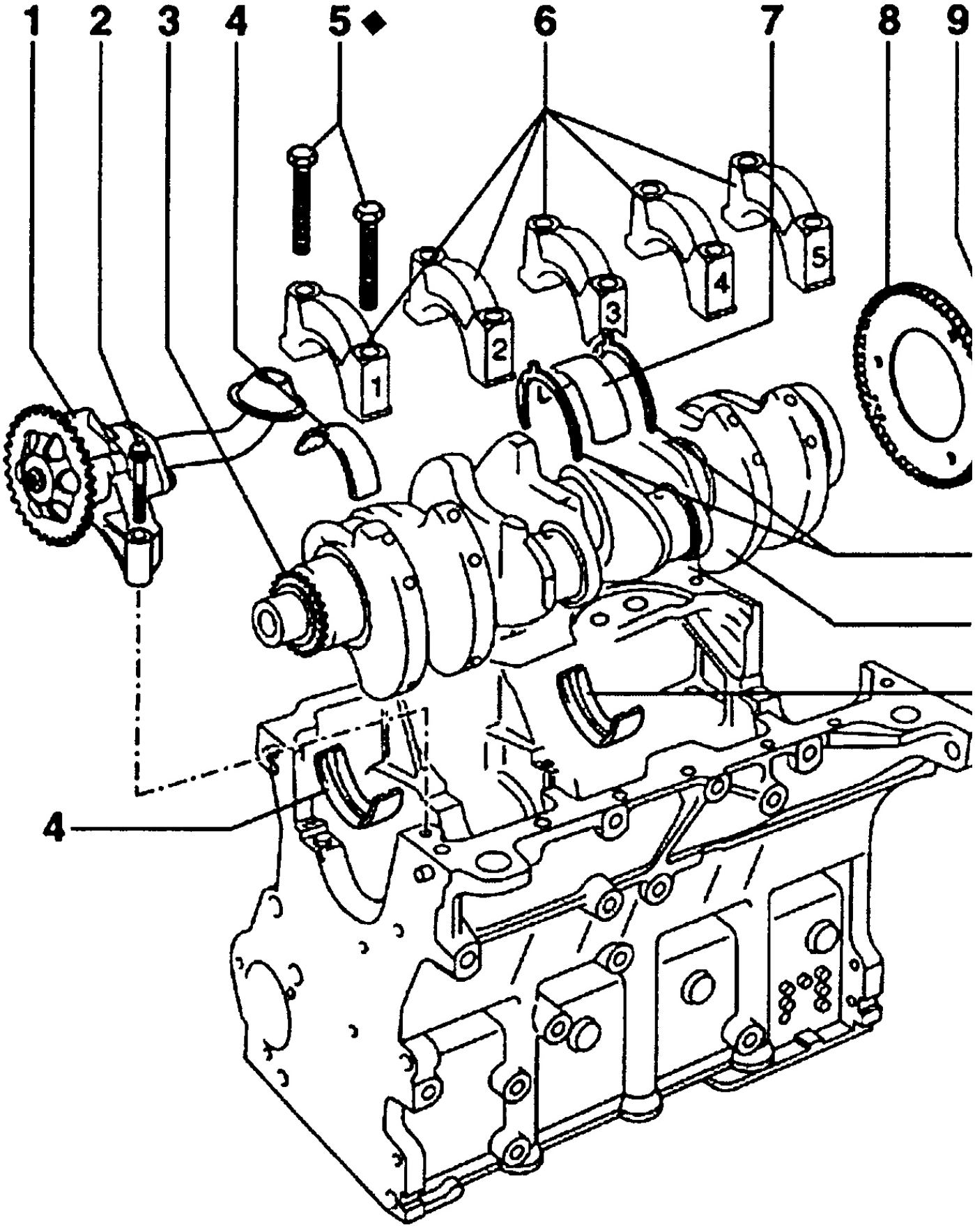
Fig. 109: Installing Connecting Rod Bearings (Note Position Of Oil Hole)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Crankshaft & Main Bearings

Main bearing caps are marked with matching journal for installation in original position. See **Fig. 110** . Use plastigage to measure oil clearance. Measure crankshaft end play. See **THRUST WASHER** .

From the factory, upper crankshaft bearings are installed with the right thickness. Colored marks are used to identify bearing thickness. A letter in the lower part of the block determines which thickness of bearing must be installed where. See **Fig. 111** . Also see **CRANKSHAFT BEARINGS** .



1. Oil Pump
2. Fastener Bolt
6. Bearing Caps
7. No. 3 Bearing Shell

Fig. 110: Identifying Crankshaft Assembly & Related Components
Courtesy of VOLKSWAGEN UNITED STATES, INC.

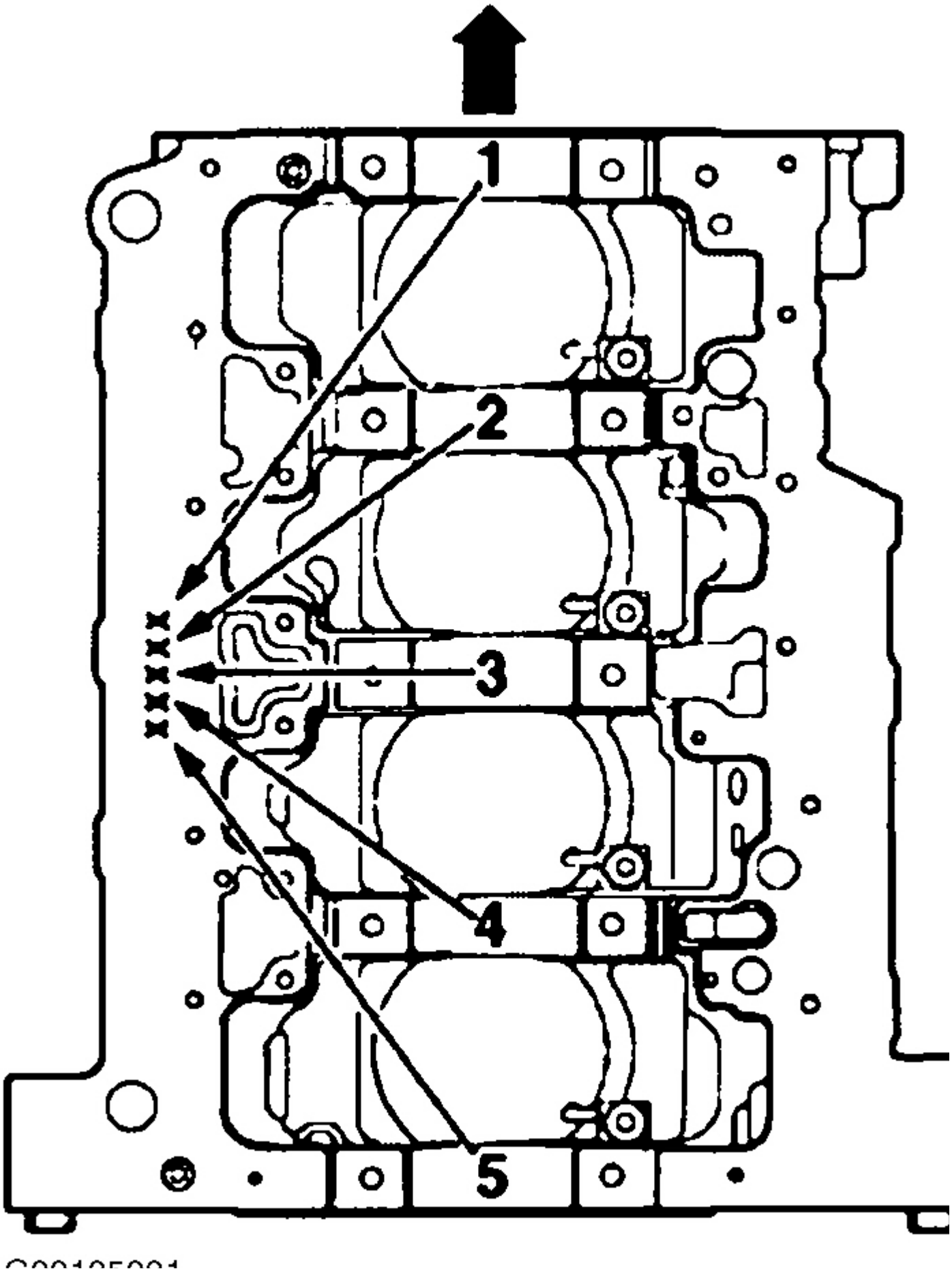


Fig. 111: Identifying Location Of "Letter" Marks Stamped in Block For Bearing Thickness (Arrow Shows Drive Direction)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

CRANKSHAFT BEARINGS

Application	(1) Specification
S	Black
R	Red
G	Yellow
(1) Lower crankshaft bearing shells are always supplied as replacement part with the color marking of Yellow.	

Thrust Washer

Insert feeler gauge between No. 3 main bearing and crankshaft thrust face to measure end play. Replace thrust washer as necessary. See **CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS** table under ENGINE SPECIFICATIONS.

Cylinder Block

Measure cylinder bore diameter in 3 places: at center of bore and .39" (10 mm) from top and bottom of bore. See **Fig. 112** . If cylinder bore diameter is not within specification, hone cylinder bore until diameter meets first oversize specification. See **CYLINDER BLOCK** under ENGINE SPECIFICATIONS. When measuring cylinder bore, maximum allowable difference between actual measurement and standard specification is .0031" (.08 mm).

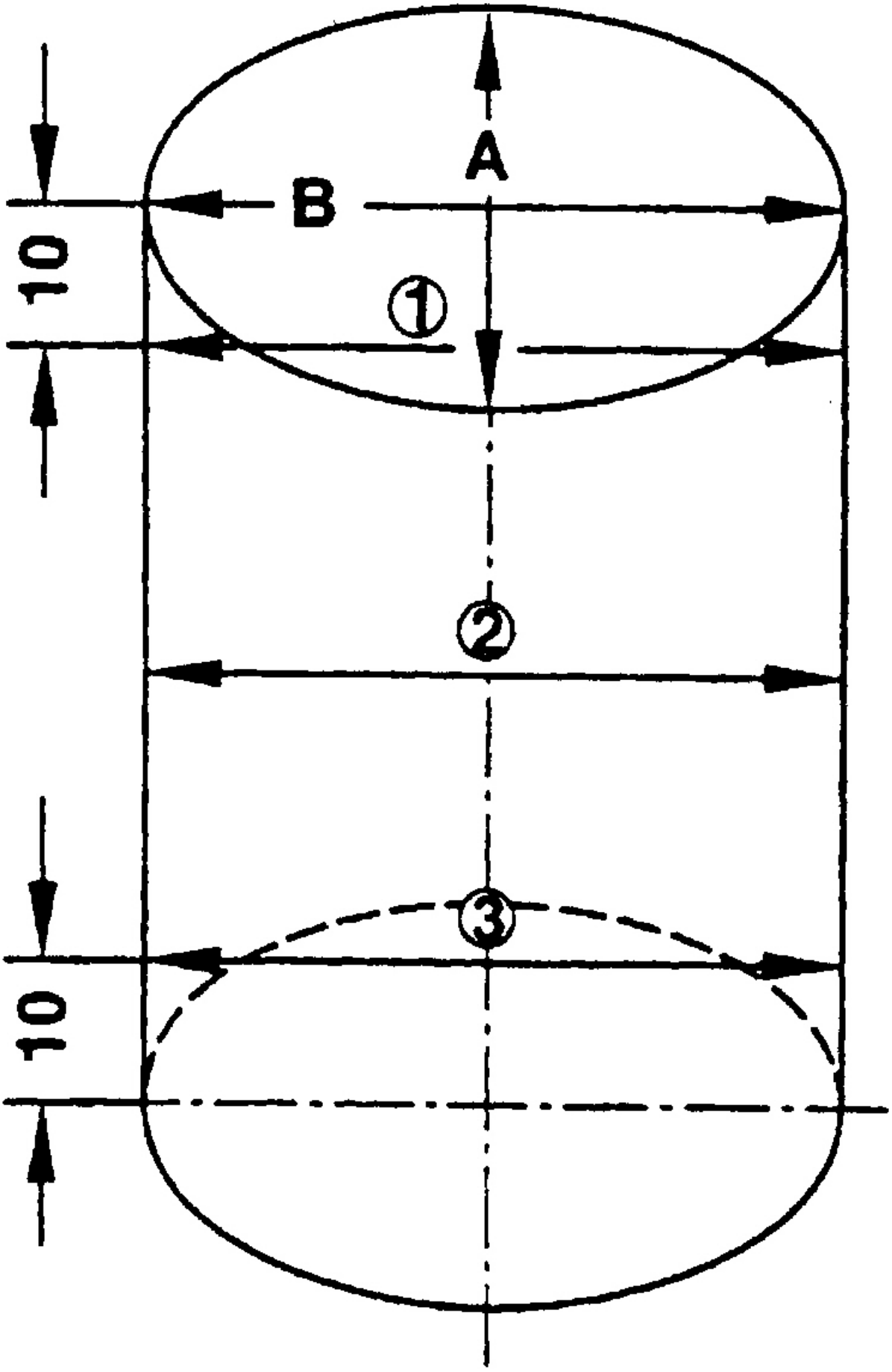


Fig. 112: Identifying Locations For Checking Cylinder Bore
Courtesy of VOLKSWAGEN UNITED STATES, INC.

ENGINE OILING

ENGINE LUBRICATION SYSTEM

Crankcase Capacity

See **CRANKCASE CAPACITY** table.

CRANKCASE CAPACITY

Application	Qts. (L)
Without Filter Replacement	3.8 (4.1)
With Filter Replacement	4.3 (4.6)

Oil Pressure

Check oil pressure with engine at normal operating temperature. Oil pressure at idle should be is 14-36 psi (1.0-2.0 bar). Oil pressure at 3000 RPM should be 44-73 psi. (3.0-4.5 bar). At higher RPM, oil pressure should not exceed 100 psi (7.0 bar). Inspect oil pump as necessary. See **OIL PUMP** .

Oil Spray Jet (For Piston Cooling)

Oil spray jet bolt contains a pressure relief valve. See **Fig. 106** . The opening pressure for the pressure relief valve is 23-26 psi (1.6-1.8 bar). Do not substitute standard bolt for pressure relief valve.

OIL PUMP

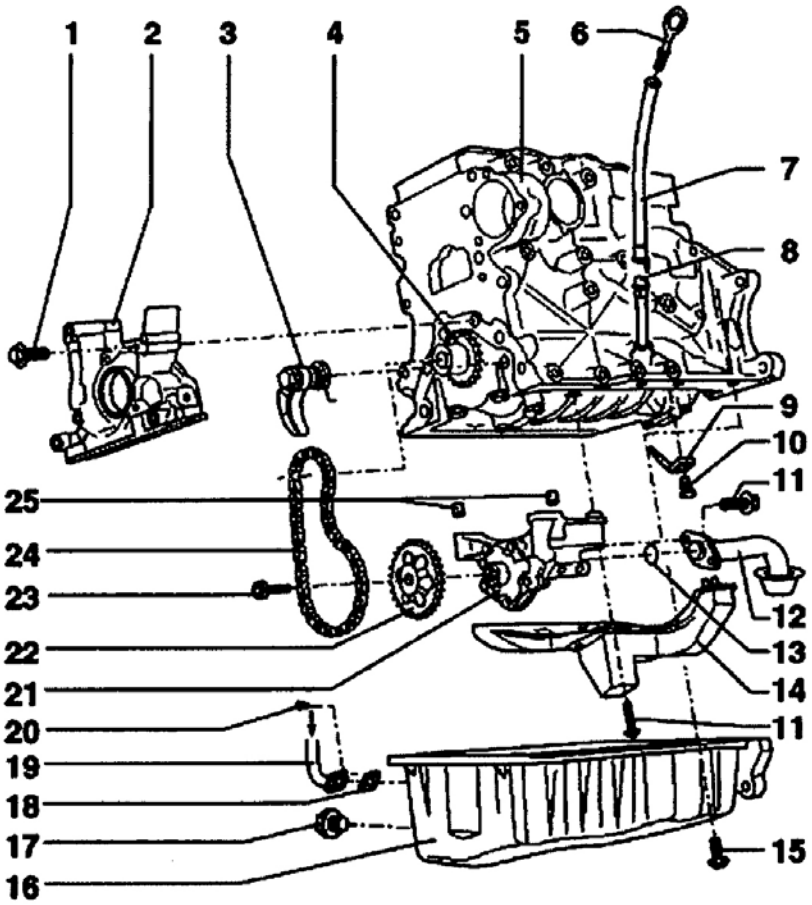
NOTE: For help in identifying components and component locations, refer to illustrations. See Fig. 113 -Fig. 114 .

Removal & Installation

Remove oil pan. See **OIL PAN** . Remove front oil seal flange. See **CRANKSHAFT FRONT OIL SEAL FLANGE** . Remove chain tensioner. Mark running direction of chain. Remove oil pump attaching bolts and remove oil pump assembly. To install, reverse removal procedure. Install chain in running direction as marked. Pretension spring on tensioner, on installation. Ensure both dowel pin sleeves for centering oil pump are installed.

Inspection

Check chain, tensioner, drive sprocket and oil pump sprocket for wear or damage (chips or nicks). Inspect oil pump, if running surfaces or gears are scored, replace oil pump assembly. Ensure oil pickup (suction pipe) is clean and unrestricted. Inspect oil cooler for contamination. Ensure oil pressure relief is not scored. Replace component(s) that are faulty.



1 - 15 Nm (11 ft lbs)

2 - Sealing flange

- Insert with silicone sealant D 176 404 A2

3 Chain - tensioner with tensioning rail, 15 Nm (11 ft lbs)

- When installing, pretension spring and fit

4 - Chain sprocket

- For oil pump drive
- Check for wear

5 - Cylinder block

6 - Dipstick

- Oil level must not be above the max. mark!

7 - Guide

- Pull off to extract oil

8 - Guide tube

9 - Oil spray jet

- For piston cooling

10 - Pressure relieve valve, 27 Nm (19 ft lbs)

11 - 15 Nm (11 ft lbs)

12 - Suction pipe

- Clean strainer if soiled

13 - O-ring

- Replace

14 - Baffle plate

15 - 15 Nm (11 ft lbs)

- Loosen and tighten with T-bar and socket, 10 mm 3185
- Remove with hexagon key extension, 5 mm 3249

16 - Oil pan

- Clean sealing surface before installing
- Install with silicone sealant D 176 404 A2

17 - Oil drain plug, 30 Nm (22 ft lbs)

- Replace if leaking. See Parts Catalog for correct application. In some cases, seal and drain plug are combined; do not interchange with separate seal and drain plug.

18 - Seal

- Replace

19 - Oil return pipe

- From turbocharge

20 - 10 Nm (7 f

21 - Oil pump

- With positive pressure valve 12 bar
- Before installing, check tha both dowe sleeves fo centering pump/cyli head are installed
- Replace if running surfaces and gears are scored

22 - Chain sprocket

23 - 25 Nm (18

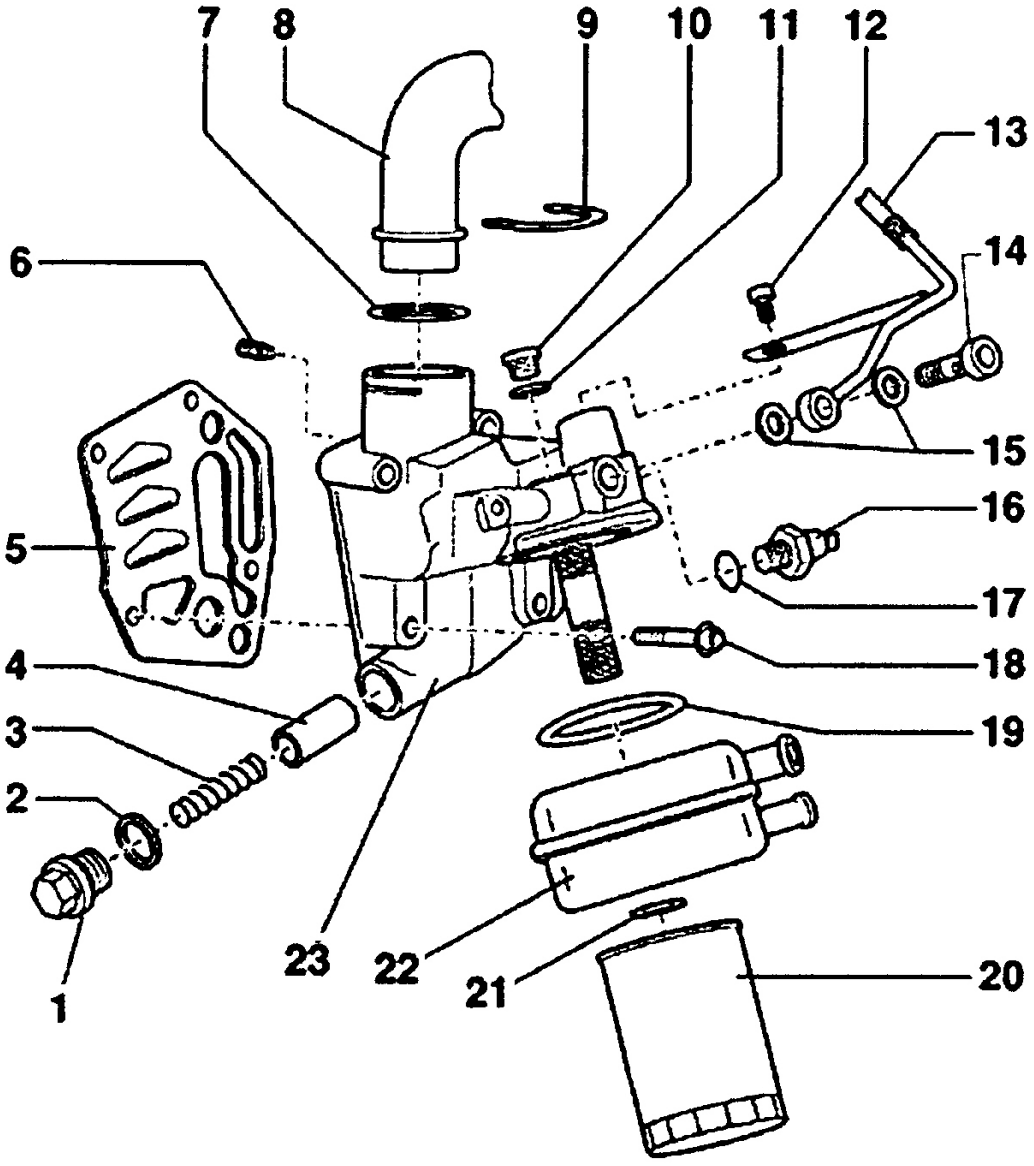
24 - Chain

- Mark direction of rotation before removing
- Check for wear

25 - Dowel sleeves

G00135079

Fig. 113: Identifying Engine Oiling System Components
Courtesy of VOLKSWAGEN UNITED STATES, INC.



1 - Sealing plug, 40 Nm (29 ft lbs)

2 - Seal

- If sealing ring is leaking nip open and replace.

3 - Spring

- For pressure

4 - Piston

- For pressure relief valve, approx. 4 bar

5 - Gasket

- Replace

6 - Non-return valve, 8 Nm (6 ft lbs)

7 - O-ring

- Replace

10 - Sealing plug, 15 Nm (11 ft lbs)

11 - Seal

- If sealing ring is leaking nip open and replace

12 - 20 Nm (15 ft lbs)

13 - Oil

14 - Banjo bolt, 30 Nm (22 ft lbs)

15 - Gasket

- Replace

16 - 1.4 bar oil pressure switch (F1), 25 Nm (18 ft lbs)

- Black

17 - Seal

18 - 15 Nm + 1/4 turn (90°) further

- Replace

19 - Gasket

- Replace
- Fit into groove on oil cooler

20 - Oil filter

- Loosen with strap wrench
- Tighten by hand

- Observe installation instructions on oil filter

21 - 25 Nm (18 l

22 - Oil cooler

- Ensure clearance to adjacent components
- Coat contact area to flange, outside the seal, with AMV 188 100 02

Fig. 114: Identifying Oil Filter Bracket & Related Components
Courtesy of VOLKSWAGEN UNITED STATES, INC.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Accessary Drive Belt Tensioner Bolt	18 (25)
Camshaft Drive Gear Bolt	48 (65)
Catalytic Converter	
To-Front Exhaust Pipe Bolt	18 (25)
To-Turbocharger Bolt	30 (40)
CMP Sensor Shutter Wheel Bolt	18 (25)
Connecting Rod Bearing Cap Nut (1)	
Step 1	22 (30)
Step 2	(2)
Crankshaft Front Oil Seal Flange Bolt	11 (15)
Crankshaft Main Bearing Cap Bolt (1)	
Step 1	48 (65)
Step 2	(2)
Crankshaft Rear Oil Seal Carrier Bolts	11 (15)
Crankshaft Timing Sprocket Bolt (1)	
Step 1	66 (90)
Step 2	(2)
Cylinder Head Bolt (1)	
Step 1	30 (40)
Step 2	(2)
Step 3	(2)
Drive Plate (Flywheel)-To-Crankshaft Bolt (1)	
Step 1	22 (30)
Step 2	44 (60)
Step 3	(2)
Driveshaft-To-Transaxle Flange Joint	30 (40)
Engine Mount-To-Body Bolt (3)	
Step 1	30 (40)
Step 2	(2)
Engine Mount/Bracket-To-Mount Bolt (3)	18 (25)
Engine Mount-To-Engine Bracket Bolt (3)	
Step 1	44 (60)

Step 2	(2)
Exhaust Manifold-To-Cylinder Head Bolt/Nut	18 (25)
Intake Manifold Bracket Bolts	14 (20)
Intermediate Shaft Sprocket Bolt	59 (80)
Oil Pan Bolt	11 (15)
Oil Pan Drain Plug	37 (50)
Oil Pump Bolt	11 (15)
Oil Pump Chain Tensioner Bolt	11 (15)
Oil Pump Drive Sprocket Bolt	18 (25)
Oil Seal Flange Front	11 (15)
Oil Seal Flange Rear	11 (15)
Pendulum Support-To-Subframe (4)	
Step 1	14 (20)
Step 2	(2)
Pendulum Support-To-Transmission (4)	
Step 1	30 (40)
Step 2	(2)
Piston Oil Pressure Relief Valve	20 (27)
Pressure Plate-To-Flywheel Bolt (1)	
Step 1	22 (30)
Step 2	44 (60)
Step 3	(2)
Starter Mount Bolt	48 (65)
Timing Belt Tensioner Nut	18 (25)
Torque Converter-To-Drive Plate	44 (60)
Transaxle Mount-To-Body Bolts	(5)
Transaxle-To-Engine Block	
M 10 Bolts	33 (45)
M 12 Bolts	59 (80)
Turbocharger Coolant Feed Line	25 (35)
Turbocharger Coolant Return Line	25 (35)
Turbocharger-To-Exhaust Manifold (1)	22 (30)
Vibration Damper Pulley Bolt	18 (25)
Water Pump Bolts	11 (15)
	INCH Lbs. (N.m)
Camshaft Bearing Cap Bolt	89 (10)
Chain Tensioner	89 (10)
CMP Sensor Bolt	89 (10)
Thermostat Housing Bolts	89 (10)
Turbocharger Oil Return Line	89 (10)
Valve Cover Retaining Nut	89 (10)

(1) Use NEW bolts.

(2) Tighten an additional 90 degrees.

(3) See illustration to identify bolt position. See **Fig. 47** .

(4) See illustration to identify bolt position. See **Fig. 49** .

(5) Tighten bolt No. 1 to 30 ft. lbs. (40 N.m), then tighten an additional 90 degrees. See **Fig. 48** . Tighten bolt No. 2 to 18 ft. lbs. (25 N.m). Tighten bolt No. 3 to 30 ft. lbs. (40 N.m), then tighten an additional 90 degrees.

ENGINE SPECIFICATIONS

GENERAL SPECIFICATIONS

GENERAL SPECIFICATIONS

Application	Specification
Displacement	110 Cu. In. (1.8L)
Bore	3.189" (81.01)
Stroke	3.40" (86.4 mm)
Compression Ratio	9.5:1
Fuel System	Motronic SFI

CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS

CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS

Application	In. (mm)
Crankshaft End Play	
Standard	.003-.009 (.07-.23)
Service Limit	.011 (.30)
Main Bearings	
Journal Diameter	
Standard	
Nominal	2.1260 (54.000)
Maximum	2.1268 (54.022)
Minimum	2.1243 (53.958)
1st Undersize	
Nominal	2.1161 (53.750)
Maximum	2.1170 (53.772)
Minimum	2.1145 (53.708)
2nd Undersize	
Nominal	2.1063 (53.500)
Maximum	2.1071 (53.522)
Minimum	2.1046 (53.458)
3rd Undersize	
Nominal	2.0965 (53.250)

Maximum	2.0973 (53.272)
Minimum	2.0948 (53.208)
Journal Out-Of-Round	(1)
Journal Taper	(1)
Oil Clearance	
Standard	.0008-.0024 (.020-.060)
Service Limit	.005 (.15)
Connecting Rod Bearings	
Journal Diameter	
Standard	
Nominal	1.8819 (47.800)
Maximum	1.8828 (47.823)
Minimum	1.8802 (47.758)
1st Undersize	
Nominal	1.8720 (47.550)
Maximum	1.8729 (47.572)
Minimum	1.8704 (47.508)
2nd Undersize	
Nominal	1.8622 (47.300)
Maximum	1.8631 (47.323)
Minimum	1.8605 (47.258)
3rd Undersize	
Nominal	1.8524 (47.051)
Maximum	1.8532 (47.074)
Minimum	1.8507 (47.008)
Journal Out-Of-Round	(1)
Journal Taper	(1)
Oil Clearance	
Standard	.002-.012 (.05-.31)
Service Limit	.015 (.37)
(1) Information is not available from manufacturer.	

CONNECTING RODS

CONNECTING RODS

Application	**In. (mm)**
Bore Diameter	
Pin Bore	(1)
Crankpin Bore	(1)
Center-To-Center Length	(1)
Side Play	

Standard	.002-.012 (.05-.31)
Service Limit	.015 (.37)
(1) Information is not available from manufacturer.	

PISTONS, PINS & RINGS

PISTONS, PINS & RINGS

Application	In. (mm)
Pistons	
Clearance	.0017 (.045)
Standard Diameter	3.187 (80.96)
1st Oversize	3.207 (81.46)
Pins	
Diameter	(1)
Piston Fit	(1)
Rod Fit	(1)
Rings End Gap	
No. 1 & 2	
AWD	
Standard	.006-.016 (.15-.40)
Service Limit	.031 (.80)
AWW & AWP	
Standard	.007-.016 (.20-.40)
Service Limit	.031 (.80)
Side Clearance	
AWD	
Standard	.00078-.0027 (.02-.07)
Service Limit	.0047 (.12)
AWW & AWP	
Standard	.002-.003 (.06-.09)
Service Limit	.007 (.20)
No. 3 (Oil Control Ring)	
End Gap	
Standard	.010-.020 (.25-.50)
Service Limit	.039 (1.00)
Side Clearance	
AWD	
Standard	.00078-.002 (.02-.06)
Service Limit	.0047 (.12)
AWW & AWP	
Standard	.001-.002 (.03-.06)
Service Limit	.006 (.15)

(1) Information is not available from manufacturer.

CYLINDER BLOCK

CYLINDER BLOCK

Application	In. (mm)
Cylinder Bore	
Standard Diameter	3.189 (81.01)
1st Oversize	3.209 (81.51)
Maximum Taper	.003 (.08)

VALVES & VALVE SPRINGS

VALVES & VALVE SPRINGS

Application	Specification
Intake Valves	
Face Angle	45°
Head Diameter	1.059" (26.9 mm)
Length	4.127-4.147" (104.84-105.34 mm)
Minimum Margin	(1)
Stem Diameter	.234" (5.96 mm)
Valve Stem Installed Height (Minimum)	
Center	1.32" (33.7 mm)
Outer	1.29" (34.0 mm)
Exhaust Valves	
Face Angle	45°
Head Diameter	1.177" (29.9 mm)
Length	4.080-4.100" (103.64-104.14 mm)
Minimum Margin	(1)
Stem Diameter	.233" (5.94 mm)
Valve Stem Installed Height (Minimum)	1.35" (34.4 mm)

(1) DO NOT machine valves. Hand lap only.

CYLINDER HEAD

CYLINDER HEAD

Application	Specification
Cylinder Head Height (Minimum)	5.480" (139.2 mm)
Maximum Warpage	.004" (.10 mm)
Valve Seats	
Intake Valve	
Seat Angle	45°
Seat Width	.059-070" (1.50-1.80 mm)

Exhaust Valve	
Seat Angle	45°
Seat Width	.070" (1.80 mm)
Valve Guides	
Intake Valve	
Valve Guide Installed Height	(1)
Valve Stem-To-Guide Oil Clearance	(2) .031" (.80 mm)
Exhaust Valve	
Valve Guide Installed Height	(1)
Valve Stem-to-Guide Oil Clearance	(2) .031" (.80 mm)

(1) Valve guide shoulder flush with cylinder head.

(2) New valve installed in cylinder head. Dial indicator used to measure valve wobble in guide.

CAMSHAFT

CAMSHAFT

Application	In. (mm)
Journal Diameter	
Standard	(1)
Undersize	(1)
End Play	.007 (.20)
Runout	.0004 (.010)
Oil Clearance (Maximum)	.004 (.10)

(1) Information is not available from manufacturer.

