

ENGINE

3.6 Liter - Crankshaft, Cylinder Block - Engine Code(s): BLV & CNNA

13 CRANKSHAFT, CYLINDER BLOCK

GENERAL INFORMATION

CRANKSHAFT BEARING SHELL, ALLOCATING

The main bearing shells are allocated to the cylinder block and crankshaft with the correct thickness by the factory. Colored dots serve to identify the bearing thicknesses.

If the cylinder block or crankshaft are being replaced, then the bearing shells must be allocated.

The bearing shell for the cylinder block (upper bearing shell) is always marked in yellow.

Using the letters on the cylinder block and crankshaft, determine the correct color identification for the bearing shell in the bearing cap (lower bearing shell).

The first letter is for bearing cap one, the second for bearing cap two, etc.

Cylinder Block Identification

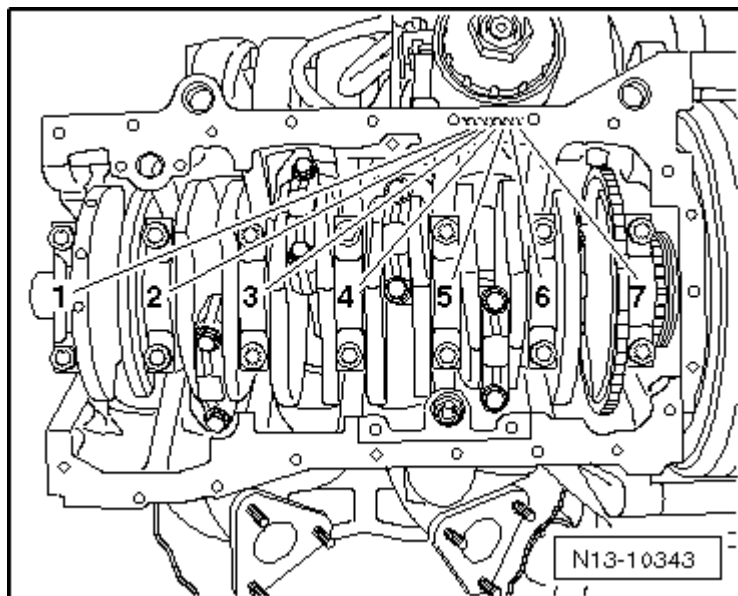


Fig. 1: Identifying Cylinder Block Identification
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

The letters are located on the oil pan sealing surface.

Crankshaft Identification

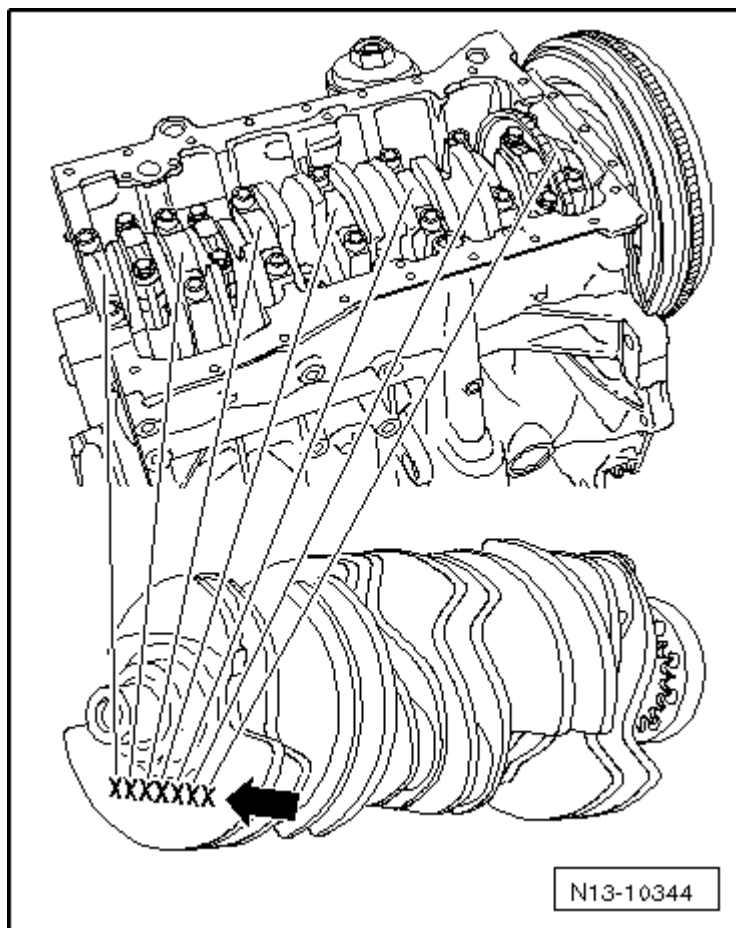


Fig. 2: Identifying Crankshaft Identification

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

The letters are located on the outer crankshaft counterweight for cylinder 1.

-- Note the letters and then match it to the color identification in the table.

Letter on the Cylinder Block	Letter on the Crankshaft Counterweight	Bearing Shell Color Identification for the Bearing Cap	Bearing Shell Color Identification for the Cylinder Block
A, B, C, D, E	R	Red	Yellow
A, B, C, D, E	G	Red	Yellow
A, B, C, D, E	B	Yellow	Yellow
A, B, C, D, E	V	Blue	Yellow
G, H, I	R	Red	Yellow
G, H, I	G	Red	Yellow
G, H, I	B	Yellow	Yellow
G, H, I	V	Blue	Yellow
K, L, M	R	Red	Yellow
K, L, M	G	Yellow	Yellow

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ENGINE 3.6 Liter - Crankshaft, Cylinder Block - Engine Code(s): BLV & CNNA

K, L, M	B	Blue	Yellow
K, L, M	V	Purple	Yellow

Example:

Bearing Cap	1	2	3	4	5	6	7
Letters on the Cylinder Block	G	H	H	H	G	E	G
Letters on the Crankshaft Counterweight	G	B	B	V	B	B	G
Bearing Shell Color Identification for the Bearing Cap	Red	Yellow	yellow	Blue	Yellow	Yellow	Red

DESCRIPTION AND OPERATION

Engine Code BLV

Engine Code CNNA

All

RIBBED DRIVE BELT OVERVIEW

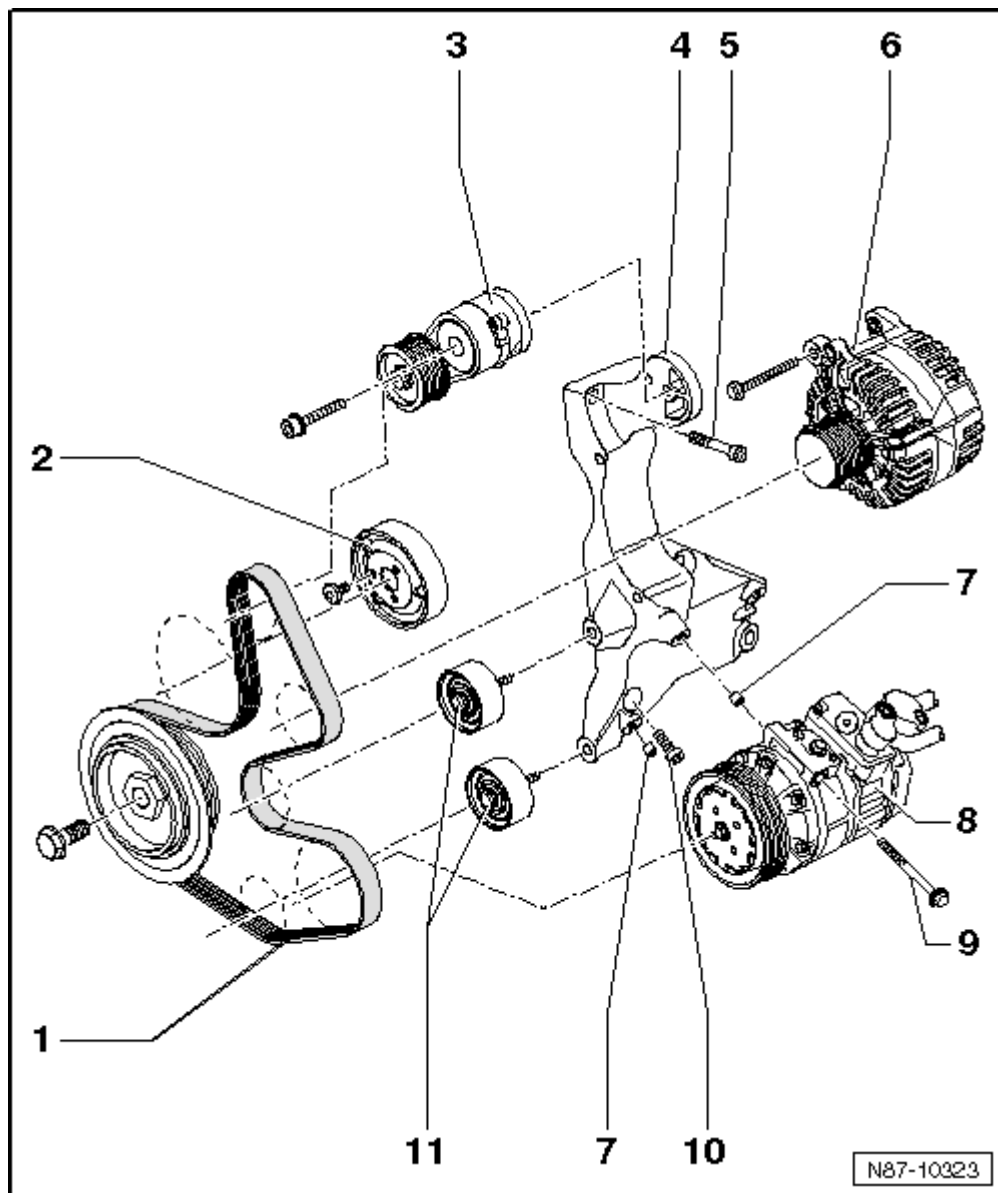


Fig. 3: Identifying A/C Compressor Sub-Assembly

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Ribbed Belt

- **Removing and installing** , refer to **RIBBED BELT**.

2. Coolant Pump Pulley

3. Belt Tensioner

4. Accessory Bracket

- **Removing and installing** , refer to **ACCESSORY BRACKET**.

5. Bolt

- **23 Nm**
- Used to align the accessory bracket.

6. Generator

- **Removing and installing** , refer to **Removal and Installation** .

7. Alignment Sleeve

- Quantity: 2
- Make sure that the seating between the accessory bracket and the A/C compressor is correct.

8. Air Conditioning (A/C) Compressor

- **Removing and installing** , refer to **Removal and Installation** .

9. Bolt

- **23 Nm**
- M8 x 100
- Quantity: 3

10. Bolt

- **23 Nm**
- Used to align the accessory bracket.

ENGINE OVERVIEWS

NOTE: The engine is to be secured to the engine and transmission holder VAS 6095 when performing assembly work.

If large quantities of metal particles or abraded material are detected during engine repairs, it may mean the crankshaft or rod bearings are damaged. To prevent further damage, perform the following steps after the repair:

Clean the oil passages.

Replace the oil check valve.

Replace the oil spray jets.

Replace the engine oil cooler.

Replace the oil filter element.

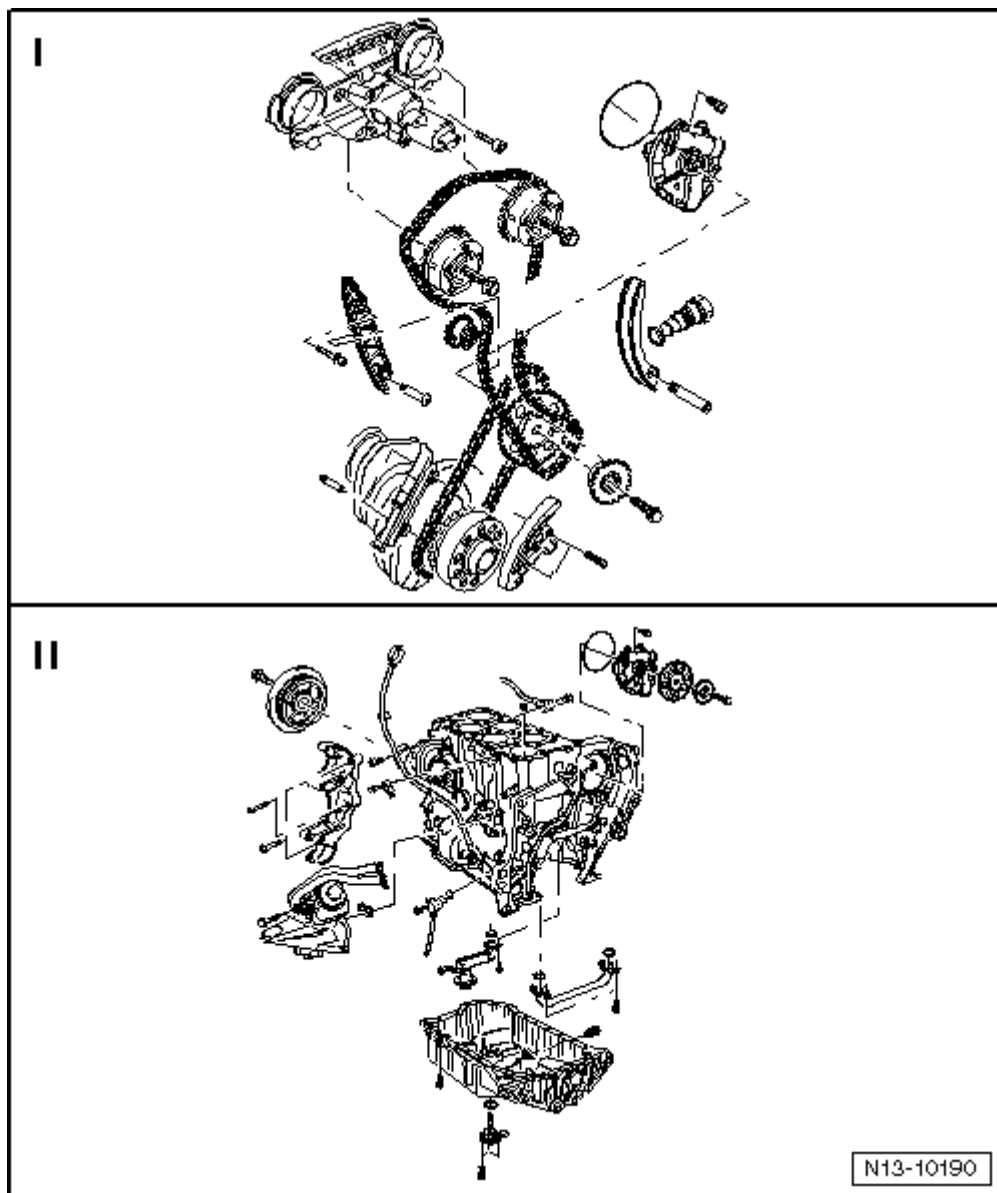


Fig. 4: Identifying Engine, Disassembling And Assembling Overview
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. I - CHAIN DRIVE
2. II - CYLINDER BLOCK AND ATTACHMENTS

CHAIN DRIVE

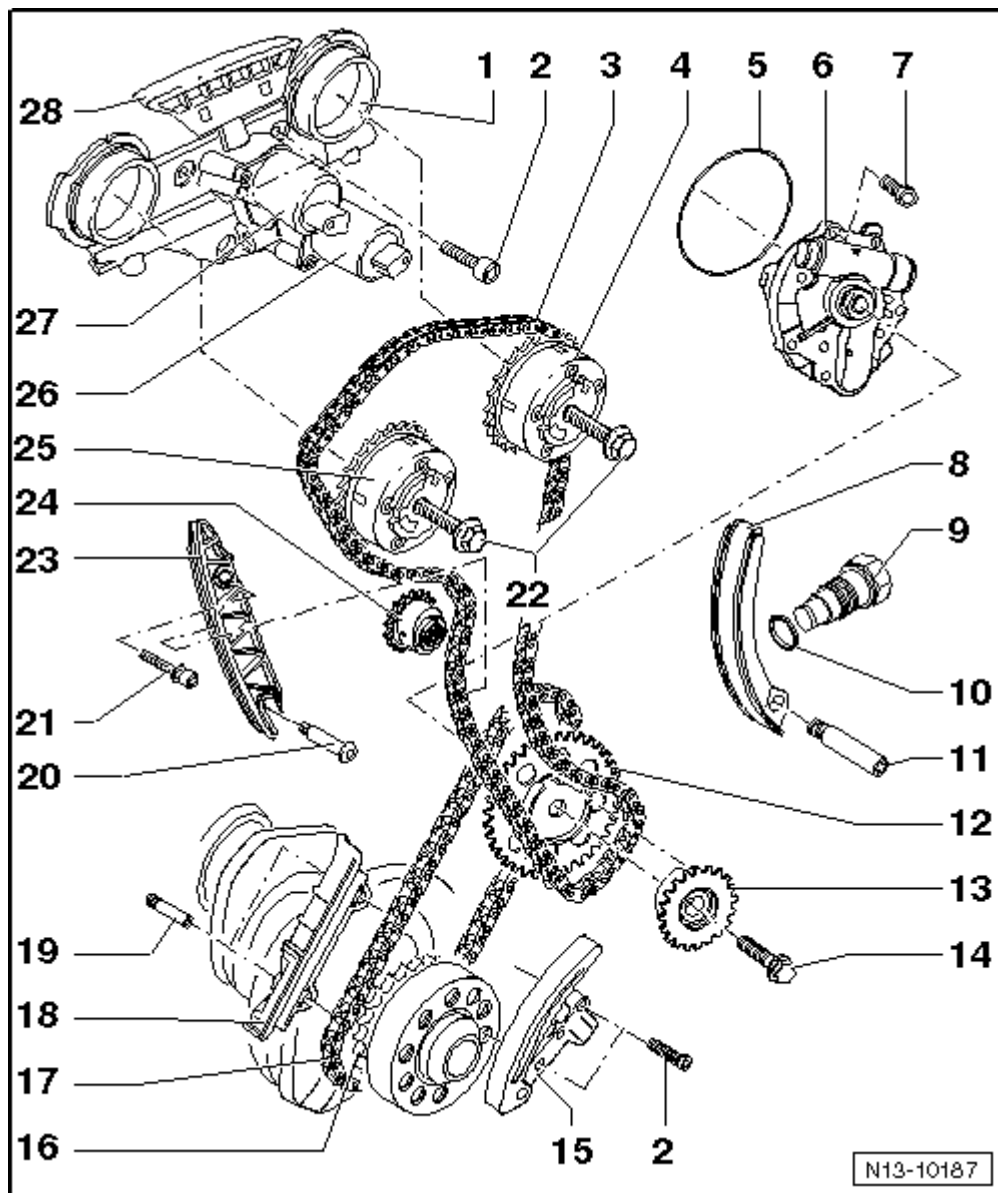


Fig. 5: Identifying Engine, Disassembling And Assembling Part I
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Control Housing

- Oil the contact surface of the seals before installing.
- **Removing and installing** , refer to **CAMSHAFTS** .
- Camshaft adjustment valve removing and installing, refer to **CAMSHAFT ADJUSTMENT VALVES** .
- Check the control housing strainer for contamination before installation. Refer to **Fig. 7**.

2. Bolt

- **8 Nm + 90° (1/4) additional turn.**
- Install using liquid locking fluid D 000 600 A2

3. Timing Chain
 - For the camshafts.
 - Mark the direction of rotation before removing (installed position). Refer to **Fig. 6**.
 - **Installing** , refer to **CAMSHAFT AND OIL PUMP TIMING CHAINS** .
4. Exhaust Camshaft Adjuster
 - Identification: 32A
 - **Installing** , refer to **CAMSHAFT AND OIL PUMP TIMING CHAINS** .
5. Seal
 - Always replace.
6. Oil Pump
 - **Removing and installing** , refer to **OIL PUMP** .
7. Bolt
 - **8 Nm**
 - Always replace.
8. Tensioning Rail
 - For the camshaft timing chain -item 3-.
9. Chain Tensioner
 - **50 Nm**
 - For the camshaft timing chain -item 3-.
 - Only rotate the engine with the chain tensioner installed.
10. Seal
 - Replace if damaged or leaking.
11. Pin
 - **10 Nm**
 - For the tensioning rail -item 8-.
12. Chain Sprocket
 - For the oil pump timing chain -item 17-.
 - **Installing** , refer to **CAMSHAFT AND OIL PUMP TIMING CHAINS** .
13. Chain Sprocket
 - For the camshaft timing chain -item 3-.
 - **Installing** , refer to **CAMSHAFT AND OIL PUMP TIMING CHAINS** .
14. Bolt
 - **60 Nm + 90° (1/4) additional turn.**
 - Always replace.
 - Only use bolts with a strength category of 10.9.
15. Chain Tensioner with Tensioning Rail
 - For the oil pump timing chain -item 17-.
 - Before installation, release the locking device in the chain tensioner using a small screwdriver and

press the tensioning rail against the chain tensioner.

- Only rotate the engine with the chain tensioner installed.

16. Drive Sprocket

- Integral part of the crankshaft.
- The milled tooth aligned with the crankshaft main bearing cap joint = Top Dead Center (TDC) for cylinder 1. Refer to **CAMSHAFT AND OIL PUMP TIMING CHAINS** .

17. Timing Chain

- For the oil pump.
- Mark the direction of rotation before removing (installed position). Refer to **Fig. 6**.
- **Installing** , refer to **CAMSHAFT AND OIL PUMP TIMING CHAINS** .

18. Guide Rail

- For the oil pump timing chain -item 17-.
- Remove and install together with the timing chains. Refer to **CAMSHAFT AND OIL PUMP TIMING CHAINS** .

19. Pin, without Collar

- **10 Nm**
- For the guide rail -item 18-.

20. Pin

- **10 Nm**

21. Bolt

- **23 Nm**

22. Bolt

- **60 Nm + 90° (1/4) additional turn.**
- Always replace.
- The sensor wheel contact surface on the bolt head must be dry when installing.
- When removing and installing, counter hold the camshaft using a 27 mm open end wrench. Refer to **CAMSHAFTS** .

23. Guide Rail

- For the camshaft timing chain -item 3-.

24. Drive Sprocket

- For the high pressure pump.

25. Intake Camshaft Adjuster

- Identification: 24E
- **Installing** , refer to **CAMSHAFT AND OIL PUMP TIMING CHAINS** .

26. Exhaust Camshaft Adjustment Valve 1 -N318-

- For the exhaust camshaft.
- Mark the connector belonging to the component before disconnecting.
- **Removing and installing** , refer to **CAMSHAFT ADJUSTMENT VALVES** .

27. Camshaft Adjustment Valve 1 -N205-

- For the intake camshaft.
- Mark the connector belonging to the component before disconnecting.
- **Removing and installing** , refer to CAMSHAFT ADJUSTMENT VALVES .

28. Guide Rail

- For the camshaft timing chain -item 3-.
- Clipped into the control housing.

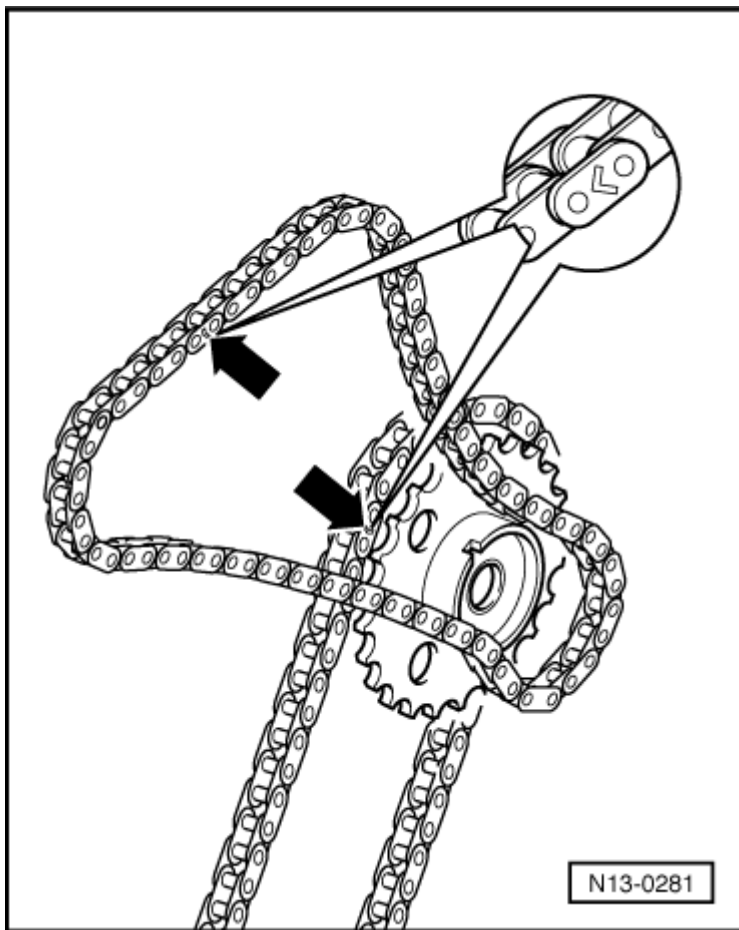


Fig. 6: Identifying Marks On Roller Chains

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Mark the timing chains before removing (for example, with a paint arrow pointing in the direction of rotation).

NOTE: Do not mark the chain using a center punch or similar means!

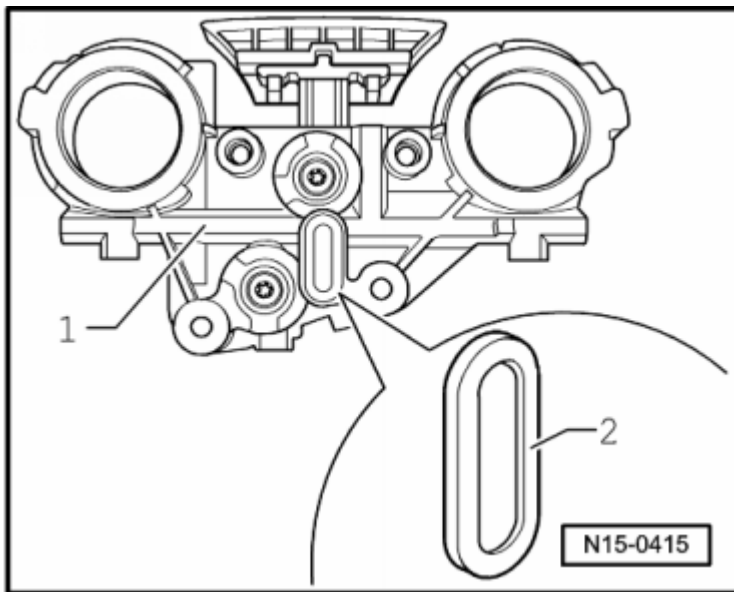


Fig. 7: Identifying Backside Of Control Housing & Screen
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CYLINDER BLOCK AND ATTACHMENTS

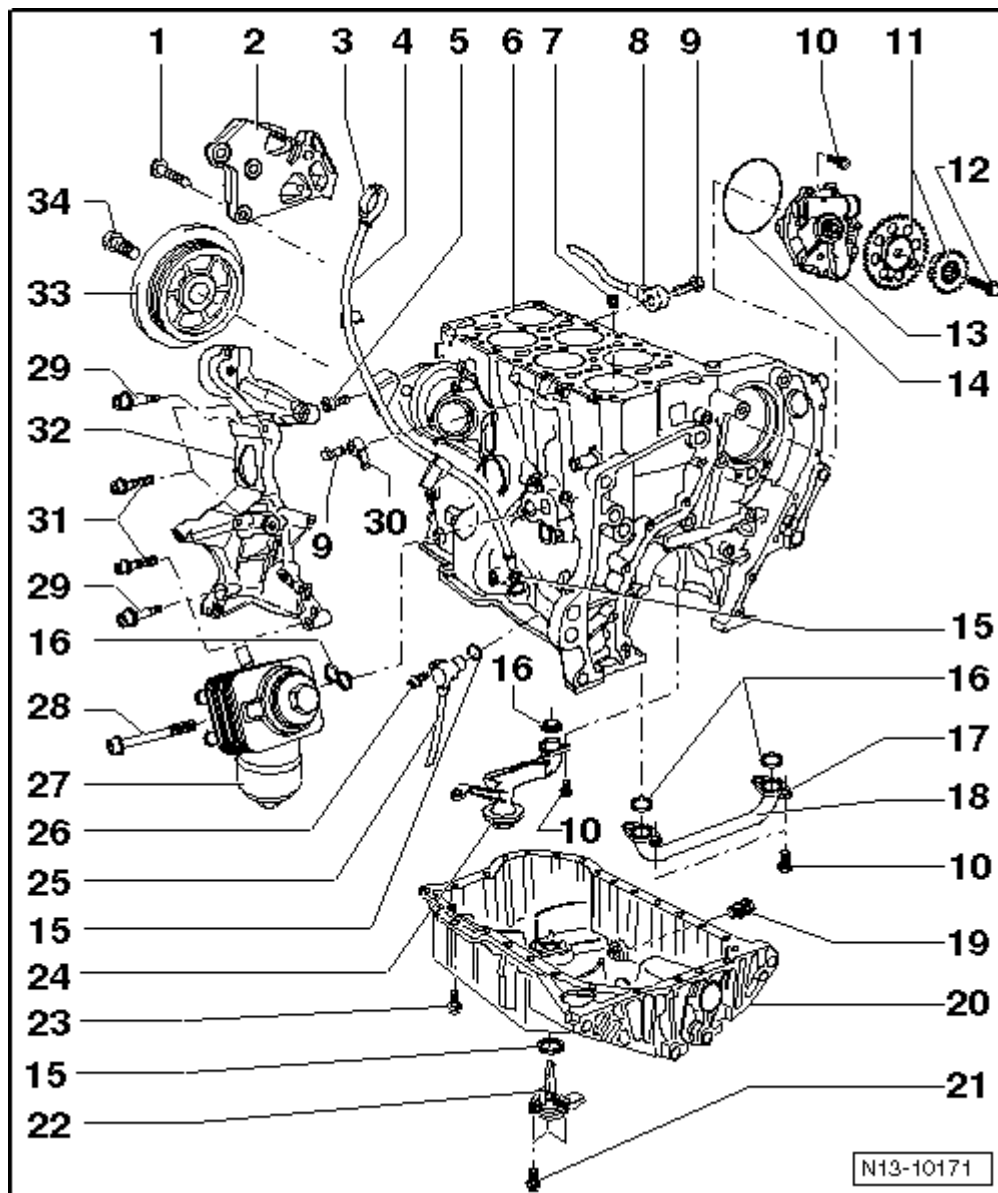


Fig. 8: Identifying Cylinder Block And Attachments
 Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Bolt
 - 50 Nm + 90° (1/4) additional turn.
 - Always replace.
2. Engine Mount Bracket
3. Oil Dipstick
 - The oil level must not be above the Max. mark!
 - Marks, refer to **ENGINE OIL**.
4. Oil Dipstick Guide Tube
 - For the oil dipstick.

- Secured by a bolt to intake manifold.
5. Bolt
 - **6 Nm**
 - To the intake manifold.
 6. Cylinder Block
 - Sealing flange and drive plate overview. Refer to **SEALING FLANGE AND DRIVE PLATE OVERVIEW**.
 - Crankshaft overview. Refer to **CRANKSHAFT OVERVIEW**.
 - Piston and connecting rod overview. Refer to **PISTON AND CONNECTING ROD OVERVIEW**.
 7. Oil Check Valve
 - Not installed.
 8. Knock Sensor 1 -G61-
 - Installed location: between cylinders 1 and 3.
 9. Bolt
 - **20 Nm**
 - The tightening specification affects the function of the knock sensor.
 10. Bolt
 - **8 Nm**
 - Always replace.
 11. Chain Sprocket
 - Installing, refer to **CAMSHAFT AND OIL PUMP TIMING CHAINS** .
 12. Bolt
 - **60 Nm + 90° (1/4) additional turn.**
 - Always replace.
 - Only use bolts with a strength category of 10.9.
 13. Oil Pump
 - **Removing and installing** , refer to **OIL PUMP** .
 14. Seal
 - Always replace.
 - Coat with oil before installing.
 15. O-ring
 - Always replace.
 16. Gasket
 - Always replace.
 17. Flange
 - Pay attention to the installed position.
 18. Oil Pipe

19. Oil Drain Plug
 - **30 Nm**
 - Always replace.
 - With a permanent seal.
20. Oil Pan
 - **Removing and installing** , refer to **OIL PAN** .
21. Bolt
 - **10 Nm**
22. Oil Level Thermal Sensor -G266-
23. Bolt
 - **11 Nm**
24. Suction Pipe
 - For the oil pump.
25. Engine Speed Sensor -G28-
26. Bolt
 - **10 Nm**
27. Oil Filter Housing
 - Overview, refer to one **OIL FILTER HOUSING OVERVIEW**
 - Coolant hose connection diagram. Refer to **COOLANT HOSE CONNECTION DIAGRAM** .
28. Bolt
 - **23 Nm**
29. Bolt
 - **23 Nm**
 - For aligning the accessory bracket.
30. Knock Sensor 2 -G66-
 - Installed location: between cylinders 4 and 6.
31. Bolt
 - **23 Nm**
32. Accessory Bracket
 - For the generator and Air Conditioning (A/C) compressor.
 - **Removing and installing** , refer to **ACCESSORY BRACKET**.
33. Vibration Damper
 - **Removing and installing** , refer to **VIBRATION DAMPER**.
 - **Removing and installing** the ribbed belt. Refer to **RIBBED BELT**.
34. Bolt
 - **Removal and installation** , refer to **VIBRATION DAMPER**.

RIBBED DRIVE BELT OVERVIEW

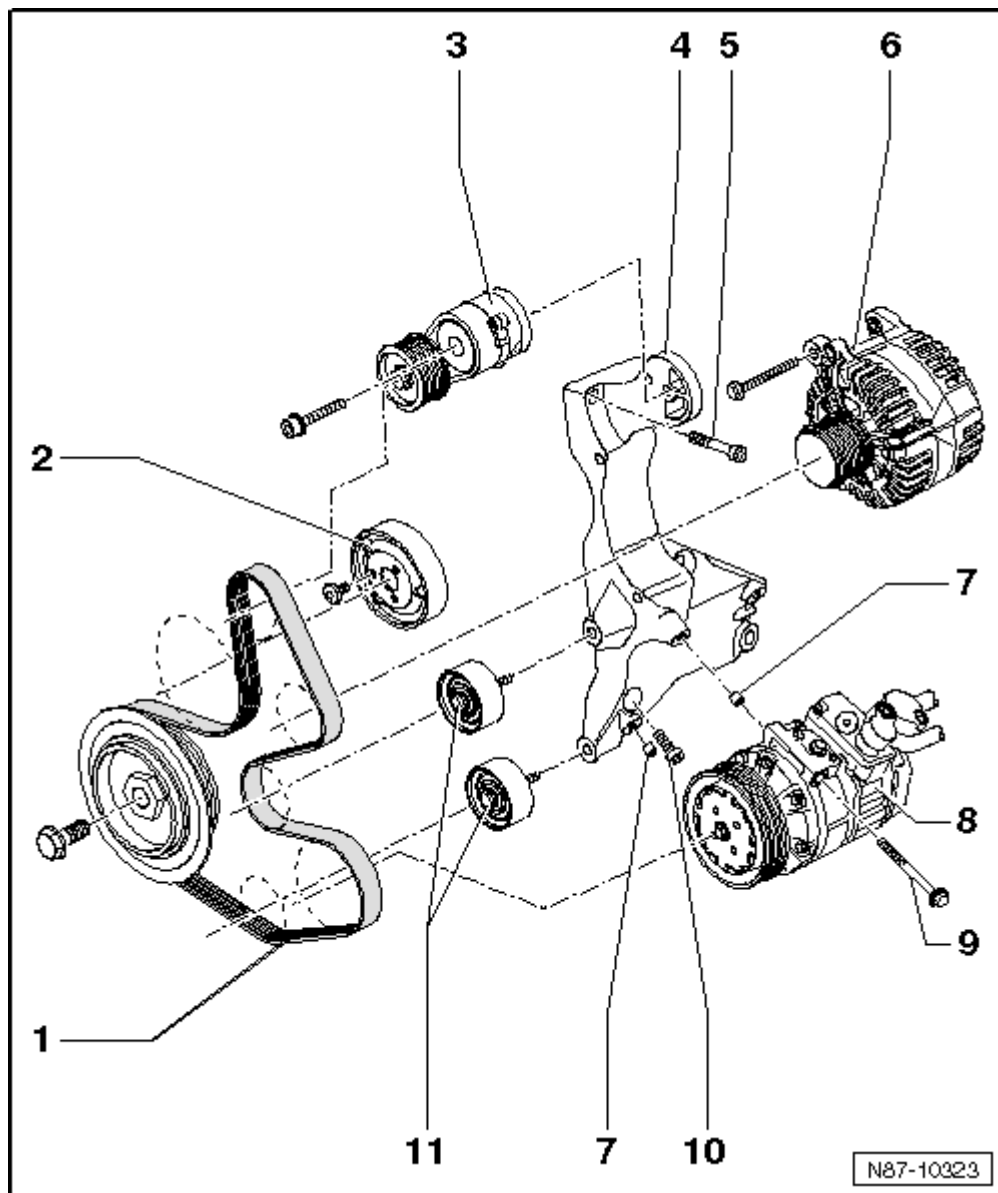


Fig. 9: Identifying A/C Compressor Sub-Assembly

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Ribbed Belt

- **Removing and installing** , refer to **RIBBED BELT**.

2. Coolant Pump Pulley

3. Belt Tensioner

4. Accessory Bracket

- **Removing and installing** , refer to **ACCESSORY BRACKET**.

5. Bolt

- **23 Nm**
- Used for aligning the accessory bracket.

6. Generator

- **Removing and installing** , refer to **Removal and Installation** .

7. Alignment Sleeves

- Quantity: 2
- Make sure that the seating between the accessory bracket and the A/C compressor is correct.

8. Air Conditioning (A/C) Compressor

- **Removing and installing** , refer to **REMOVAL AND INSTALLATION** .

9. Bolt

- **23 Nm**
- M8 x 100
- Quantity: 3

10. Bolt

- **23 Nm**
- Used for aligning the accessory bracket.

ENGINE OVERVIEW

NOTE: The engine is to be secured to the engine and transmission holder VAS 6095 when performing assembly work.

If large quantities of metal particles or abraded material are detected during engine repairs, it may mean the crankshaft or rod bearings are damaged. To prevent further damage, perform the following steps after the repair:

Clean the oil passages.

Replace the oil check valve.

Replace the oil spray jets.

Replace the engine oil cooler.

Replace the oil filter element.

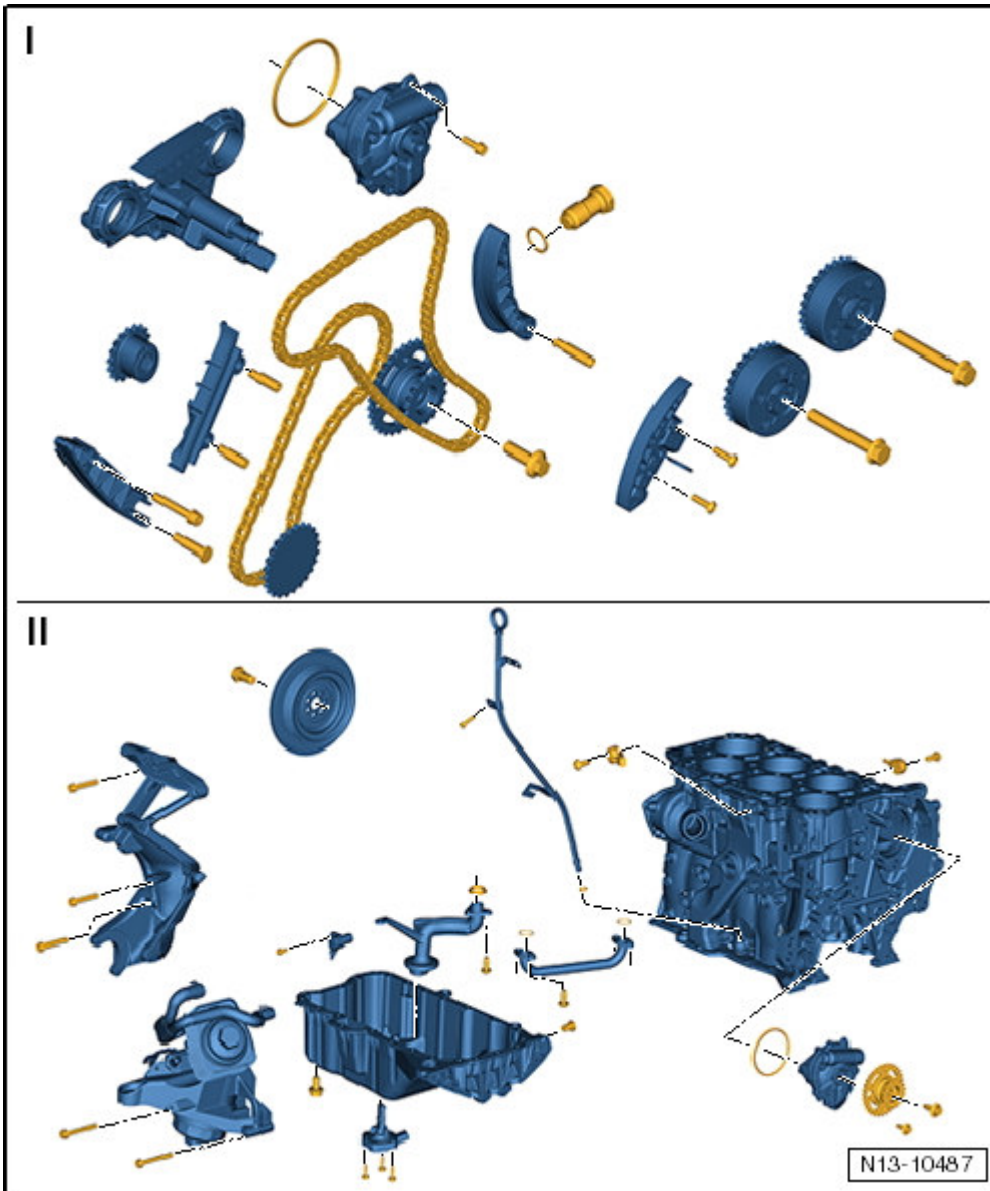


Fig. 10: Identifying Engine Overview

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. I - CHAIN DRIVE
2. II - CYLINDER BLOCK AND ATTACHMENTS

CHAIN DRIVE

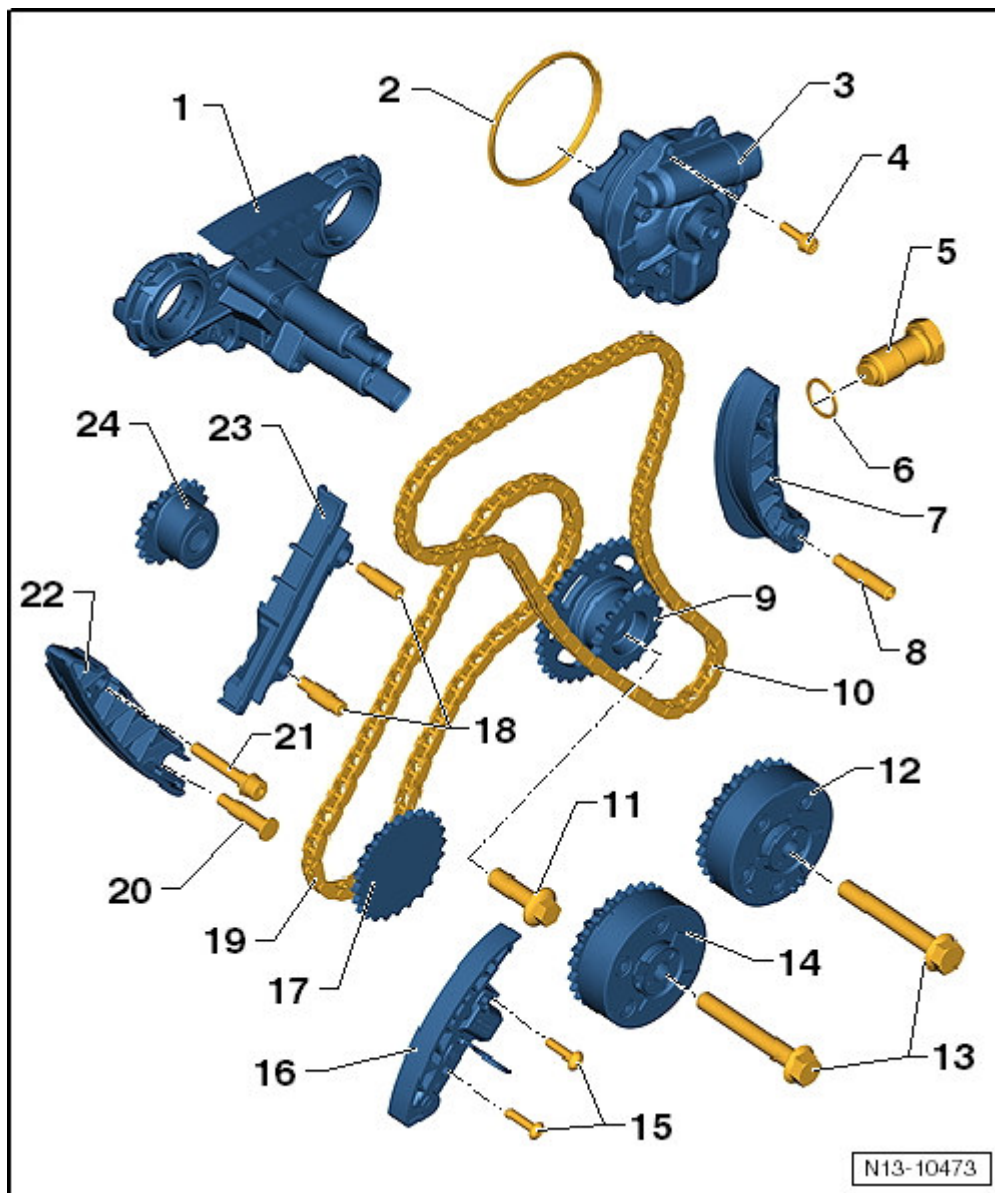


Fig. 11: Identifying Timing Chains And Adjusters

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Control Housing

- Oil the contact surface of the seals before installing.
- **Removing and installing** , refer to CAMSHAFTS .
- Assembly overview, refer to CONTROL HOUSING OVERVIEW .
- Check the control housing strainer for contamination before installation. Refer to CONTROL HOUSING OVERVIEW .

2. Seal

- Always replace.

3. Oil Pump

- **Removing and installing** , refer to **OIL PUMP** .
4. Bolt
 - **8 Nm**
 - Install using liquid locking fluid D 000 600 A2.
 5. Chain Tensioner
 - **50 Nm**
 - For the camshaft timing chain -item 10-.
 - Only rotate the engine with the chain tensioner installed.
 6. Seal
 - Replace if damaged or leaking.
 7. Tensioning Rail
 - For the camshaft timing chain -item 10-.
 8. Pin
 - **10 Nm**
 - For the tensioning rail -item 7-.
 9. Chain Sprocket
 - For the timing chains.
 10. Timing Chain
 - For the camshafts.
 - Mark the direction of rotation before removing (installed position). Refer to **Fig. 12**.
 - **Removing and installing** , refer to **CAMSHAFT TIMING CHAIN** .
 11. Bolt
 - **60 Nm + 90° (1/4) additional turn.**
 - Always replace.
 12. Exhaust Camshaft Adjuster
 - Identification: 32A
 - **Removing and installing** , refer to **CAMSHAFT ADJUSTER WITH TIMING CHAIN, INSTALLING** .
 13. Bolt
 - **60 Nm + 90° (1/4) additional turn.**
 - Always replace.
 - The contact surface of the sensor wheel at the bolt head must be dry when installing.
 - When removing and installing, counter-hold the camshaft using a 27 mm open end wrench. Refer to **CAMSHAFTS** .
 14. Intake Camshaft Adjuster
 - Identification: 24E
 - **Removing and installing** , refer to **CAMSHAFT ADJUSTER WITH TIMING CHAIN, INSTALLING** .

15. Bolt
 - **10 Nm**
16. Chain Tensioner with Tensioning Rail
 - For the oil pump timing chain -item 19-.
 - Only rotate the engine with the chain tensioner installed.
17. Drive Sprocket
 - Integral part of the crankshaft.
 - The milled tooth aligned with the crankshaft main bearing cap joint = Top Dead Center (TDC) for cylinder 1, install the oil pump timing chain. Refer to **CAMSHAFT AND OIL PUMP TIMING CHAINS**.
18. Pin without Collar
 - **10 Nm**
 - For the guide rail -item 23-.
19. Timing Chain
 - For the oil pump.
 - Mark the direction of rotation before removing (installed position). Refer to **Fig. 12**.
 - **Installing**, refer to **OIL PUMP**.
20. Pin
 - **10 Nm**
 - For the guide rail.
21. Bolt
 - **23 Nm**
22. Guide Rail
 - For the camshaft timing chain -item 10-.
23. Guide Rail
 - For the oil pump timing chain -item 19-.
 - Together with the camshaft timing chain, removing and installing. Install the oil pump timing chain. Refer to **OIL PUMP**.
24. Drive Sprocket
 - For the high pressure pump.
 - With needle bearings.
 - Oil the needle bearing before installing.

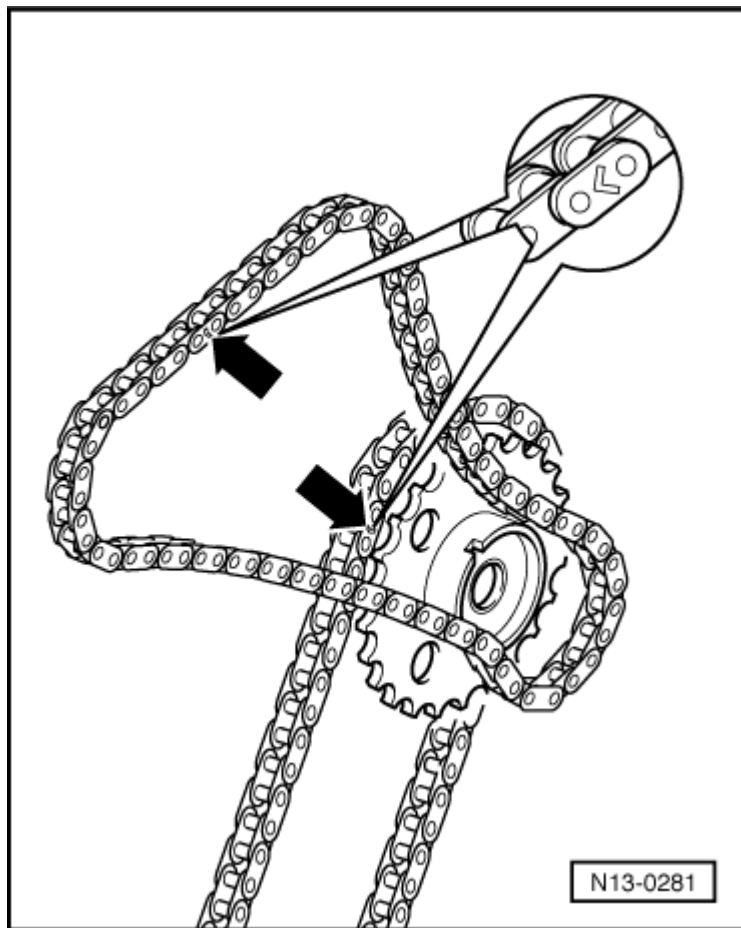


Fig. 12: Identifying Marks On Roller Chains

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Mark the timing chains before removing (for example, with a paint arrow, pointing in the direction of rotation).

NOTE: **Do not mark the chain using a center punch or similar means!**

CYLINDER BLOCK AND ATTACHMENTS

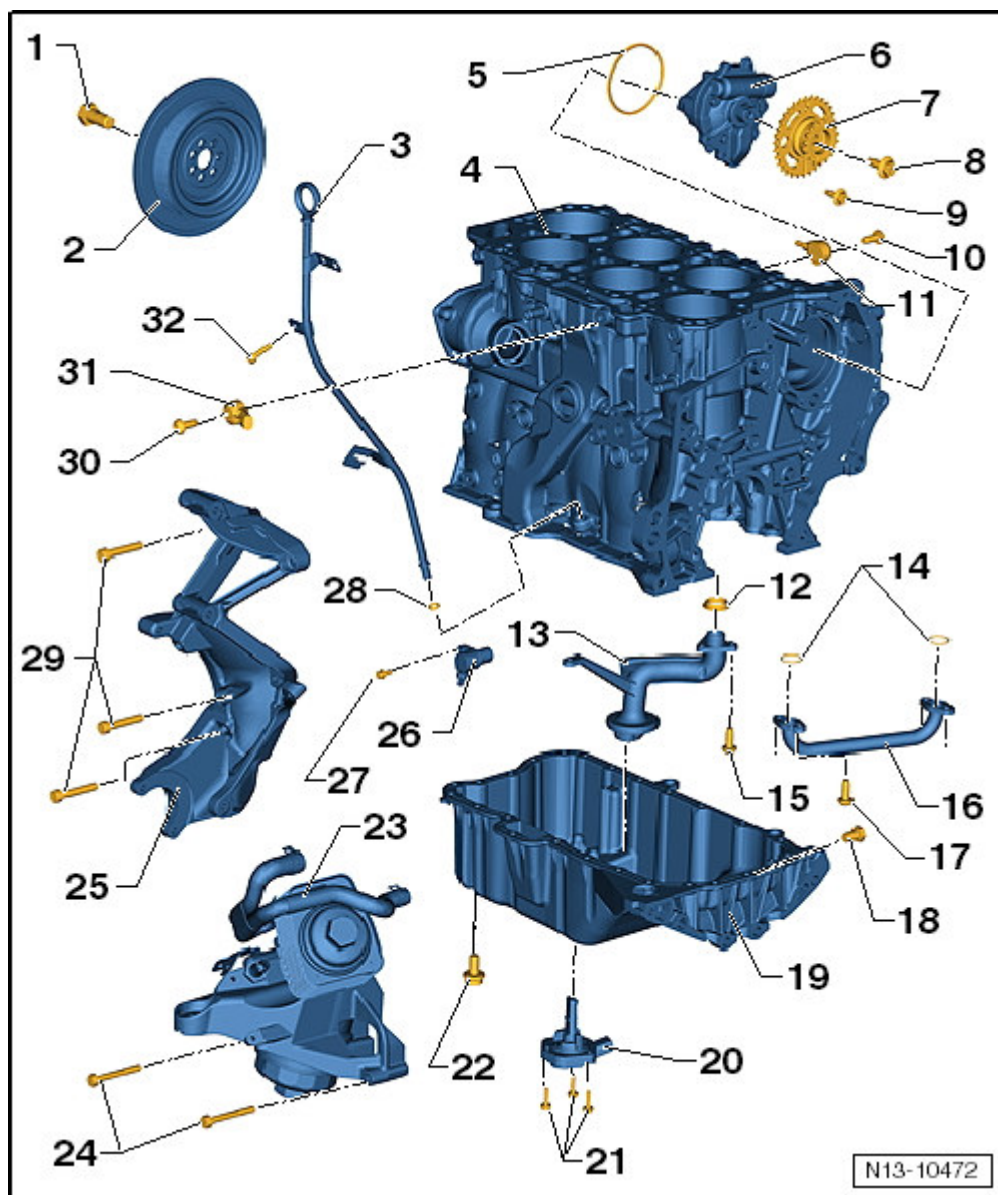


Fig. 13: Identifying Cylinder Block And Attaching Components

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Bolt

- 60 Nm + 180° (1/2) additional turn.
- Quantity: 7

2. Vibration Damper

- **Removing and installing** , refer to **VIBRATION DAMPER**.
- **Removing and installing** the ribbed belt. Refer to **RIBBED BELT**.

3. Oil Dipstick Guide Tube

- For the oil dipstick.
- Secured by a bolt to the intake manifold.

4. Cylinder Block
 - Sealing flange and drive plate overview. Refer to **SEALING FLANGE AND DRIVE PLATE OVERVIEW**
 - Piston and connecting rod overview. Refer to **PISTON AND CONNECTING ROD OVERVIEW**.
5. Seal
 - Always replace.
 - Coat with oil before installing.
6. Oil Pump
 - **Removing and installing** , refer to **OIL PUMP** .
7. Chain Sprocket
8. Bolt
 - **60 Nm + 90° (1/4) additional turn.**
 - Always replace.
9. Bolt
 - **8 Nm**
 - Install using liquid locking fluid D 000 600 A2.
10. Bolt
 - **20 Nm**
 - The tightening specification affects the function of the knock sensor.
11. Knock Sensor 1 -G61-
 - Installed location: between cylinders 1 and 3, below the exhaust manifold.
12. Gasket
 - Always replace.
13. Suction Pipe
 - For the oil pump.
14. O-rings
 - Always replace.
15. Bolt
 - **8 Nm**
 - Install using liquid locking fluid D 000 600 A2.
16. Oil Pipe
17. Bolt
 - **8 Nm**
 - Install using liquid locking fluid D 000 600 A2.
18. Oil Drain Plug
 - **30 Nm**
 - Always replace.

- With a permanent seal.
19. Oil Pan
 - **Removing and installing** , refer to **OIL PAN** .
 20. Oil Level Thermal Sensor -G266-
 21. Bolt
 - **12 Nm**
 22. Bolt
 - **10 Nm**
 23. Oil Filter Housing
 - Overview, refer to **OIL FILTER HOUSING OVERVIEW** .
 24. Bolt
 - **23 Nm**
 25. Accessory Bracket
 - For the generator and Air Conditioning (A/C) compressor.
 - **Removing and installing** , refer to **ACCESSORY BRACKET** .
 26. Engine Speed Sensor -G28-
 27. Bolt
 - **10 Nm**
 28. O-ring
 - Always replace.
 29. Bolt
 - **23 Nm**
 30. Bolt
 - **20 Nm**
 - The tightening specification affects the function of the knock sensor.
 31. Knock Sensor 2 -G66-
 - Installed location: between cylinders 4 and 6.
 32. Bolt
 - **6 Nm**
 - To the intake manifold.

SEALING FLANGE AND DRIVE PLATE OVERVIEW

NOTE: **Secure the engine to engine and transmission holder VAS 6095 when working on it.**

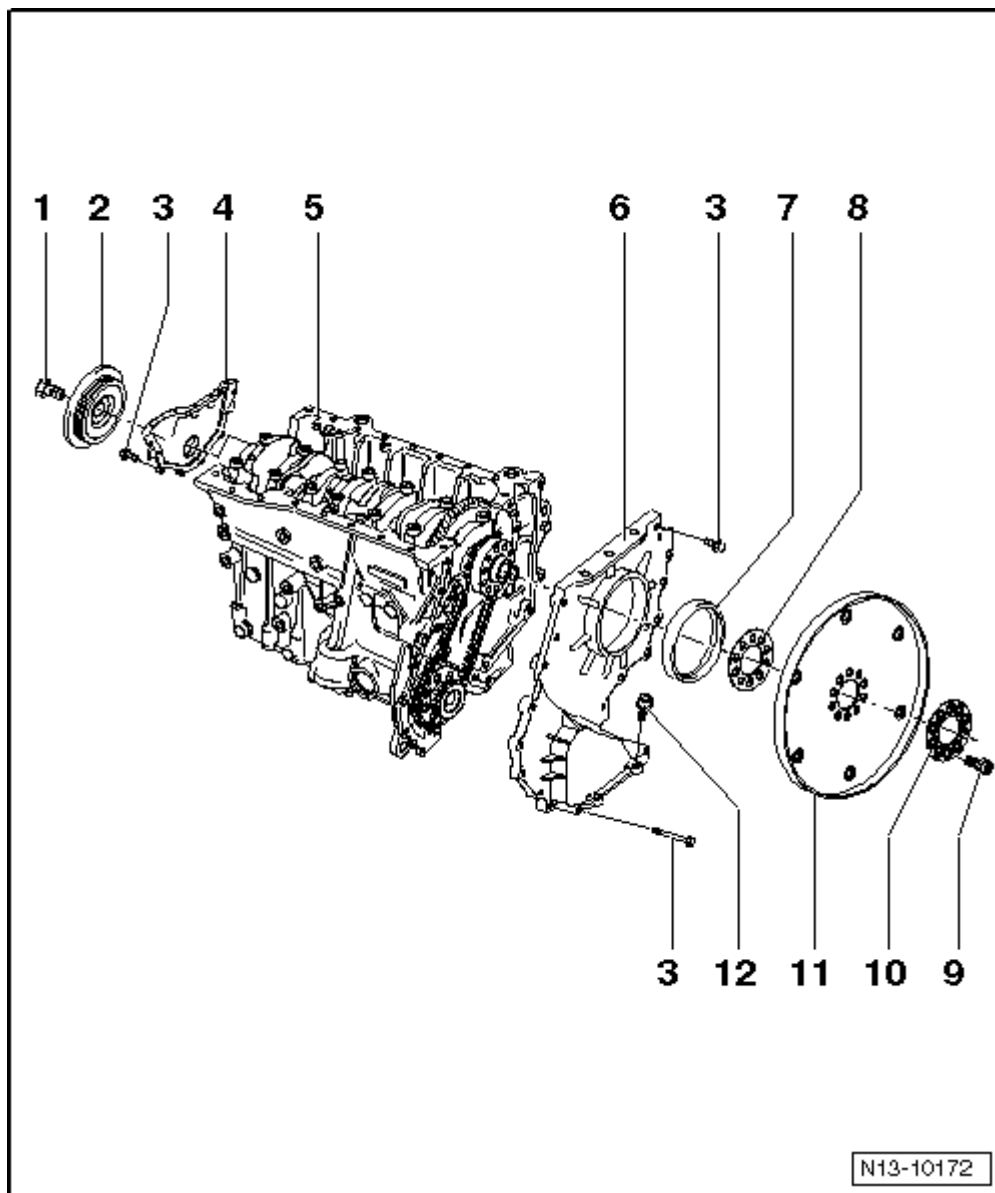


Fig. 14: Identifying Sealing Flange And Drive Plate, Assembly Overview
 Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Bolt

- **Removing and installing** , refer to one of the following:

Engine code BLV, refer to **VIBRATION DAMPER**.

Engine code CNNA, refer to **VIBRATION DAMPER**.

2. Vibration Damper

- **Removing and installing** , refer to one of the following:

Engine code BLV, refer to **VIBRATION DAMPER**.

Engine code CNNA, refer to **VIBRATION DAMPER**.

3. Bolt

- **10 Nm**

4. Sealing Flange

- **Removing and installing** , refer to one of the following:

Engine code BLV, refer to **CRANKSHAFT SEALING FLANGE, VIBRATION DAMPER SIDE**

Engine code CNNA, refer to **CRANKSHAFT SEALING FLANGE, VIBRATION DAMPER SIDE**

- Coat the sealing surfaces with silicone adhesive sealant D 176 501 A1.

5. Cylinder Block

- Crankshaft overview. Refer to **CRANKSHAFT OVERVIEW**.
- Piston and connecting rod overview. Refer to **PISTON AND CONNECTING ROD OVERVIEW**.

6. Sealing Flange

- **Removing and installing** , refer to **SEALING FLANGE, TRANSMISSION SIDE**.

7. Seal

- Remove using the pulling hook T20143/2.
- Polytetrafluoroethylene (PTFE) version of the seal.
- Do not lubricate or grease the sealing lip on the seal.
- Wipe off any oil on the crankshaft journal with a clean cloth before installing.
- **Installing** , refer to **CRANKSHAFT SEAL, TRANSMISSION SIDE**.

8. Shim

9. Bolt

- **60 Nm + 90° (1/4) additional turn.**
- Always replace.
- To loosen or tighten, use the counter hold tool T10044 (with 5 mm spacers), or the counter-holder tool T10069.

10. Washer

11. Drive Plate

- **Removing and installing** , refer to **DRIVE PLATE**.

12. Bolt

- **23 Nm**

COVER AND SEALING FLANGE OVERVIEW

Mechanical vacuum pump overview. Refer to **MECHANICAL VACUUM PUMP OVERVIEW** .

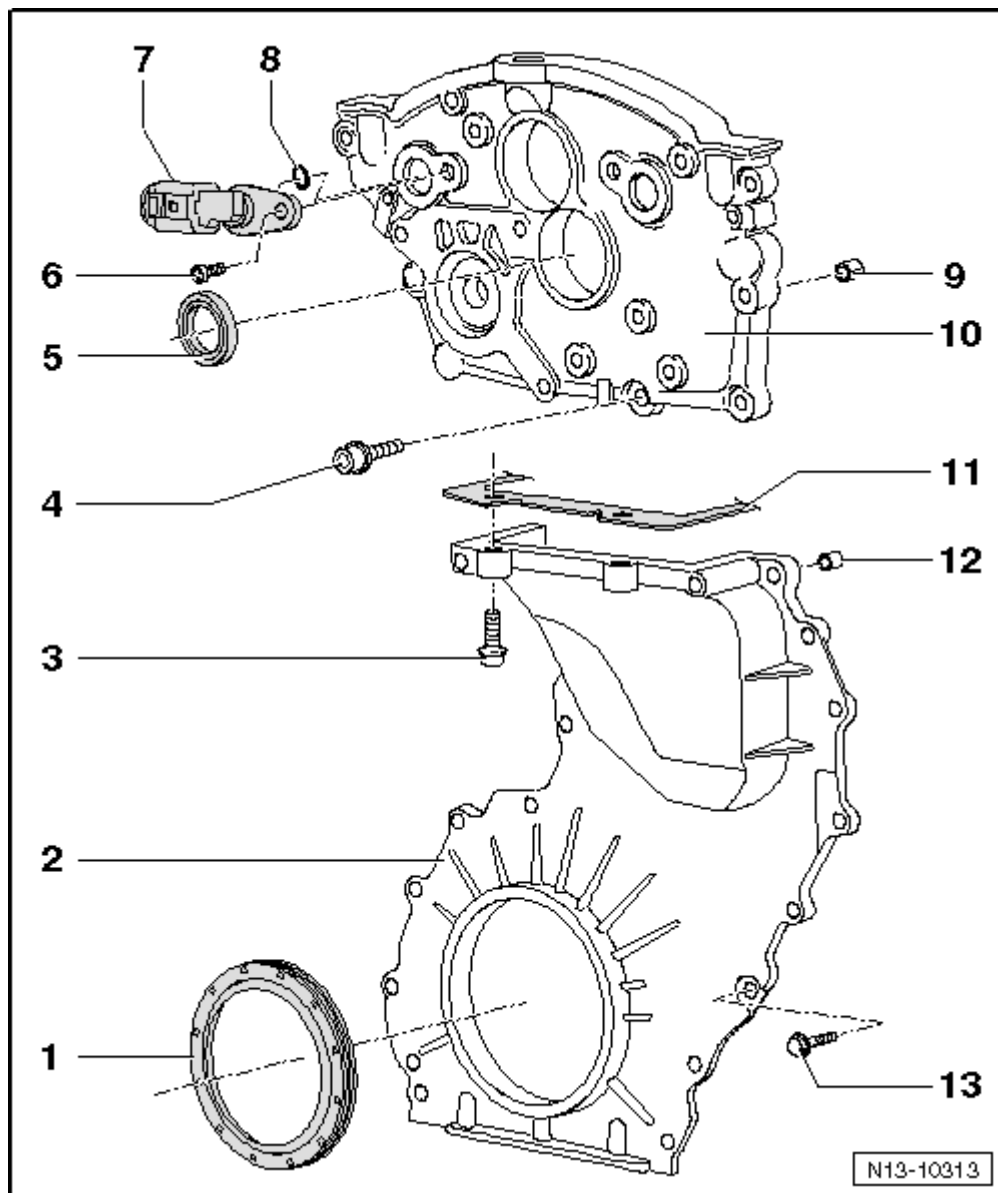


Fig. 15: Identifying Timing Chain Cover And Sealing Flange Overview
 Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Seal
 - For the crankshaft.
 - **Removing and installing** , refer to **CRANKSHAFT SEAL, TRANSMISSION SIDE.**
2. Sealing Flange
 - Transmission side.
 - **Removing and installing** , refer to **SEALING FLANGE, TRANSMISSION SIDE.**
3. Bolt
 - **23 Nm**
4. Bolt

- **8 Nm**
 - Tighten in a diagonal sequence and in steps.
5. Seal
- Quantity: 2
 - For the camshaft adjustment valve 1 -N205- and the exhaust camshaft adjustment valve 1 -N318-.
 - Replace if leaking or damaged.
 - **Removing and installing** , refer to **COVER SEAL, INSTALLING** .
6. Bolt
- **8 Nm**
7. Camshaft Position Sensor
- Camshaft position sensor -G40- and camshaft position sensor 2 -G163-.
8. O-ring
- Always replace.
 - Quantity: 2
9. Alignment Pins
- Quantity: 2
10. Cover
11. Cylinder Head Gasket
- Clean the holes and fill with sealant.
12. Alignment Pins
13. Bolt
- **10 Nm**

CRANKSHAFT OVERVIEW

NOTE: Before removing the crankshaft, prepare for appropriate storage, so that the sensor wheel -item 6- does not make contact or become damaged.

The engine is to be secured to the engine and transmission holder VAS 6095 when performing assembly work.

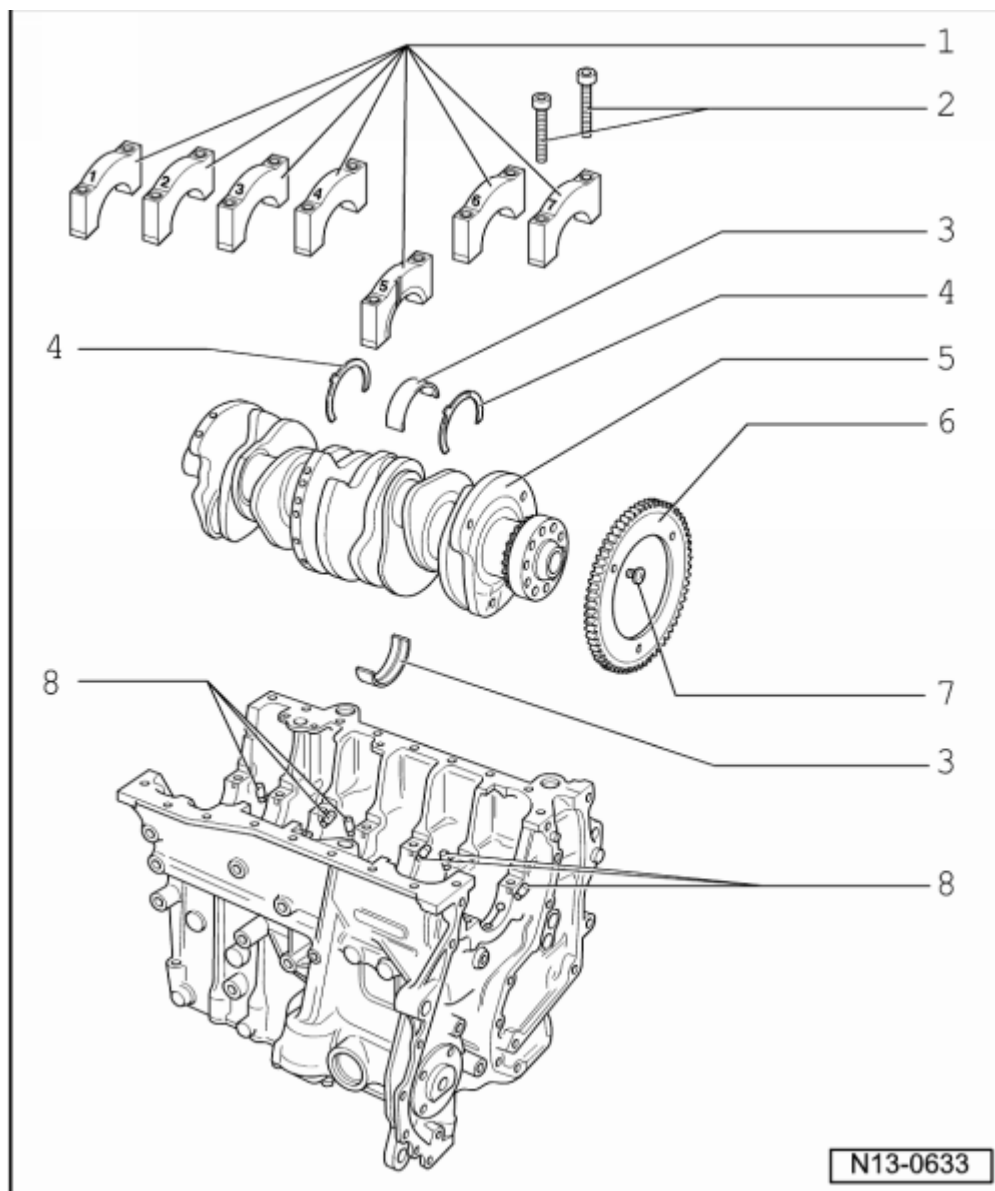


Fig. 16: Identifying Crankshaft, Assembly Overview
 Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Bearing Cap

- Bearing cap 1: Vibration damper side.
- Bearing cap 5, with notches for the thrust washers.
- Retaining tabs on the bearing shells and the cylinder block/bearing caps must align above one another.

2. Bolt

- **30 Nm + 180° (1/2) additional turn.**
- Always replace.
- Two additional 90° turns is permitted.

3. Bearing Shell, 1 through 7

- For bearing caps without a oil groove.
- For the cylinder block with a oil groove.
- Do not interchange used bearing shells (mark them).
- Crankshaft bearing shell allocating. Refer to **CRANKSHAFT BEARING SHELL, ALLOCATING.**

4. Thrust Washer

- For bearing cap 5.
- Observe the locating point.

5. Crankshaft

- If replacing the crankshaft, allocate the crankshaft bearing shells. Refer to **CRANKSHAFT BEARING SHELL, ALLOCATING.**
- Before removing, observe the note at the top.
- Axial play:

New: 0.07 to 0, 23 mm

Wear limit: 0.30 mm

- Check the radial clearance using Plastigage®:

0.02 to 0.06 mm

Wear limit: 0.10 mm

- Do not rotate the crankshaft when measuring the radial play.
- Crankshaft dimensions:

Crankshaft bearing: 59.958 to 59.978 mm

Connecting rod bearing: 53.958 to 53.978 mm

- It is not permissible to rework the crankshaft.

6. Sensor Wheel

- For the engine speed sensor -G28-.
- Always replace.
- Installing, refer to **CRANKSHAFT SENSOR WHEEL, INSTALLING.**

7. Screw

- **10 Nm + 90° (1/4) additional turn.**
- Always replace.

8. Oil Spray Jet

- For crankshaft bearings 2 through 7.

- For piston cooling.
- Opening pressure:

2.0 bar

- **Removing and installing** , refer to **OIL SPRAY JET** .
- See the note in the engine overviews, refer to one of the following:

Engine code BLV, refer to **ENGINE OVERVIEWS**.

Engine code CNNA, refer to **ENGINE OVERVIEWS**.

PISTON AND CONNECTING ROD OVERVIEW

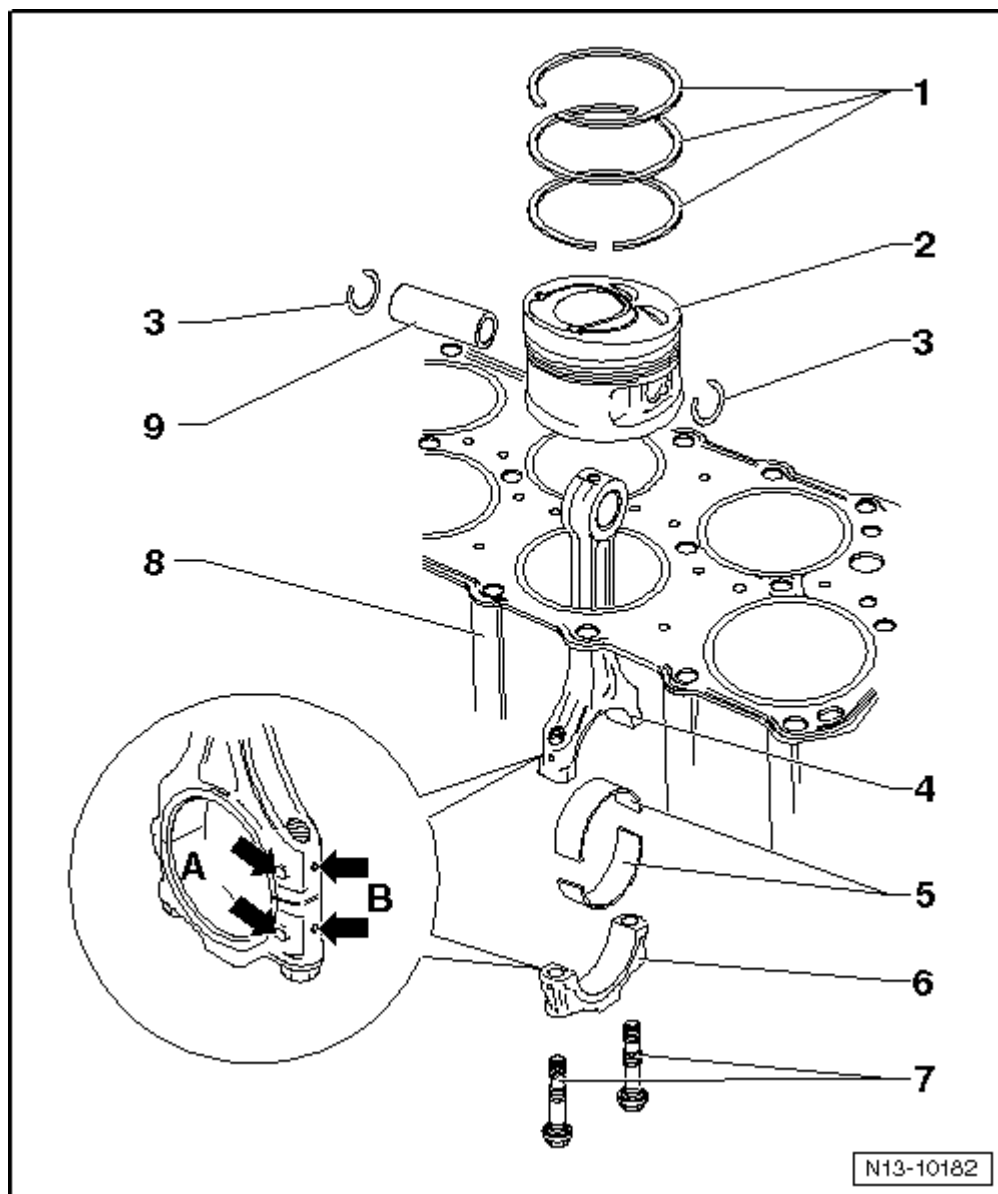


Fig. 17: Identifying Piston And Connecting Rod Assembly Overview
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Piston Rings

- Offset gaps by 120°.
- Use piston ring pliers for removal and installation.
- "TOP" faces toward the piston crown.
- Checking the ring gap. Refer to **PISTON RING GAP, CHECKING**.
- Checking the piston ring groove clearance. Refer to **PISTON RING GROOVE CLEARANCE, CHECKING**.

2. Piston

- Checking, refer to **PISTON, CHECKING**.
- Mark the installed location to the connecting rod and to the cylinder to which it belongs.
- The 2 deep valve recesses in the piston head point toward the center of the cylinder block.
- **Removing and installing**, refer to **PISTON**.

3. Locking Ring

- Make sure it is secure.

4. Connecting Rod

- Only replace as a set.
- Mark which cylinder to which it belongs -B-.
- Installed position: Marks -A- must align.

5. Bearing Shell

- Pay attention to the installed position.
- Do not interchange used bearing shells (mark them).
- The bearing shell retaining tabs must be firmly seated in the notches.
- Axial clearance:

New: 0.05 to 0.31 mm

Wear limit: 0.40 mm

- Measure the radial clearance using Plastigage®:

New: 0.02 to 0.07 mm

Wear limit: 0.10 mm

- Do not rotate the crankshaft when measuring radial play.

6. Connecting Rod Bearing Cap

- Mark which cylinder to which it belongs -B-.
- Installed position: Marks -A- must align.

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ENGINE 3.6 Liter - Crankshaft, Cylinder Block - Engine Code(s): BLV & CNNA

7. Bolt

- **40 Nm + 90° (1/4) additional turn.**
- Always replace.
- Lubricate the threads and contact surface.
- Only tighten to 40 Nm to measure the radial play, do not tighten the additional torque angle.

8. Cylinder Block

- Checking the cylinder bore. Refer to **CYLINDER BORE, CHECKING**.
- Crankshaft overview. Refer to **CRANKSHAFT OVERVIEW**.
- For the correct piston and cylinder dimensions, refer to **PISTON AND CYLINDER DIMENSIONS**.

9. Piston Pin

- If difficult to move, heat the piston to 60 °C (140 °F).
- Remove and install using the pilot drift VW 222 A.

SPECIFICATIONS

PISTON AND CYLINDER DIMENSIONS

		Piston Diameter	Cylinder Bore Diameter
Basic dimension	mm	88.945	89.010

FASTENER TIGHTENING SPECIFICATIONS

Component	Fastener Size	Nm
Air Conditioning Compressor to Accessory Bracket Bolt	M8 x 100	23
Camshaft Adjuster to Camshaft Bolt ⁽¹⁾	-	60 + 90°
Camshaft Position Sensor to Cover Bolt	-	8
Chain Tensioner to Cylinder Block	-	50
Chain Tensioner with Tensioning Rail to Cylinder Block Bolt ⁽²⁾	-	8 + 90°
Connecting Rod Bearing Cap to Connecting Rod Bolt ⁽¹⁾	-	30 + 90°
Control Housing to Cylinder Head Bolt ⁽²⁾	-	8 + 90°
Cover to Cylinder Head Bolt ⁽⁵⁾	-	8
Crankshaft Bearing Cap to Cylinder Block Bolt	-	30 + 180°
Crankshaft Sensor Wheel to Crankshaft Screw ⁽¹⁾	-	10 + 90°
Drive Plate to Crankshaft Bolt ⁽¹⁾	-	60 + 90°
Engine Mount Bracket to Cylinder Block Bolt ⁽¹⁾	-	50 + 90°
Engine Speed Sensor to Cylinder Block Bolt	-	10

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ENGINE 3.6 Liter - Crankshaft, Cylinder Block - Engine Code(s): BLV & CNNA

Guide Rail to Cylinder Head Pin	-	10
Guide Rail to Cylinder Block Bolt	-	23
Guide Rail to Cylinder Block Pin	-	10
Knock Sensor to Cylinder Block Bolt ⁽⁴⁾	-	20
Oil Dipstick Guide Tube to Intake Manifold Bolt	-	6
Oil Drain Plug to Oil Pan ⁽¹⁾	-	30
Oil Filter Housing to Cylinder Block Bolt	-	23
Oil Level Thermal Sensor to Oil Pan Bolt	-	10
Oil Pan to Cylinder Block Bolt	-	11
Oil Pipe to Cylinder Block Bolt ⁽¹⁾	-	8
Oil Pump to Cylinder Block Bolt ⁽¹⁾	-	8
Sealing Flange to Cover Bolt	-	23
Sealing Flange to Cylinder Block Bolt	-	10
Sprocket to Oil Pump Bolt ⁽³⁾	-	60 + 90°
Suction Pipe to Cylinder Block Bolt ⁽¹⁾	-	8
Tensioning Rail to Cylinder Block Pivot Pin	-	10
Vibration Damper to Crankshaft Bolt ⁽¹⁾	-	100 + 180°

(1) Always replace

(2) Install the bolts using liquid locking fluid D 000 600 A2

(3) Only use bolts with a strength category of 10.9

(4) The tightening specification affects the function of the knock sensor

(5) Tighten in a diagonal sequence and in steps

Accessory Bracket Bolt Tightening Sequence and Specification

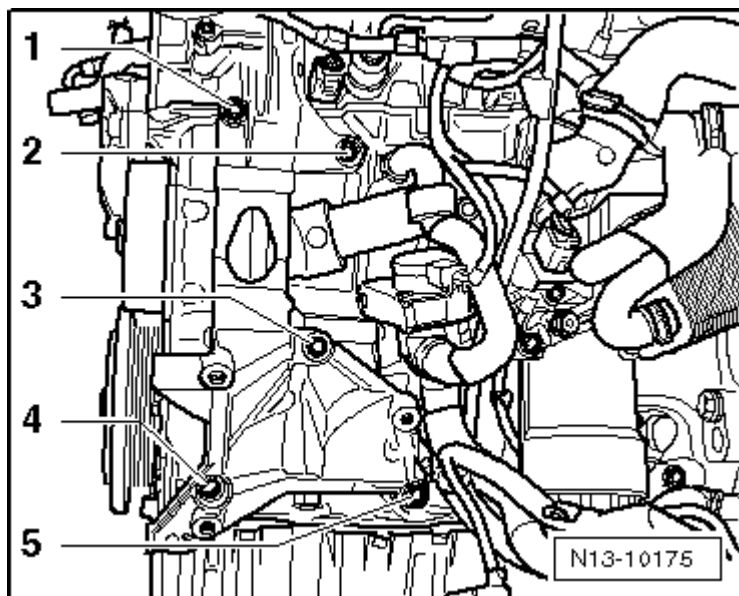


Fig. 18: Identifying Bracket On Cylinder Block, Removal/Installation
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Install and tighten the bolts -2 and 4- hand tight.
- Install and tighten the bolts -1, 3 and 5- hand tight.
- Tighten all the bolts in a diagonal sequence to 23 Nm.

DIAGNOSIS AND TESTING

PISTON, RINGS AND CYLINDER BORE, CHECKING

PISTON RING GAP, CHECKING

Special tools and workshop equipment required

- Feeler Gauge

Test Sequence

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

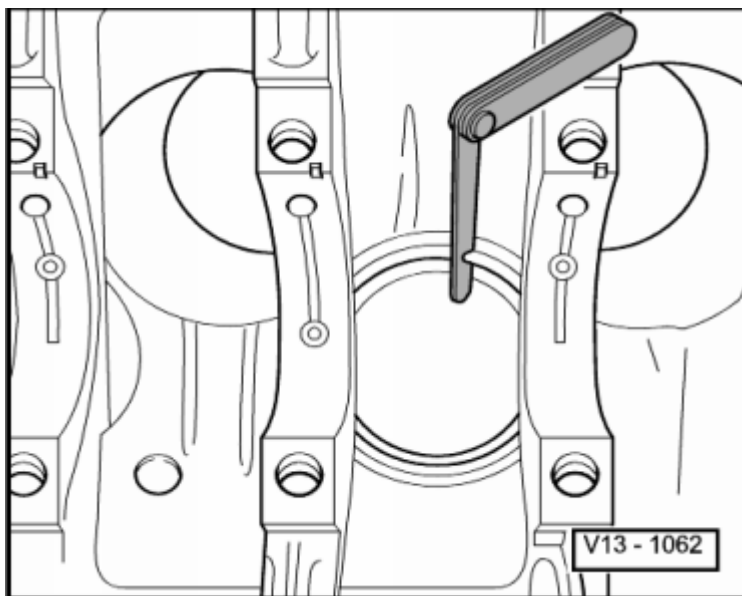


Fig. 19: Checking Piston Ring Gap

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Piston Ring		Gap	
		New	Wear limit
Compression ring	mm	0.30 ••• 0.45	1.0
Stepped compression ring	mm	0.30 ••• 0.50	1.0
Oil scraping ring	mm	0.20 ••• 0.90	1.2

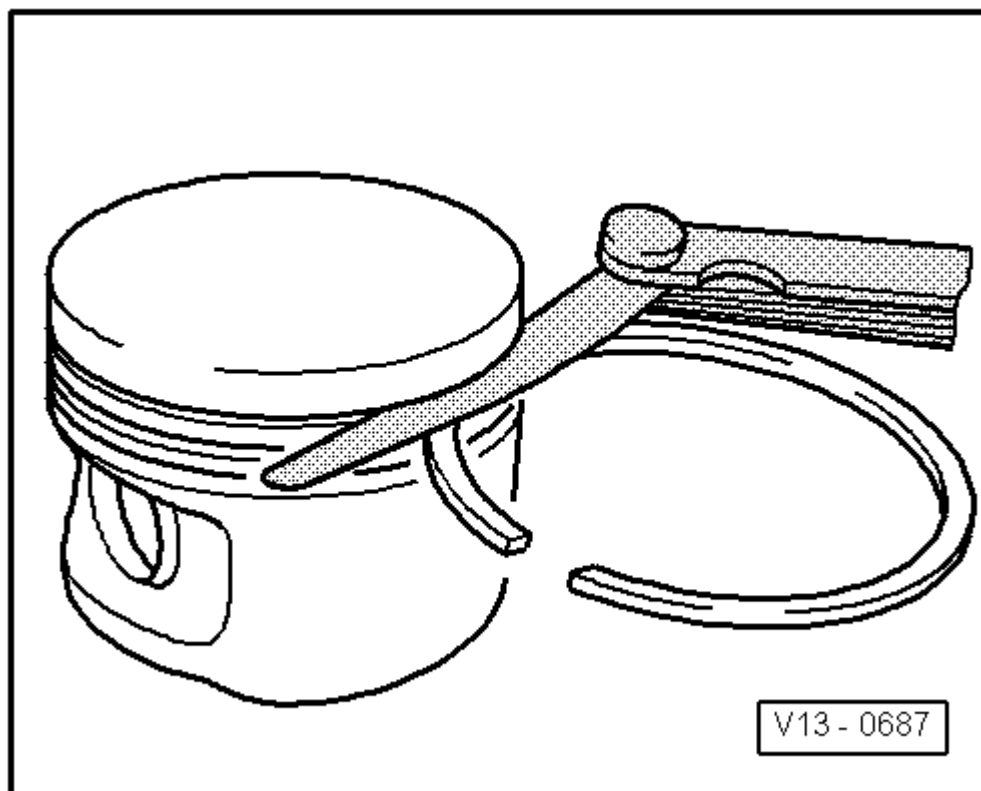
PISTON RING GROOVE CLEARANCE, CHECKING

Special tools and workshop equipment required

- Feeler Gauge

Test Sequence

Clean the ring groove before checking.

**Fig. 20: Checking Piston Ring Gap**

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Piston Ring		Ring to Groove Clearance	
		New	Wear limit
Compression ring	mm	0.04 ••• 0.06	0.12
Stepped compression ring	mm	0.03 ••• 0.06	0.15
Oil scraping ring	mm	0.02 ••• 0.06	0.15

PISTON, CHECKING**Special tools and workshop equipment required**

- Micrometer 75-100 mm VAS 6071

Test Sequence

-- Take the measurement approximately 15 mm from the lower edge of the piston skirt and offset 90° to the piston axis.

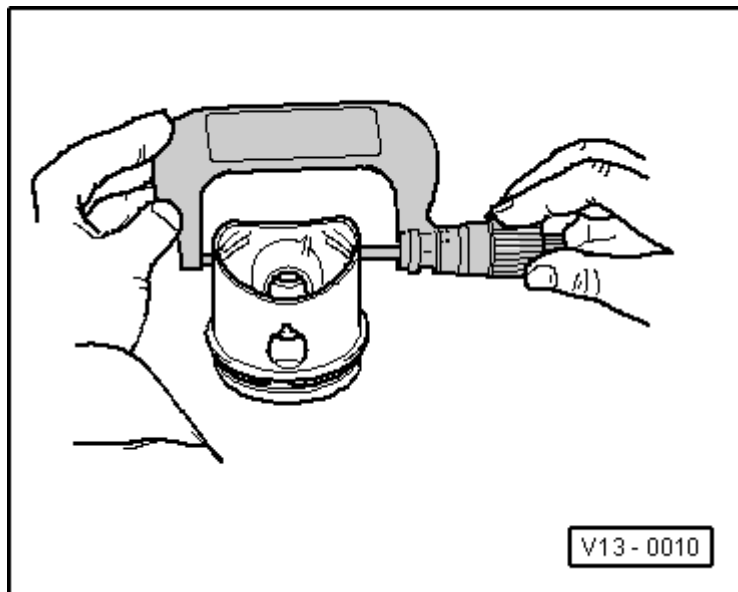


Fig. 21: Checking Piston

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Deviation from nominal dimension: Max. 0.06 mm

CYLINDER BORE, CHECKING

Special tools and workshop equipment required

- Cylinder Gauge VAS 6078

Test Sequence

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

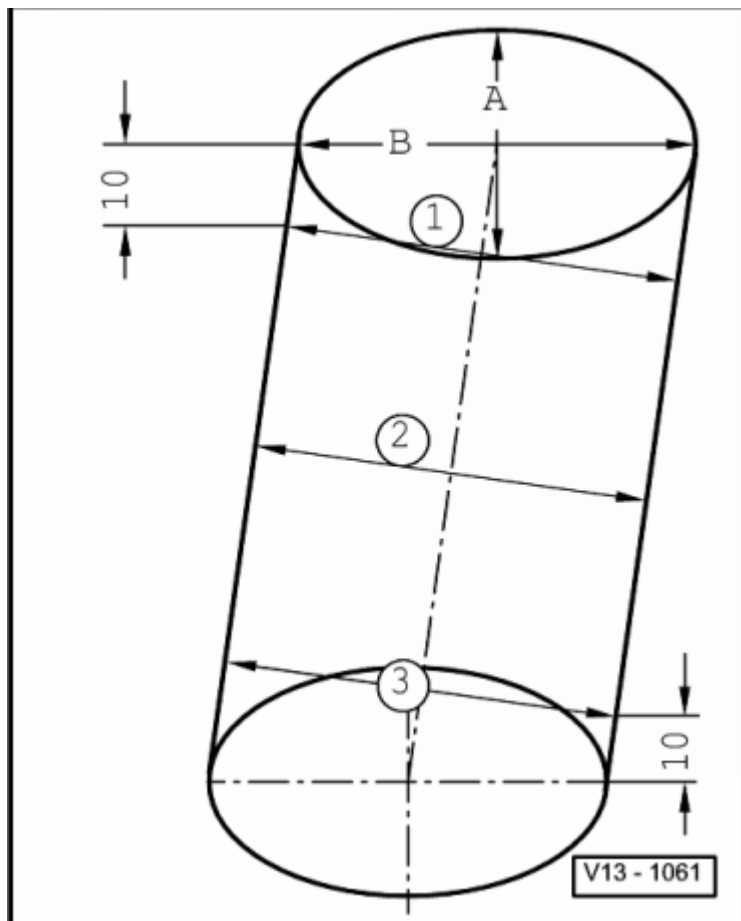


Fig. 22: Checking Cylinder Bore

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Deviations from nominal dimension: 0.08 mm.

NOTE: Measurement of the cylinder bore must not be performed when the cylinder block is installed on the engine and transmission holder VAS 6095 or the holding fixture VW 540, false measurements are possible.

REMOVAL AND INSTALLATION

Engine Code BLV

Engine Code CNNA

All

RIBBED BELT, ENGINE CODE BLV

Special tools and workshop equipment required

- Connecting Pin T10027

Removing

- Remove the engine cover.
- Remove the noise insulation. Refer to **Description and Operation** .
- Mark the running direction of the ribbed belt before removing.
- Install a box end wrench -1- onto the belt tensioner bolt and rotate in the -direction of the arrow- far enough until the connecting pin T10027 can be inserted into the tensioner.

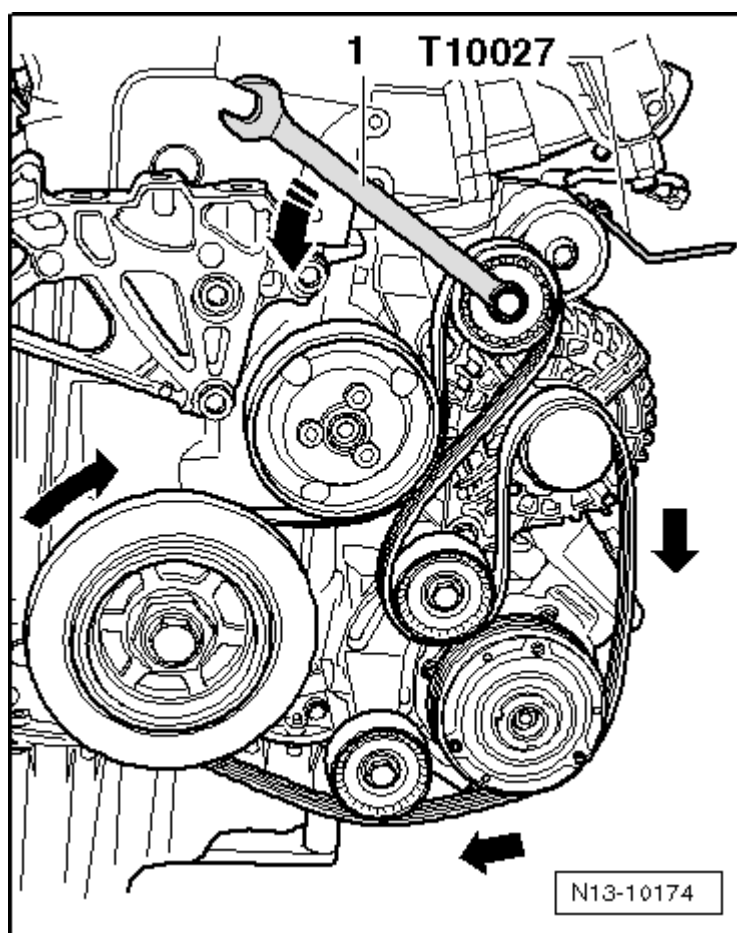


Fig. 23: Identifying Ribbed Belt Routing
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Remove the ribbed belt.

Installing

NOTE: Before installing the ribbed belt, make sure that all ancillaries (generator and Air

Conditioning (A/C) compressor) are secured tightly.

Check the idler pulleys for ease of movement

The ribbed belt must not be kinked.

Note the previously marked belt rotation direction and be sure that it is seated correctly on the pulleys.

-- Install the ribbed belt as illustrated.

-- Then, rotate the tensioner slightly in the -direction of the arrow- using a box end wrench -1-. This releases the tension on the connecting pin T10027 in the tensioner and it can be pulled out.

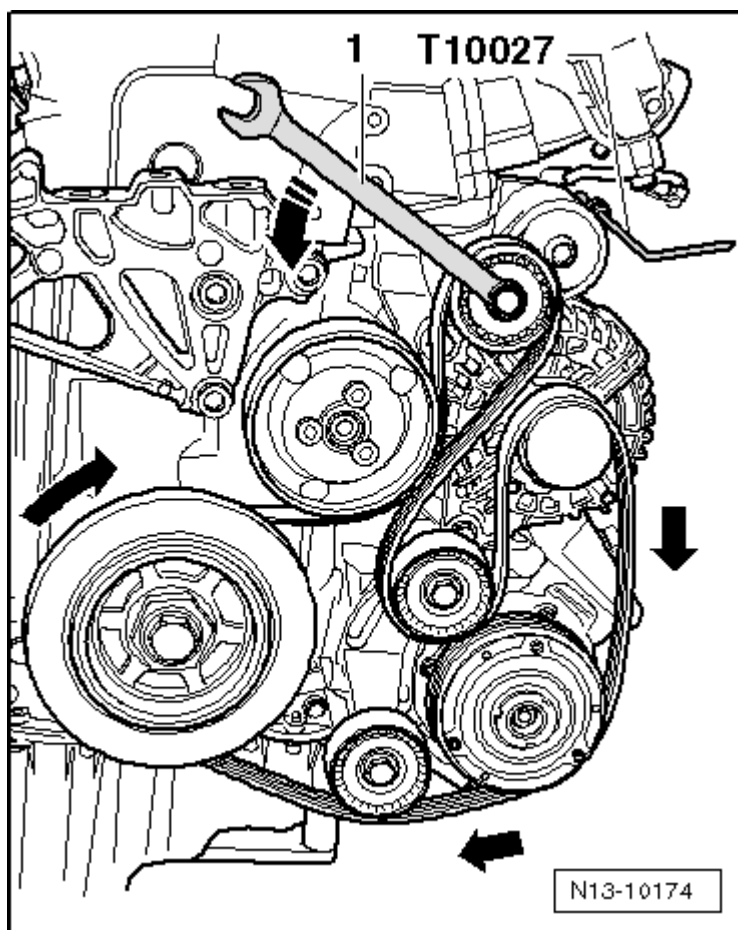


Fig. 24: Identifying Ribbed Belt Routing
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

After installing the ribbed belt, start the engine and make sure the ribbed belt is running correctly.

ACCESSORY BRACKET, ENGINE CODE BLV

Removing

- Remove the ribbed belt. Refer to **RIBBED BELT**.
- Remove the generator. Refer to **Removal and Installation** .
- Remove the Air Conditioning (A/C) compressor. Refer to **Removal and Installation** .
- Remove the accessory bracket bolts and bracket.

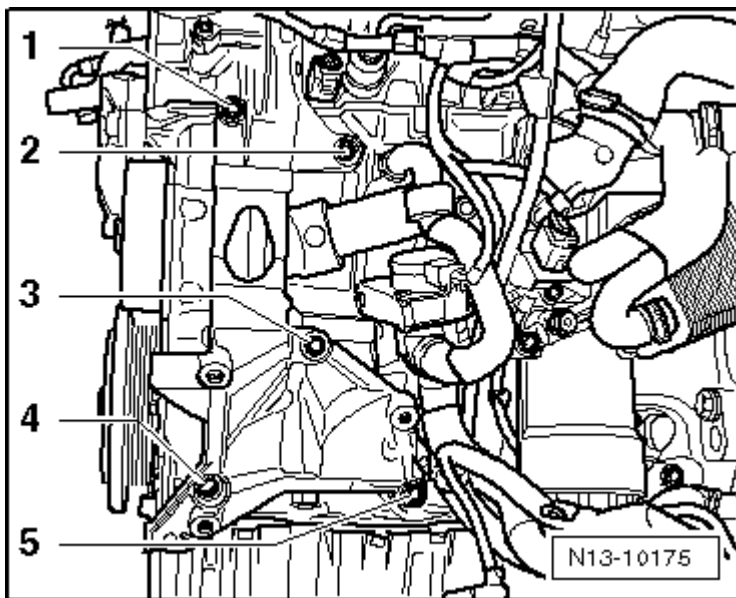
Installing

Fig. 25: Identifying Bracket On Cylinder Block, Removal/Installation
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Position the accessory bracket to the cylinder block.
- First, install the bolts -2 and 4- hand tight.
- Then, install the bolts -1, 3 and 5- hand tight.
- Now, tighten all the bolts to 23 Nm in a diagonal sequence.

Further installation is in the reverse order of removal.

VIBRATION DAMPER, ENGINE CODE BLV**Special tools and workshop equipment required**

- Counter-Holder Tool T10069

- Two Arm Puller T10040
- Puller Legs with Thrust Piece T10040/2A+/3

NOTE: The two arm puller T10040 is only necessary for tight fitting vibration dampers.

Removing

- Remove the ribbed belt. Refer to **RIBBED BELT**.
- Secure the vibration damper using the counter-holder tool T10069.
- Loosen the vibration damper bolt and unscrew it approximately 10 mm.
- Remove the vibration damper from the crankshaft hub. If the vibration damper cannot be removed, use the two arm puller T10040 and puller legs T10040/2A and T10040/3.

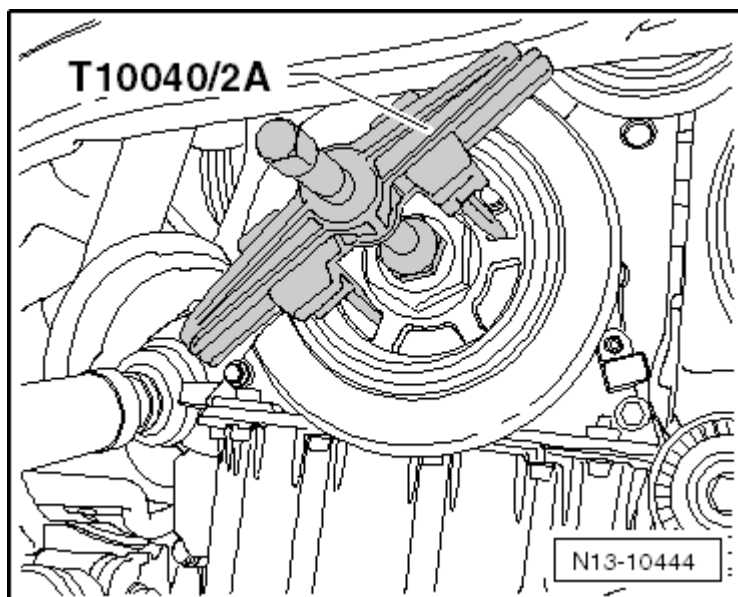


Fig. 26: Identifying Vibration Damper With Two Arm Puller, Removal/Installation
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Installing

CAUTION: Check the rubber connection between the inner ring and the outer ring of the vibration damper for cracks and flaking. If rubber connection damage is identified, the vibration damper must be replaced.

- Clean the threads in the crankshaft using an M18 x 1.5 thread tap.
- Replace the vibration damper bolts.

-- Position the vibration damper and tighten the bolt using the torque wrench V.A.G 1601 and the counter-holder tool T10069.

Tightening specification: 100 Nm + 180° (1/2) additional turn.

-- Install the ribbed belt. Refer to **RIBBED BELT**.

CRANKSHAFT SEALING FLANGE, VIBRATION DAMPER SIDE, ENGINE CODE BLV

Special tools and workshop equipment required

- Counter-Holder Tool T10069
- Assembly Tool T10215
- Torque Wrench (40-200 Nm) V.A.G 1332
- Torque Wrench V.A.G 1601
- Silicone Adhesive Sealant D 176 501 A1

Removing

-- Remove the ribbed belt. Refer to **RIBBED BELT**.

-- Remove the vibration damper. To do so, secure the vibration damper using the counter-holder tool T10069. Refer to **VIBRATION DAMPER**.

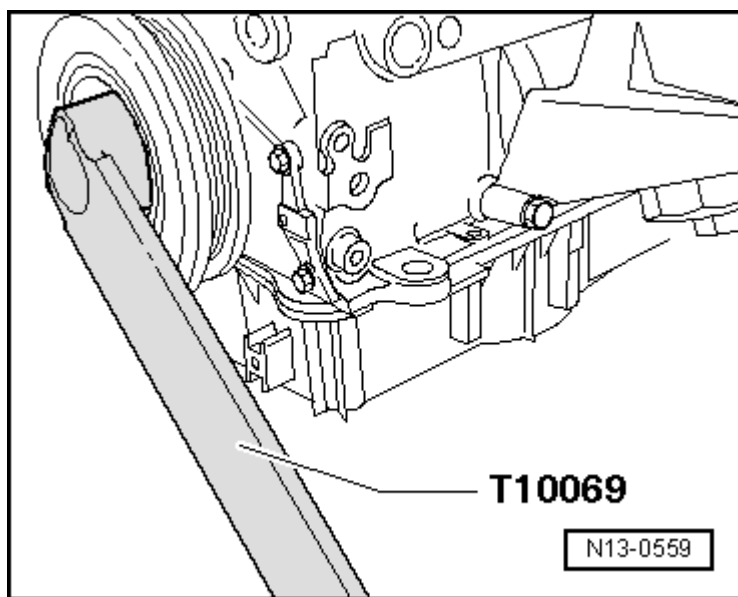


Fig. 27: Identifying Counter-Holder T10069 To Hold Vibration Damper
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the oil pan. Refer to **OIL PAN**.

-- Remove the sealing flange bolts and sealing flange.

-- Remove any sealant residue on the sealing surfaces.

Installing

-- Before installing, remove any remaining oil from the crankshaft journal with a clean cloth.

-- Cut the tube nozzle at the front mark (nozzle diameter: approximately 3 mm).

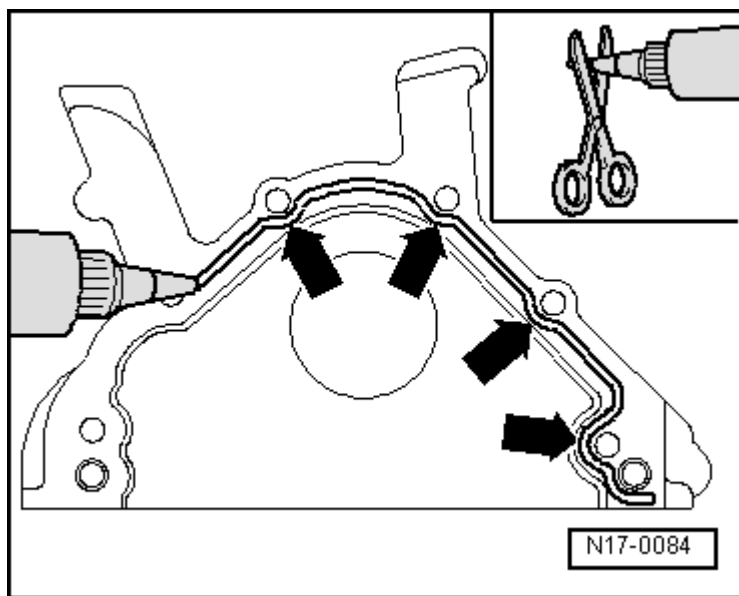


Fig. 28: Applying Silicone Sealing Compound

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Apply a bead of silicone adhesive sealant D 176 501 A1 approximately 2 to 3 mm thick, as shown -arrows- onto the clean sealing flange sealing surface.

NOTE: Cover the seal with a clean cloth before applying the sealant bead.

The sealant bead must not be thicker than 2 to 3 mm or the excess sealant could get into the oil pan and clog the suction pipe strainer.

Note the expiration date of the sealant.

The sealing flange must be installed within 5 minutes after application of the sealant.

-- Insert the guide sleeve T10215/1 -1- onto the crankshaft journal -3-.

-- Now, slide the sealing flange with seal -2- carefully over the guide sleeve.

-- Secure the sealing flange to the cylinder block. **Tightening specification: 10 Nm**

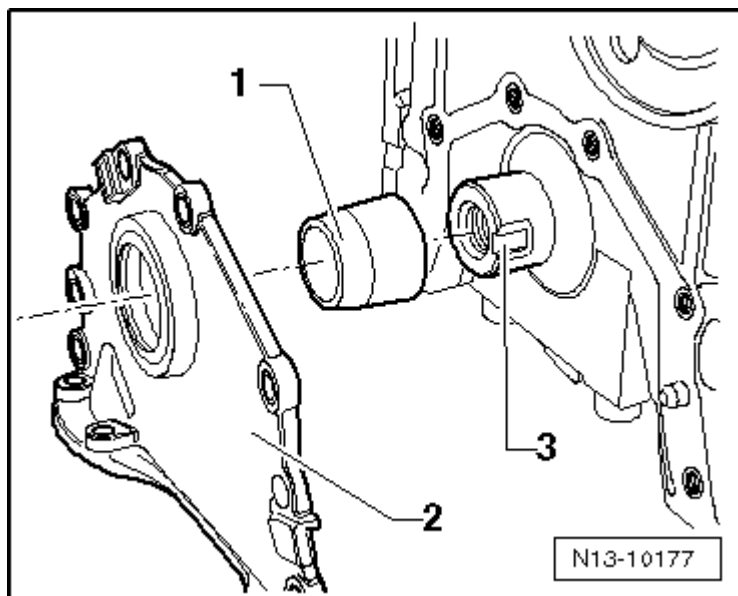


Fig. 29: Identifying Guide Sleeve T10215/1, Crankshaft Pin & Sealing Ring
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Install the oil pan. Refer to **OIL PAN** .
- Install the vibration damper. Refer to **VIBRATION DAMPER**.
- Install the ribbed belt. Refer to **RIBBED BELT**.

RIBBED BELT, ENGINE CODE CNNA

Special tools and workshop equipment required

- Connecting Pin T10027

Removing

- Remove the engine cover.
- Remove the noise insulation. Refer to **Description and Operation** .
- Identify the rotation direction for the ribbed belt before removing.
- Instal a box end wrench -1- onto the belt tensioner bolt and rotate in the -direction of the arrow- far enough until the connecting pin T10027 can be inserted into the tensioner.

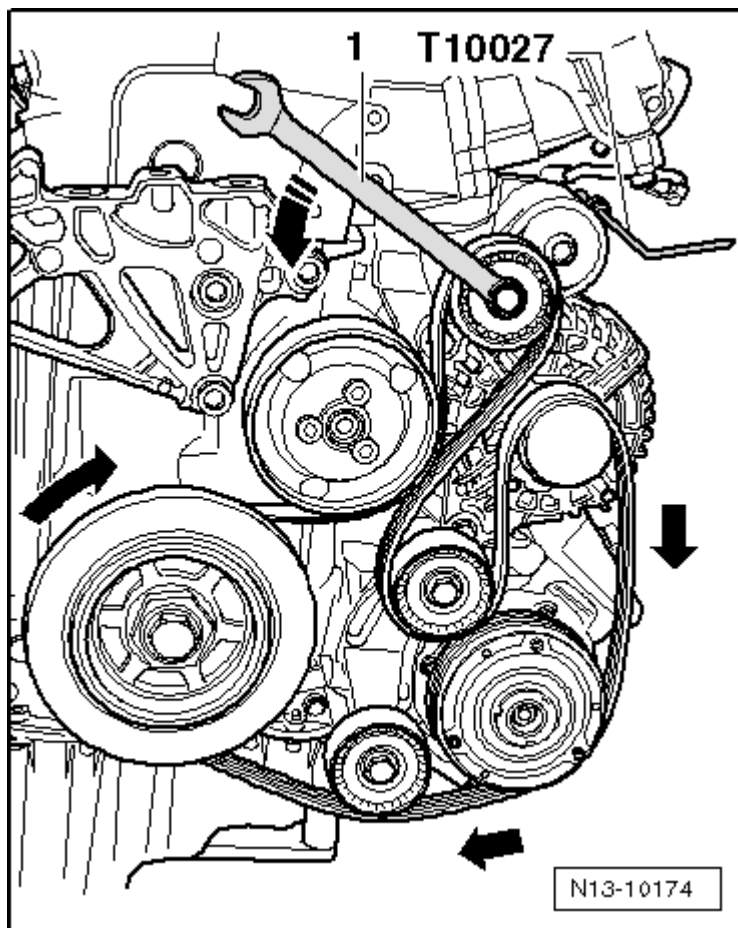


Fig. 30: Identifying Ribbed Belt Routing
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the ribbed belt.

Installing

NOTE: Before installing the ribbed belt, make sure that all ancillaries (generator and Air Conditioning (A/C) compressor) are secured tightly.

Check the idler pulleys for ease of movement

The ribbed belt must not be kinked.

Note the previously marked belt rotation direction and be sure that it is seated correctly on the pulleys.

-- Install the ribbed belt as illustrated.

-- Then, rotate the tensioner slightly in the -direction of the arrow- using a box end wrench -1-. This releases the tension on the connecting pin T10027 in the tensioner and it can be removed.

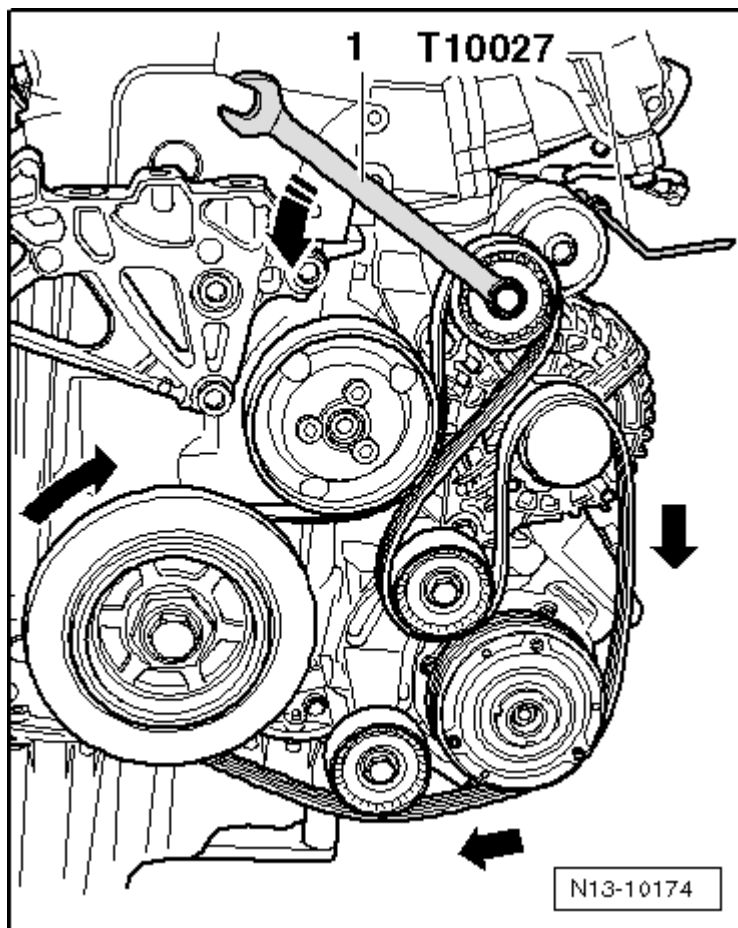


Fig. 31: Identifying Ribbed Belt Routing
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

After installing the ribbed belt, start the engine and make sure the ribbed belt is running correctly.

ACCESSORY BRACKET, ENGINE CODE CNNA

Removing

- Remove the ribbed belt. Refer to **RIBBED BELT**.
- Remove the generator. Refer to **Removal and Installation** .
- Remove the Air Conditioning (A/C) compressor. Refer to **REMOVAL AND INSTALLATION** .
- Remove the accessory bracket bolts and bracket.

Installing

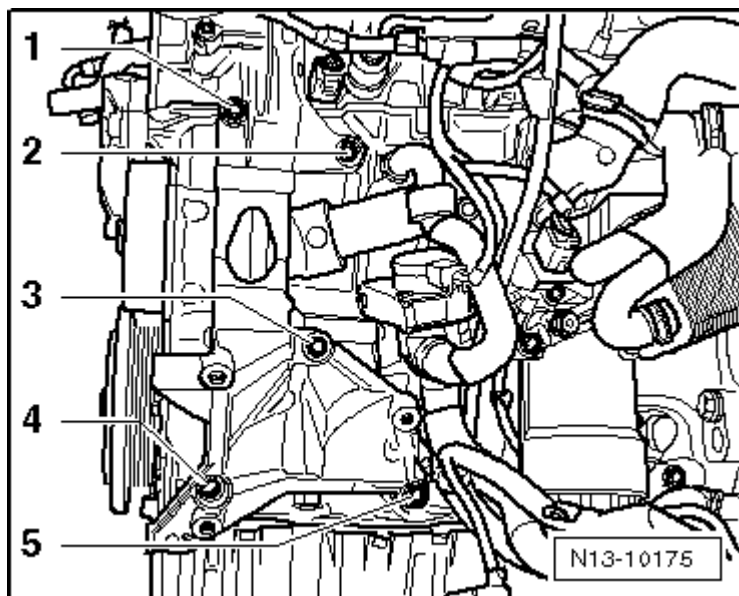


Fig. 32: Identifying Bracket On Cylinder Block, Removal/Installation
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Position the accessory bracket to the cylinder block.
- First, install the bolts -2 and 4- hand tight.
- Then, install the bolts -1, 3 and 5- hand tight.
- Now, tighten all the bolts to 23 Nm in a diagonal sequence.

Further installation is in the reverse order of removal.

VIBRATION DAMPER, ENGINE CODE CNNA

Special tools and workshop equipment required

- Counterhold Tool T10172

Removing

- Remove the ribbed belt. Refer to **RIBBED BELT**.
- Secure the vibration damper using the counterhold tool T10172.

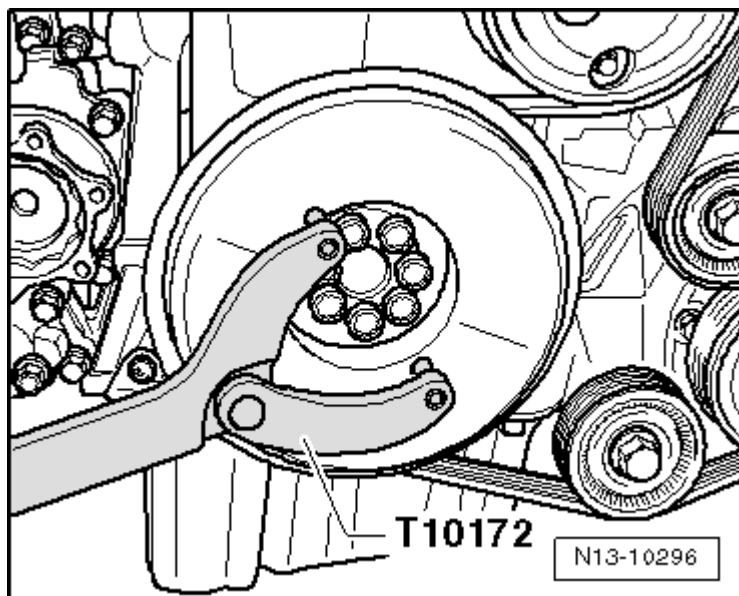


Fig. 33: Loosening and Tightening the Vibration Damper Bolts
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Loosen the bolts and remove the vibration damper from the crankshaft.

Installing

CAUTION: Check the rubber connection between the inner ring and the outer ring of the vibration damper for cracks and flaking. If rubber connection damage is identified, the vibration damper must be replaced.

-- Replace the vibration damper bolts.

-- Position the vibration damper and tighten the new bolts hand tight.

-- Secure the vibration damper using the counterhold tool T10172.

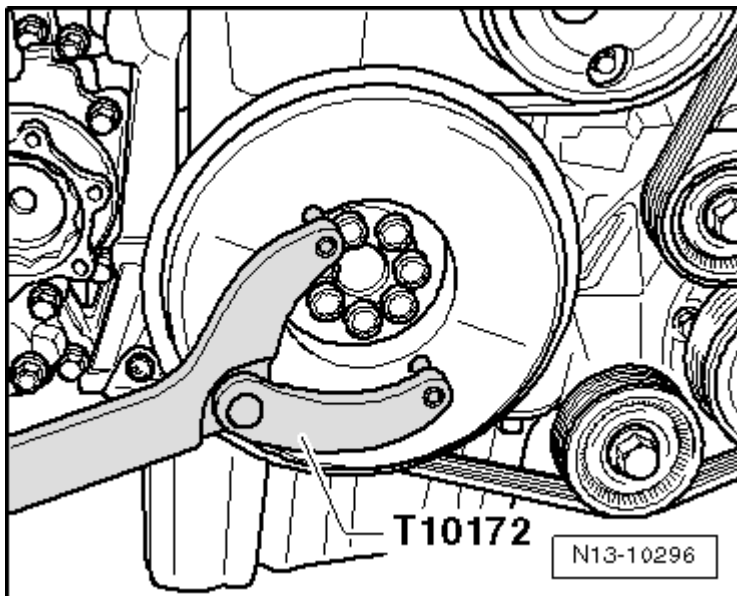


Fig. 34: Loosening and Tightening the Vibration Damper Bolts
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Tighten the bolts to 60 Nm + 180° (1/2) additional turn.

-- Install the ribbed belt. Refer to **RIBBED BELT**.

CRANKSHAFT SEALING FLANGE, VIBRATION DAMPER SIDE, ENGINE CODE CNNA

Special tools and workshop equipment required

- Torque Wrench (5-50 Nm) V.A.G 1331
- Torque Wrench (40-200 Nm) V.A.G 1332
- Counterhold Tool T10172
- Silicone Adhesive Sealant D 176 501 A1

Removing

-- Remove the ribbed belt. Refer to **RIBBED BELT**.

-- Remove the vibration damper. To do so, secure the vibration damper using the counterhold tool T10172. Refer to **VIBRATION DAMPER**.

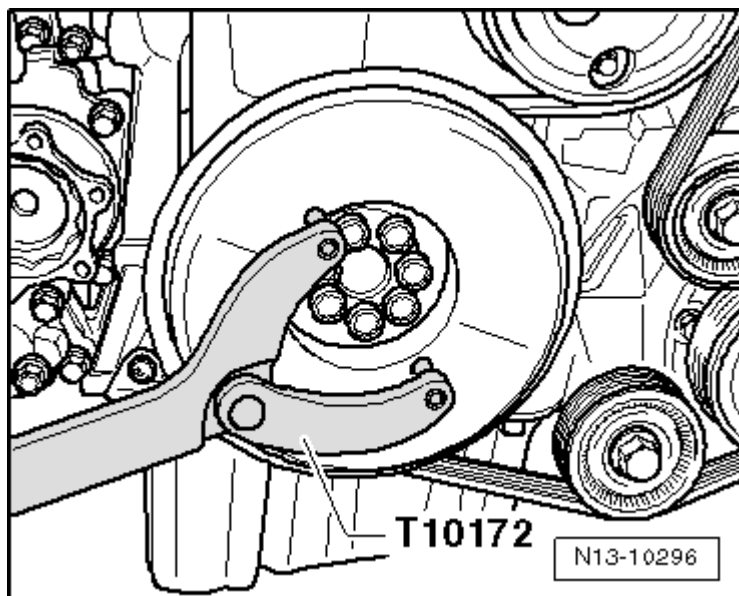


Fig. 35: Loosening and Tightening the Vibration Damper Bolts
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Remove the oil pan. Refer to **OIL PAN** .
- Remove the sealing flange bolts and flange.
- Remove any sealant residue from the sealing surfaces.

Installing

NOTE: **The supplied guide sleeve may be removed before installing.**

- Before installing, remove any remaining oil from the crankshaft journal with a clean cloth.
- Cut the sealant tube nozzle at the front mark (nozzle diameter: approximately 3 mm).

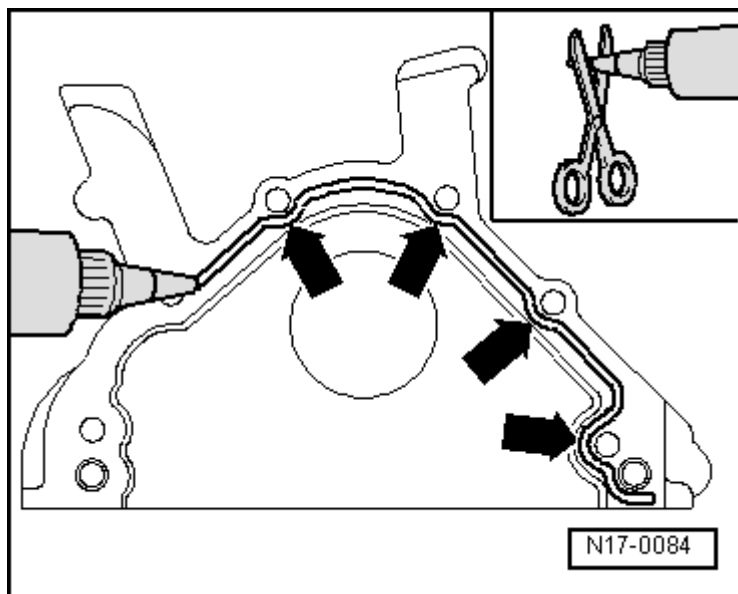


Fig. 36: Applying Silicone Sealing Compound

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Apply a bead of silicone adhesive sealant D 176 501 A1 approximately 2 to 3 mm thick as shown -arrows- onto the clean sealing flange sealing surface.

NOTE: **Cover the seal with a clean cloth before applying the sealant.**

The sealant bead must not be thicker than 2 to 3 mm or the excess sealant could get into the oil pan and clog the suction pipe strainer.

Note the expiration date of the sealant.

The sealing flange must be installed within 5 minutes after application of the sealant.

-- Install the sealing flange -1- and the seal guide sleeve -2- onto the crankshaft journal.

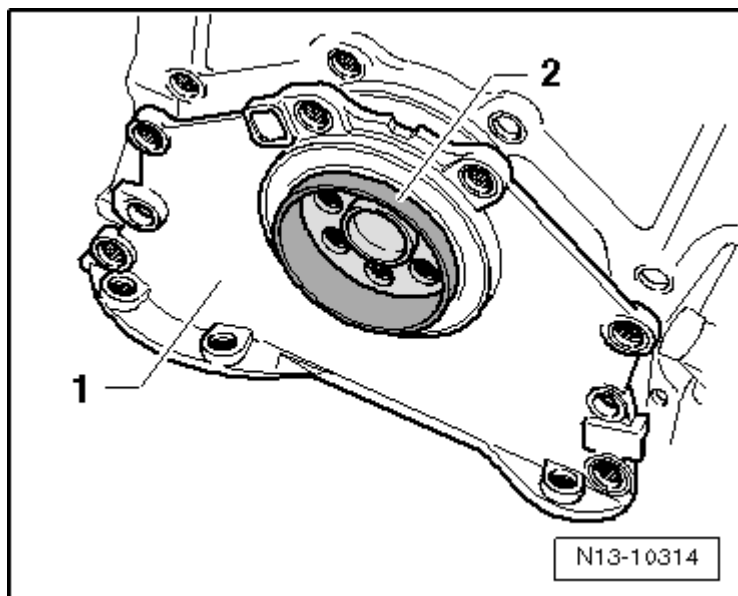


Fig. 37: Identifying Sealing Flange & Seal Guide Sleeve
 Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Carefully slide the sealing flange and seal over the guide sleeve.
- Secure the sealing flange to the cylinder block. Tightening specification: 10 Nm
- Install the oil pan. Refer to **OIL PAN**.

NOTE: The vibration damper bolts must be replaced.

- Install the vibration damper. Refer to **VIBRATION DAMPER**.
- Install the ribbed belt. Refer to **RIBBED BELT**.

CRANKSHAFT SEAL, TRANSMISSION SIDE

Special tools and workshop equipment required

- Assembly Tool T10122
- Pulling Hook T20143

Removing

- Place the pulling hook T20143/2 behind the sealing lip on the seal as illustrated.

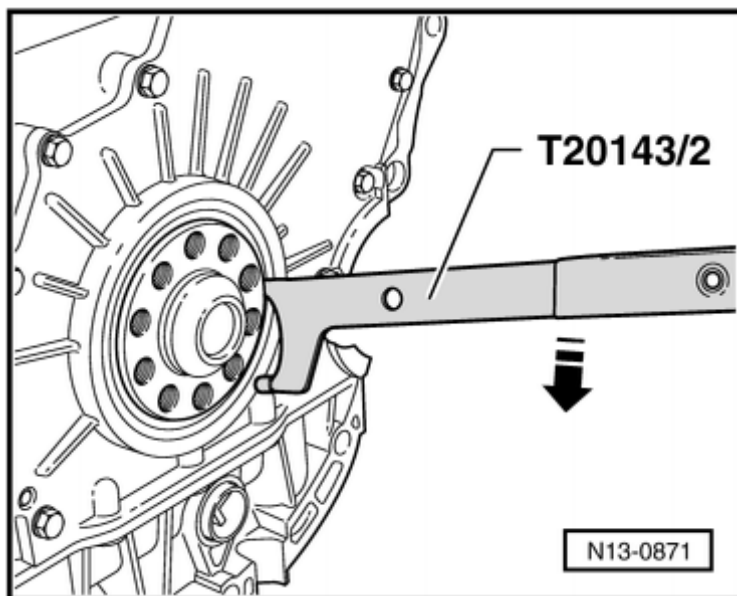


Fig. 38: Identifying Removal Hook T20143/2 Placed Behind Sealing Lip Of Oil Seal
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Support the pulling hook T20143/2 on the sealing flange and pry out the seal in the -direction of the arrow-.

Installing

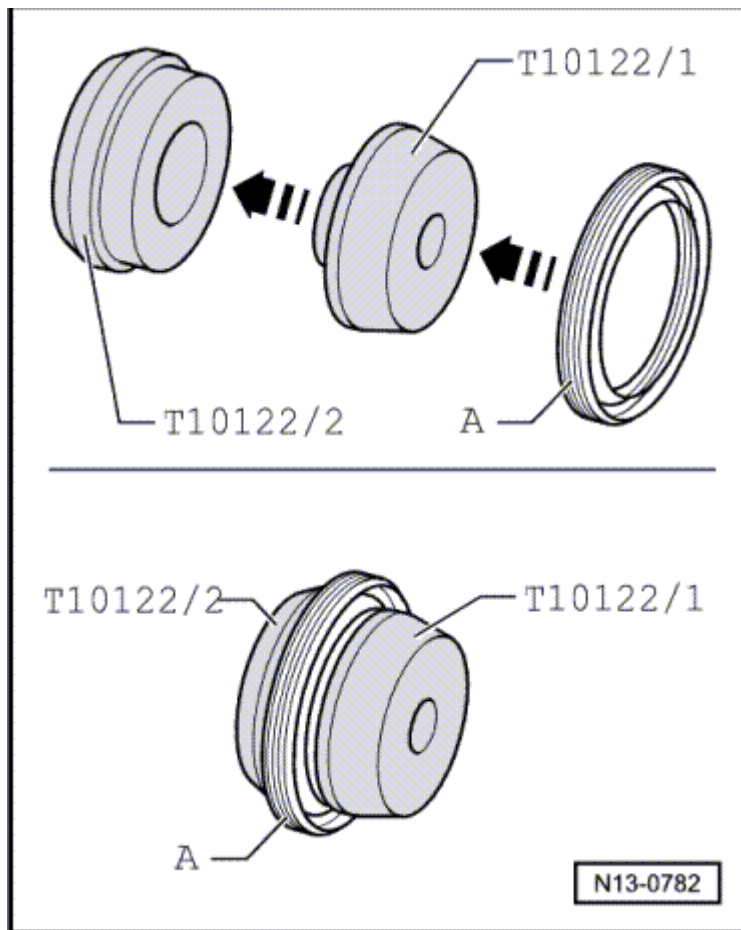


Fig. 39: Identifying Seal, Sleeve T10122/1 And Assembly Tool T10122/2
 Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Pull the seal -A- over the sleeve T10122/1 onto the sleeve T10122/2.
- Separate both sleeves.
- Then, place the sleeve T10122/2 with a dry seal, onto the crankshaft journal.
- Now, drive the seal into the sealing flange until seated using the assembly tool T10122/3.

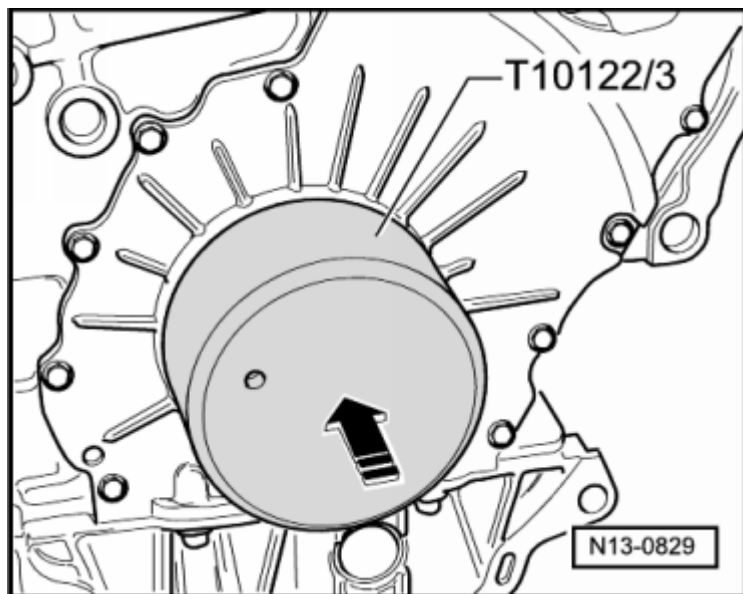


Fig. 40: Driving Seal Into Sealing Flange Until Stop Using Thrust Piece T10122/3
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

SEALING FLANGE, TRANSMISSION SIDE

Special tools and workshop equipment required

- Hand Drill with Plastic Brush Attachment
- Protective Eyewear
- Silicone Adhesive Sealant D 176 501 A1

Removing

- Remove the drive plate. Refer to **DRIVE PLATE**.
- Remove the oil pan. Refer to **OIL PAN**.
- Remove the sealing flange bolts -1 and 2-.

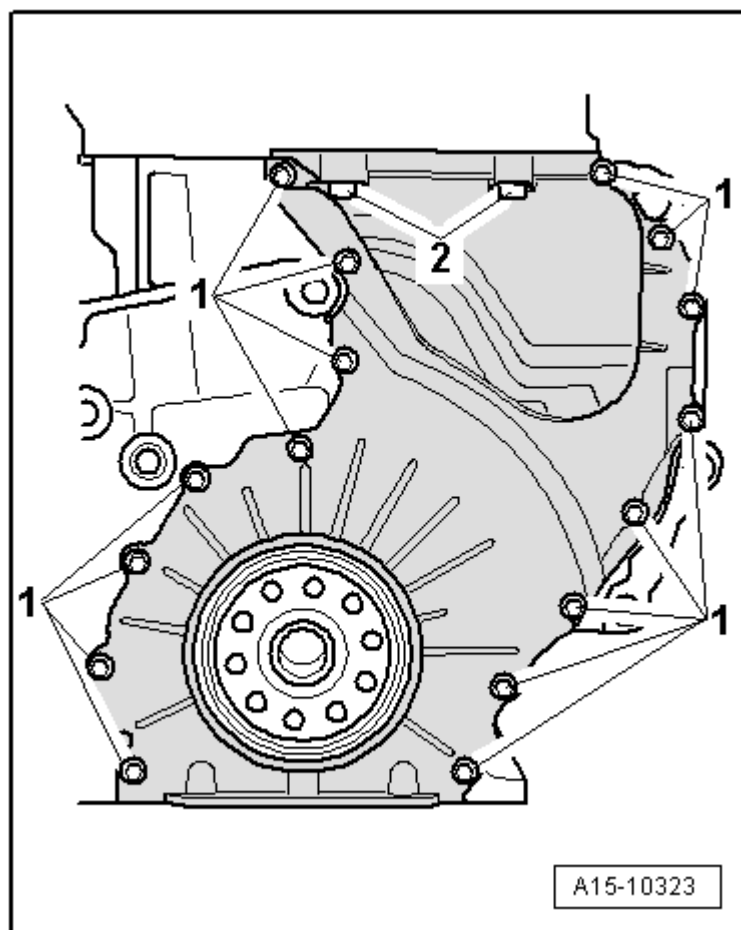


Fig. 41: Identifying Sealing Flange Bolts

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CAUTION: The cylinder head gasket could be damaged. The cylinder head gasket can kink if it is bent too much. A kinked cylinder head gasket must be replaced.

- Remove the sealing flange bolts and flange from the cylinder block horizontally.
- Press the seal out of the sealing flange.

Installing

- For the correct tightening specifications, refer to COVER AND SEALING FLANGE OVERVIEW.

CAUTION: Risk of contaminating the lubrication system with sealant residue. Carefully cover the exposed parts of the engine in order to prevent any sealant residue from falling in.

- Using a rotating plastic brush, remove any remaining sealant from the sealing flange and cylinder block

sealing surfaces. Wear protective eyewear.

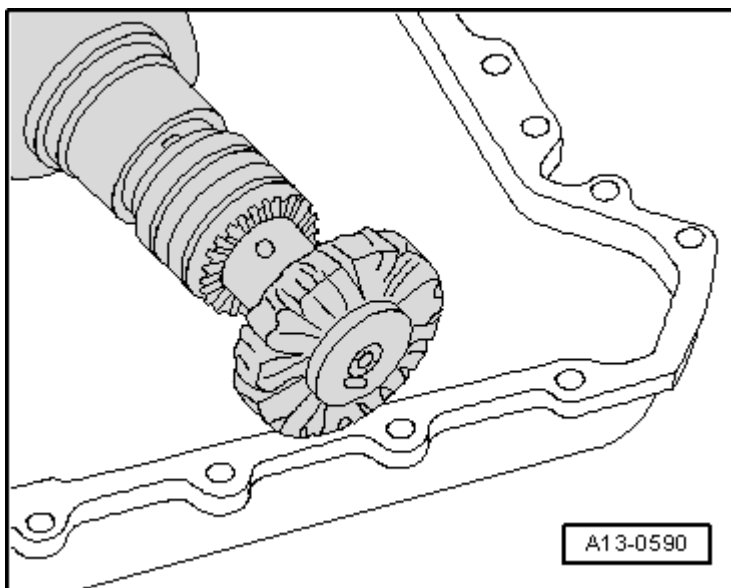


Fig. 42: Identifying Rotating Plastic Brush To Remove Sealant Residue From Sealing Flange, Cylinder Block And Upper Part Of Oil Pan

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Clean the sealing surfaces, they must be free of oil and grease.
- Clean the holes -arrow- in the cylinder head gasket of old sealant.

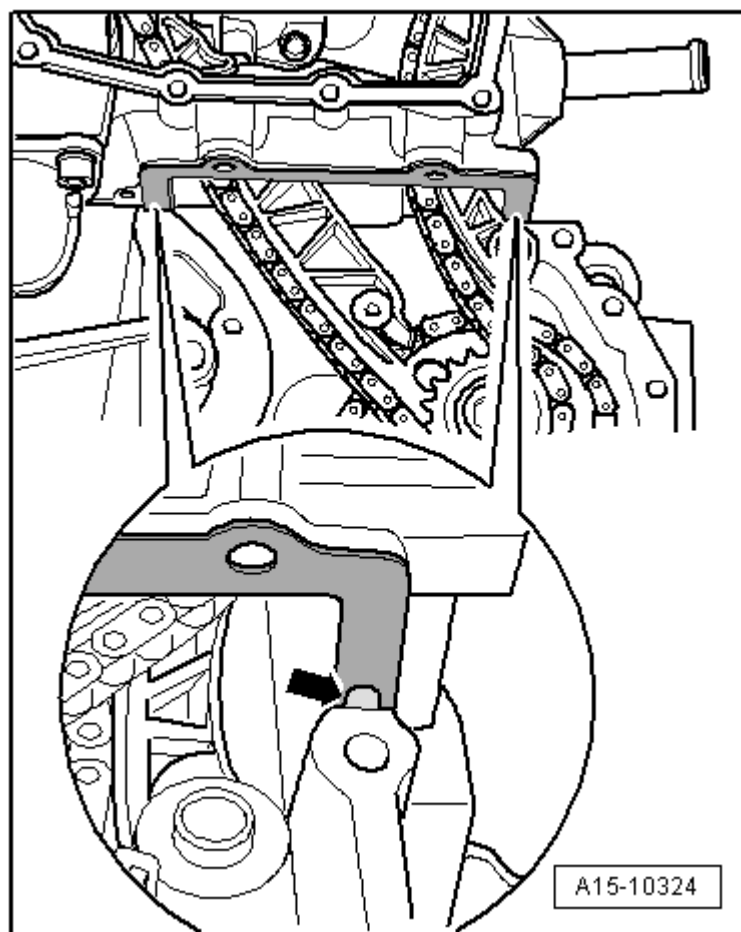


Fig. 43: Cleaning Holes -Arrow- In Cylinder Head Gasket Of Old Sealant
 Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

NOTE: With the cylinder head installed, the holes in the cylinder head gasket are only half visible.

CAUTION: The cylinder head gasket could be damaged. The cylinder head gasket can kink if it is bent too much. A kinked cylinder head gasket must be replaced.

-- Bend the end of the cylinder head gasket down slightly -arrows- until the upper sealing surface of the cylinder gasket and cylinder head can be cleaned.

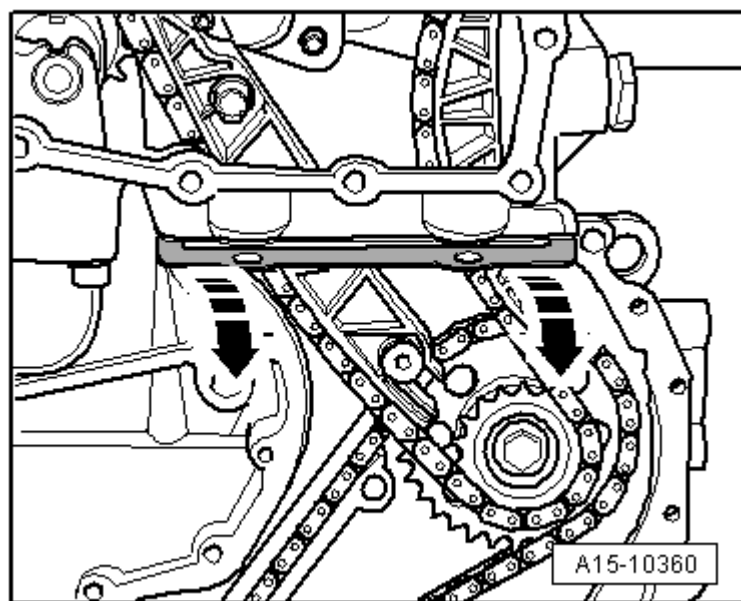


Fig. 44: Bending End Of Cylinder Head Gasket Down Slightly
 Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Clean the top and bottom of the cylinder head gasket, it must be free of oil and grease.
- Cut the sealant tube nozzle at the front mark (nozzle diameter: approximately 2 mm).

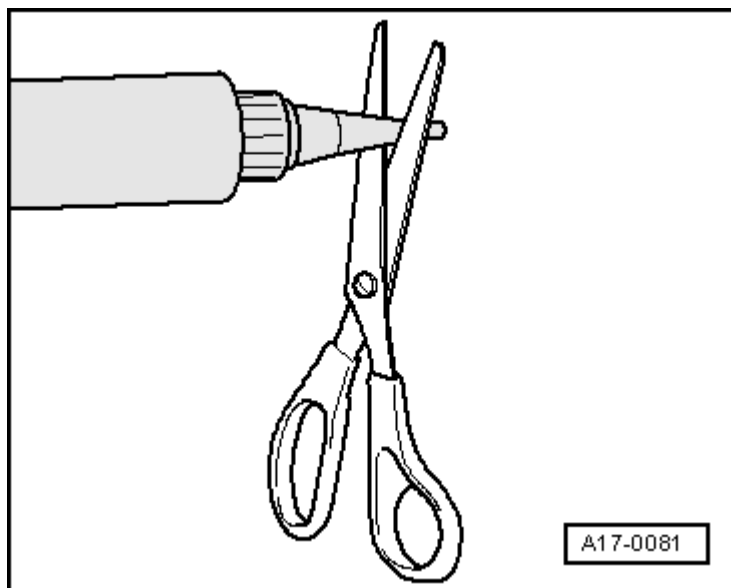


Fig. 45: Cutting Tube Nozzle At Front Marking (Nozzle Diameter Approx. 2 mm)
 Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Lightly coat the top and bottom of the cylinder head gasket with lubricant by bending the gasket down slightly again -arrows-.

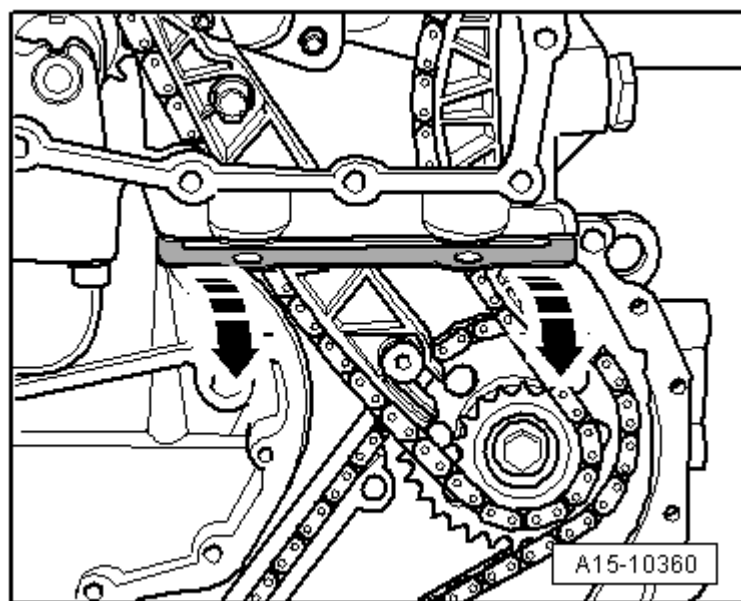


Fig. 46: Bending End Of Cylinder Head Gasket Down Slightly
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- To coat the surface between the cylinder head and gasket, use a flat object, for example, a feeler gauge.

-- Place a thin sealant bead -arrows- from below, in both corners between the cylinder head gasket and cylinder block so that the cylinder head gasket holes are filled.

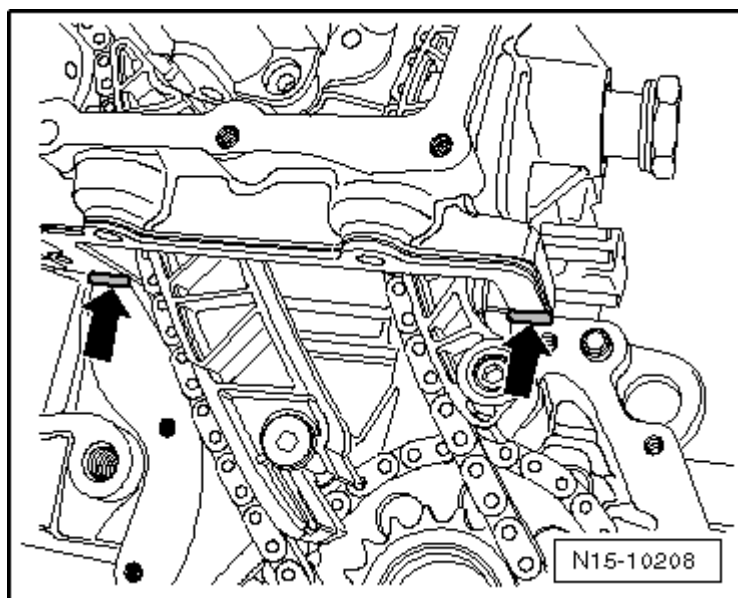


Fig. 47: Identifying Sealant Locations For Corners Of Cylinder Block/Cylinder Head
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Make sure the sealing flange alignment sleeves are installed in the cylinder block.

-- Apply silicone adhesive sealant D 176 501 A1 onto the sealing flange as shown.

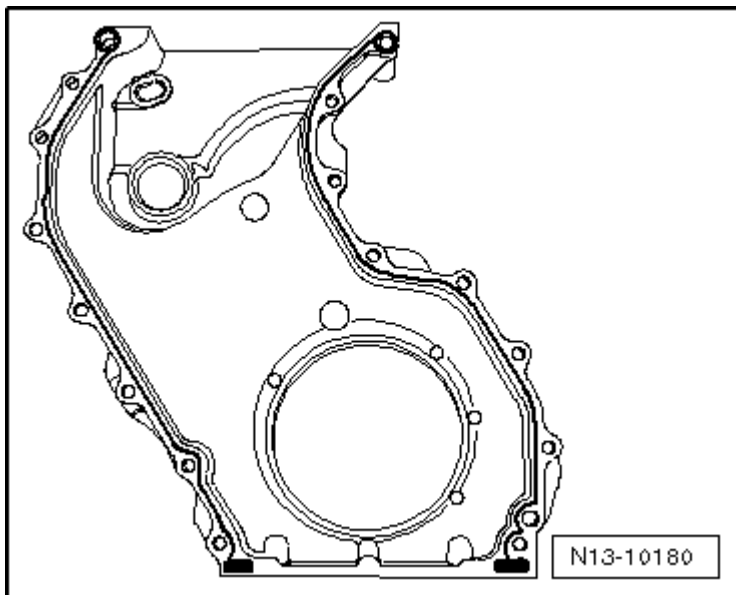


Fig. 48: Applying Sealant On Clean Sealing Surfaces Of Sealing Flange
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

NOTE: **The sealing flange must be installed within 5 minutes of applying the sealant.**

-- Tighten the sealing flange bolts in 3 stages as follows:

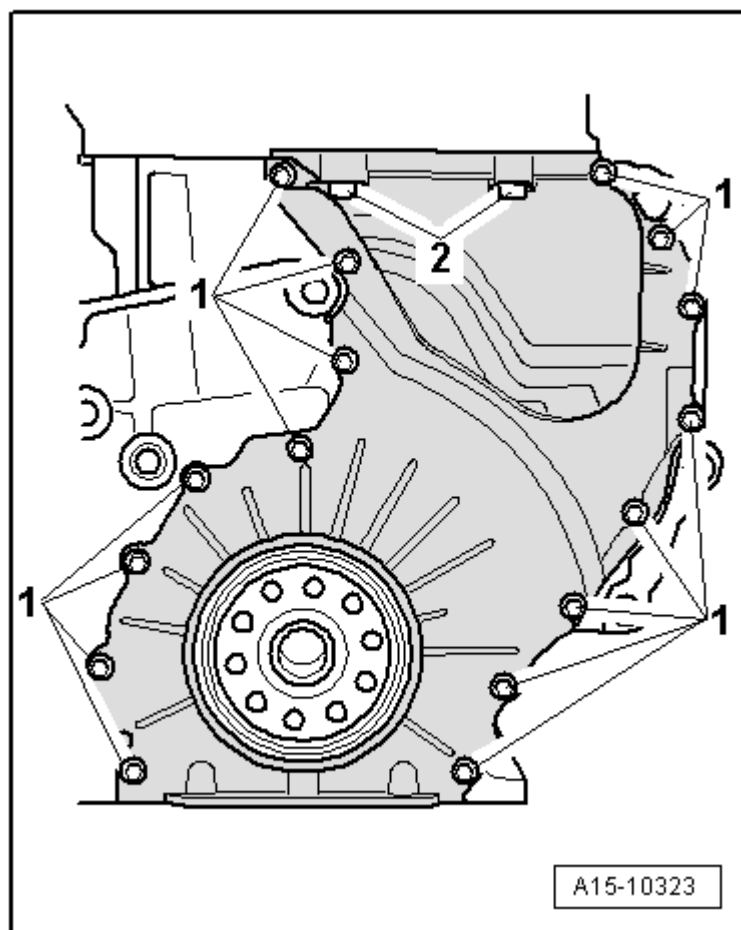


Fig. 49: Identifying Sealing Flange Bolts

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

A - Tighten the bolts -1- to **5 Nm** .

B - Tighten the bolts -2- to **23 Nm** .

C - Tighten the bolts -1- to **10 Nm** .

Further installation is in the reverse order of removal paying attention to the following:

-- Install the crankshaft seal. Refer to **CRANKSHAFT SEAL, TRANSMISSION SIDE**.

-- Install the oil pan. Refer to **OIL PAN** .

-- Install the drive plate. Refer to **DRIVE PLATE**.

DRIVE PLATE

Special tools and workshop equipment required

- Counter-Holder Tool T10069
- Torque Wrench (40-200 Nm) V.A.G 1332

Removing

-- Remove the transmission. Refer to **TRANSMISSION [FOR TRANSMISSION(S): 09M]** or refer to **TRANSMISSION [FOR TRANSMISSION(S): 09MA]** .

-- Remove the drive plate. To do so, secure the vibration damper using the counter-holder tool T10069 or the counterhold tool T10172. Refer to one of the following:

Engine code BLV (counter-holder tool T10069), refer to **VIBRATION DAMPER**.

Engine code CNNA (counterhold tool T10172), refer to **VIBRATION DAMPER**.

-- Loosen the drive plate bolts in a diagonal sequence and remove them.

-- Remove the drive plate.

Installing

-- Install the drive plate onto the crankshaft.

-- Install at least 3 old bolts and tighten them to **30 Nm** .

-- Measure dimension -a- via 3 holes for the torque converter via an assisting ruler and a depth measurement tool and calculate the mean value.

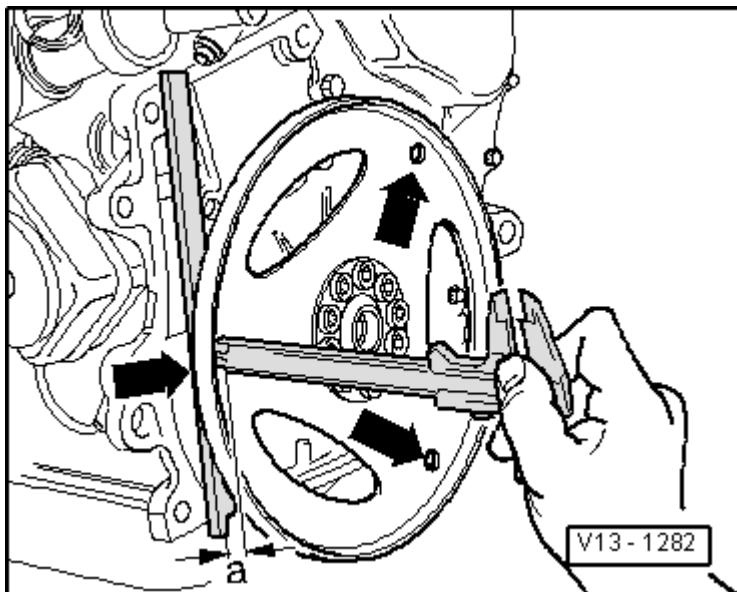


Fig. 50: Checking Dimension Through 3 Holes For Securing Torque Converter Using A Straight Edge And Depth Gauge And Calculate Average

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Compare the average (measured distance + thickness of straight edge) with the specification. Specified value: 15.7 to 17.3 mm

If the specified value is not reached:

-- Remove the drive plate and install an appropriate shim -1-.

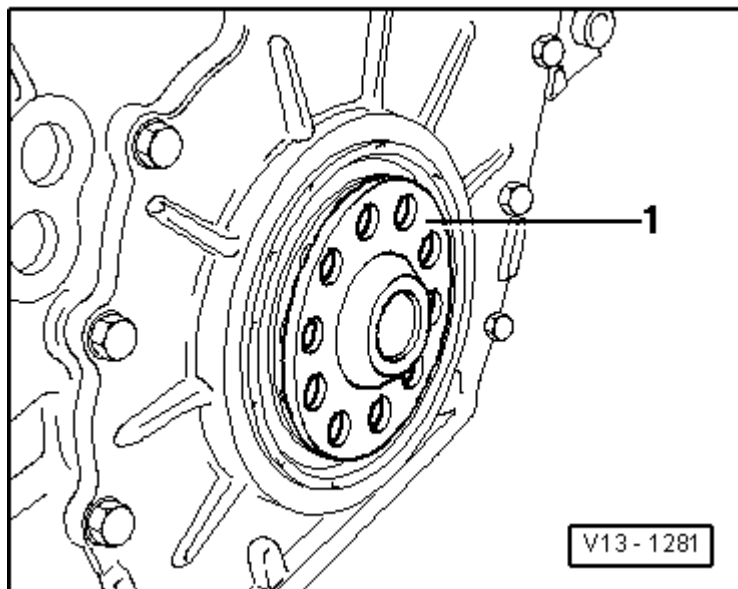


Fig. 51: Identifying Appropriate Shim

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

NOTE: Only one shim of the appropriate thickness may be used.

If the specified value is obtained:

-- Install new bolts and tighten by hand.

-- Then, tighten the bolts to **60 Nm + 90° (1/4) additional turn** .

-- Install the transmission. Refer to **TRANSMISSION [FOR TRANSMISSION(S): 09M]** or refer to **TRANSMISSION [FOR TRANSMISSION(S): 09MA]** .

CRANKSHAFT SENSOR WHEEL, INSTALLING

Special tools and workshop equipment required

- Torque Wrench (5-50 Nm) V.A.G 1331
- Locking fluid D 154 100 A1

Procedure

Make sure the crankshaft to sensor wheel contact surface is free of oil and grease.

NOTE: After tightening for the second time, the points where the screw heads contact the sensor wheel become so deformed that the screw heads at the crankshaft - 3- -arrows- and the sensor wheel lies >>loosely<< under the screws.

Installation of the sensor wheel is only possible in one position, the bore holes are shifted.

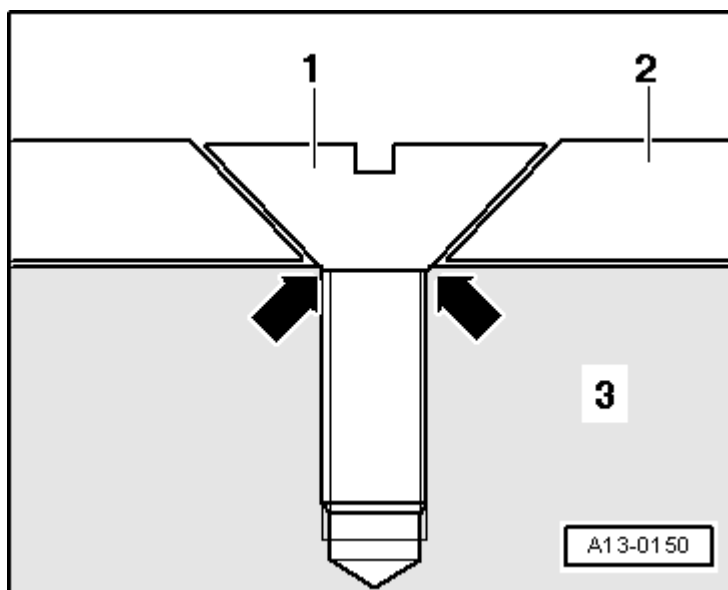


Fig. 52: Identifying Attachment Points, Countersunk Screws, Crankshaft & Sensor Wheel

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Apply a thin coat of liquid locking fluid D 154 100 A1 to the contact surfaces of the crankshaft and sensor wheel for additional security.

-- When installing, make sure that mark >>VR6<< -arrow- aligns with the individual threaded hole on the crankshaft.

-- Tighten the new screws lightly by hand.

-- Then, tighten the new screw -1- to **10 Nm + 90° (1/4) additional turn** .

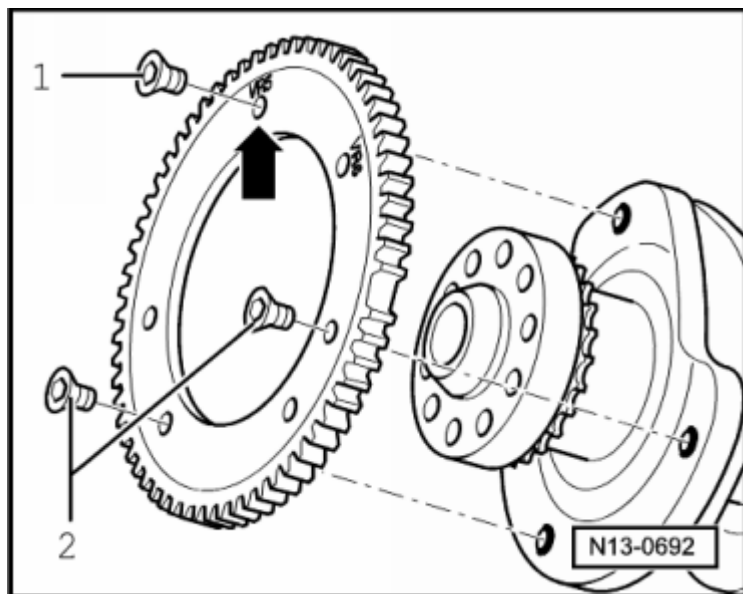


Fig. 53: Identifying VR6 And Bolts

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Then, tighten the new screws -2- to **10 Nm + 90° (1/4) additional turn** .

PISTON

Special tools and workshop equipment required

- Funnel for Piston Installation T10333

Removing

-- Remove the cylinder head. Refer to **CYLINDER HEAD** .

-- Remove the oil pan. Refer to **OIL PAN** .

-- Remove the connecting rod bearing cap bolts and cap and push the piston upward and out.

Installing

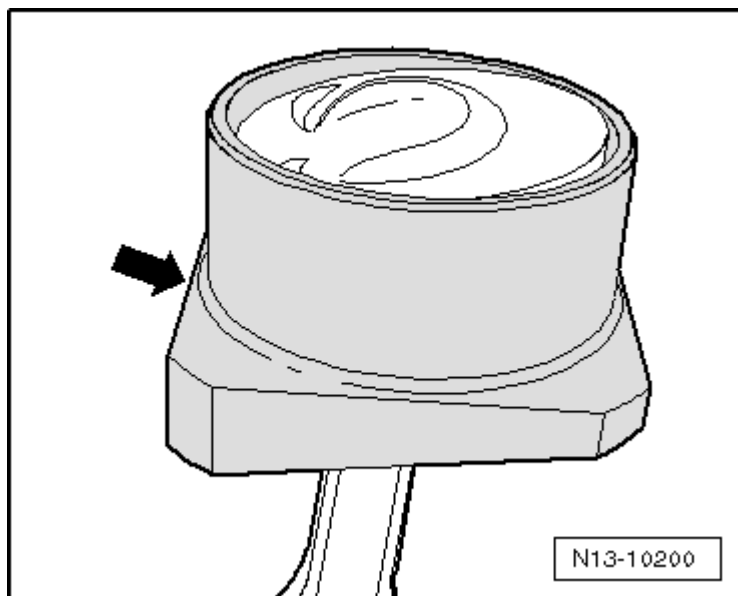


Fig. 54: Identifying Piston Installation Tool

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

NOTE: The funnel for piston installation T10333 with a piston inserted, is placed on the cylinder block so that the high, straight side -arrow- of the tool faces toward the center of the cylinder block.

-- Before installing the pistons, remove the alignment sleeves -arrow- from the bores.

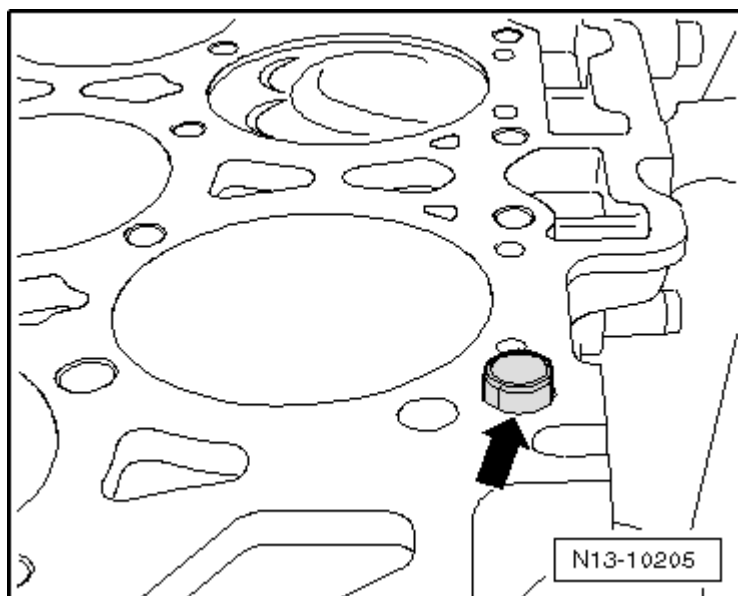


Fig. 55: Identifying Alignment Bushing

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Pistons for cylinders 1, 3 and 5 must be installed so that the deep valve recesses -1- point toward the center of the cylinder block and the arrows -3- point toward the vibration damper.

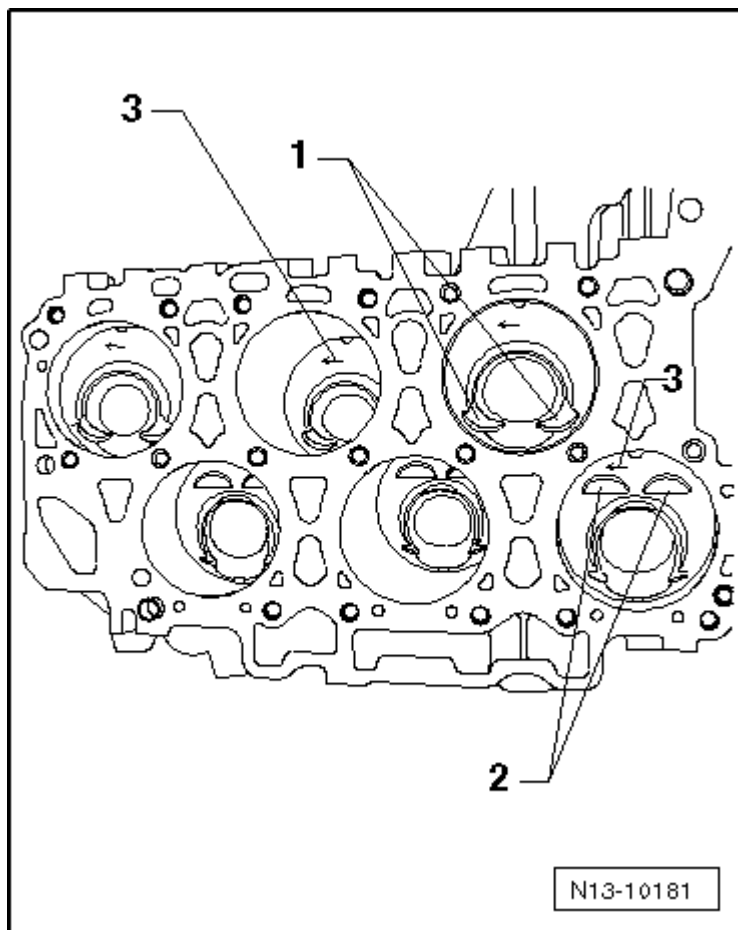


Fig. 56: Identifying Pistons Cylinders Positions

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Pistons for cylinders 2, 4 and 6 must be installed so that the deep valve recesses -2- point toward the center of the cylinder block and the arrows -3- point toward the vibration damper.

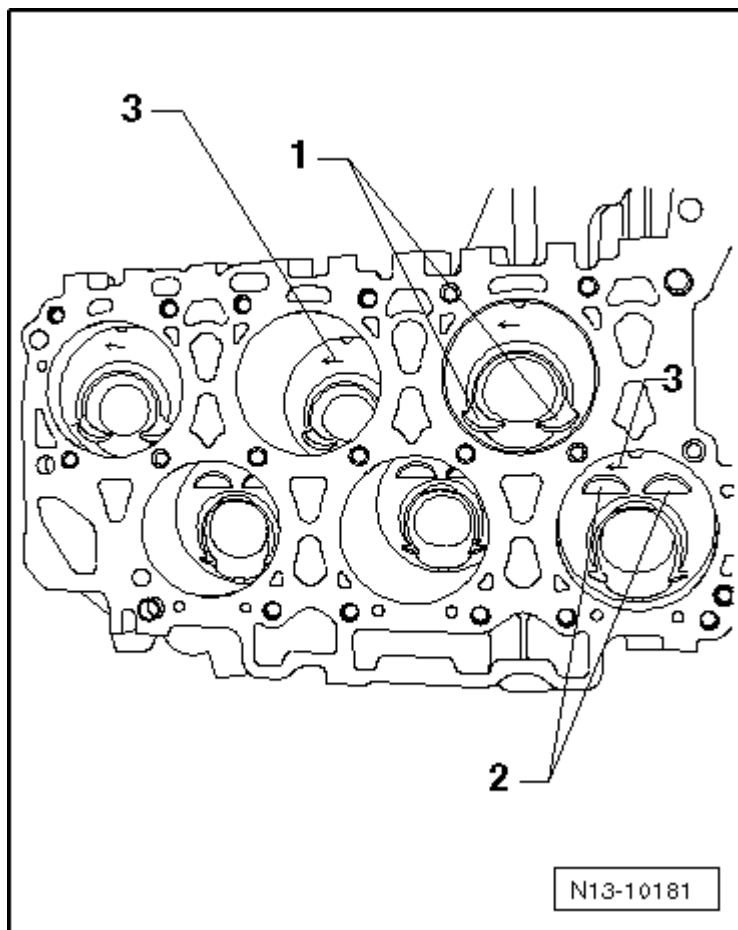


Fig. 57: Identifying Pistons Cylinders Positions

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Slide the piston into the funnel for piston installation T10333 from the top. The side of the piston -arrow- must extend approximately 15 mm past the lower edge of the installation tool.

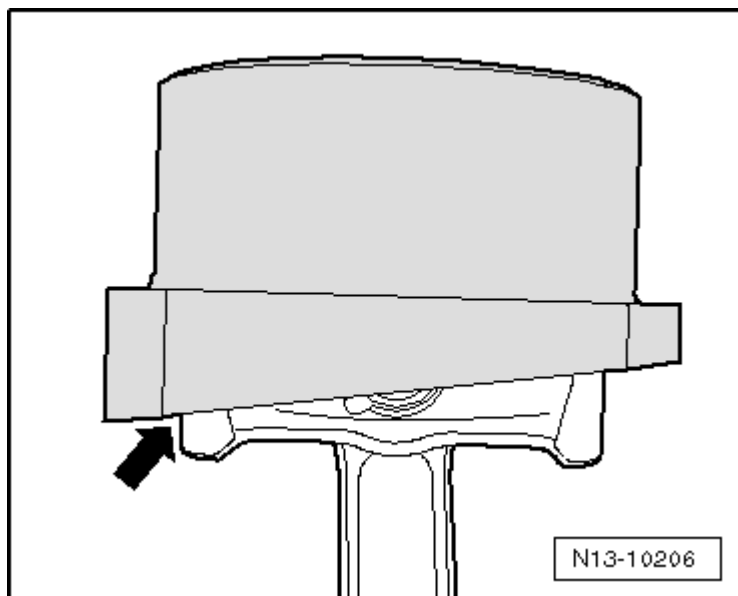


Fig. 58: Sliding Correct Piston For Each Cylinder From Above Into Piston Installation Tool
 Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Now, place the piston with tool into the appropriate cylinder bore. The high side of the piston installation tool -arrow- must face toward the center of the cylinder block.

-- Place the tool securely onto the cylinder block and slide the piston completely into the cylinder bore.

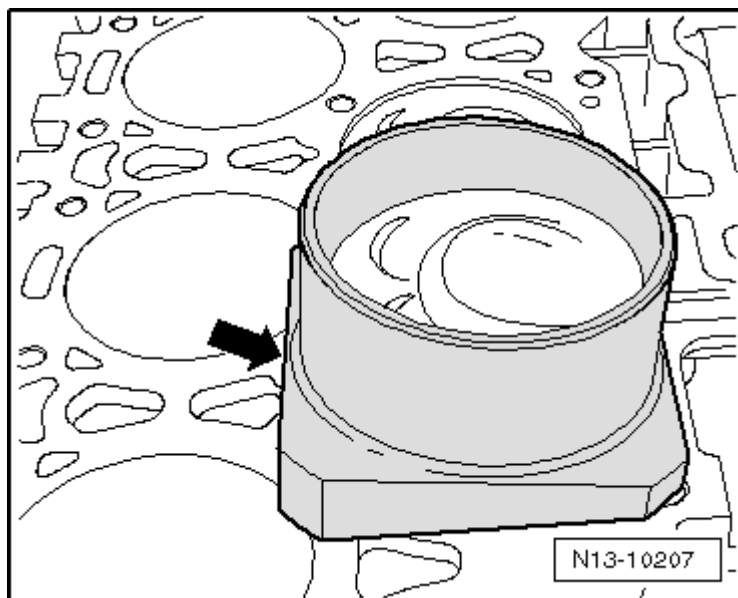


Fig. 59: Placing Funnel Securely On Cylinder Block And Slide Piston Completely Into Cylinder Bore
 Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- After the pistons have been installed, reinstall the alignment sleeves -arrow- back into their bores.

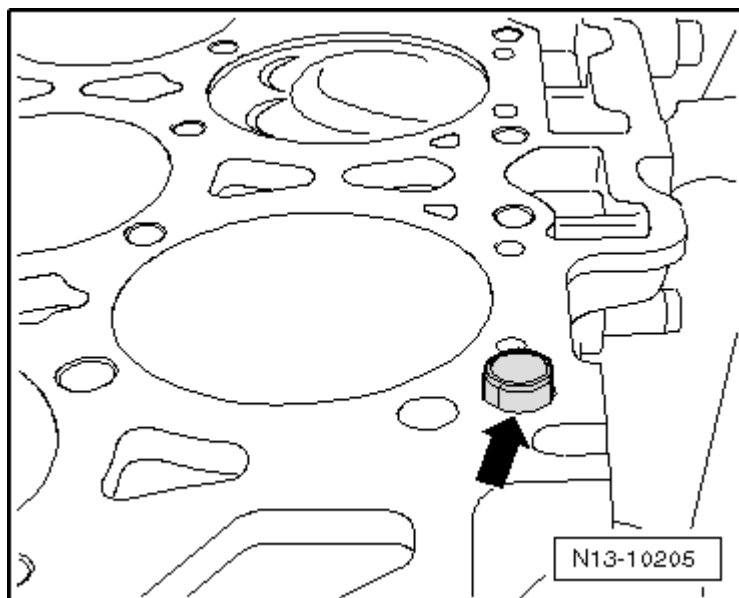


Fig. 60: Identifying Alignment Bushing

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Further installation is in the reverse order of removal.

SPECIAL TOOLS - ENGINE CODE(S): BLV

Special tools and workshop equipment required

- Micrometer 75-100 mm VAS 6071
- Cylinder Gauge VAS 6078
- Puller Legs with Thrust Piece T10040/2A+/3
- Connecting Pin T10027

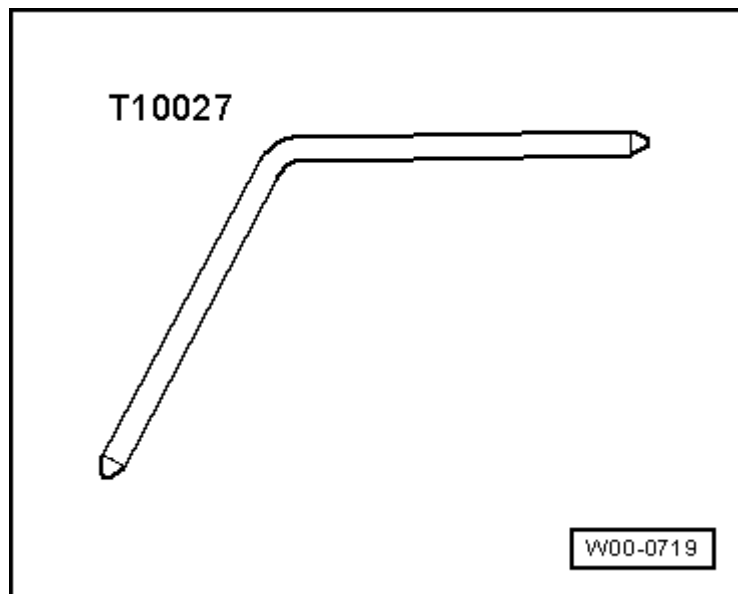


Fig. 61: Identifying Connecting Pin T10027

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Two Arm Puller T10040

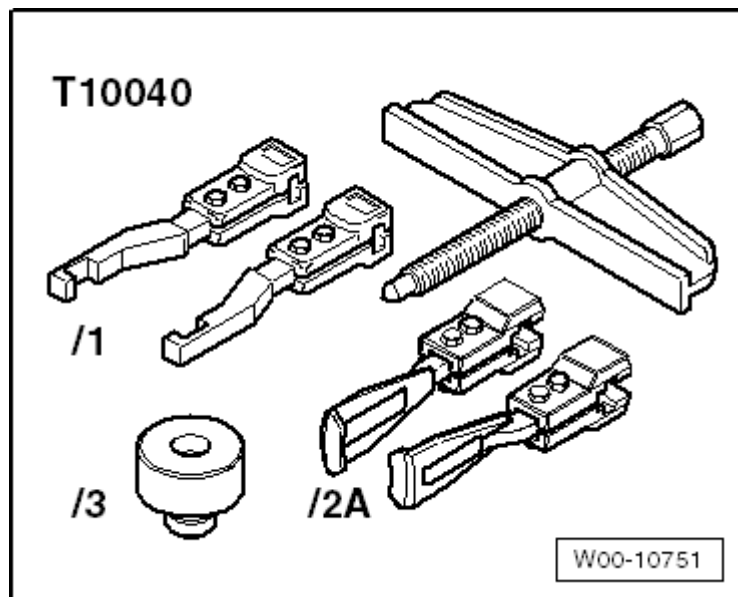


Fig. 62: Identifying Two Arm Puller

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Assembly Tool T10122

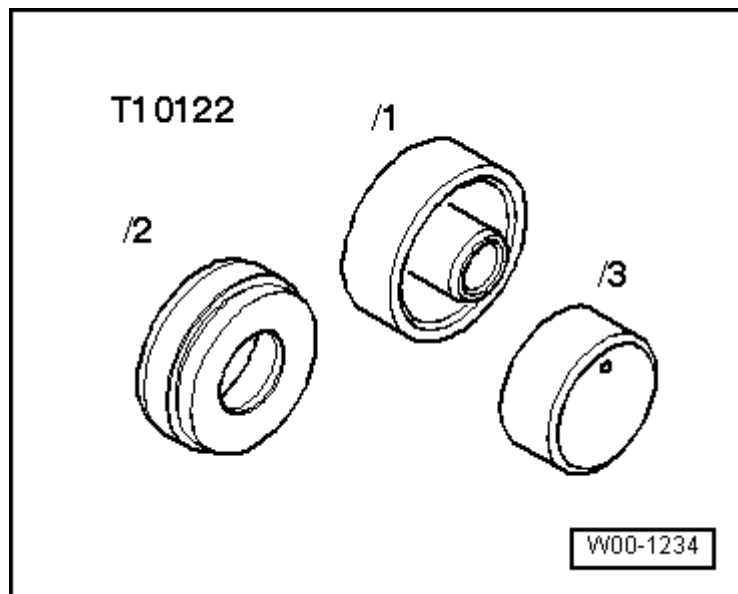


Fig. 63: Identifying Installation Tool T10122

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Pulling Hook T20143

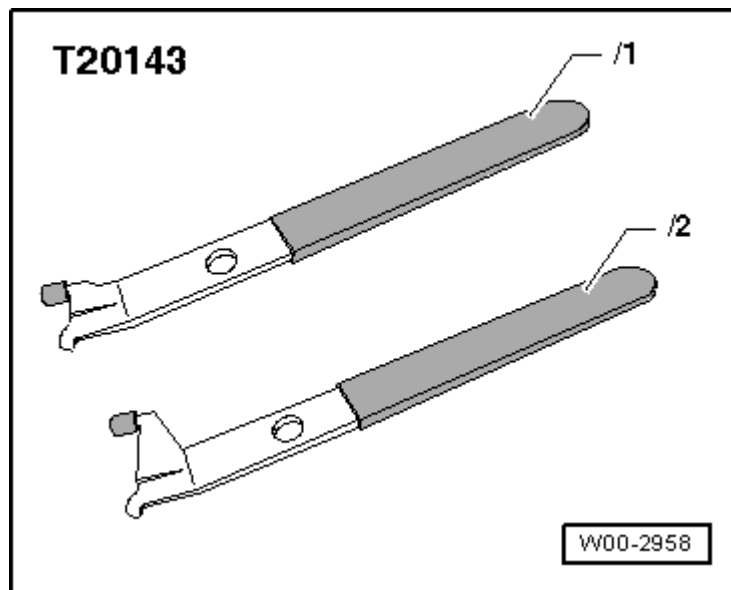


Fig. 64: Identifying Extractor Hook T20143

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

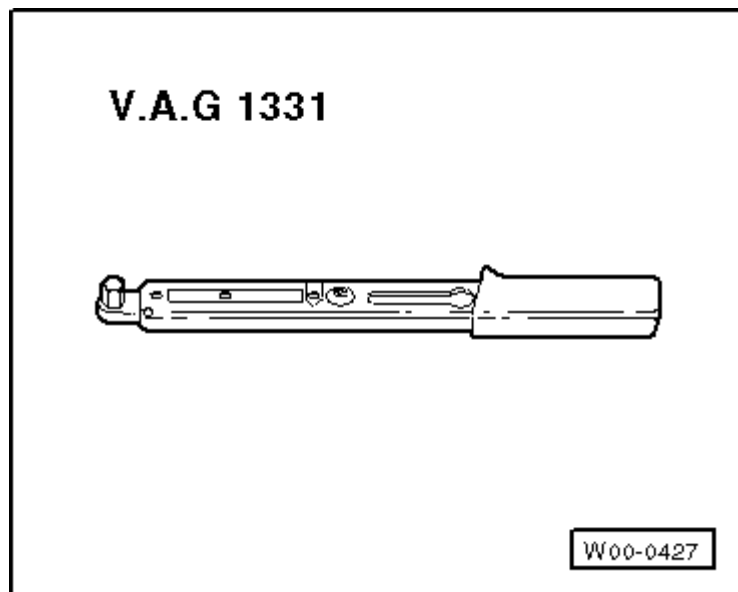


Fig. 65: Identifying Torque Wrench (5 To 50 Nm) V.A.G 1331
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Funnel for Piston Installation T10333

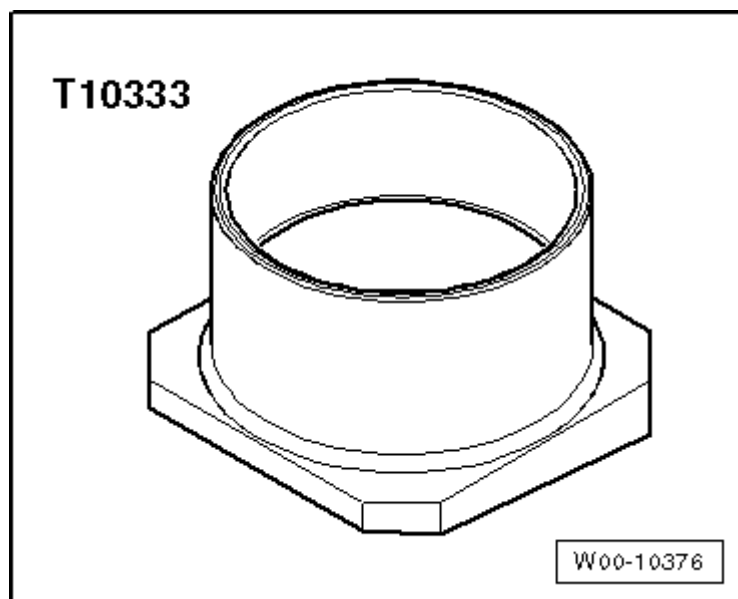


Fig. 66: Identifying Funnel T10333
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

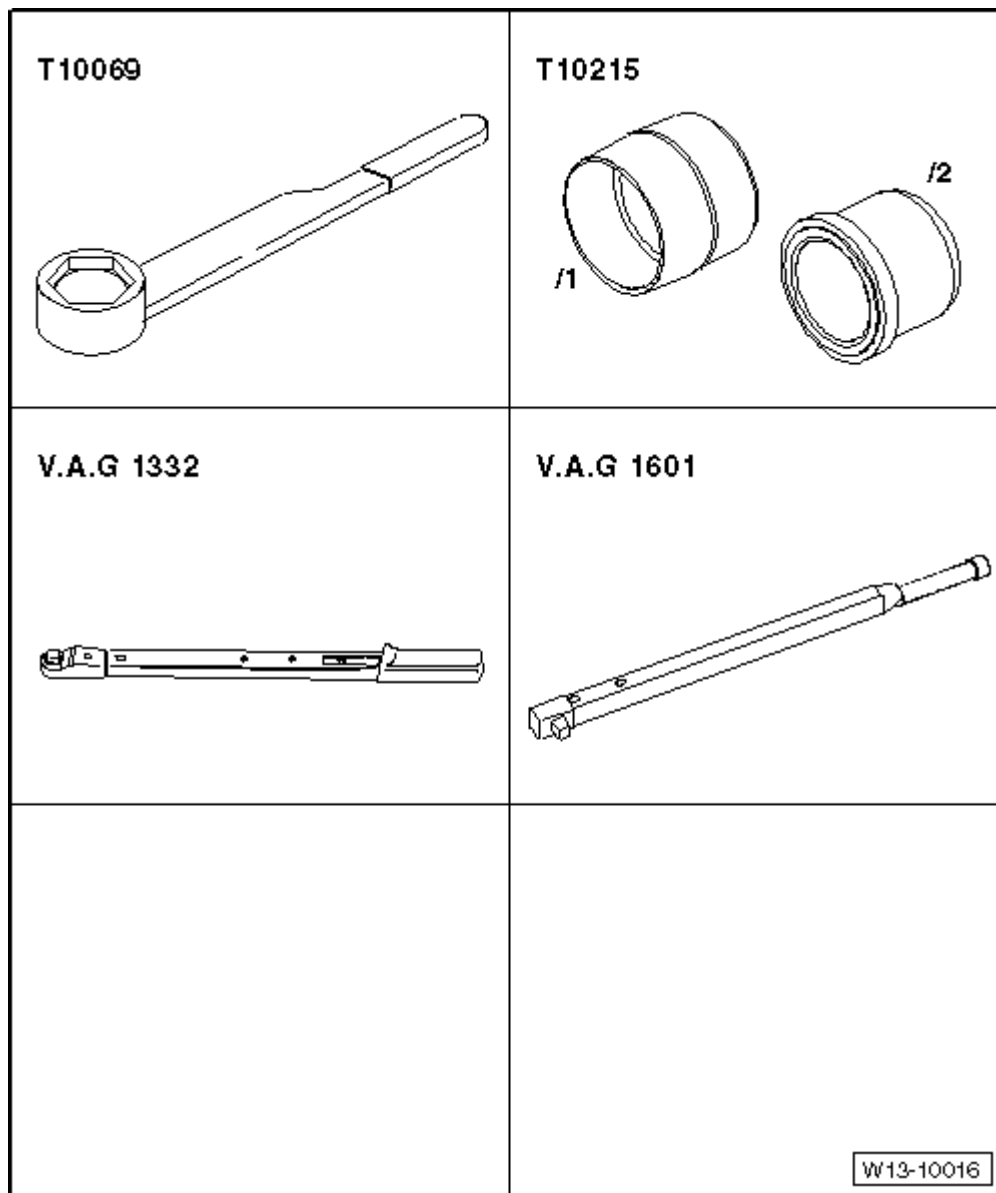


Fig. 67: Identifying Special Tools - Sealing Flange For Crankshaft (Harmonic Balancer Side), Replacing
 Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Special tools and workshop equipment required

- Counter-Holder Tool T10069
- Assembly Tool T10215
- Torque Wrench (40-200 Nm) V.A.G 1332
- Torque Wrench V.A.G 1601

SPECIAL TOOLS - ENGINE CODE(S): CNNA

Special tools and workshop equipment required

- Micrometer 75-100 mm VAS 6071
- Cylinder Gauge VAS 6078
- Connecting Pin T10027

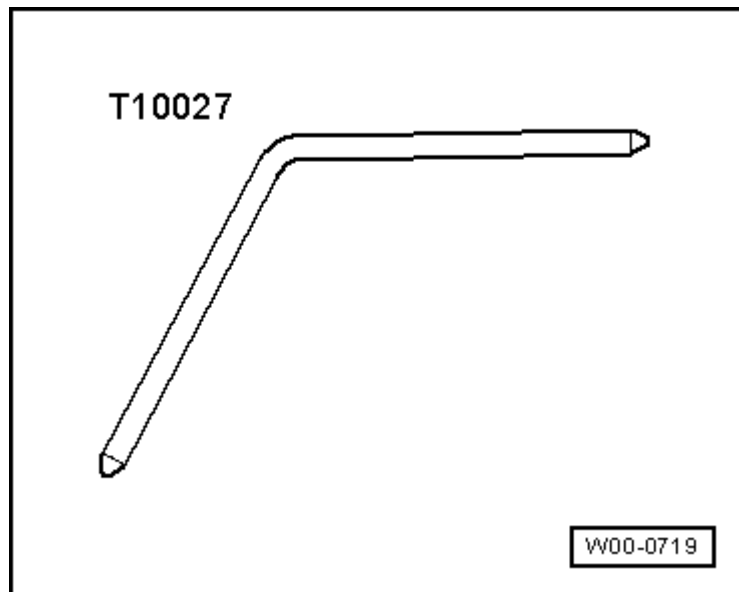


Fig. 68: Identifying Connecting Pin T10027

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Counterhold Tool T10172

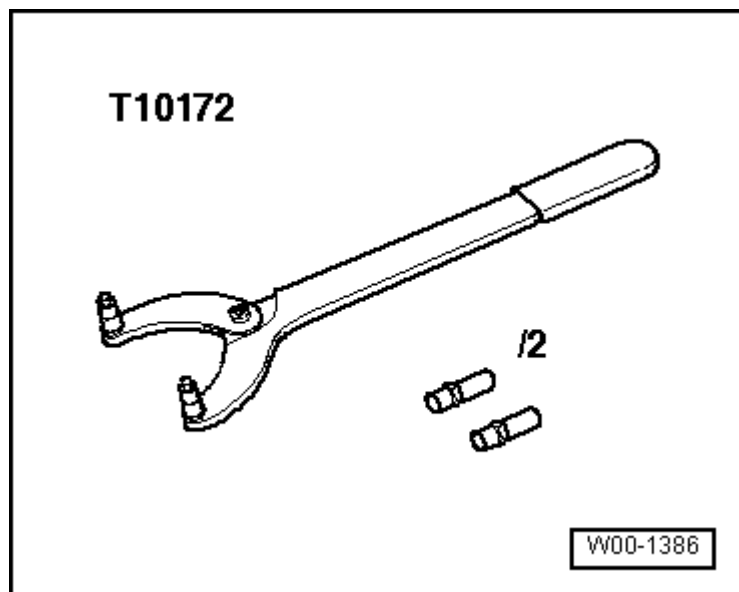


Fig. 69: Identifying Counter-Holder Tool T10172

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

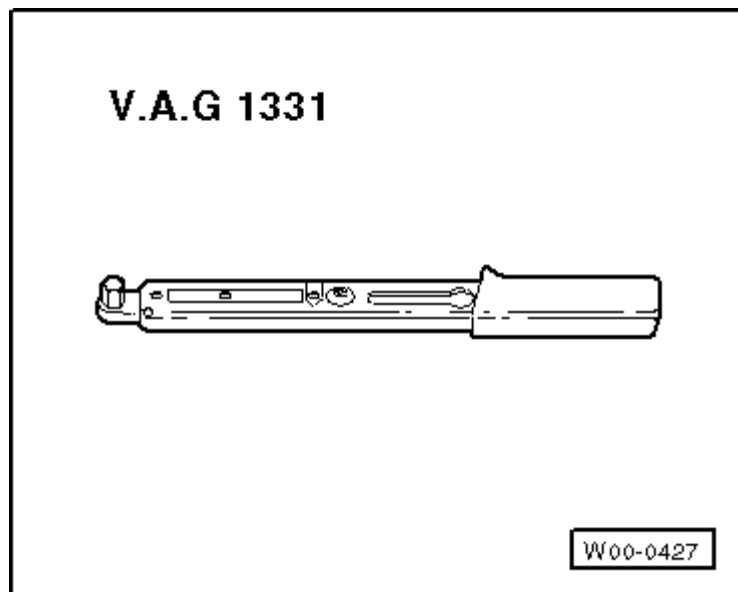


Fig. 70: Identifying Torque Wrench (5 To 50 Nm) V.A.G 1331
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Torque Wrench (40-200 Nm) V.A.G 1332

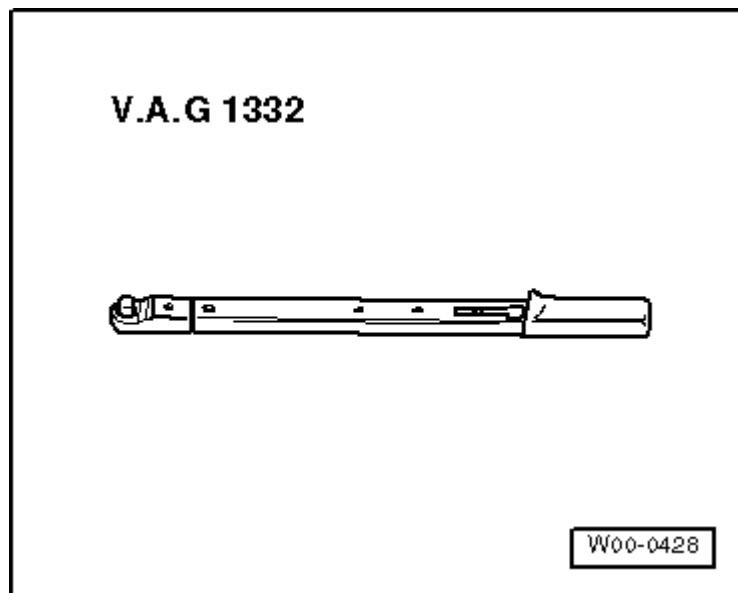


Fig. 71: Identifying Torque Wrench 40-200 Nm V.A.G. 1332
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Assembly Tool T10122

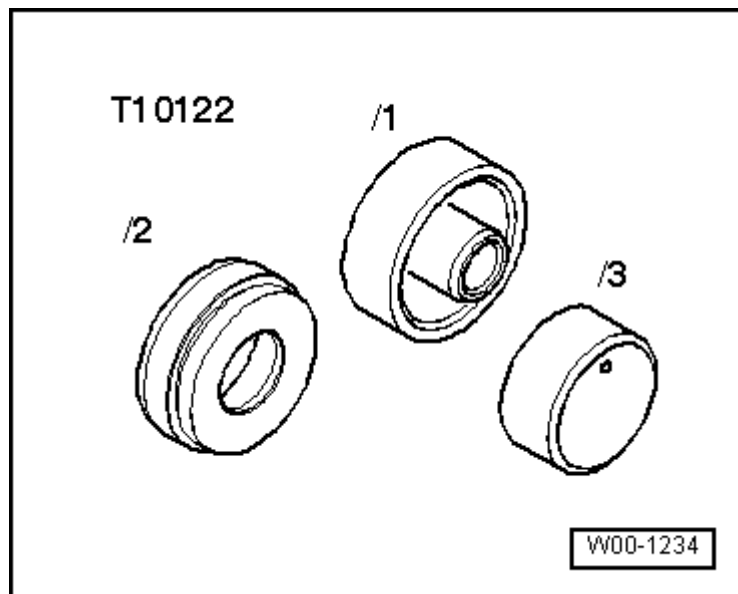


Fig. 72: Identifying Installation Tool T10122

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Pulling Hook T20143

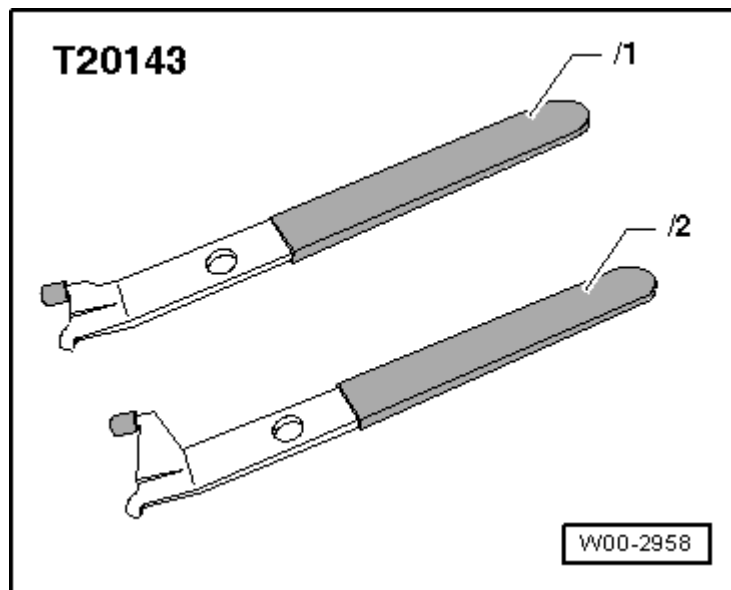


Fig. 73: Identifying Extractor Hook T20143

Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Counter-Holder Tool T10069

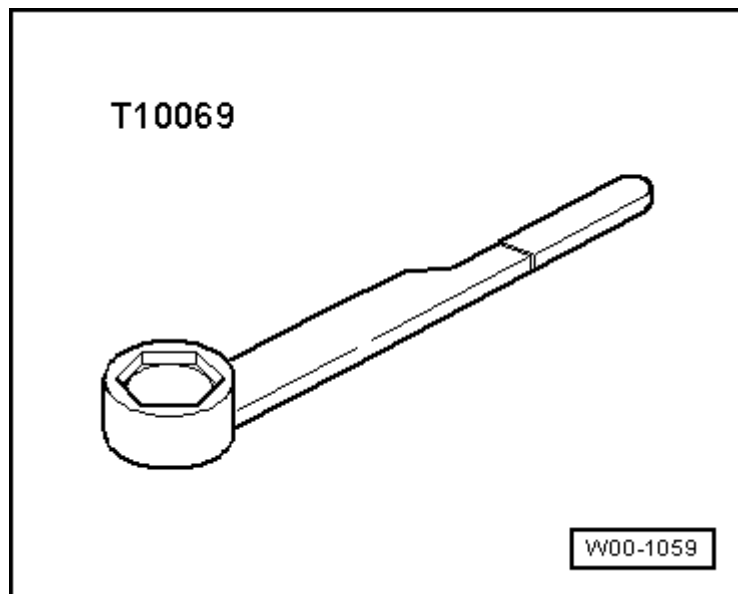


Fig. 74: Identifying Counter-Holder Tool T10069
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Funnel for Piston Installation T10333

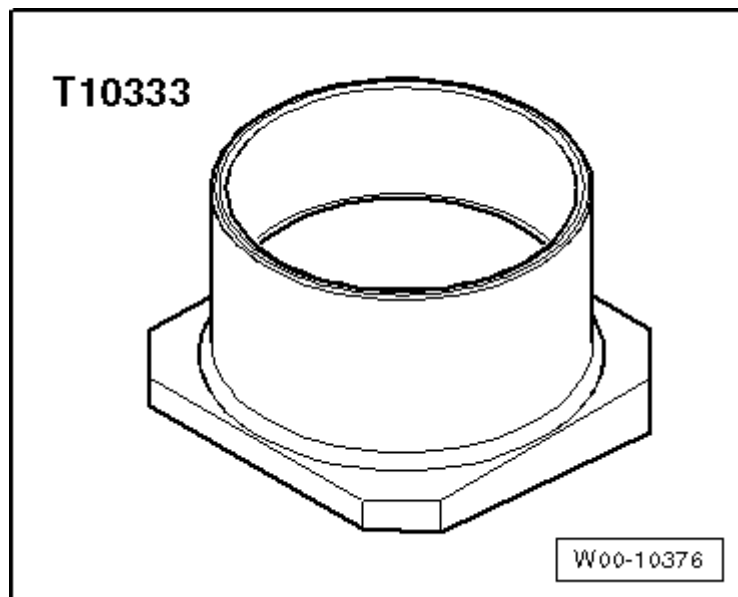


Fig. 75: Identifying Funnel T10333
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

ENGINE

2.0 Liter - Cylinder Head, Valvetrain - Engine Code(s): CBFA & CCTA

15 CYLINDER HEAD, VALVETRAIN

DESCRIPTION AND OPERATION

CYLINDER HEAD OVERVIEW

NOTE: Replace the cylinder head bolts.

Always replace self-locking nuts, bolts which have been tightened to a torque angle, as well as gaskets and O-rings.

The plastic protectors installed to protect the open valves must only be removed immediately before installing the cylinder head.

When replacing the cylinder head or cylinder head gasket, the coolant must be completely replaced.

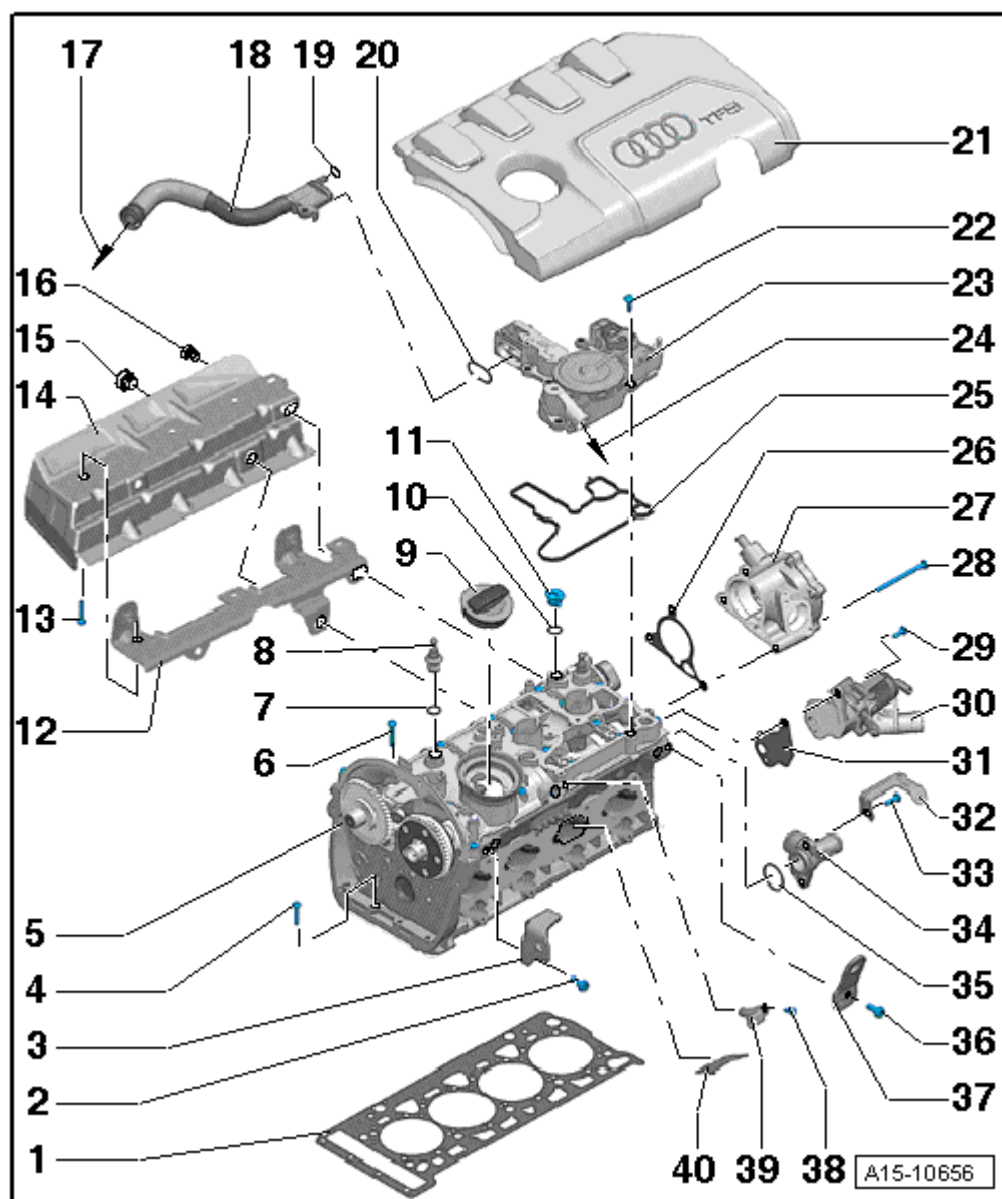


Fig. 1: Identifying Assembly Overview: Cylinder Head

Courtesy of VOLKSWAGEN UNITED STATES, INC.

1. **Cylinder Head Gasket**
 - Always replace.
 - Note the installed position: Part number faces the cylinder head.
2. **Bolt**
 - 25 Nm
3. **Transport Strap**
4. **Bolt**
 - Tightening sequence, refer to **Fig. 4**.
5. **Cylinder Head**

- Removing and installing, refer to **CYLINDER HEAD**.
 - Checking for distortion, refer to **Fig. 5**.
6. **Bolt**
 - Always replace.
 - Observe the sequence for loosening, refer to **Fig. 3**.
 - Observe the sequence for tightening, refer to **Fig. 4**.
 7. **O-ring**
 - Always replace.
 - Lubricate with engine oil.
 8. **Ball Stud**
 - 5 Nm
 - With a ball head for the engine cover.
 9. **Cap**
 - With a seal.
 10. **O-ring**
 - Always replace.
 - Lubricate with engine oil.
 11. **Sealing Plug**
 12. **Bracket**
 13. **Bolt**
 - 9 Nm
 14. **Heat Shield**
 15. **Bolt**
 - 20 Nm
 16. **Bolt**
 - 20 Nm
 17. **to the Intake Hose/Turbocharger**
 18. **Ventilation Pipe**
 19. **O-ring**
 - No replacement part.
 20. **Gasket**
 - No replacement part.
 21. **Engine Cover**
 22. **Bolt**
 - Tightening sequence, refer to **Fig. 2**.
 23. **Crankcase Ventilation**
 - Observe the tightening sequence, refer to **Fig. 2**.
 24. **to the Intake Manifold**

25. Gasket

- No replacement part.

26. Gasket

- Replace if damaged.

27. Vacuum Pump

- Removing and installing, refer to **VACUUM PUMP**.

28. Bolt

- 9 Nm

29. Bolt

- 9 Nm
- For engine code CBFA only.

30. Secondary Air Injection Solenoid Valve -N112-

- For engine code CBFA only.

31. Gasket

- Always replace.
- For engine code CBFA only.

32. Mounting Plate**33. Bolt**

- 9 Nm

34. Connecting Piece**35. O-ring**

- Always replace.
- Lubricate with coolant.

36. Bolt

- 25 Nm

37. Transport Strap**38. Bolt**

- 9 Nm

39. Camshaft Position Sensor -G40-**40. Partition Plate**

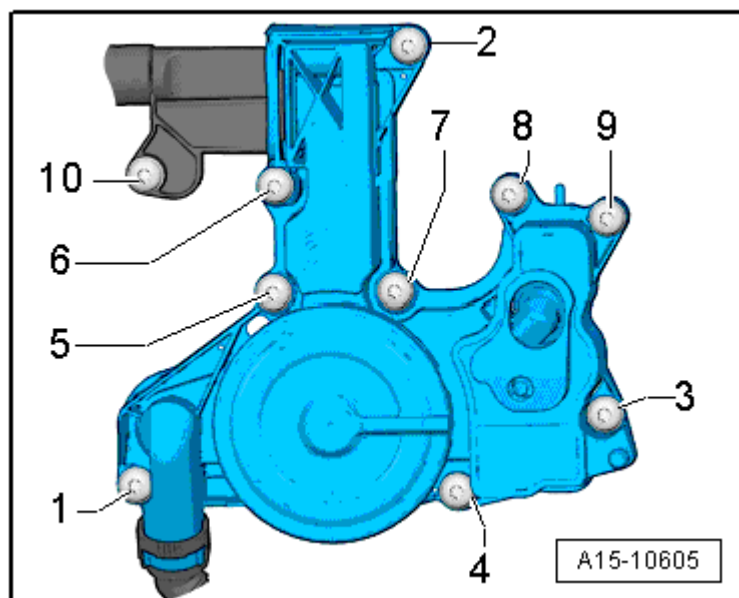


Fig. 2: Identifying Crankcase Ventilation - Tightening Sequence
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Tighten the crankcase ventilation bolts -1 to 10- in sequence to 11 Nm.

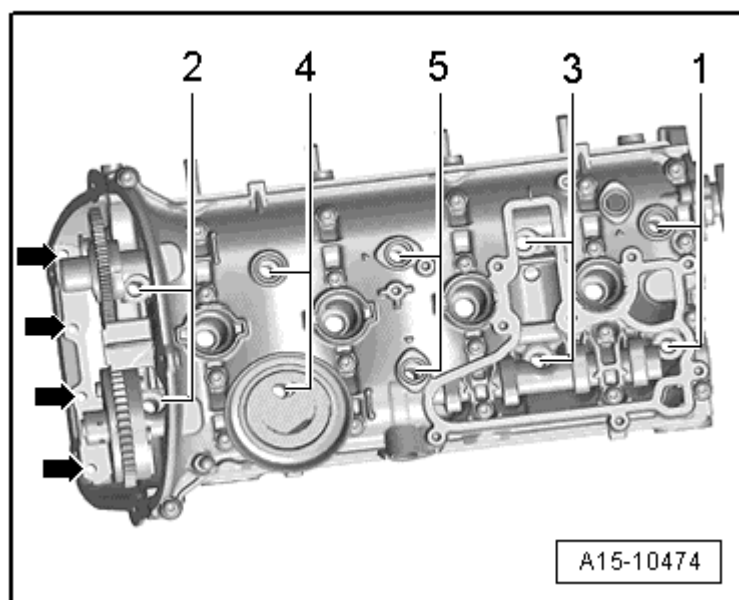


Fig. 3: Identifying Cylinder Head - Loosening Sequence
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the bolts -arrows-.

-- Loosen the cylinder head bolts in sequence -1 through 5-.

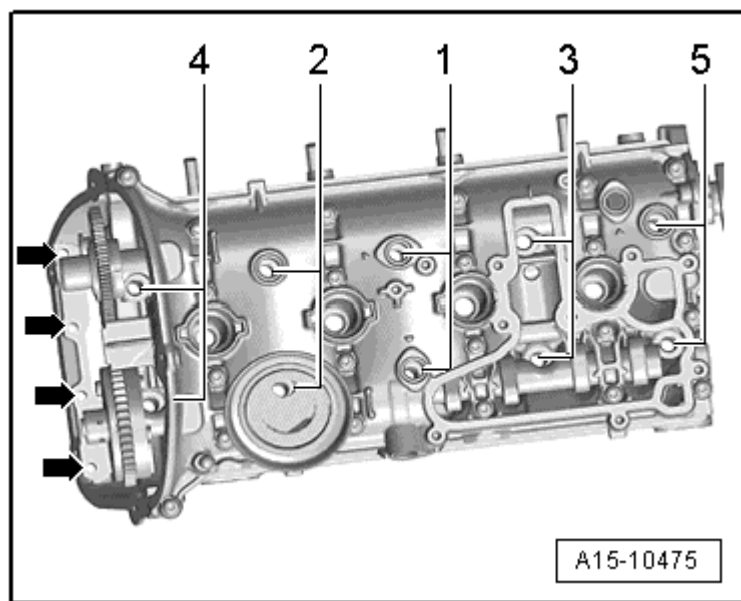


Fig. 4: Identifying Cylinder Head - Tightening Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tighten the cylinder head bolts in sequence -1 through 5-.
- Tighten the bolts to 40 Nm using a torque wrench.
- Tighten the bolts an additional 90° (1/4) turn using a ratchet.
- Tighten the bolts an additional 90° (1/4) turn using a ratchet.
- Tighten the bolts -arrows- to 8 Nm.
- Tighten the bolts -arrows- an additional 90° (1/4) turn using a ratchet.

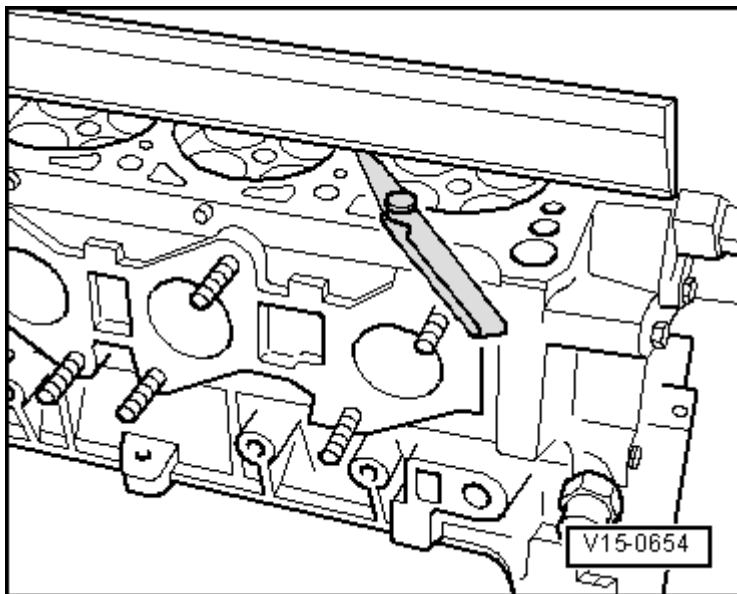


Fig. 5: Identifying Check For Distortion On Cylinder Head Straight Edge 500 mm -VAS 6075- And Feeler Gauges

Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Check the cylinder head at several locations for distortion using a straight edge 500 mm -VAS 6075- and a feeler gauge.

- Max. permissible distortion: 0.05 mm

VALVETRAIN OVERVIEW

NOTE: The cylinder head and the cylinder head cover must be replaced together.

After installing the camshafts, the engine may not be started for approximately 30 minutes. The hydraulic lash adjusters must seat themselves (otherwise the valves will crash into the pistons).

After working on the valvetrain and lifters, carefully rotate the crankshaft by hand at least 2 full revolutions before starting to be sure that valves do not strike the pistons.

Always replace gaskets and seals.

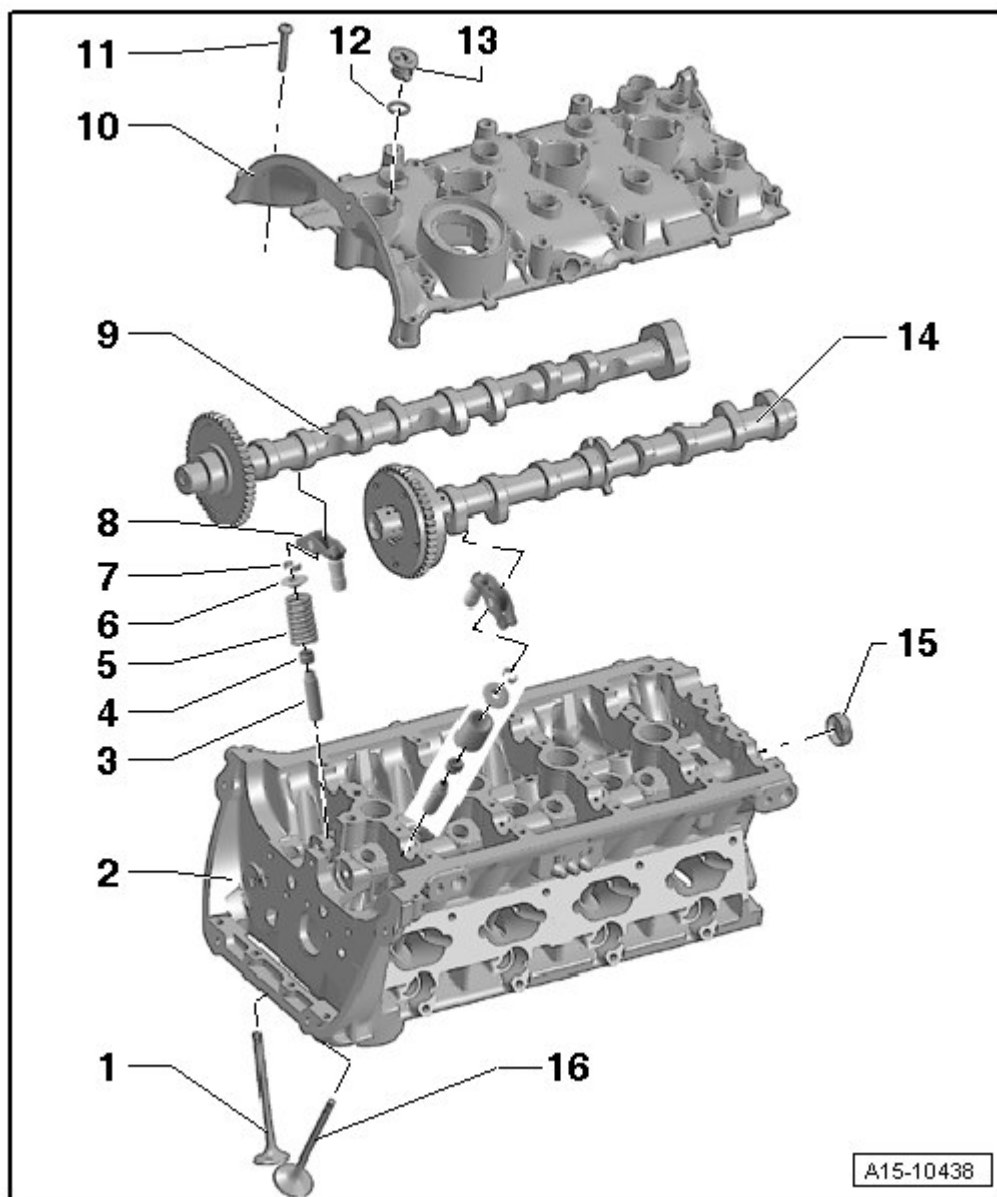


Fig. 6: Identifying Assembly Overview: Valvetrain
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1. Exhaust Valve

- Do not grind, only hand lapping is permitted.
- Valve dimensions, refer to **Fig. 8**.
- Checking valve guides, refer to **VALVE GUIDE, CHECKING**.

2. Cylinder Head

3. Valve Guide

- Checking, refer to **VALVE GUIDE, CHECKING**.

4. Valve Stem Seal

5. Valve Spring

6. Valve Spring Plate**7. Valve Retainers****8. Roller Rocker Arm with Hydraulic Lash Adjuster**

- Do not interchange.
- Lubricate the contact surfaces.

9. Exhaust Camshaft

- Check the radial clearance using Plastigage R (roller rocker arm removed).
- Radial play on bearing diameter - 24 mm: 0.024 to 0.066 mm.
- Radial play on bearing diameter - 32 mm: 0.030 to 0.051 mm.
- Run out:

Max. 0.04 mm.

10. Cylinder Head Cover

- With integrated camshaft bearings.
- Clean the sealing surface, reworking is not permitted.
- Remove the old sealant residue.

11. Bolt

- Always replace.
- Tightening sequence, refer to **Fig. 7**.

12. O-ring

- Always replace.
- Lubricate with engine oil.

13. Sealing Plug**14. Intake Camshaft**

- Check the radial clearance using Plastigage R (roller rocker arm removed).
- Radial play on bearing diameter - 24 mm: 0.024 to 0.066 mm.
- Run out:

Max. 0.04 mm.

15. Cap

- Always replace.
- Removing: With the cylinder head cover installed, pierce through one side of the cover with an awl and pry it out.
- Installing: Without sealant, press in 1 to 2 mm using the thrust piece -3334-.

16. Intake Valve

- Do not grind, only hand lapping is permitted.
- Valve dimensions, refer to **Fig. 8**.

- Checking the valve guides, refer to **VALVE GUIDE, CHECKING.**

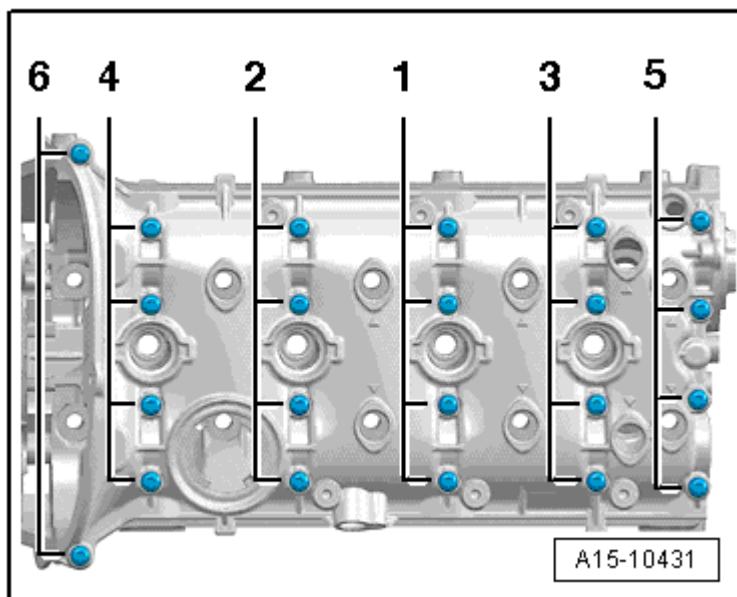


Fig. 7: Identifying Cylinder Head Cover - Tightening Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Replace the bolts.
- Hand tighten the bolts in several passes in sequence -1 through 6-.
- Tighten the bolts in sequence -1 through 6- to 8 Nm using a torque wrench.
- Tighten the bolts an additional 90° (1/4) turn using a ratchet in sequence -1 through 6-.

NOTE: **Ensure the cylinder head cover is not tilted.**

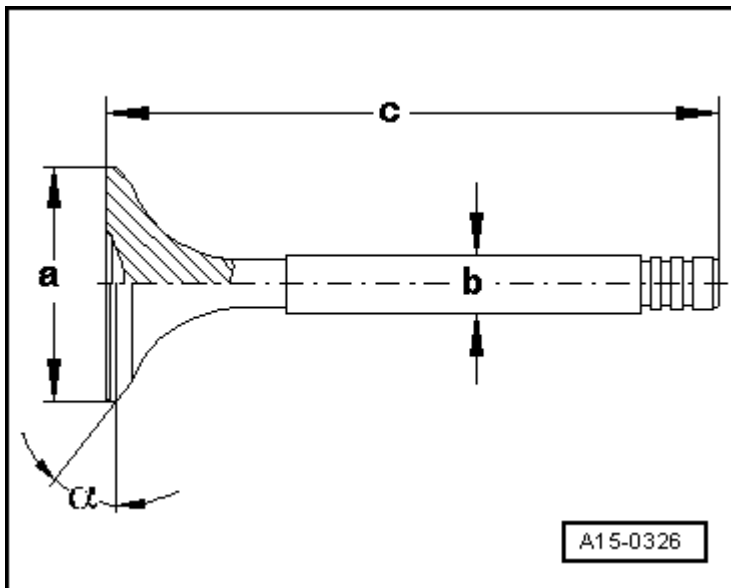


Fig. 8: Identifying Valve Dimensions

Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE: Intake and exhaust valves must not be refaced by grinding. Only hand lapping is permitted.

Dimension		Intake Valve	Exhaust Valve
diameter a	mm	33.85 0.10	28.0 0.1
diameter b	mm	5.98 0.007	5.955 0.007
c	mm	103.97	101.87
a	°	45	45

TIMING CHAIN COVERS OVERVIEW

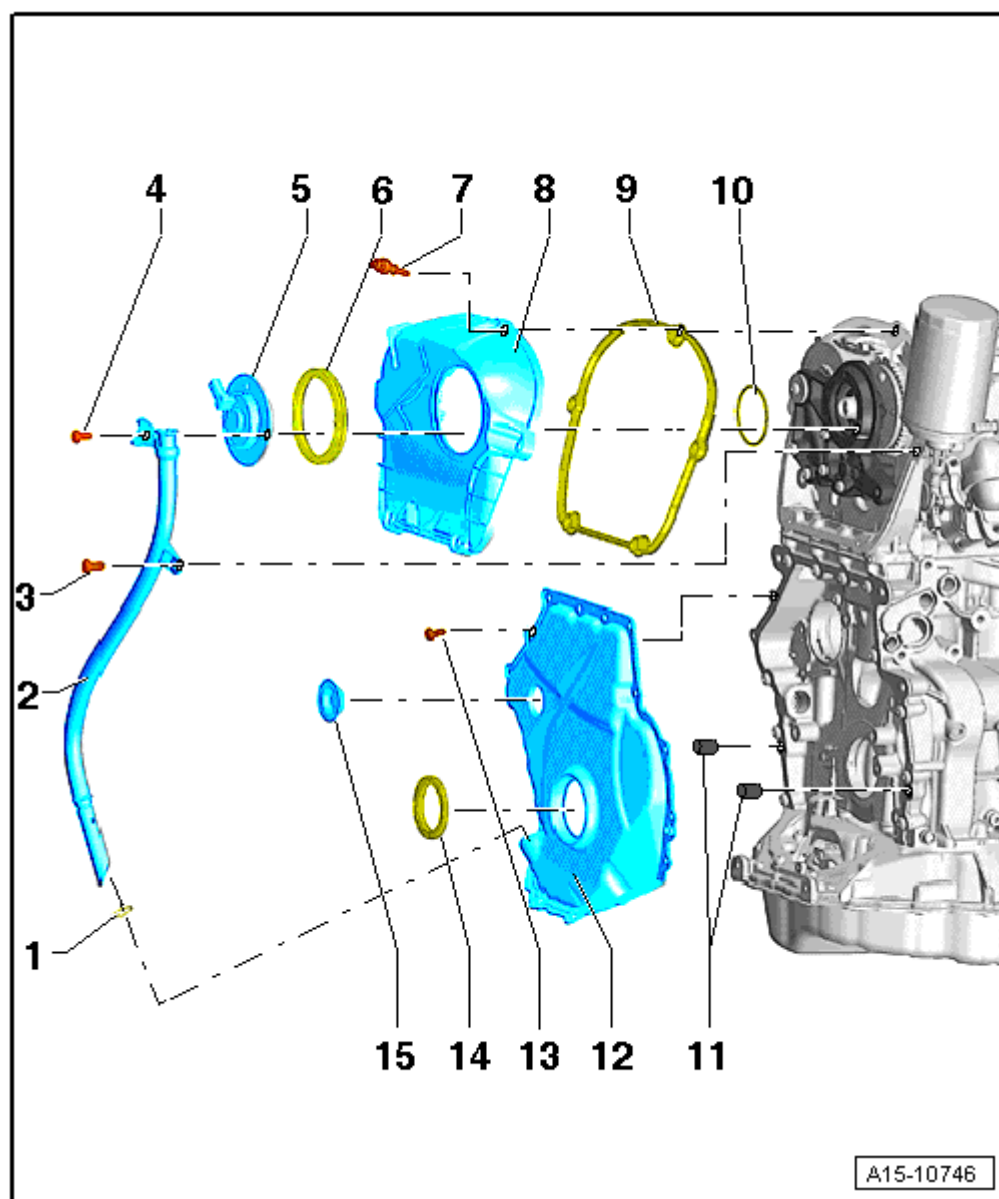


Fig. 9: Identifying Assembly Overview: Timing Chain Covers

Courtesy of VOLKSWAGEN UNITED STATES, INC.

1. **O-ring**
 - Always replace.
 - Lubricate before installing.
2. **Oil Dipstick Guide Tube**
3. **Bolt**
 - 9 Nm
4. **Bolt**
 - 9 Nm
5. **Camshaft Adjustment Valve 1 -N205-**

- Removing and installing, refer to **CAMSHAFT ADJUSTMENT VALVE 1 -N205-**.
6. **Seal**
 - Lubricate before installing.
 - Replace if damaged.
 7. **Bolt**
 - Tightening sequence, refer to **UPPER TIMING CHAIN COVER**.
 8. **Upper Timing Chain Cover**
 - Removing and installing, refer to **UPPER TIMING CHAIN COVER**.
 - Tightening sequence, refer to **Fig. 10**.
 9. **Gasket**
 - Replace if damaged.
 10. **O-ring**
 - Always replace.
 - Lubricate before installing.
 11. **Alignment Sleeve**
 - For centering the cover.
 12. **Lower Timing Chain Cover**
 - Tightening sequence, refer to **Fig. 11**.
 - Removing and installing, refer to one of the following:
 - Passat and CC, refer to **LOWER TIMING CHAIN COVER**.
 13. **Bolt**
 - Always replace.
 - Observe the tightening sequence **Fig. 11**.
 14. **Shaft Seal**
 - For the vibration damper.
 - Removing and installing, refer to **VIBRATION DAMPER SHAFT SEAL**.
 15. **Sealing Plug**
 - Always replace.

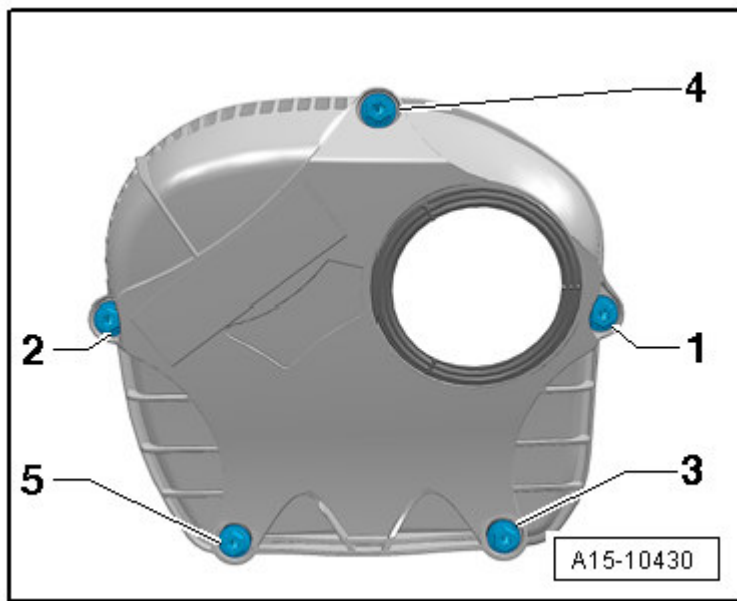


Fig. 10: Identifying Upper Timing Chain Cover - Tightening Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Tighten the bolts in 2 passes in sequence -1 through 5- :

1. **Tighten the bolts by hand**
2. **Tighten the bolts to 9 Nm**

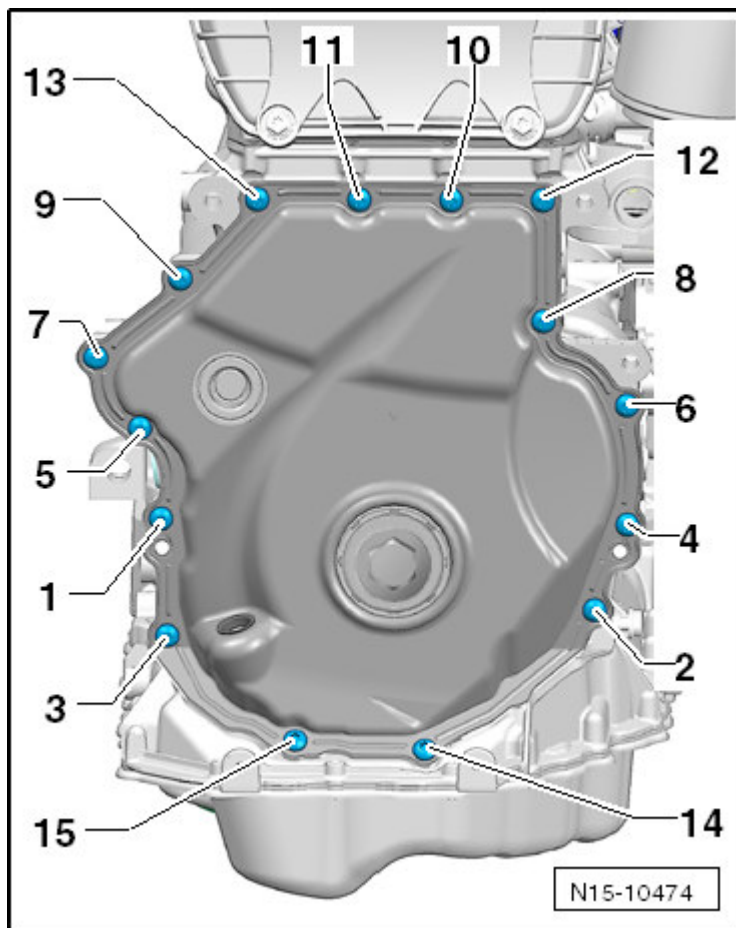


Fig. 11: Identifying Lower Timing Chain Cover Bolts
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Tighten the bolts in 2 passes in sequence -1 through 15- :

1. Tighten the bolts to 8 Nm
2. Tighten the bolts an additional 45° (1/8) turn

CAMSHAFT TIMING CHAIN OVERVIEW

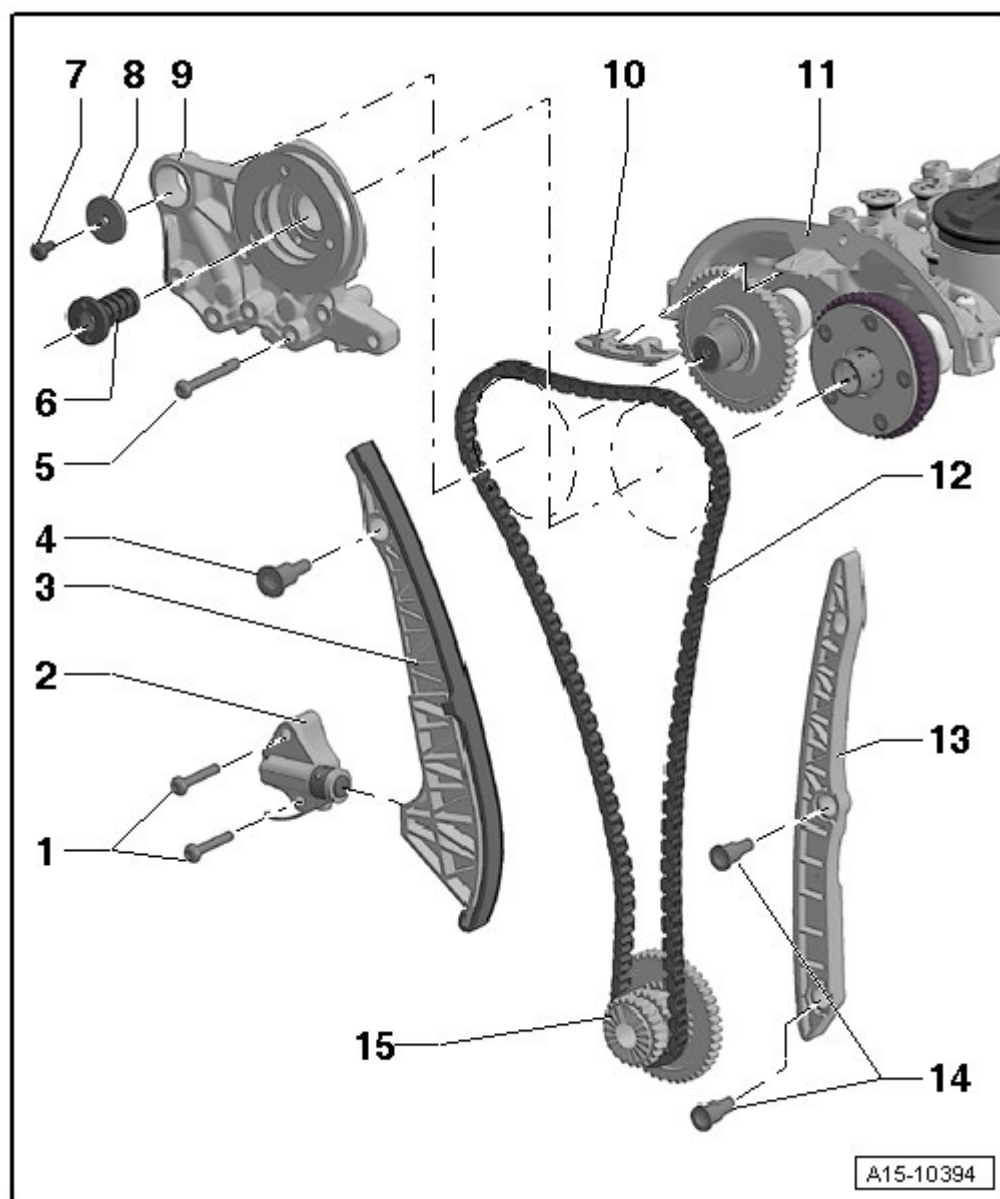


Fig. 12: Identifying Assembly Overview: Camshaft Timing Chain

Courtesy of VOLKSWAGEN UNITED STATES, INC.

1. **Bolt**
 - 9 Nm
2. **Chain Tensioner**
 - Is under tension.
 - Disconnect the locking pin -T40011- before removing.
3. **Timing Chain Tensioning Rail**
4. **Guide Pin**
 - 20 Nm
5. **Bolt**

- 9 Nm
- 6. **Control Valve**
 - 35 Nm
 - Left hand threads.
 - Remove using the assembly tool T10352.
- 7. **Bolt**
 - M6 bolt: 8 Nm + an additional 90° (1/4) turn.
 - M8 bolt: 20 Nm + an additional 90° (1/4) turn.
 - Always replace.
- 8. **Washer**
- 9. **Bearing Bracket**
- 10. **Camshaft Timing Chain Guide Rail**
- 11. **Camshaft Housing**
- 12. **Camshaft Timing Chain**
 - Before removing, mark the direction of rotation with paint.
 - Removing and installing, refer to **CAMSHAFT TIMING CHAIN**.
- 13. **Camshaft Timing Chain Guide Rail**
- 14. **Guide Pin**
 - 20 Nm
- 15. **Sprocket**
 - On the crankshaft.
 - Installed position, refer to **Fig. 13**.

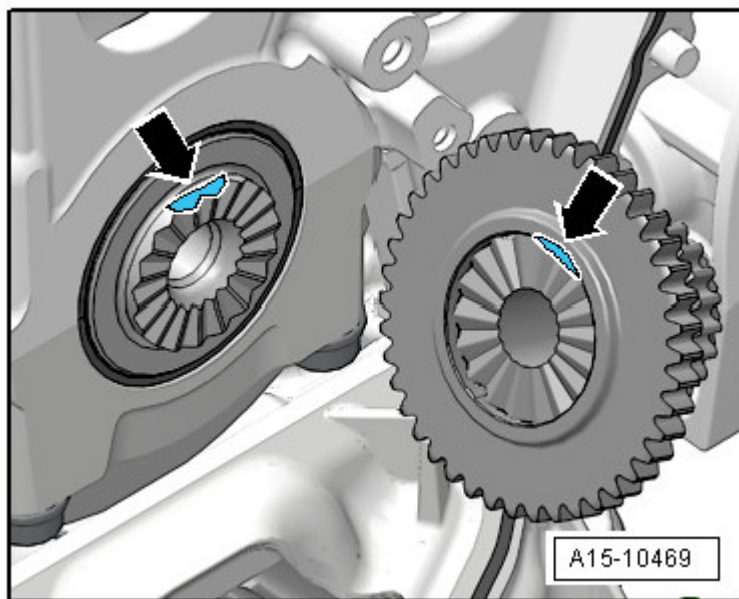


Fig. 13: Identifying Chain Sprocket Crankshaft - Installation Position

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Both surfaces -arrows- must line up across from each other.

BALANCE SHAFT TIMING CHAIN OVERVIEW

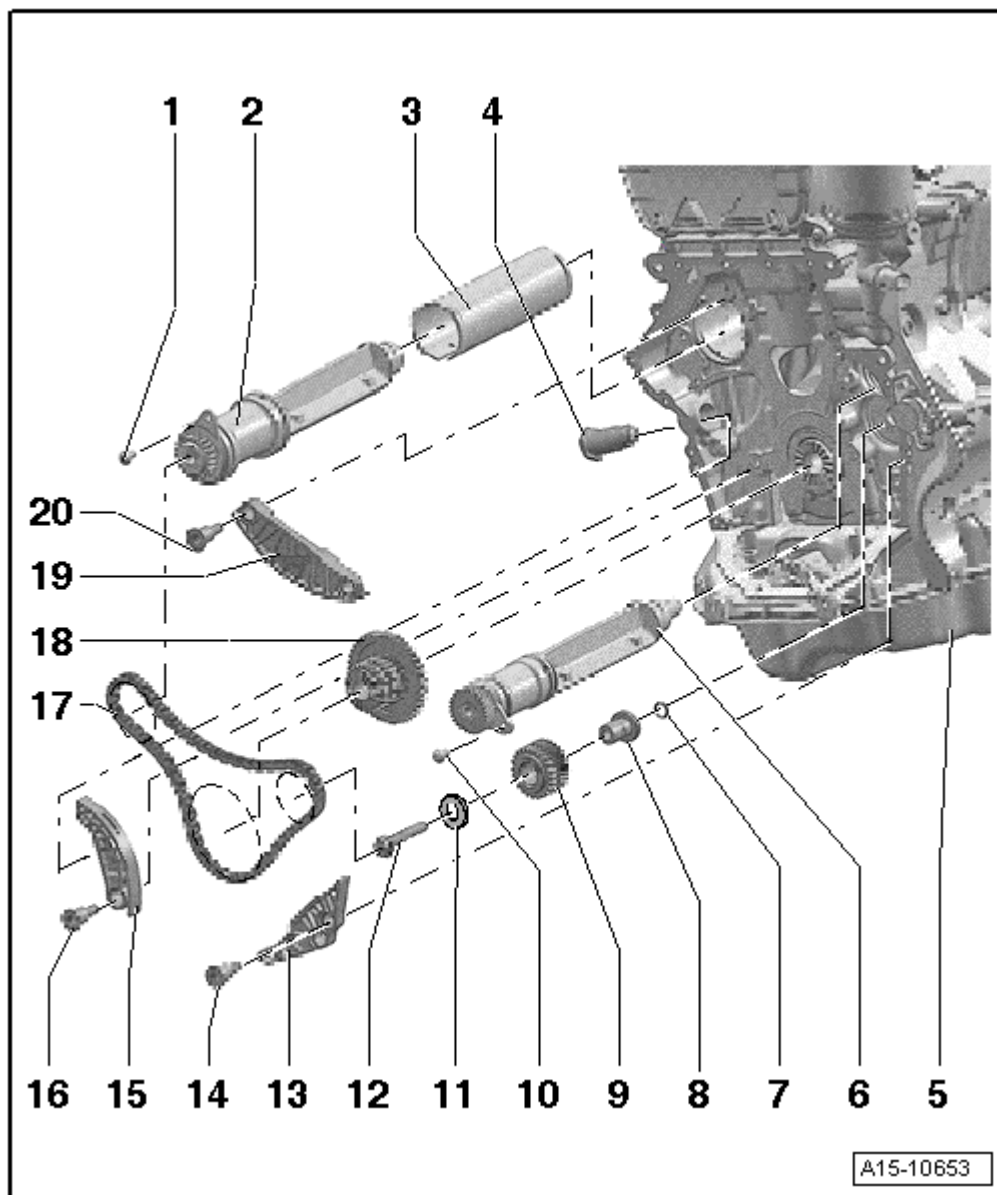


Fig. 14: Identifying Assembly Overview: Balance Shaft Timing Chain
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

1. Bolt

- 9 Nm

2. Balance Shaft

- Replace after removing.

- Exhaust side.
 - Lubricate the bearing with engine oil.
 - Removing, refer to **EXHAUST CAMSHAFT BALANCE SHAFT**.
3. **Pipe for the Balance Shaft**
 - Installed position, refer to **Fig. 15**.
 4. **Chain Tensioner**
 - 65 Nm
 - Install using liquid locking fluid.
 5. **Cylinder Block**
 6. **Balance Shaft**
 - Replace after removing.
 - Intake side.
 - Lubricate the bearing with engine oil.
 - Removing, refer to **INTAKE CAMSHAFT BALANCE SHAFT**.
 7. **O-ring**
 - Lubricate with engine oil.
 8. **Bearing Pin**
 - Lubricate with engine oil.
 - Installed position, refer to **Fig. 16**.
 9. **Intermediate Shaft Sprocket**
 - For the balance shaft.
 - The intermediate shaft sprocket must be replaced if the bolt is loosened.
 10. **Bolt**
 - 9 Nm
 11. **Washer**
 12. **Bolt**
 - The intermediate shaft sprocket must be replaced if the bolt is loosened.
 - Tightening sequence, refer to **Fig. 17**.
 13. **Guide Rail**
 - For the timing chain.
 14. **Guide Pin**
 - 20 Nm
 15. **Tensioning Rail**
 - For the timing chain.
 16. **Guide Pin**
 - 20 Nm
 17. **Timing Chain**
 - Removing and installing, refer to **BALANCE SHAFT TIMING CHAIN**.

18. Sprocket

- Installed position, refer to **Fig. 13**.

19. Guide Rail

- For the balance shaft timing chain.

20. Guide Pin

- 20 Nm

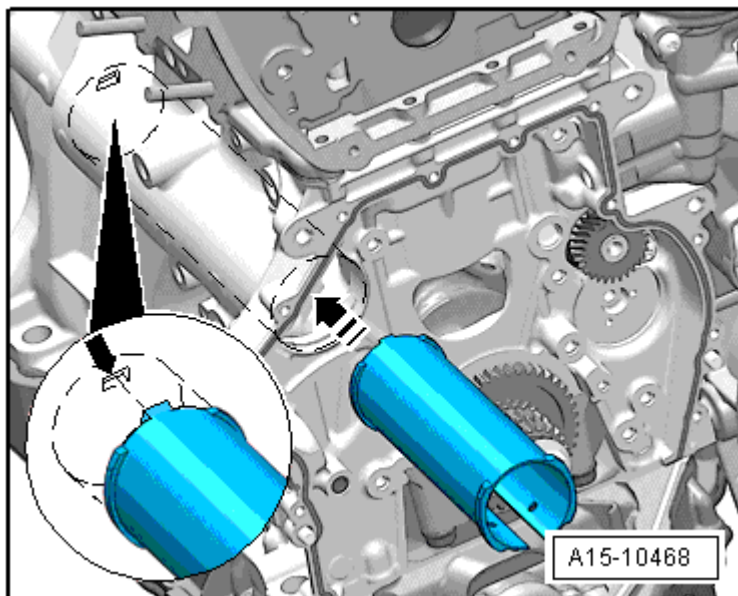


Fig. 15: Identifying Pipe For Balance Shaft - Installation Position
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- The pin from the balance shaft pipe must fit into the groove -arrow-

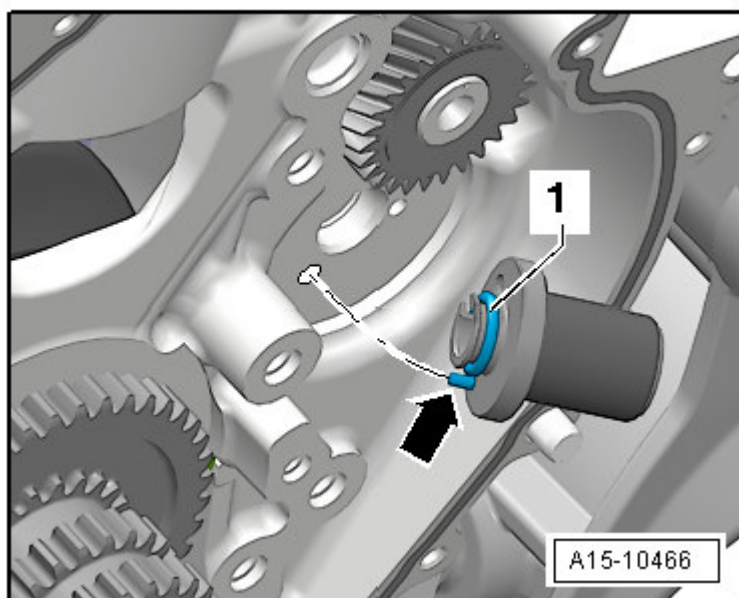


Fig. 16: Identifying Bearing Pins - Installation Position
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Replace and lubricate the O-ring -1-
- The pin -arrow- for the bearing pin must engage in the hole in the cylinder block.
- Lubricate the bearing pin.

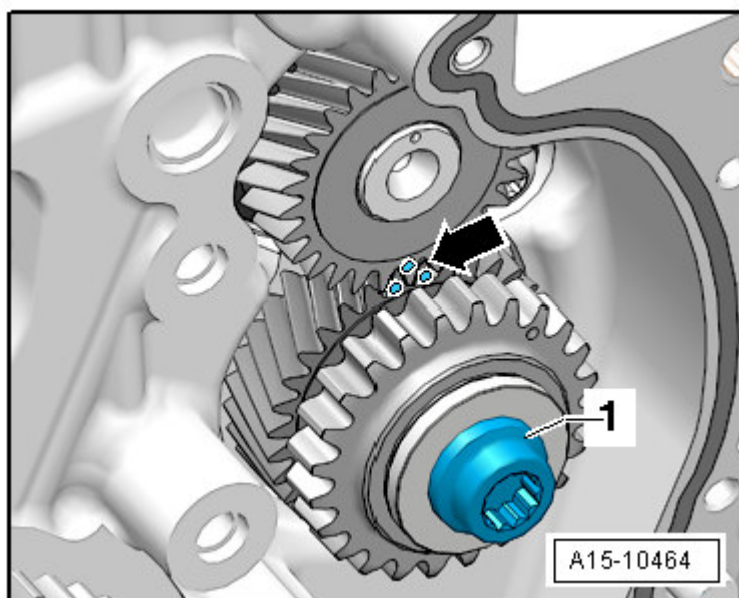


Fig. 17: Identifying Intermediate Shaft Sprocket
Courtesy of VOLKSWAGEN UNITED STATES, INC.

CAUTION: Always replace the intermediate shaft sprocket. Otherwise the backlash will not adjust itself and it could result in engine damage. The new

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intermediate shaft sprocket has an anti-friction coating that wears off after a short period of use, which automatically adjusts the backlash.

-- Tighten the bolt as follows:

-- Tighten the bolt to 10 Nm using a torque wrench.

-- Turn the chain sprocket.

The chain sprocket may not have any play; if so, loosen and tighten again.

-- Tighten the bolt to 30 Nm using a torque wrench.

-- Tighten the bolt an additional 90° (1/4) turn using a ratchet.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Component	Fastener Size	Nm
Balance Shaft to Cylinder Block Bolt	-	9
Balance Shaft Timing Chain Guide Rail to Cylinder Block Guide Pin	-	20
Balance Shaft Timing Chain, Chain Tensioner to Cylinder Block ⁽²⁾	-	65
Balance Shaft Timing Chain Tensioning Rail to Cylinder Block Guide Pin	-	20
Ball Stud to Cylinder Head Cover	-	5
Bearing Bracket to Cylinder Head Bolt	-	9
Bearing Bracket to Exhaust Camshaft Bolt ⁽¹⁾		
	M6	8 + 90°
	M8	20 + 90°
Camshaft Adjustment Valve 1 to Upper Timing Chain Cover Bolt	-	9
Camshaft Position Sensor to Cylinder Block Bolt	-	9
Camshaft Timing Chain, Chain Tensioner to Cylinder Block Bolt	-	9
Camshaft Timing Chain Guide Rail to Cylinder Block Guide Pin	-	20
Camshaft Timing Chain Tensioning Rail to Cylinder Block Guide Pin	-	20
Control Valve to Intake Camshaft ⁽⁴⁾	-	35
Heat Shield to Bracket Bolt	-	9
Heat Shield to Cylinder Head Bolt	-	20

Mounting Plate/Connecting Piece to Cylinder Head Bolt	-	9
Oil Dipstick Guide Tube/Camshaft Adjustment Valve 1 to Upper Timing Chain Cover Bolt	-	9
Oil Dipstick Guide Tube to Cylinder Head Bolt	-	9
Secondary Air Injection Solenoid Valve to Cylinder Head Bolt ⁽³⁾	-	9
Transport Strap to Cylinder Head Bolt	-	25
Vacuum Pump to Cylinder Head Bolt	-	9

(1) Always replace

(2) Install with locking compound.

(3) Engine code CBFA only

(4) Left hand threads

Crankcase Ventilation Bolt Tightening Sequence and Specification

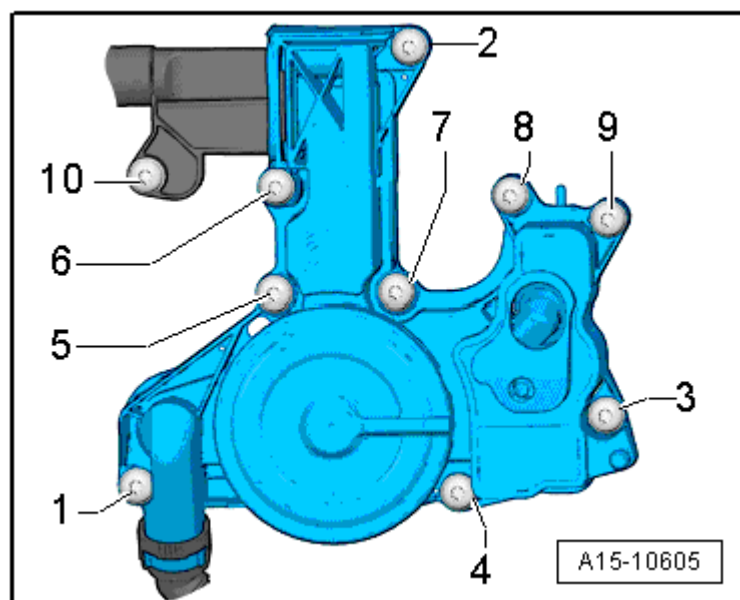


Fig. 18: Identifying Crankcase Ventilation - Tightening Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Tighten the crankcase ventilation bolts in sequence -1 through 10- to 11 Nm.

Cylinder Head Cover Bolt Tightening Sequence and Specification

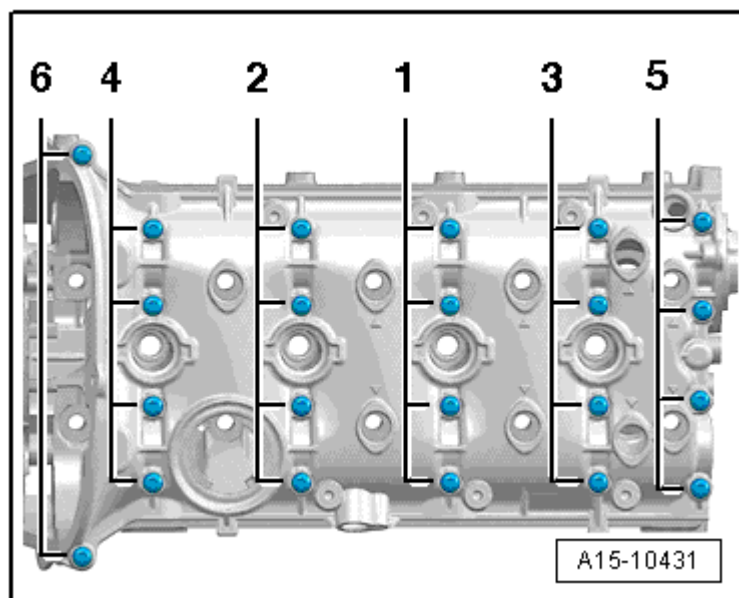


Fig. 19: Identifying Cylinder Head Cover - Tightening Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Replace the bolts.

- Hand tighten the bolts in several passes in sequence -1 through 6-.
- Tighten the bolts in sequence -1 through 6- to 8 Nm.
- Tighten the bolts in sequence -1 through 6- an additional 90° (1/4) turn.

Cylinder Head Bolt Tightening Sequence and Specification

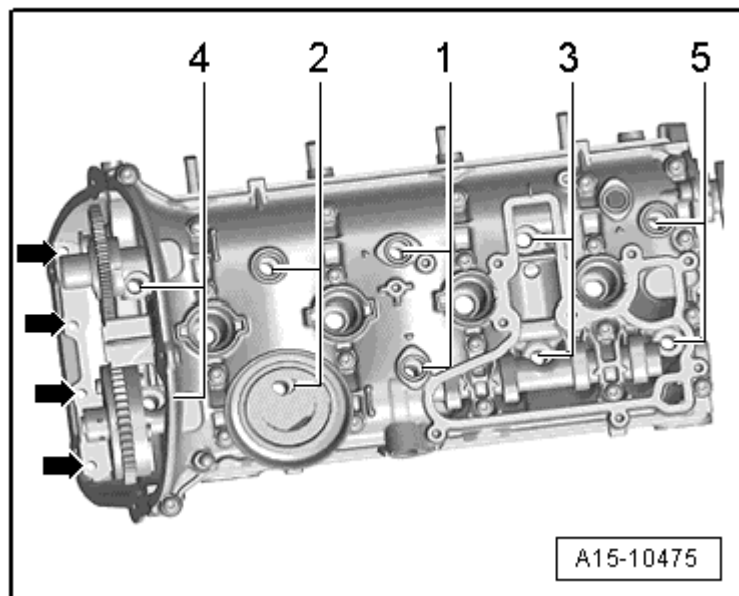


Fig. 20: Identifying Cylinder Head - Tightening Sequence

Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Tighten the cylinder head bolts in sequence -1 through 5-

- Tighten the bolts to 40 Nm.
- Tighten the bolts an additional 90° (1/4) turn.
- Tighten the bolts an additional 90° (1/4) turn.
- Tighten the bolts -arrows- to 8 Nm.
- Tighten the bolts -arrows- an additional 90° (1/4) turn.

Upper Timing Chain Cover Bolt Tightening Sequence and Specification

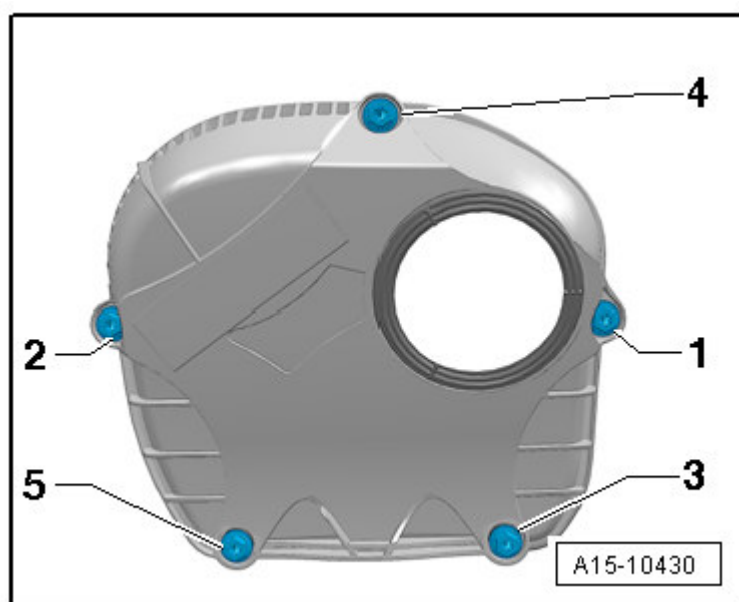


Fig. 21: Identifying Upper Timing Chain Cover - Tightening Sequence

Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Tighten the bolts in 2 passes in sequence -1 through 5- :

1. Tighten the bolts by hand
2. Tighten the bolts to 9 Nm

Lower Timing Chain Cover Bolt Tightening Sequence and Specification

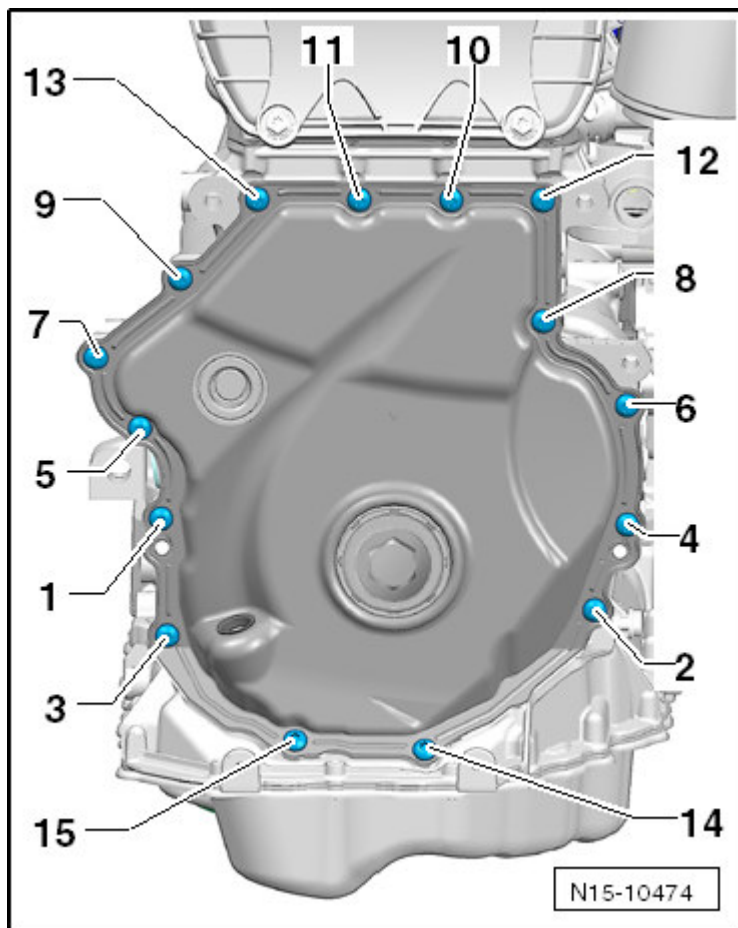


Fig. 22: Identifying Lower Timing Chain Cover Bolts
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Tighten the bolts in 2 passes in sequence -1 through 15- :

1. Tighten the bolts to 8 Nm
2. Tighten the bolts an additional 45° (1/8) turn

Intermediate Shaft Sprocket Bolt Tightening Sequence and Specification

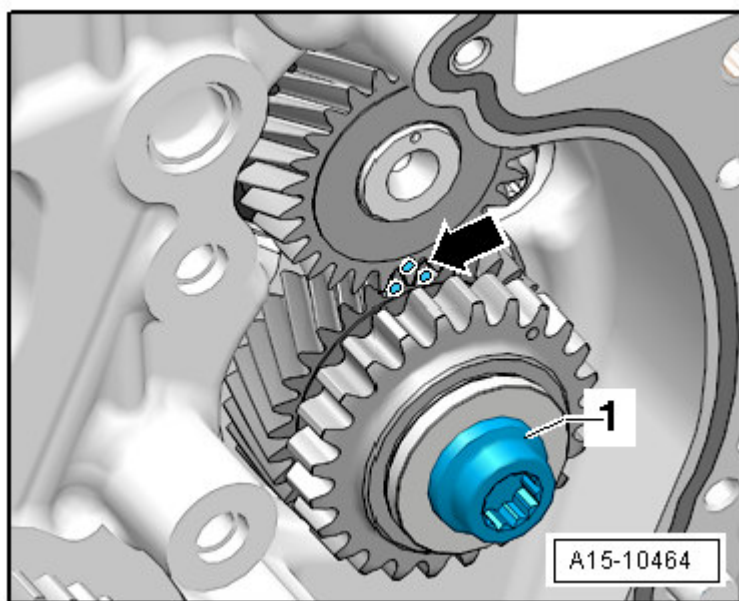


Fig. 23: Identifying Intermediate Shaft Sprocket
Courtesy of VOLKSWAGEN UNITED STATES, INC.

WARNING: Always replace the intermediate shaft sprocket. Otherwise the backlash will not adjust itself and it could result in engine damage. The new intermediate shaft sprocket has an anti-friction coating that wears off after a short period of use, which automatically adjusts the backlash.

-- Tighten the bolt to 10 Nm.

-- Turn the chain sprocket.

The chain sprocket may not have any play; if so, loosen and tighten again.

-- Tighten the bolt to 30 Nm.

-- Tighten the bolt an additional 90° (1/4) turn.

DIAGNOSIS AND TESTING

VALVE TIMING, CHECKING

-- Remove the upper timing chain cover. Refer to UPPER TIMING CHAIN COVER.

-- Remove the noise insulation. Refer to Description and Operation .

-- Disconnect the right charge air hose at the coupling.

-- Rotate the vibration damper, from underneath, in engine rotation direction to Top Dead Center (TDC) -arrow- .

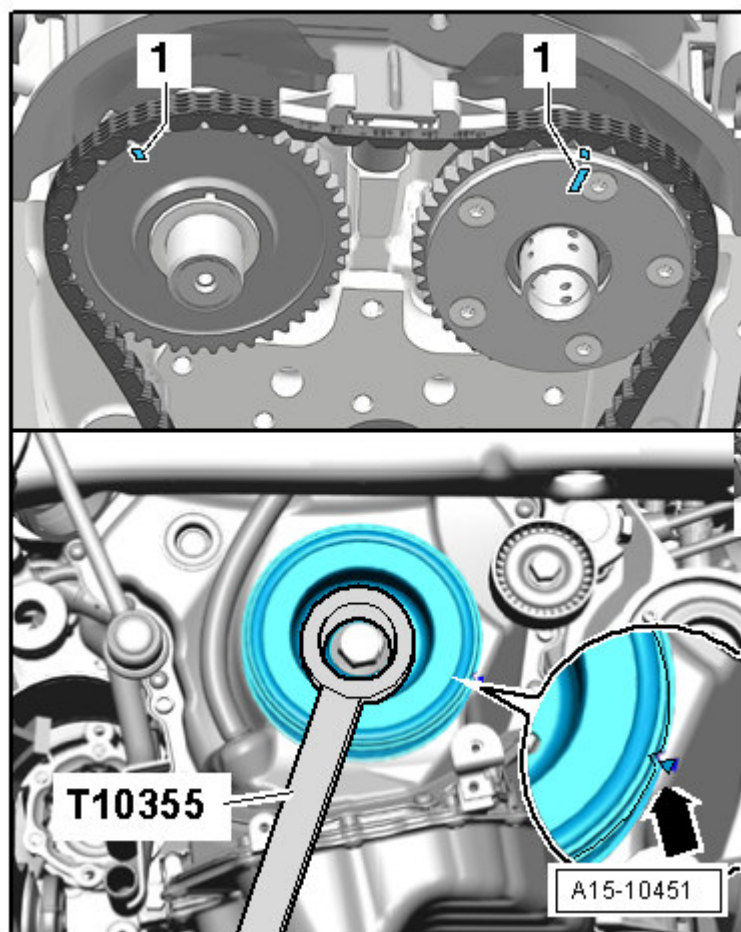


Fig. 24: Identifying Vibration Damper Rotated Into "OT" Position Using Counter Hold Tool T10355
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE: Use a ratchet with a 24 mm socket to rotate the vibration damper. Rotate the crankshaft first to TDC and then again approximately 45° in the opposite direction of the engine rotation. Next, rotate the crankshaft in engine rotation direction to TDC.

If the arrow mark on the lower timing chain cover is no longer visible, set the engine to TDC using the dial gauge -VAS 6079-, refer to SETTING THE ENGINE TO TDC USING THE DIAL GAUGE -VAS 6079-.

- The notch on the vibration damper must line up with the arrow mark on the lower timing chain cover (use a inspection mirror, if necessary).
- The marks -1- on the camshafts must point upward.

-- Measure the distance from the outer edge -A- to the mark -B- on the intake camshaft.

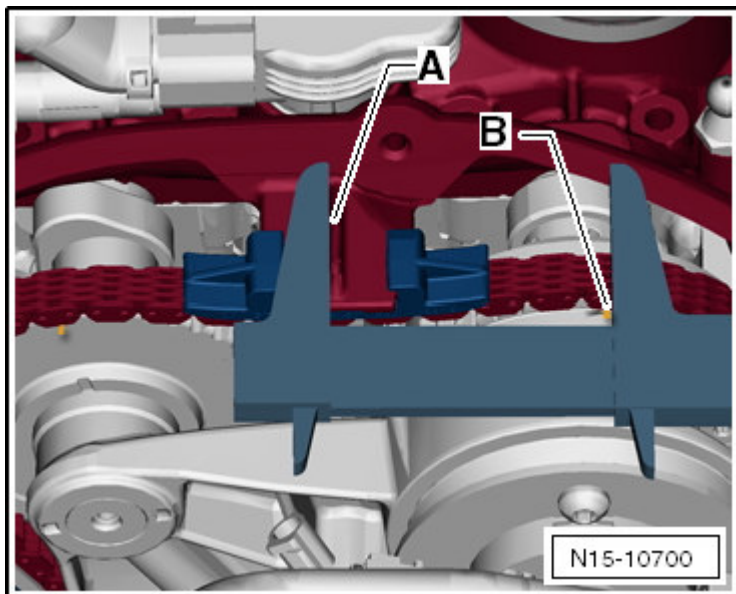


Fig. 25: Identifying Measurement Points From Outer Edge -A- To Mark -B-
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Specified value: 61 to 64 mm.

-- Once the specified value is reached, measure the distance between the mark on the intake camshaft -B- and the mark on the exhaust camshaft -C-.

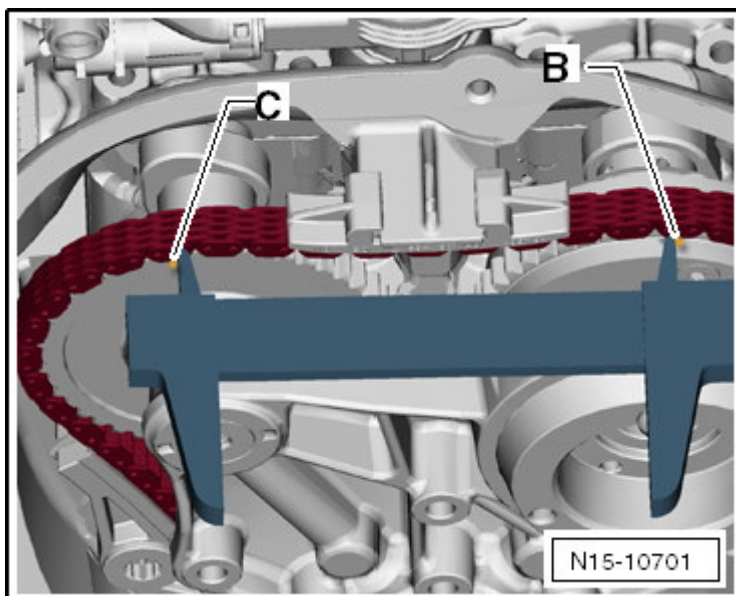


Fig. 26: Identifying Measurement Points From Mark On Intake Camshaft -B- To Mark On Exhaust Camshaft -C-
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Specified value: 124 to 126 mm

NOTE: If one tooth has an offset, there will be a deviation of approximately 6 mm from the specified value. Install the timing chain once again if there is an offset.

SETTING THE ENGINE TO TDC USING THE DIAL GAUGE -VAS 6079-

Special tools and workshop equipment required

- Dial Gauge 0-10 mm -VAS 6079-
- Adapter for the Dial Gauge -T10170- or -T10170 A-

-- Remove the upper timing chain cover. Refer to **UPPER TIMING CHAIN COVER**.

-- Rotate the crankshaft from above using a 24 mm socket on the vibration damper in engine rotation direction until the marks -arrows- are on top.

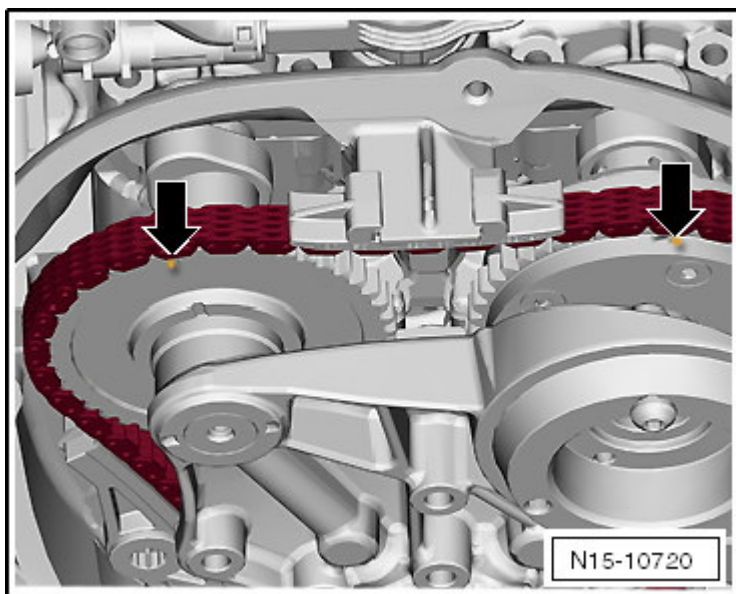


Fig. 27: Identifying Mark Points On Intake And Exhaust Camshafts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the spark plug from cylinder 1.

-- Install the adapter for the dial gauge -T10170/A- all the way into the spark plug threads.

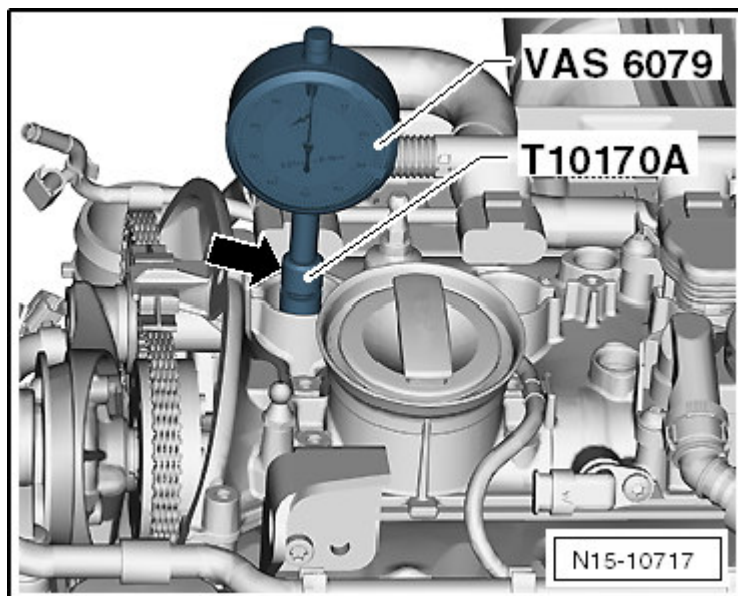


Fig. 28: Identifying Dial Gauge -VAS 6079- With Extending Piece -T10170A/1- Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Insert the dial gauge 0-10 mm -VAS 6079- with the extending piece -T10170A/1- all the way and secure it with the locking nut -arrow-.

-- Rotate the crankshaft slowly in engine rotation direction to the maximum dial reading. When the maximum dial reading is reached (Bottom Dead Center (BDC) of the gauge) the piston is at Top Dead Center (TDC).

NOTE: Rotate the crankshaft first to TDC and then again approximately 45° in the opposite direction of engine rotation. Next rotate the crankshaft in engine rotation direction to TDC.

COMPRESSION TEST

Special tools and workshop equipment required

- Spark Plug Removal Tool -3122 B-
- Ignition Coil Puller -T40039-
- Torque Wrench (5-50 Nm) -V.A.G 1331-
- Compression Tester -V.A.G 1763-

Requirements

NOTE: Follow all safety precautions. Refer to **SAFETY PRECAUTIONS** .

The engine oil temperature is a minimum of 30 °C (86 °F).

The battery voltage is at least 12.7 volts.

Procedure

- Remove the engine cover. Refer to **ENGINE COVER**.
- Disconnect the electrical connectors -arrows- from the ignition coils.

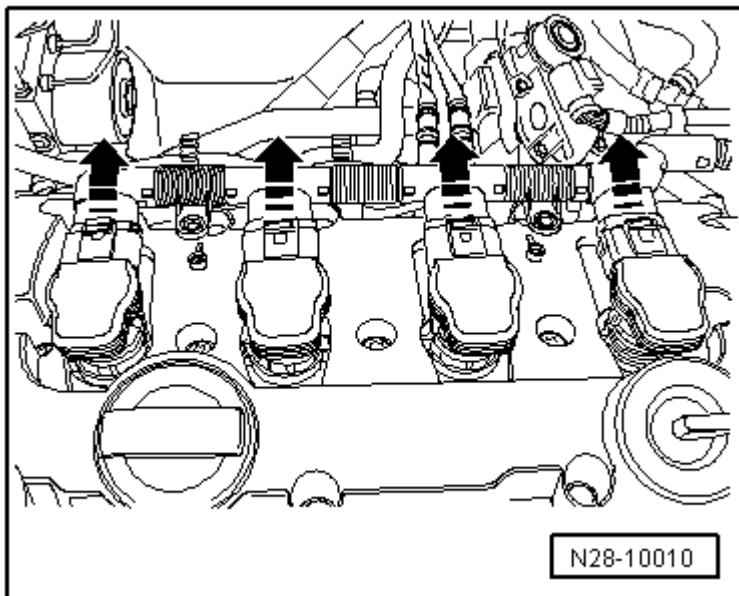


Fig. 29: Identifying Direction To Disconnect Ignition Coils Connectors
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove the ignition coils using the ignition coil puller -T40039-.

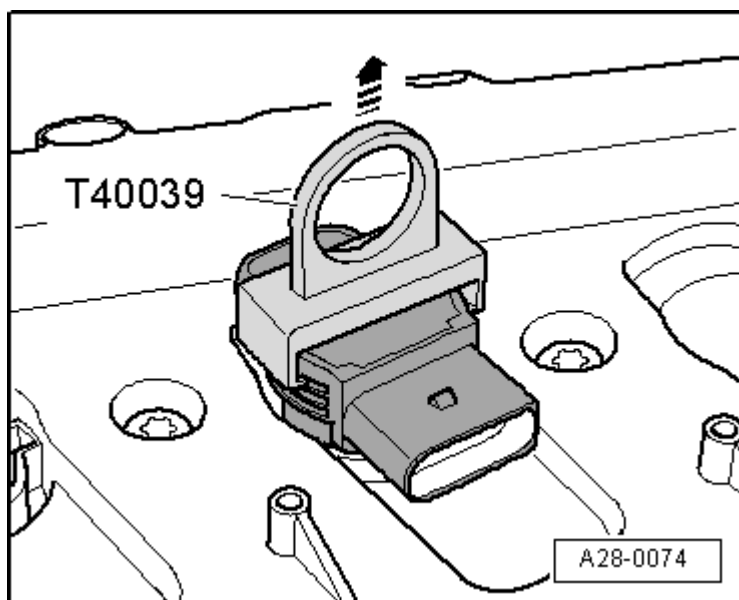


Fig. 30: Identifying Ignition Coil Puller T40039 To Remove Ignition Coils
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

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-- Remove the spark plugs, using the spark plug removal tool -3122 B-.

-- Check the compression using the compression tester -V.A.G 1763- and the adapter -V.A.G 1763/6-.

NOTE: **Using the tester, refer to the operating instructions.**

-- Operate the starter until the tester no longer indicates that the pressure is increasing.

Compression Pressure

New Bar Positive Pressure	Wear Limit Bar Positive Pressure	Difference Between Cylinders Bar Positive Pressure
11.0... 14.0	7.0	Max. 3.0

-- Install the sparks plugs. Tightening specification, refer to **IGNITION SYSTEM COMPONENT OVERVIEW** .

-- Install the ignition coils with power output stage. Refer to **IGNITION COILS WITH POWER OUTPUT STAGES** .

NOTE: **By disconnecting the ignition coil connectors, Diagnostic Trouble Codes (DTCs) are stored to memory. After the test, check the fault memory and erase, if necessary.**

-- Read the Engine Control Module (ECM) DTC memory. Refer to the vehicle diagnostic tester.

CAMSHAFT AXIAL CLEARANCE, CHECKING

Special tools and workshop equipment required

- Dial Gauge Holder -VW 387-
- Dial Gauge 0-10 mm -VAS 6079-

Test Sequence

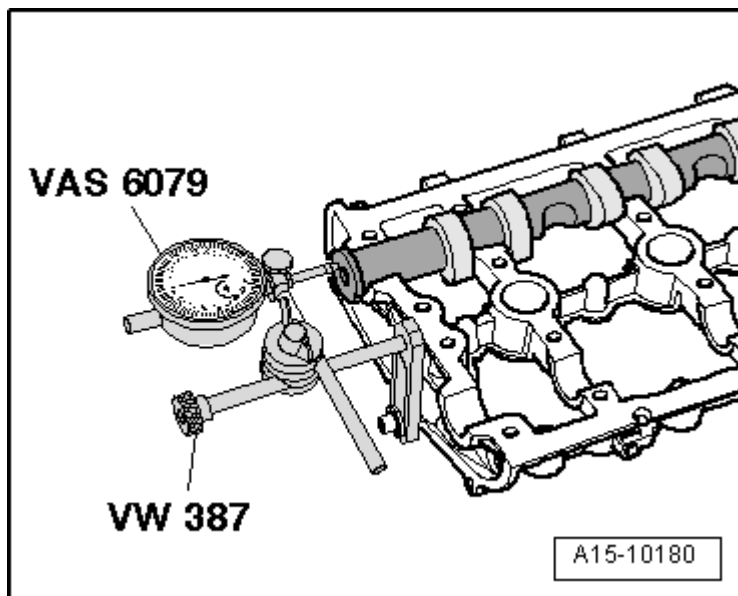


Fig. 31: Identifying Dial Gauge VAS 6079 Secured To Cylinder Head With Universal Dial Gauge Holder VW 387

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Perform the measurement with the cylinder head cover removed.
- Place the camshaft to be checked in the cylinder head.
- Secure the dial gauge 0-10 mm -VAS 6079- to the cylinder head using the dial gauge holder -VW 387-.
- Press the camshaft against dial gauge by hand.
- Set the dial gauge to "0".
- Press the camshaft off the dial gauge and read the value:
 - Axial clearance: 0.05 to 0.17 mm.

VALVE GUIDE, CHECKING

Special tools and workshop equipment required

- Dial Gauge Holder -VW 387-
- Dial Gauge 0-10 mm -VAS 6079-

Test Sequence

- Insert the valve into the guide. The valve stem tip must be flush with the guide. Due to the slight difference in stem dimensions, ensure that only an intake valve is used in the intake guide and an exhaust valve in the exhaust guide.

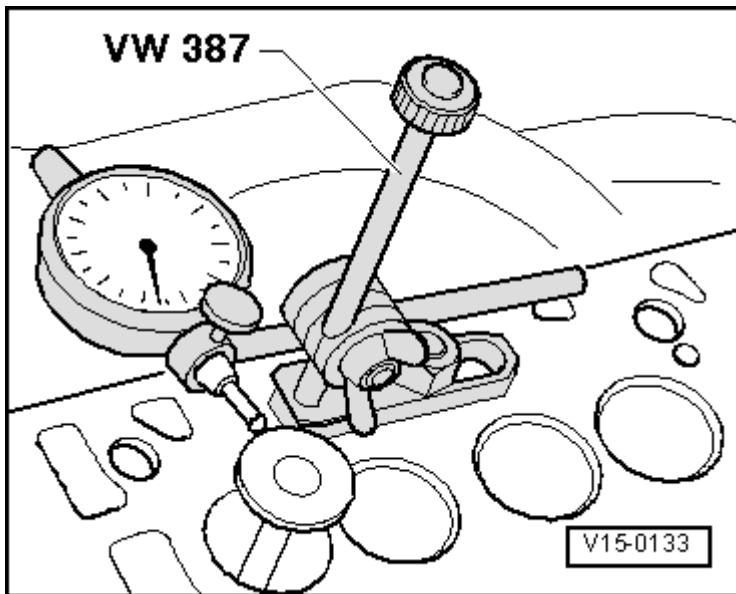


Fig. 32: Identifying Dial Gauge Holder VW 387 To Determine Valve Rock (Wear limit)
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Determine the tip clearance.

Wear Limit

Intake Valve Guide	Exhaust Valve Guide
0.80 mm	0.80 mm

NOTE: If the wear limit is exceeded, measure again using new valves. If the wear limit is still exceeded, replace the cylinder head.

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

REMOVAL AND INSTALLATION

ENGINE COVER

Removing

-- Pull the engine cover at its attachment points -arrows- upward.

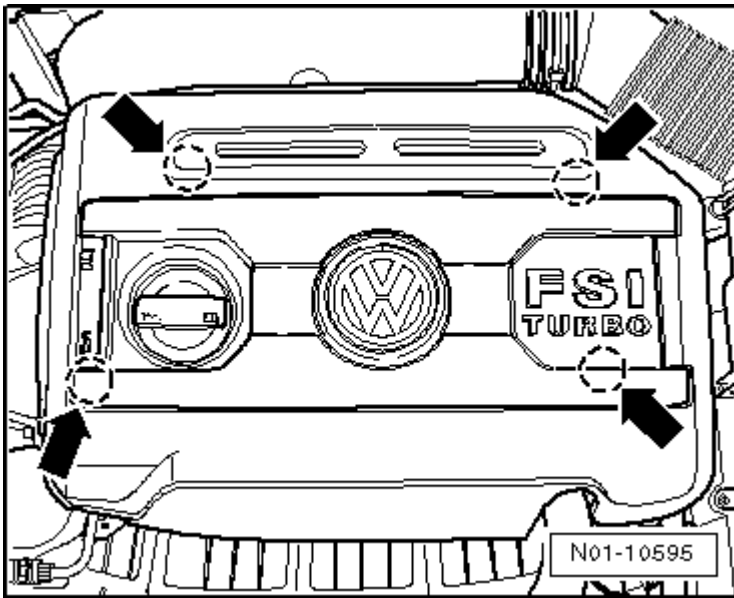


Fig. 33: Identifying Engine Cover Attachment Points
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Installing

-- Make sure the rubber insulators fit correctly into the mounts when installing.

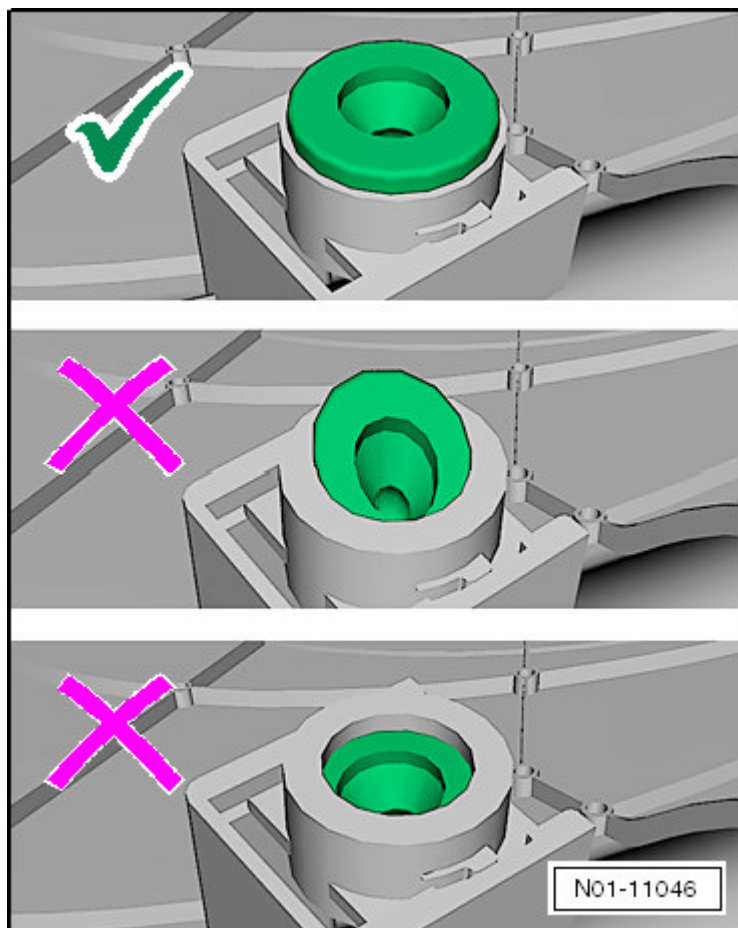


Fig. 34: Identifying Correct Installation Of Rubber Insulators
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Carefully press the engine cover onto the ball studs.
- To prevent damage, do not hit the engine cover with a fist or tools.

VACUUM PUMP

Removing

- Remove the engine cover. Refer to **ENGINE COVER**.
- Remove the air filter housing. Refer to **AIR FILTER HOUSING** .
- Remove the high pressure pump. Refer to **HIGH PRESSURE PUMP** .
- Remove the ground wire -3- and bolt -4-.

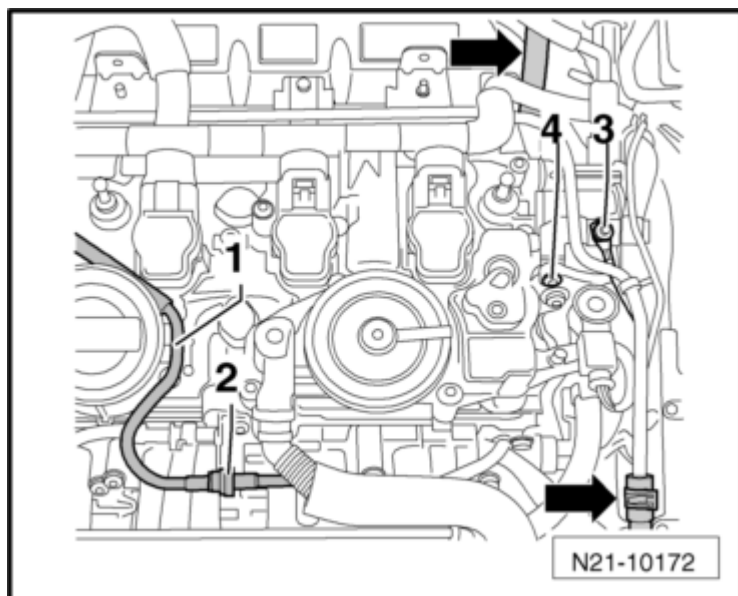


Fig. 35: Identifying Vacuum Line -1-, Ground Wire -3- And Bolt -4-
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the vacuum hose -1- from the vacuum pump.

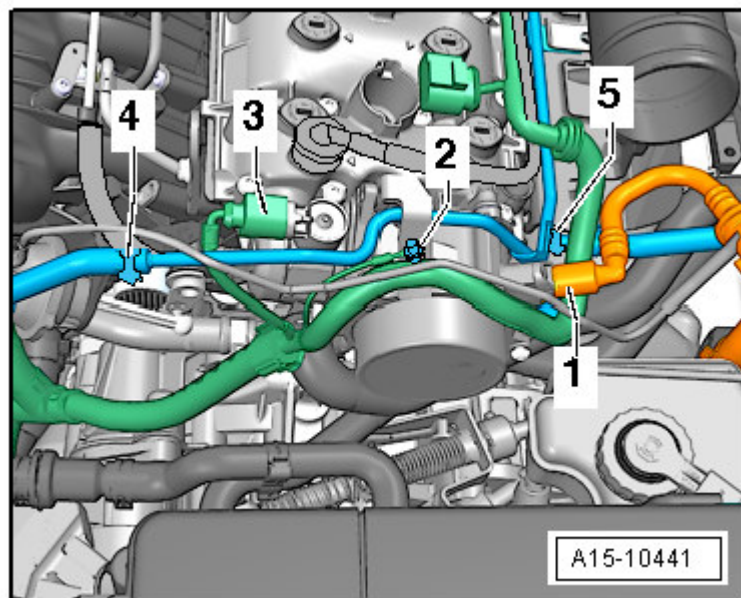


Fig. 36: Identifying Vacuum Pump, Ground Cable, Electrical Connector And Coolant Hoses
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the bolts -arrows- and remove the vacuum pump.

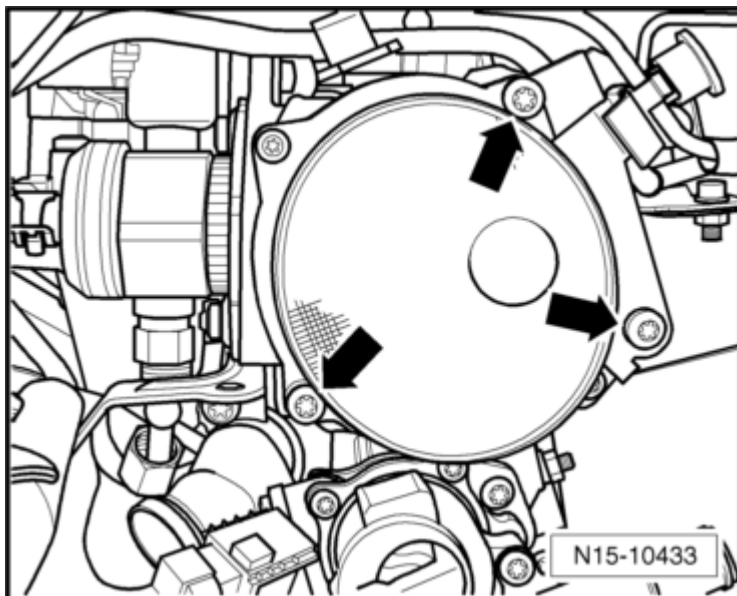


Fig. 37: Identifying Vacuum Pump Bolts

Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE: Do not disassemble the vacuum pump.

Installing

- Tightening specifications, refer to **CYLINDER HEAD OVERVIEW**.

Installation is the reverse of removal, noting the following:

- Clean the sealing surfaces.
- Install the seal on the vacuum pump, install the 2 bolts and then mount it to the cylinder head.

CAMSHAFT ADJUSTMENT VALVE 1 -N205-

Remove the charge air pipe from the noise generator, if equipped.

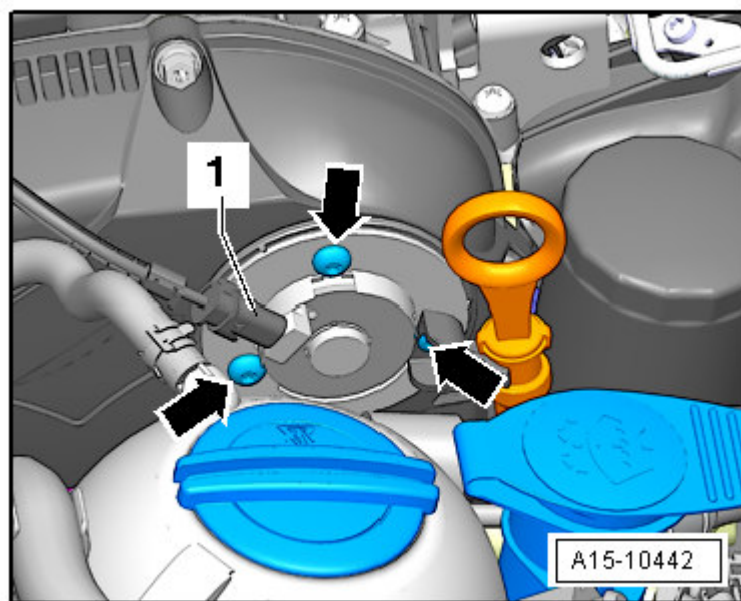


Fig. 38: Identifying Camshaft Adjustment Valve And Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect the connector from the camshaft adjustment valve 1 -1-.
- Remove the bolts -arrows- and then the camshaft adjustment valve 1.

Installing

- Tightening specifications, refer to **TIMING CHAIN COVERS OVERVIEW.**

Install in reverse order of removal. Note the following:

- Lubricate the seal and the O-ring with engine oil.

CAMSHAFTS

Special tools and workshop equipment required

- Thrust Piece -T10174-
- Assembly Tool -T10352-
- Counter Hold Tool -T10355-
- Locking Pin -T40011-
- Ignition Coil Puller -T40039-
- Torque Wrench (5-50 Nm) -V.A.G 1331-
- Sealant -D 154 103 A1-

NOTE: The sealing surfaces of the cylinder head cover and the upper cylinder head

must not be reworked.

The camshaft bearings are integrated in the cylinder head or cylinder head cover. The tension must be released from the camshaft timing chain before removing the cylinder head cover.

If the cylinder head cover was removed, the sealing cap must be replaced.

During installation, cable ties must be installed in the same location.

Removing

- Remove the engine cover. Refer to **ENGINE COVER**.
- Remove the vacuum pump. Refer to **VACUUM PUMP**.
- Remove the noise insulation. Refer to **Description and Operation**.
- Remove the front part of the right wheel housing liner and/or the right front wheel housing liner. Refer to **Removal and Installation**.
- Remove the bolts -arrows-.

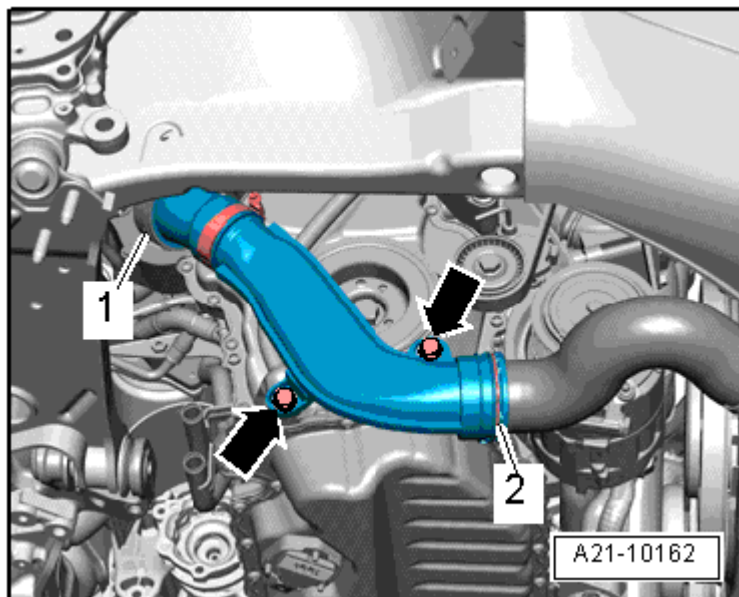


Fig. 39: Identifying Air Guide Pipe And Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Lift the clamps -1 and 2- and remove the charge air pipe.
- Disconnect the connector from the camshaft adjustment valve 1 -N205- -1-.

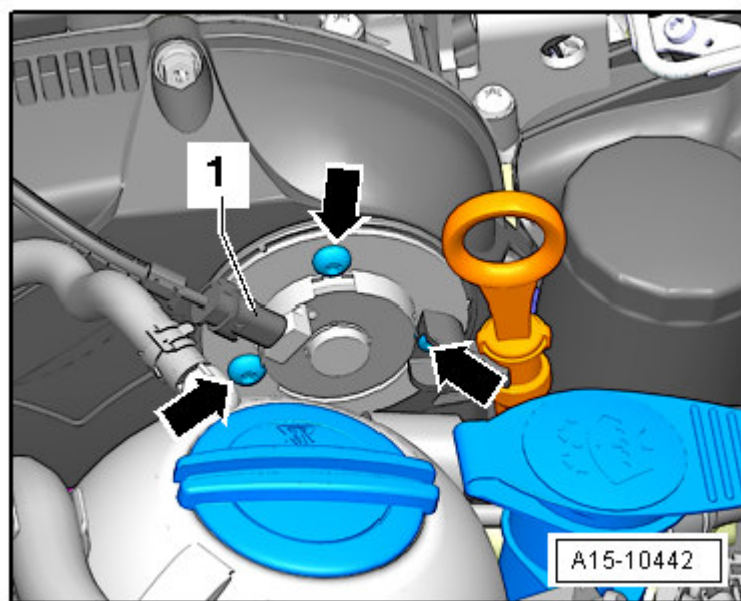


Fig. 40: Identifying Camshaft Adjustment Valve And Bolts
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove the bolts -arrows- and then the camshaft adjustment valve 1.
- Remove the upper timing chain cover. Refer to UPPER TIMING CHAIN COVER.

CAUTION: The control valve has left hand threads.

- Remove the control valve in the -direction of the arrow- using the assembly tool T10352.

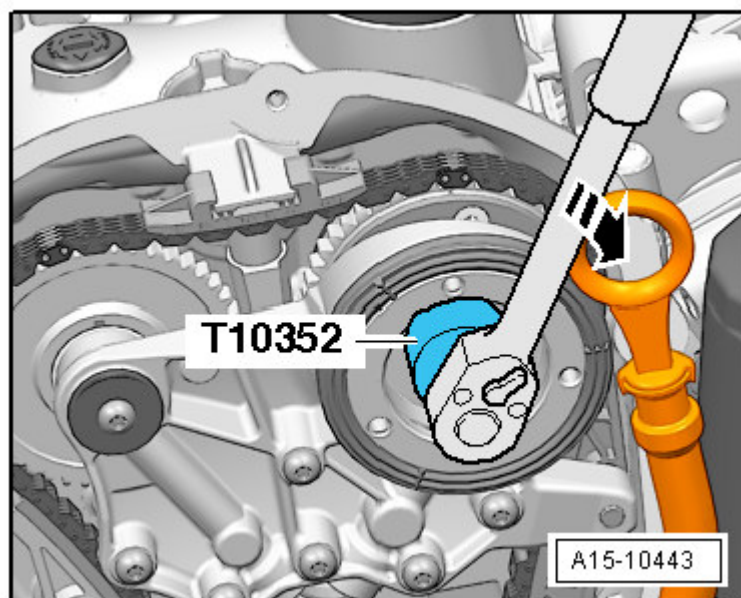


Fig. 41: Identifying Assembly Tool T10352 To Remove Control Valve
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the bolts -arrows- and remove the bearing bracket.

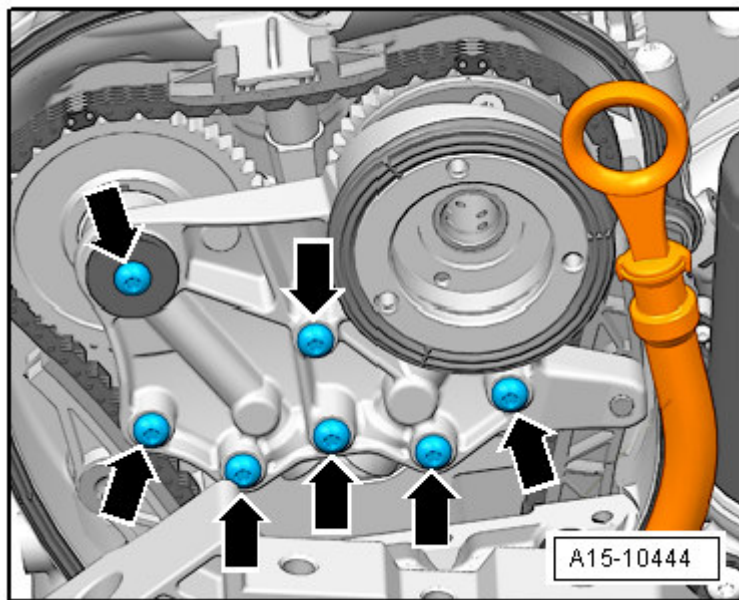


Fig. 42: Identifying Bearing Bracket Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Rotate the vibration damper to the Top Dead Center (TDC) position -arrow- using the counter hold tool - T10355-.

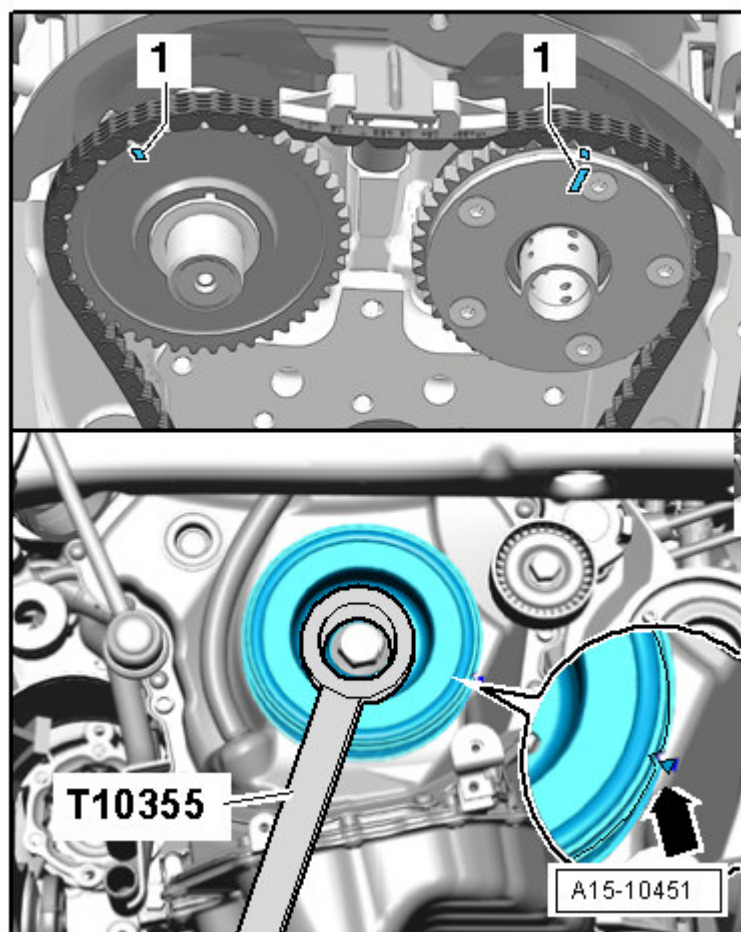


Fig. 43: Identifying Vibration Damper Rotated Into "OT" Position Using Counter Hold Tool T10355
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- The notch on the vibration damper must line up with the arrow mark -arrow- on the lower timing chain cover.
- The marks -1- on the camshafts must point upward.

-- Carefully mark the position of the drive chain to the sprockets -A arrows- with a waterproof marker. Also mark the position of the drive chain to the guide rail -B arrows-. These marks are necessary for reinstallation.

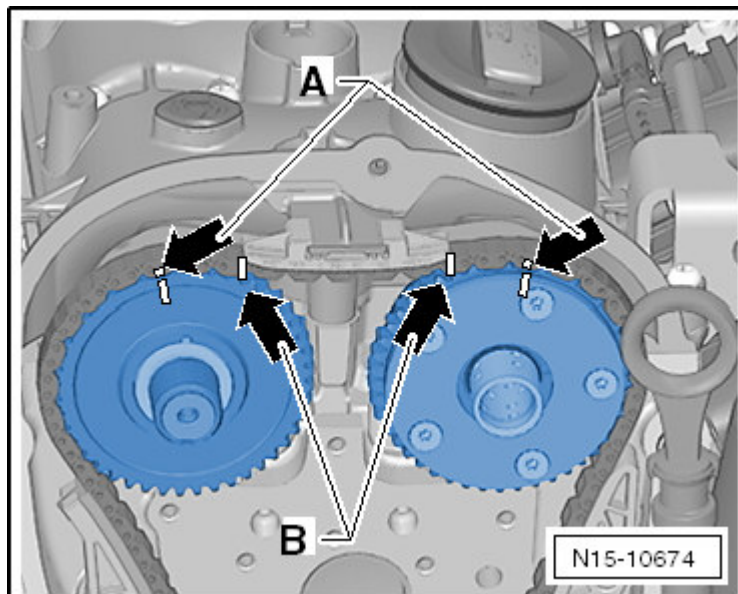


Fig. 44: Identifying Position Marks: Drive Chain To Sprockets -A- And Drive Chain To Guide Rail -B-
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the plug -arrow-.

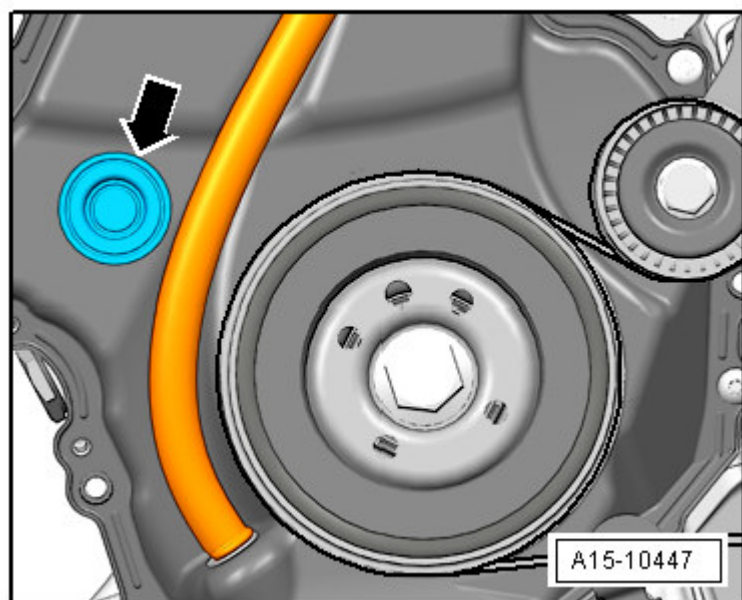


Fig. 45: Locating Plug
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

The locking wedge in the chain tensioner must be lifted in order to release the tension from the chain tensioner. Grind the end of the locking pin -T40011- down to a point. A screwdriver with a head approximately 1.5 mm wide can also be used.

CAUTION: There is a risk of damaging the chain tensioner. Proceed very carefully.

-- Lift the chain tensioner locking wedge by inserting a scribe or a suitable screwdriver into the hole in the chain tensioner in the -direction of arrow 1-.

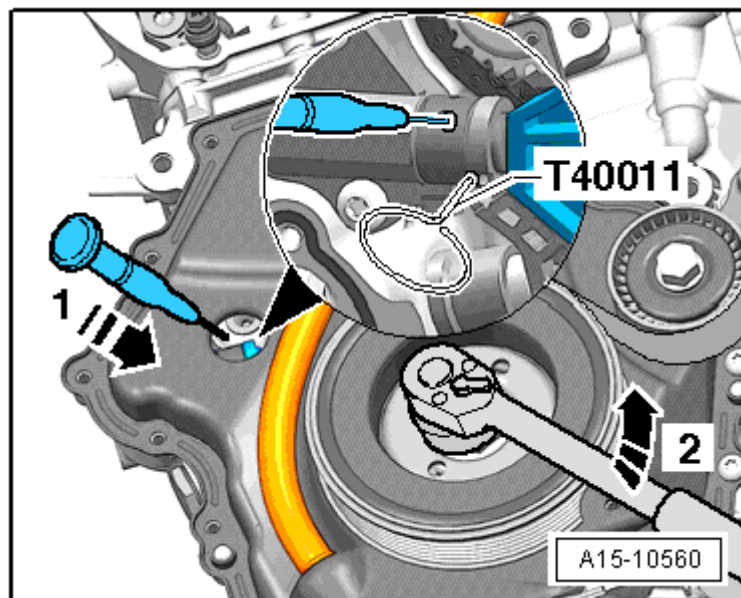


Fig. 46: Identifying Chain Tensioner Locking Wedge, Screwdriver, Crankshaft And Securing Pin T40011
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- In order to tension the chain tensioner, rotate the crankshaft opposite the engine rotation direction -2- and secure it using a locking pin -T40011-.

NOTE: The intake camshaft switches in the engine rotation direction.

-- Remove the guide pin -1- and guide the tensioning rail -2- downward.

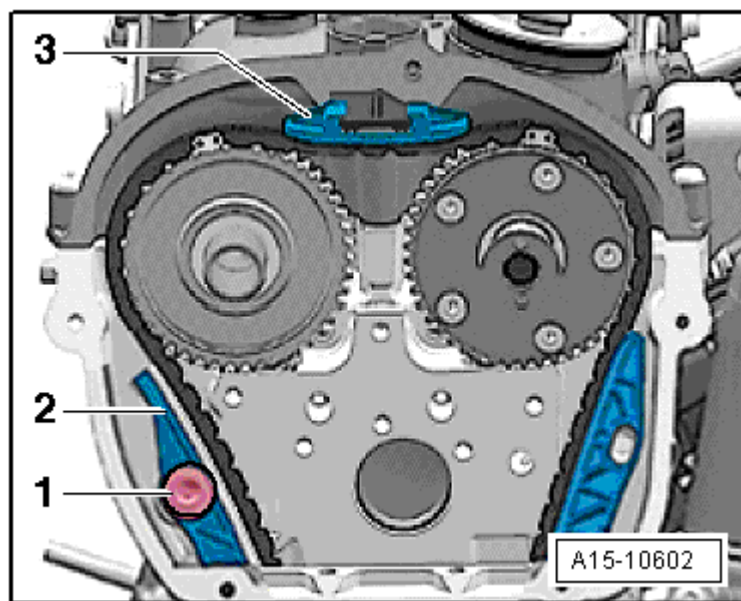


Fig. 47: Identifying Guide Tensioning Rail, Upper Guide Rai And Bolt
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the upper guide rail -3- by unlocking the latch located in the center with a screwdriver and pushing the guide rail forward.

NOTE: When the lower timing chain cover is installed, the loose chain on the crankshaft cannot jump off.

-- Remove the camshaft timing chain from the sprockets.

CAUTION: Danger of damaging the valves, piston head and lower timing chain cover.

- Make certain that the timing chain remains tensioned when turning the crankshaft by hand.
- Panels are installed on the lower timing chain cover to prevent the chain from falling down. The panels can bend if the crankshaft is rotated when the chain is loose.

-- Disconnect the connectors from the ignition coils and free up the wiring harness.

-- Remove the ignition coils using the ignition coil puller -T40039-.

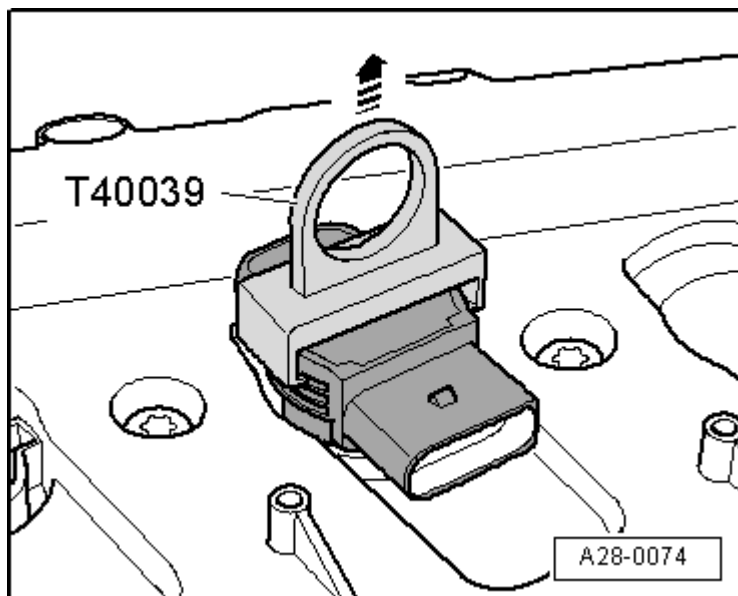


Fig. 48: Identifying Ignition Coil Puller T40039 To Remove Ignition Coils
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Disconnect the hose for the crankcase ventilation -1-.

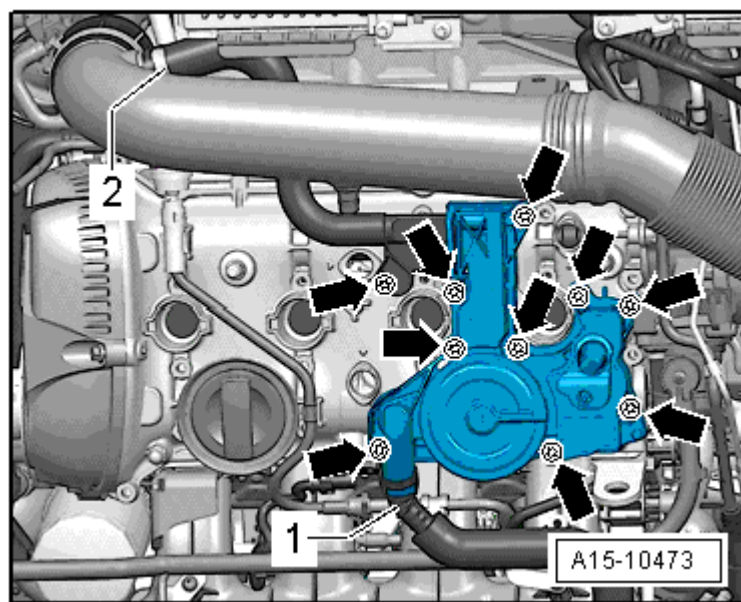
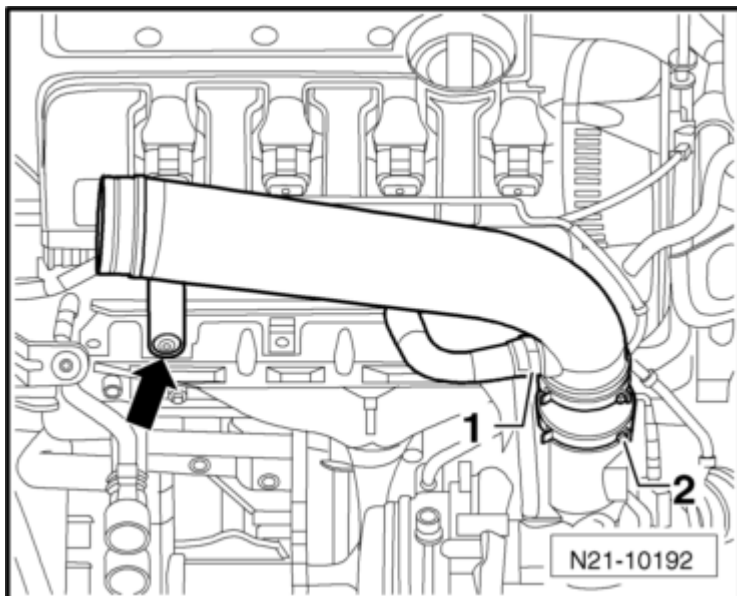


Fig. 49: Identifying Crankcase Ventilation, Tightening Sequence
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

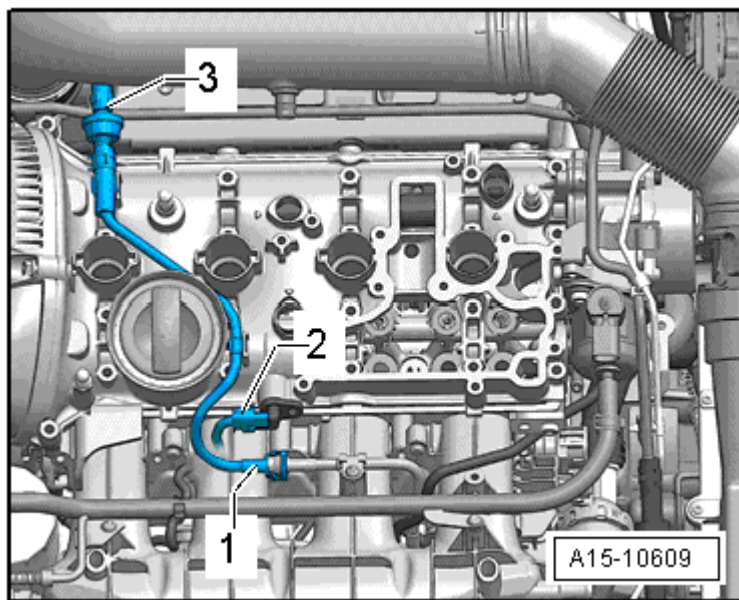
-- Remove the bolts -arrows-.

-- Remove the charge air pipe bolt -arrow-.



**Fig. 50: Identifying Charge Air Pipe Bolt -Arrow- And Hose Clamp -2-
Courtesy of VOLKSWAGEN UNITED STATES, INC.**

-- Loosen the hose clamp -2- and remove the charge air pipe together with the crankcase ventilation.



**Fig. 51: Identifying Camshaft Position Sensor G40 Electrical Connector And Lines
Courtesy of VOLKSWAGEN UNITED STATES, INC.**

-- Disconnect the vacuum line -1- and free up the wire.

-- Disconnect the connector -2- from the camshaft position sensor -G40-.

-- Remove the cylinder head cover bolts in sequence -1 through 6-.

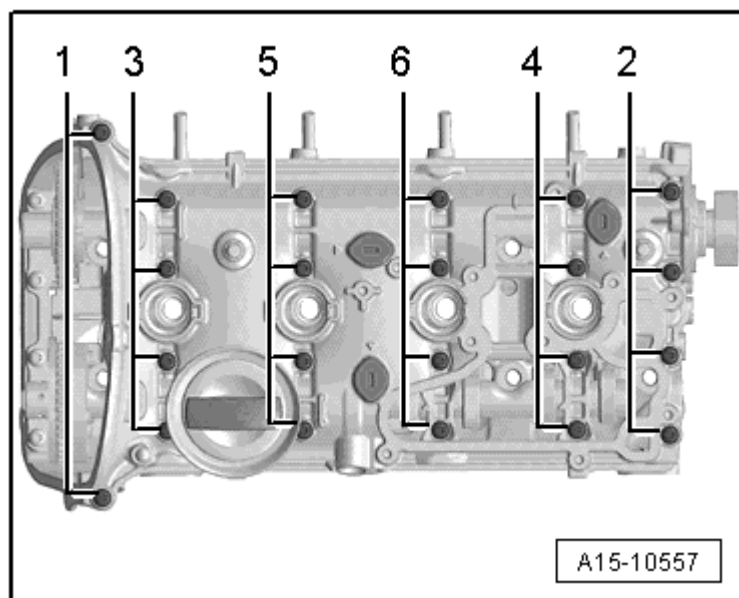


Fig. 52: Identifying Cylinder Head Cover Loosening
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove the cylinder head cover.
- Remove the camshafts.
- Prevent dirt and adhesive residue from entering the cylinder head.

Installing

- Tightening specifications, refer to VALVETRAIN OVERVIEW.

NOTE: The sealing surfaces must be completely free of oil and grease.

The pistons must not be positioned at TDC.

Make sure that all roller rocker arms make contact correctly on the valve stem ends.

Note the expiration date of the silicone sealant.

The cover must be installed within 5 minutes after application of the silicone sealant.

- Remove any sealant residue on the cylinder head using a flat blade scraper.

WARNING: Wear safety glasses.

NOTE: Prevent dirt and adhesive residue from entering the cylinder head.

-- Remove any sealant from the groove in the cylinder head cover as well as from any sealing surface using, for example, a rotating plastic brush.

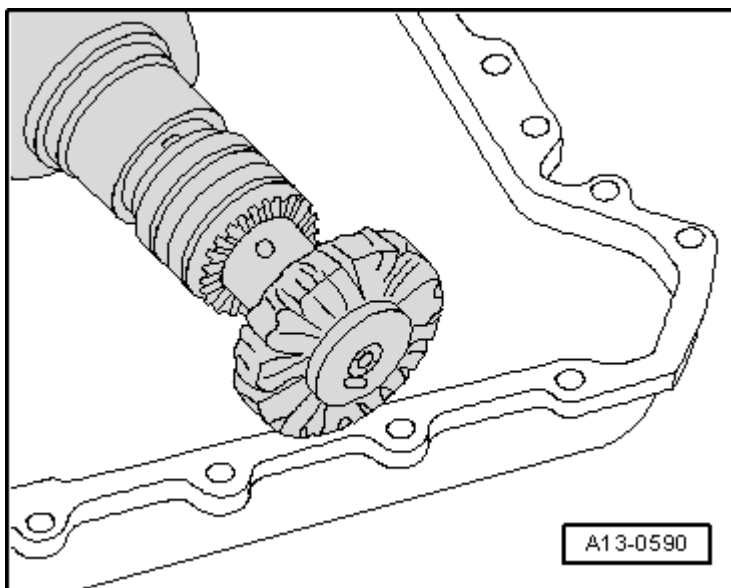


Fig. 53: Identifying Rotating Plastic Brush To Remove Sealant Residue From Sealing Flange, Cylinder Block And Upper Part Of Oil Pan

Courtesy of VOLKSWAGEN UNITED STATES, INC.

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

-- Cut the sealant tube nozzle at the front mark (nozzle diameter: approximately 2 mm).

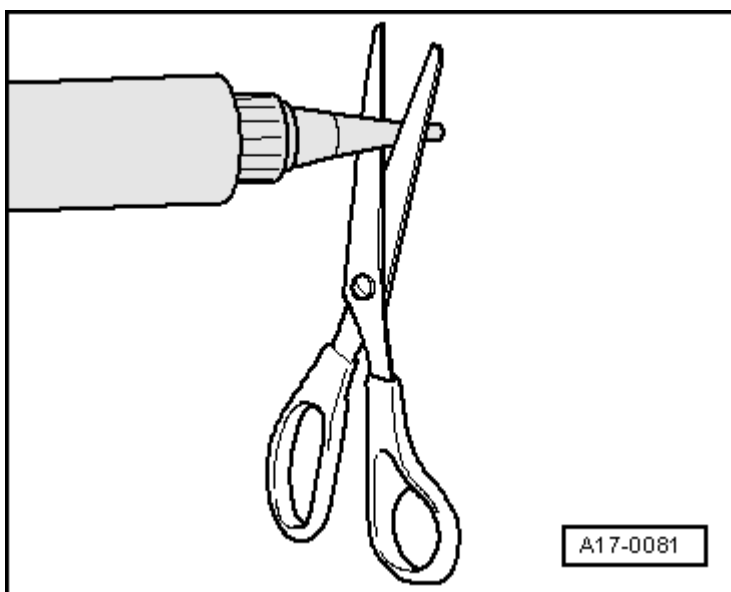


Fig. 54: Identifying Scissors To Cut Tube Nozzle At Front Marking (Nozzle Diameter Approx. 3 Mm)

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Lubricate the running surfaces of both camshafts.
- Place the camshaft into the cylinder head, the recesses -arrows- must be perpendicular to each other.

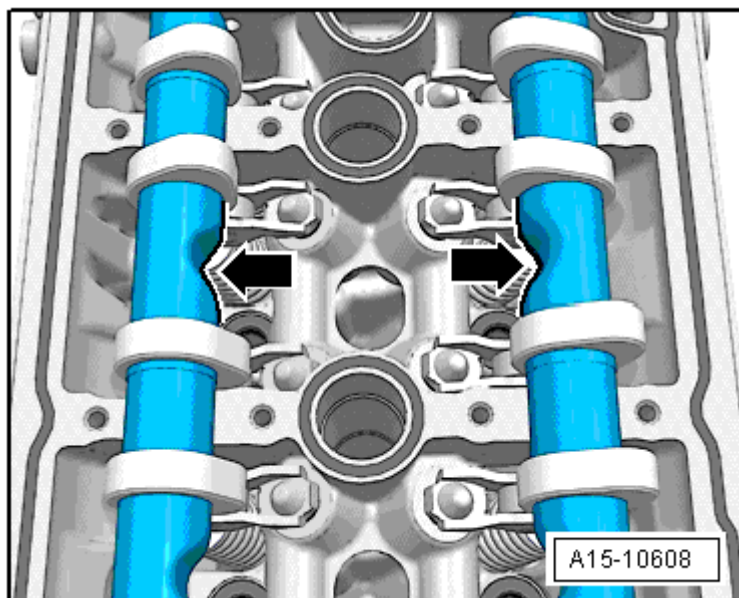


Fig. 55: Identifying Camshaft Recesses

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Replace the cylinder head cover bolts.
- Apply the silicone sealant -D 154 103 A1- on the clean sealing surface of the cylinder head cover as shown -arrows-.

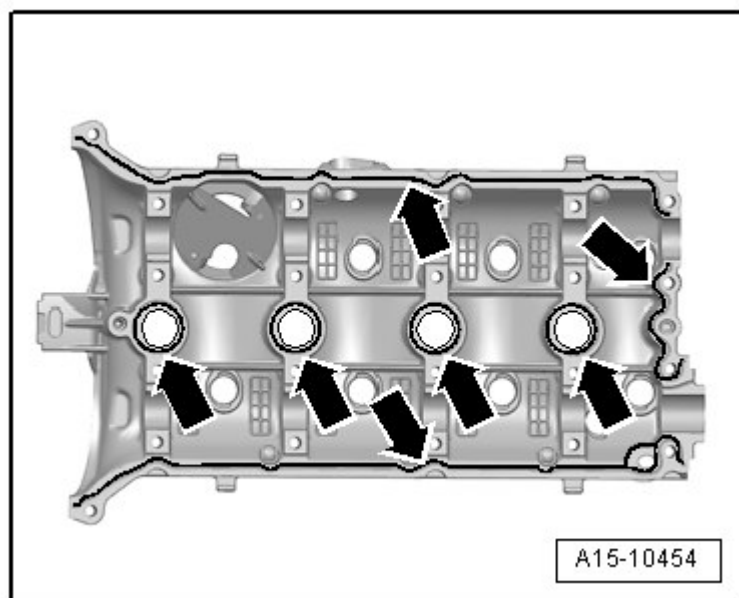


Fig. 56: Identifying Cylinder Head Cover Sealing Surface
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Thickness of sealant bead: 2 to 3 mm.

NOTE: The cylinder head cover must be installed within 5 minutes after application of the silicone sealant.

The sealant bead may not be thicker than specified, otherwise excess sealant could enter the oil pan and clog the oil intake pipe.

Note the expiration date of the sealant.

-- Tighten the bolts in several passes in the tightening sequence, refer to **Fig. 7**.

NOTE: Make sure the cylinder head cover is not tilted.

Instal the cap -1- without sealant using the thrust piece -T10174-.

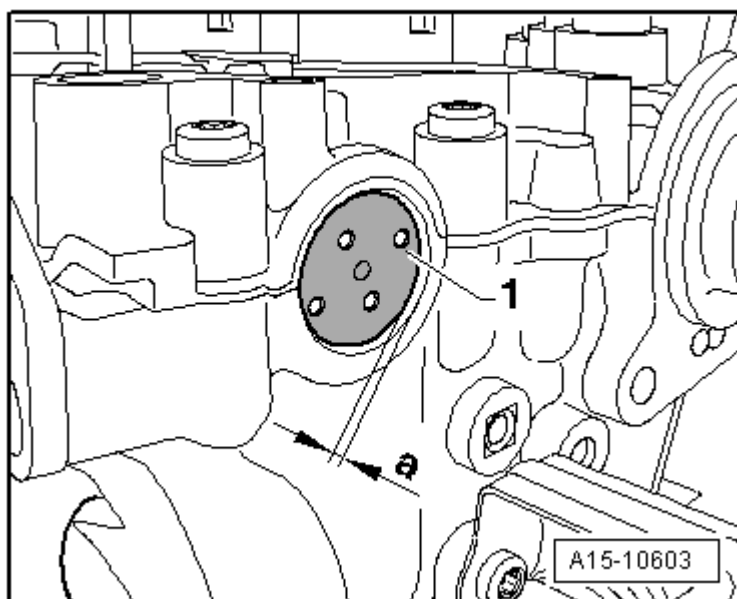


Fig. 57: Identifying Thrust Piece T10174 To Drive In Cap
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Dimension -a- : 1 to 2 mm

CAUTION: Danger of damaging the valves, piston head and lower timing chain cover.

- Make certain that the timing chain remains tensioned when turning the crankshaft by hand.
- Panels are installed on the lower timing chain cover to prevent the chain from falling down. The panels can bend if the crankshaft is rotated when the chain is loose.

-- Rotate the vibration damper to the TDC position -arrow- using the counter hold tool -T10355-.

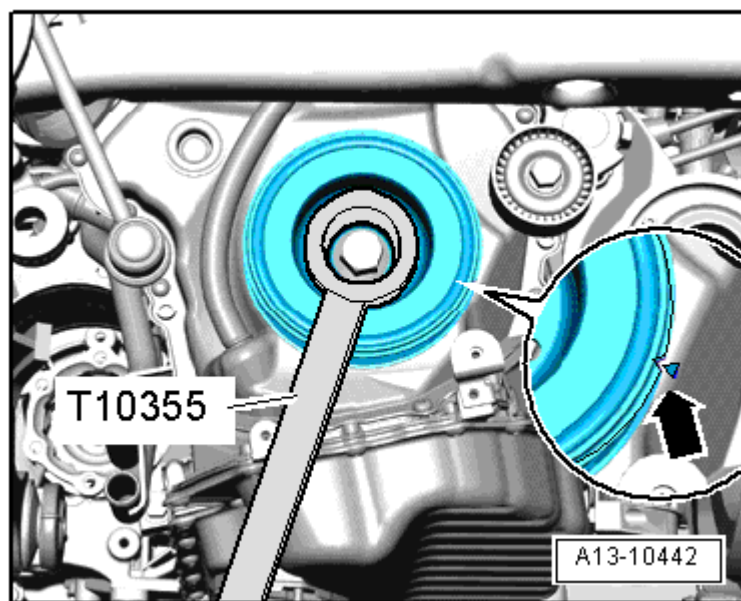


Fig. 58: Identifying Vibration Damper Rotated Into "OT" Position Using Counter Hold Tool T10355
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- The notch on the vibration damper must line up with the arrow mark -arrow- on the lower timing chain cover.

-- Mount the timing chain on the intake camshaft. The marks must align.

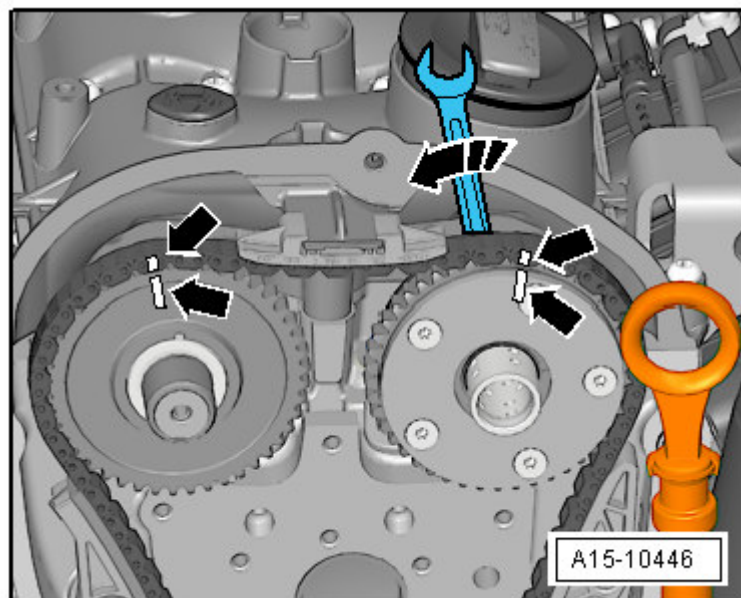


Fig. 59: Identifying Drive Chain/Chain Sprocket Markings And Turning Intake Camshaft Using Wrench
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Rotate the intake camshaft in the -direction of the arrow- with a wrench until the timing chain is taut. Hold the intake camshaft secure in this position.

-- Mount the timing chain on the exhaust camshaft: The marks on the drive chain and sprocket -A arrows- and the drive chain and guide rail -B arrows- must line up with each other.

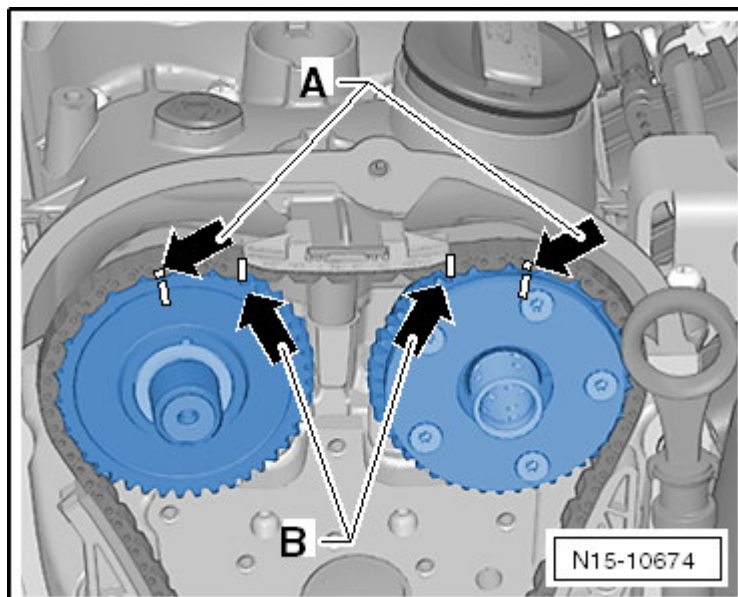


Fig. 60: Identifying Position Marks: Drive Chain To Sprockets -A- And Drive Chain To Guide Rail -B-
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Install the upper guide rail -3-.

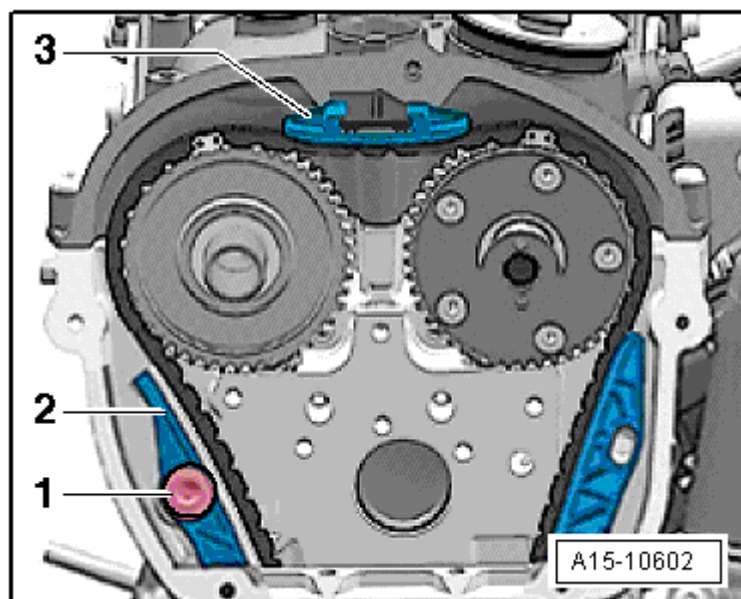


Fig. 61: Identifying Guide Tensioning Rail, Upper Guide Rai And Bolt
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Move the tensioning rail -2- up and tighten the guide pin -1-.

NOTE: If the marks on the drive chain and guide rail -B arrows- do not align even though the engine is at TDC, the drive chain has skipped on the crankshaft sprocket. Check the valve timing. Refer to VALVE TIMING, CHECKING. If the timing does not agree, the camshaft timing chain must be positioned again. Refer to CAMSHAFT TIMING CHAIN.

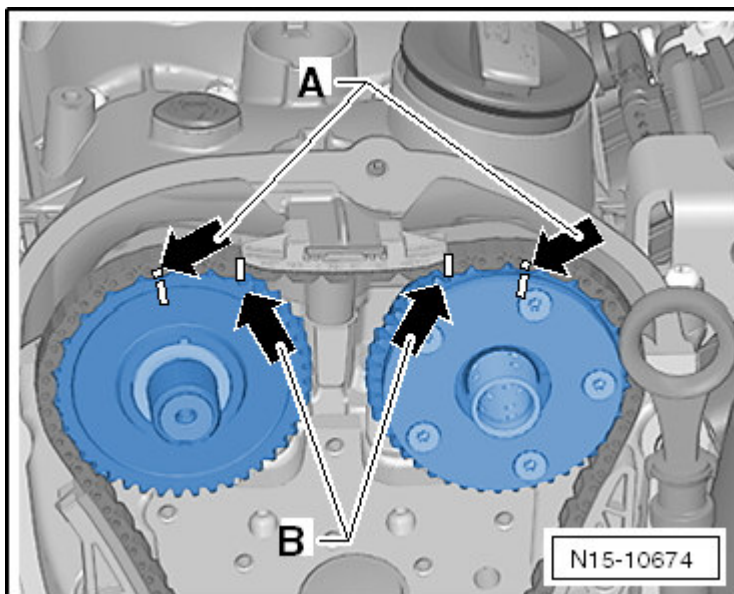


Fig. 62: Identifying Position Marks: Drive Chain To Sprockets -A- And Drive Chain To Guide Rail -B-
Courtesy of VOLKSWAGEN UNITED STATES, INC.

The rest of the installation is basically a reverse of the removal sequence.

VALVE STEM SEALS

(With the cylinder head installed)

Special tools and workshop equipment required

- Spark Plug Removal Tool -3122 B-
- Valve Seal Removal Tool -3364-
- Valve Stem Seal Driver -3365-
- Adapter -T40012-
- Torque Wrench (5-50 Nm) -V.A.G 1331-
- Valve Cotters Asm/Disasm Device -VAS 5161-
- Guide Plate for FSI Engine -VAS 5161/19B-

Removing

-- Remove the camshafts. Refer to CAMSHAFTS.

- Remove the roller rocker arms and place them on a clean surface. Make sure that they are not interchanged.
- Using the spark plug removal tool -3122 B-, remove spark plugs.
- Secure the guide plate for FSI engine -VAS 5161/19B- to the cylinder head as shown using the knurled thumb screws -VAS 5161/12-.

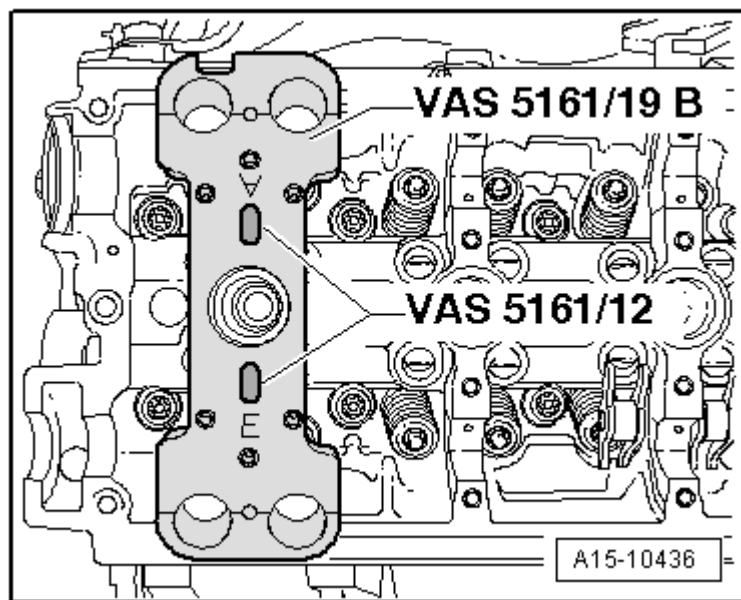


Fig. 63: Identifying FSI Engine VAS 5161/19B Guide Plate Tightened On Cylinder Head Using Knurled Bolts VAS 5161/12

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Adjust the piston of the respective cylinder to the Bottom Dead Center (BDC) position.
- Install the adapter -T40012- into the spark plug hole and connect compressed air of at least 6 bar positive pressure.

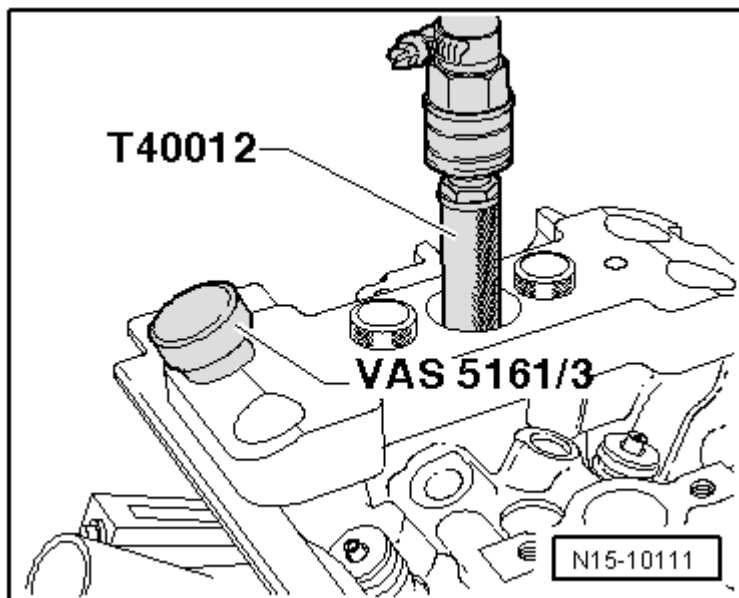


Fig. 64: Identifying Drift VAS 5161/3 And Plastic Mallet To Loosen Stuck Valve Keepers
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Using the punch -VAS 5161/3- and a plastic mallet, tap on any stuck valve retainers in order to loosen them.

Intake Side

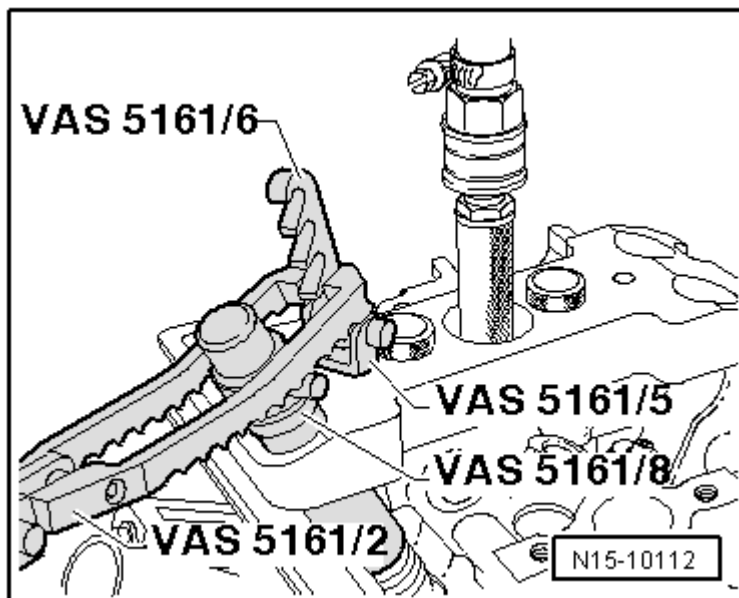


Fig. 65: Identifying Installation Of Engaging Device VAS 5161/6 With Installation Forks VAS 5161/5 Into Guide Plate VAS 5161/19

Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Install the retainer -VAS 5161/6- using the guide forks M6/M8 with threaded stud -VAS 5161/5- into the center threads in the guide plate for FSI engine -VAS 5161/19B-.

-- Install the assembly cartridge -VAS 5161/8- into the guide plate -VAS 5161/19B-.

-- Install the pressure fork with lever for assembly cartridge -VAS 5161/2- onto the retainer -VAS 5161/6-.

Exhaust Side

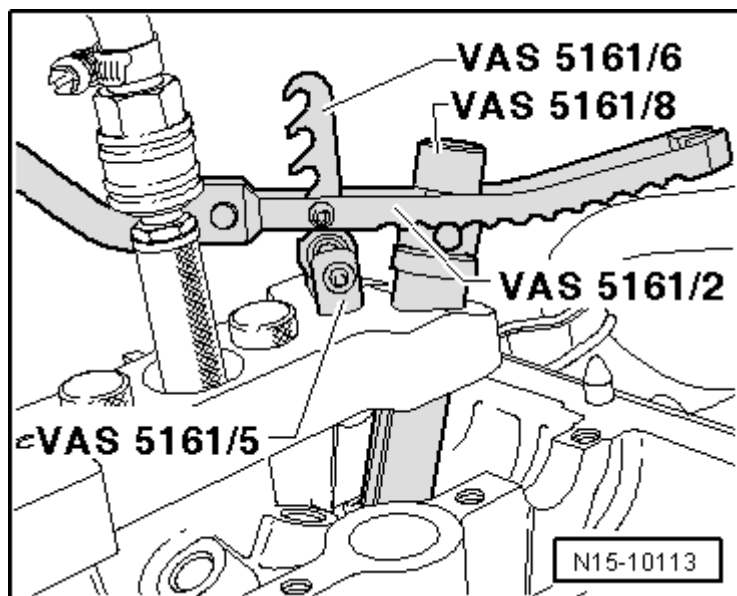


Fig. 66: Identifying Pressure Forks VAS 5161/2 Engaged
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Install the retainer -VAS 5161/6- using the guide forks M6/M8 with threaded stud -VAS 5161/5- into the outer threads in the guide plate for FSI engine -VAS 5161/19B-.

-- Press down the assembly cartridge -VAS 5161/8-. At the same time, turn the knurled knob on the assembly cartridge -VAS 5161/8- clockwise until the points engage in the valve retainers.

-- Lightly move the knurled knob back and forth, this causes the valve retainers to be pressed apart and captured in the assembly cartridge.

-- Release the pressure fork with lever for assembly cartridge -VAS 5161/2-.

-- Take out the assembly cartridge -VAS 5161/8-.

-- Remove the valve stem seal using the valve seal removal tool -3364-.

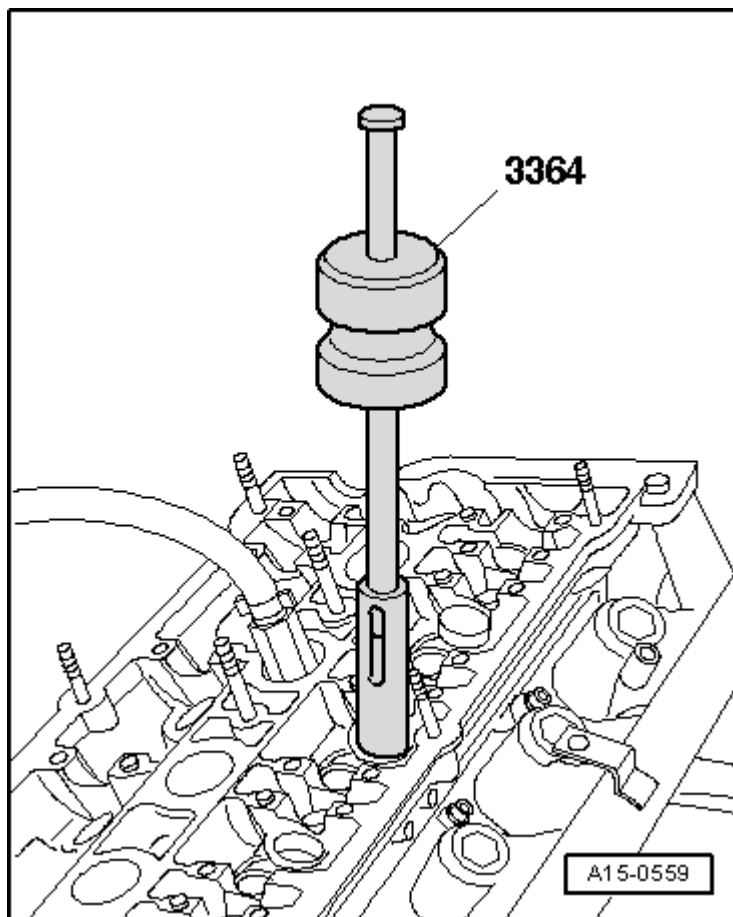


Fig. 67: Identifying Valve Seal Removal Tool 3364
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- If the valve seal removal tool -3364- cannot be used due to restricted clearance, drive the roll pin -arrow- out with a drift and remove the impact attachment.

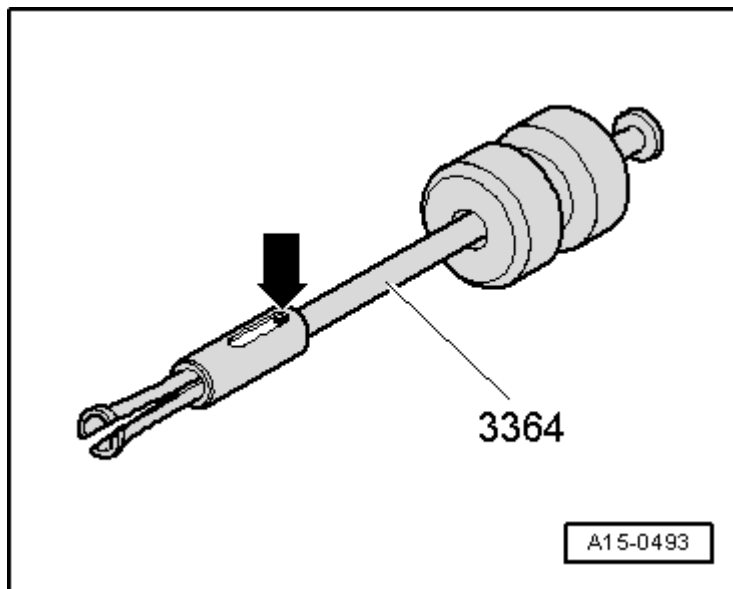
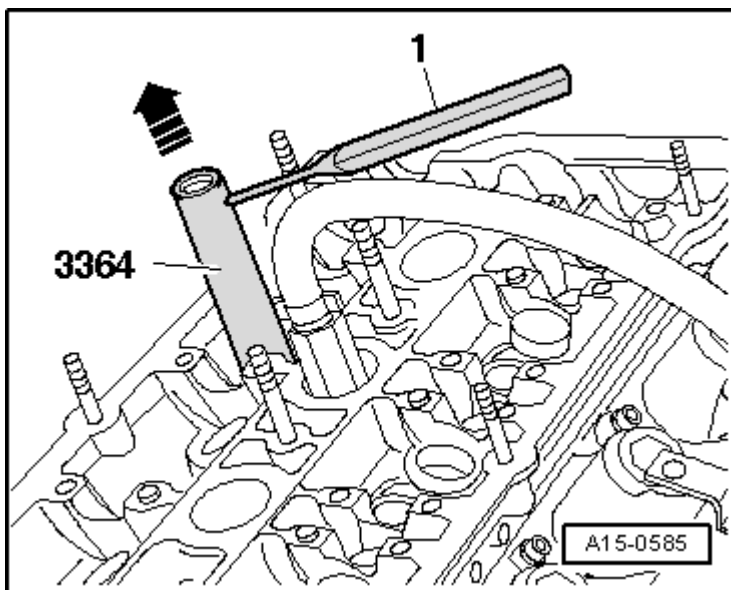


Fig. 68: Identifying Valve Seal Removal Tool 3364

Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Place the lower part of the valve seal removal tool -3364- onto the valve stem seal.

**Fig. 69: Identifying Placement Of Lower Part Of Valve Seal Removal Tool 3364 On To Valve Stem Oil Seal**

Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Insert a drift -1- into the bore in the lower part of the removal tool.

-- Using the drift -1- as a lever, pull out the valve stem seal in the -direction of the arrow-.

Installing

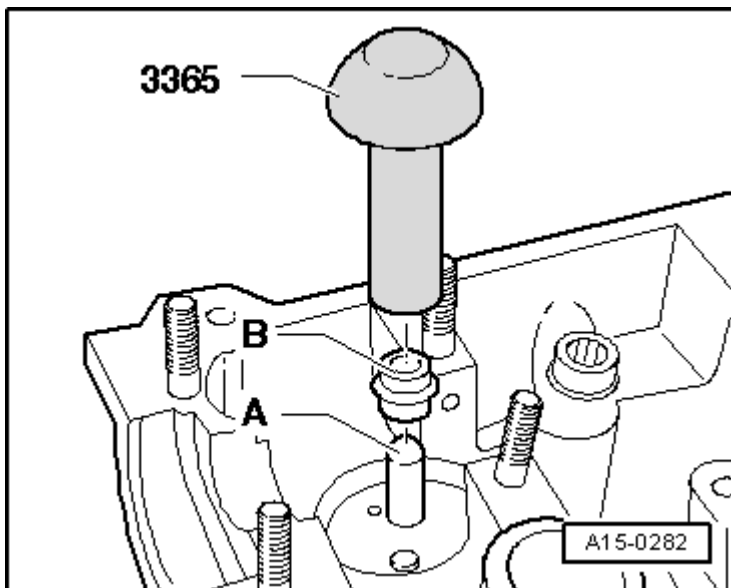


Fig. 70: Identifying Plastic Sleeve, New Valve Stem Oil Seals & Valve Stem Seal Driver 3365
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place a plastic sleeve -A- on the valve stem to prevent damage to the new valve stem seal -B-.
- Lubricate the sealing lip of the valve stem seal -B-, insert it into the valve stem seal driver -3365- and carefully slide it onto the valve guide.
- Remove the plastic sleeve -A-.
- Install the valve spring, spring plate and valve spring retainers.

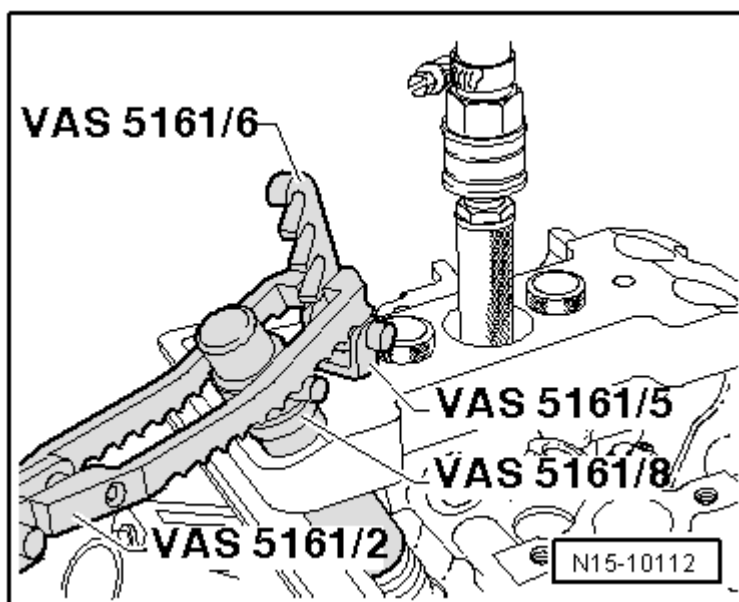


Fig. 71: Identifying Installation Of Engaging Device VAS 5161/6 With Installation Forks VAS 5161/5 Into Guide Plate VAS 5161/19
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install the special tools as shown.

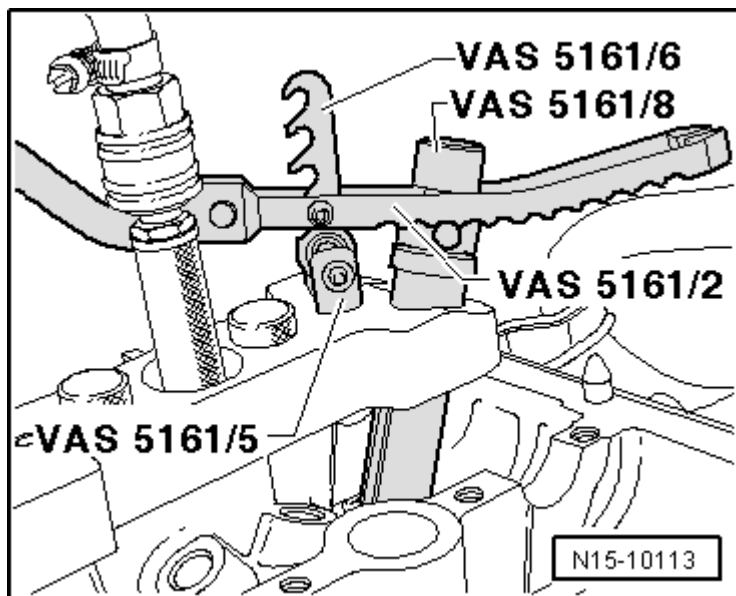


Fig. 72: Identifying Pressure Forks VAS 5161/2 Engaged
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Install the special tools as shown.

NOTE: If the valve retainers were removed from the assembly cartridge, they must be inserted into the valve insertion device -VAS 5161/18- next.

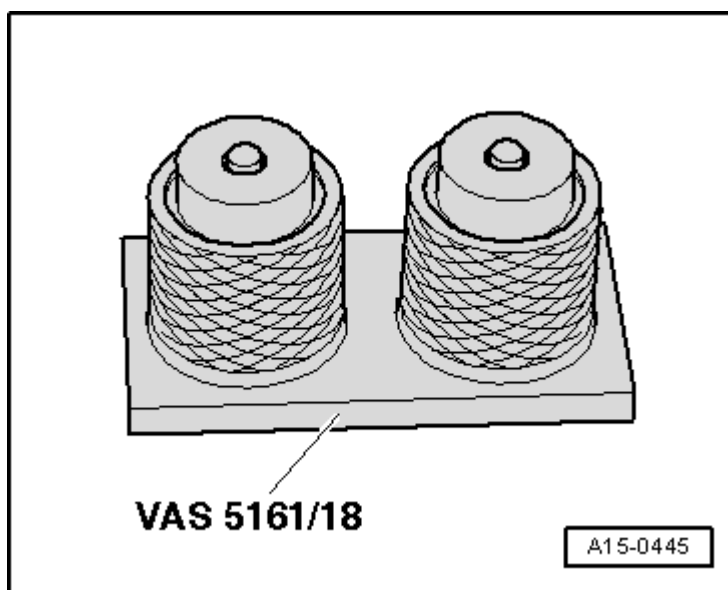


Fig. 73: Identifying Installation Cartridge VAS 5161/18
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

Press the assembly cartridge -VAS 5161/18- onto the insertion device from above and capture the valve retainers.

-- Press down the assembly cartridge -VAS 5161/8- with the pressure fork with lever for assembly cartridge -VAS 5161/2- and turn the knurled knob on the assembly cartridge back and forth while pulling it upward at the same time.

-- Release the pressure fork with lever for assembly cartridge -VAS 5161/2- with the knurled knob pulled.

-- Remove the special tools.

The rest of the installation is basically a reverse of the removal sequence.

CYLINDER HEAD

Special tools and workshop equipment required

- Engine Sling -2024 A-
- Engine Support -T10014-
- Assembly Tool -T10352-
- Counter Hold Tool -T10355-
- Locking Pin -T40011-
- Ignition Coil Puller -T40039-
- Torque Wrench (5-50 Nm) -V.A.G 1331-
- Torque Wrench (40-200 Nm) -V.A.G 1332-
- Shop Crane - Load Cap = 700-1200KG -VAS 6100-
- Engine Bung Set -VAS 6122-
- Drip Tray for -VAS 6100- -VAS 6208-
- Polydrive Bit and Drive Socket -T10070-

Removing

NOTE: During installation, cable ties must be installed in the same location.

-- Remove the engine cover. Refer to **ENGINE COVER**.

-- Remove the air filter housing. Refer to **AIR FILTER HOUSING** .

-- Loosen the hose clamp -2-.

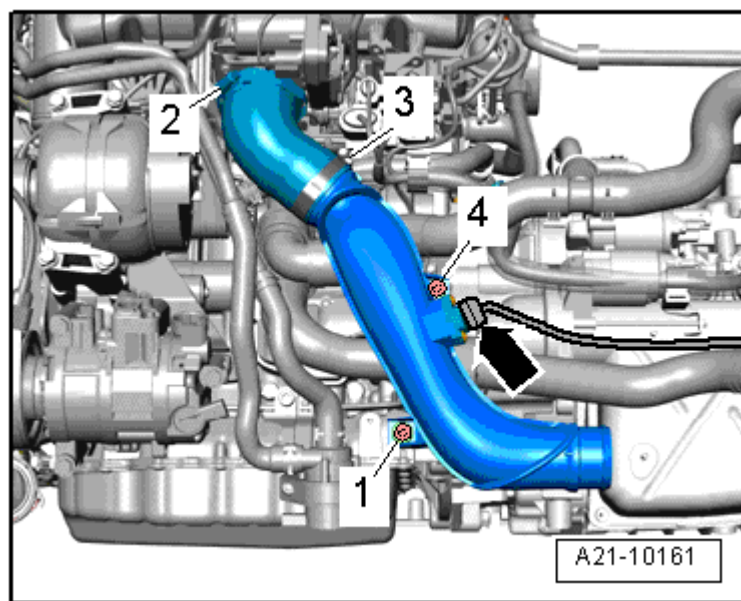


Fig. 74: Identifying Air Guide Hose Bolts, Air Guide Pipe Hose Clamps & Electrical Harness Connector
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the bolt -4-.

-- Disconnect the electrical connector -arrow- and free up the electrical wire.

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

The coolant system is under pressure when the engine is warm.

Reduce pressure by covering the coolant expansion tank cap with a cloth and open carefully.

-- Open the coolant expansion tank cap.

-- Remove the front exhaust pipe with catalytic converter. Refer to **FRONT EXHAUST PIPE WITH CATALYTIC CONVERTERS** .

-- Remove the right front wheel.

-- Remove the noise insulation. Refer to **Description and Operation** .

-- Remove the right front wheel housing liner. Refer to **Removal and Installation** .

-- Loosen the clamps -items 1 and 2- and remove the charge air hose.

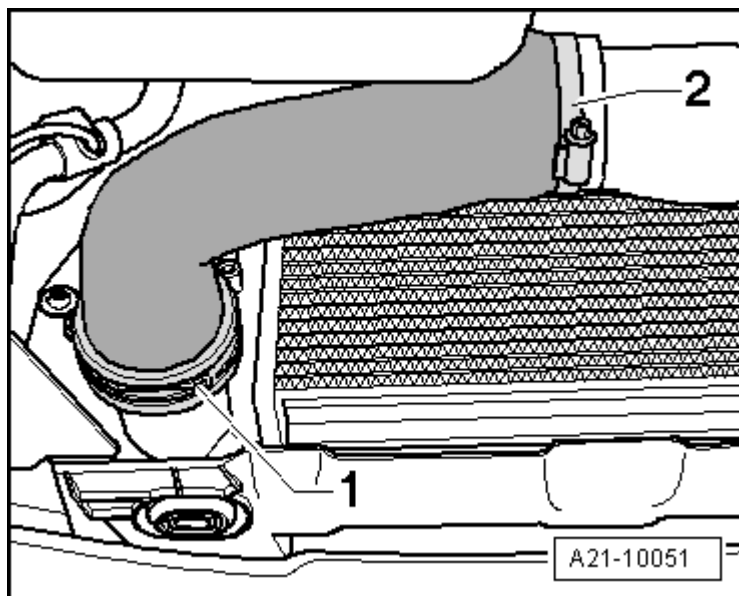


Fig. 75: Identifying Charge Air Hose And Clamps
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Drain the coolant. Refer to **DRAINING AND FILLING** .
- Remove the bolt -1- and remove the charge air pipe downward.

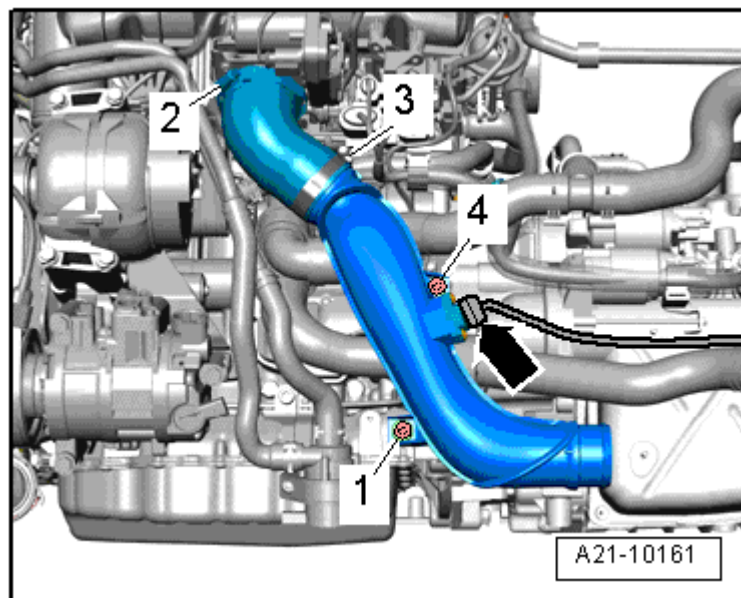


Fig. 76: Identifying Air Guide Hose Bolts, Air Guide Pipe Hose Clamps & Electrical Harness Connector
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove the bolts -arrows-.

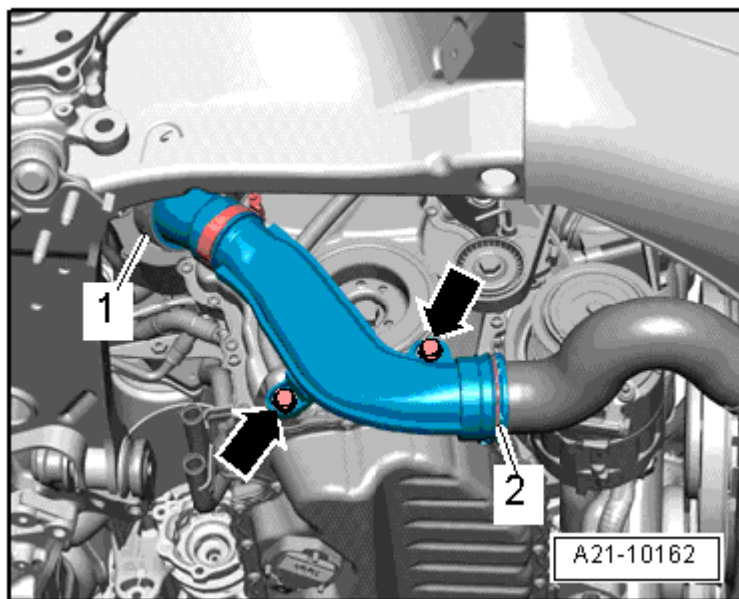


Fig. 77: Identifying Air Guide Pipe And Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Lift the clamps -1 and 2- and remove the charge air pipe.

-- Disconnect the connectors -1 and 2- and free up the wire -arrows-.

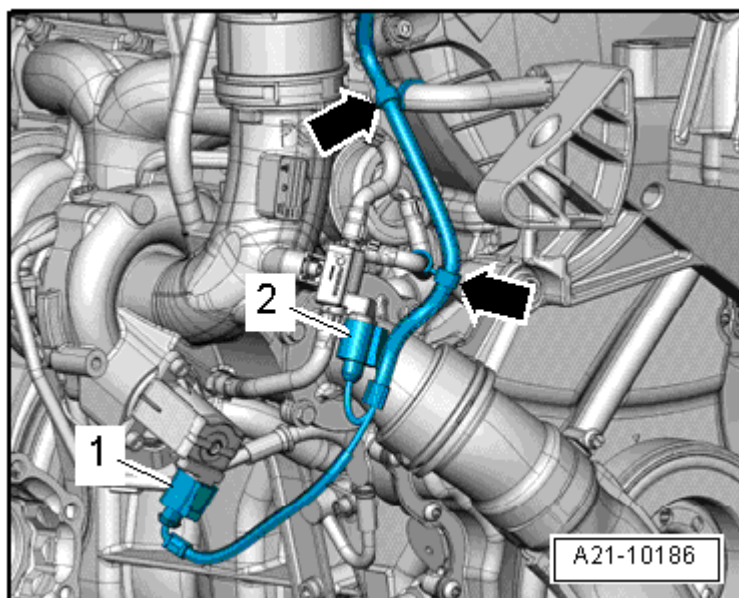


Fig. 78: Identifying Turbocharger Electrical Connectors
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Vehicles with All Wheel Drive (AWD)

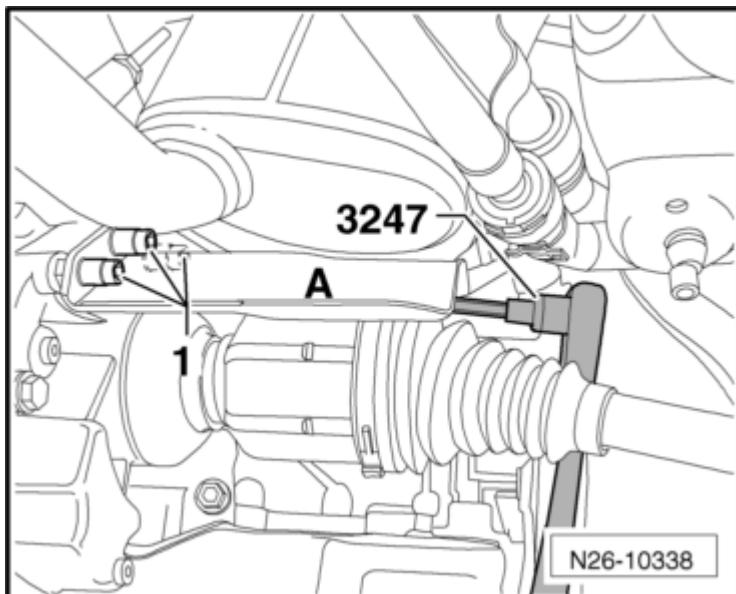


Fig. 79: Identifying, Tool -3247-, Bolts -1- And Heat Shield -A-
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the right drive axle heat shield bolts -1- using the hex ball socket -3247- and remove the shield -A-.

Continuation for all Vehicles

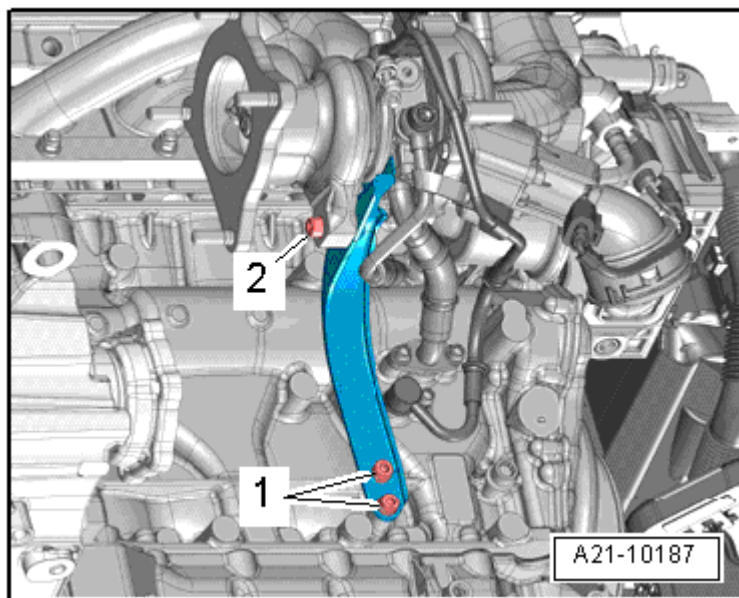


Fig. 80: Identifying Turbocharger Support And Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the bolts -1 and 2- and remove the turbocharger support.

-- Remove the banjo bolt -2- and move the coolant line to the side.

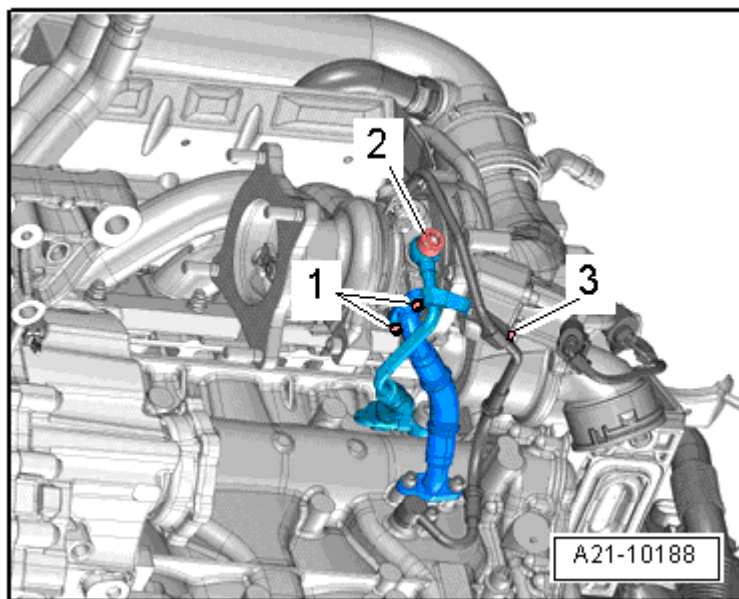


Fig. 81: Identifying Oil Return Line, Coolant Line And Oil Supply Line Fasteners
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Vehicles with Front Wheel Drive (FWD)

-- Remove the bolts -1- for the oil return line.

Vehicles with AWD

-- Remove the oil return line bolts from the crankcase.

Continuation for all Vehicles

-- Remove the bolt -3- for the oil supply line.

-- On vehicles with a noise generator: Remove the charge air pipe from the noise generator.

-- Disconnect the connector from the camshaft adjustment valve 1 -N205- -1-.

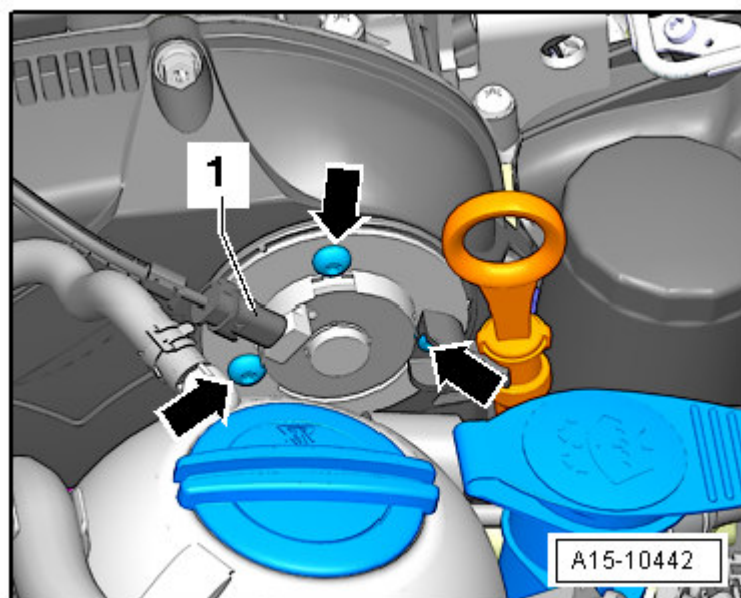


Fig. 82: Identifying Camshaft Adjustment Valve And Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect the connectors from the ignition coils and free up the wiring harness.
- Remove the ignition coils using the ignition coil puller -T40039-.

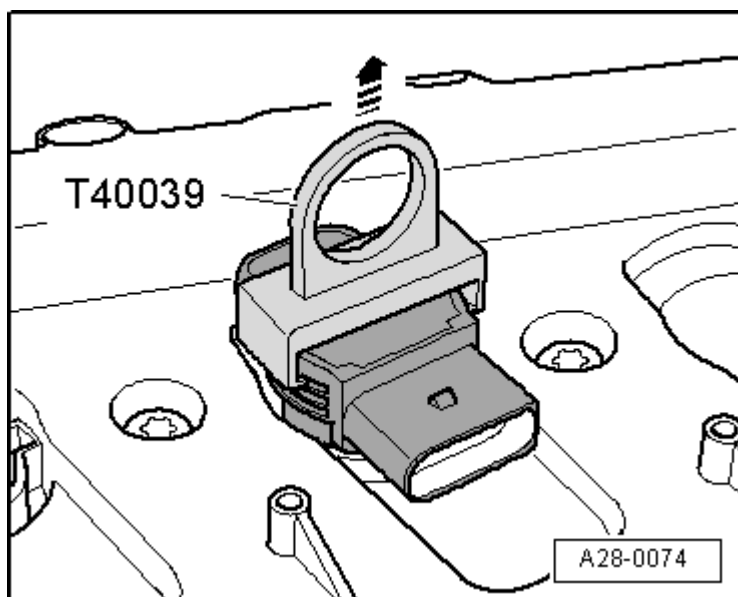


Fig. 83: Identifying Ignition Coil Puller T40039 To Remove Ignition Coils
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect the hose for the crankcase ventilation - 1 -.

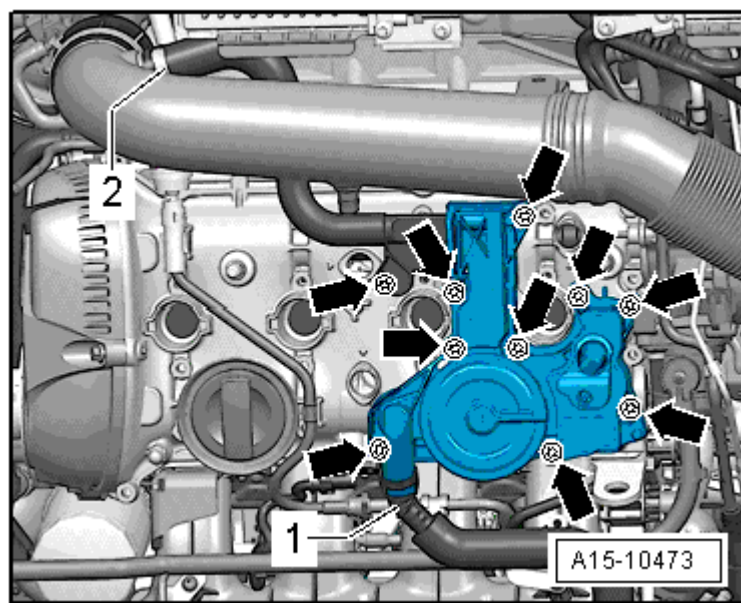


Fig. 84: Identifying Crankcase Ventilation, Tightening Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the bolts -arrows-.

-- Remove the charge air pipe bolt -arrow-.

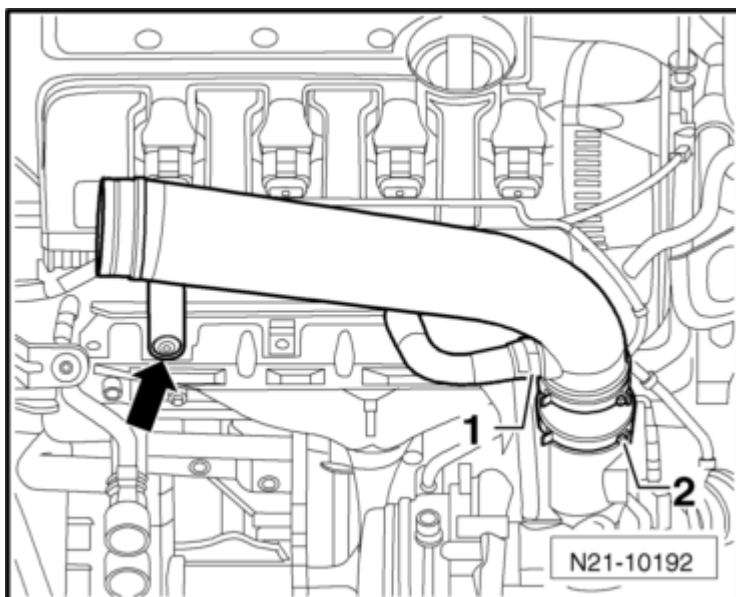


Fig. 85: Identifying Charge Air Pipe Bolt -Arrow- And Hose Clamp -2-
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Loosen the hose clamp -2- and remove the charge air pipe together with the crankcase ventilation.

WARNING: The fuel supply line is under pressure. Always wear protective eyewear

and protective clothing to prevent injuries and fuel from coming in contact with your skin. Wrap a cloth around the connection before removing a fuel hose. Remove the hose connection carefully to release the pressure.

-- Disconnect the lines - 1 through 3- from the fuel transfer.

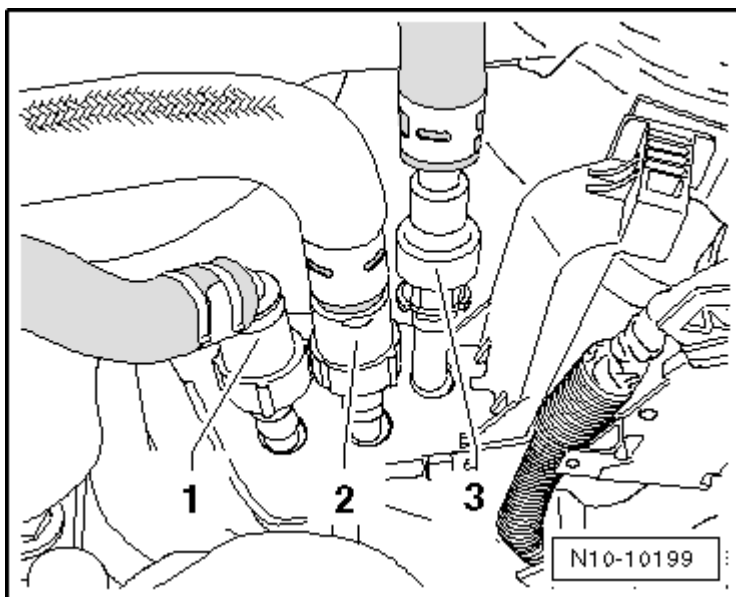


Fig. 86: Identifying Breather Line, Vacuum Line & Fuel Supply Line
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Vent line -1-

Vacuum line -2-

Fuel supply line -3-

-- Disconnect the coolant line -arrow- from to the coolant expansion tank.

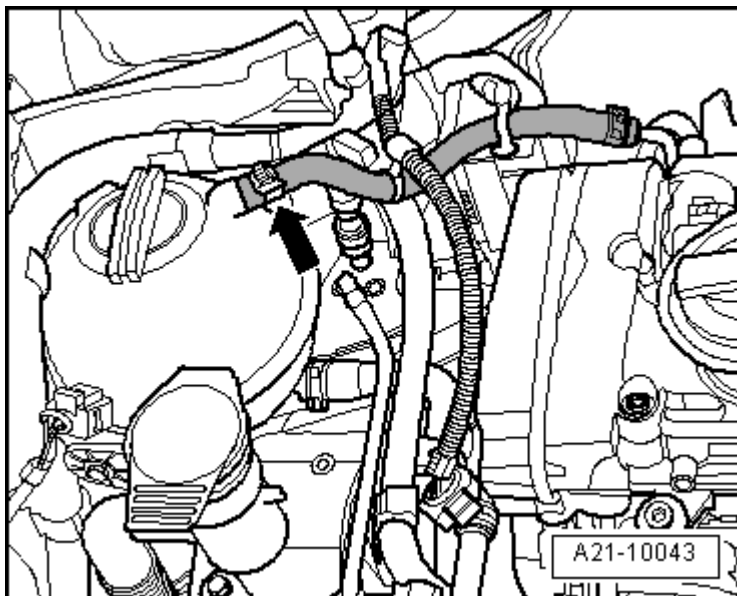


Fig. 87: Identifying Coolant Line To Coolant Expansion Tank
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the coolant hoses -arrows- from the coolant pipe.

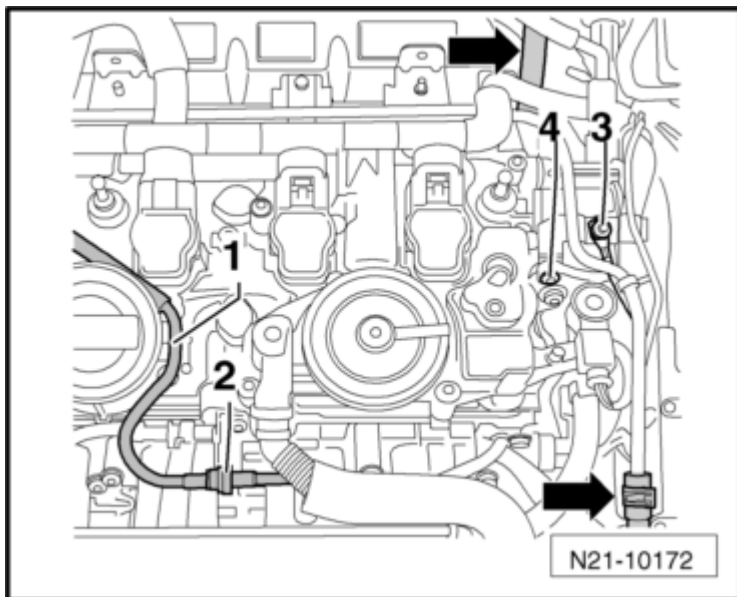


Fig. 88: Identifying Vacuum Line -1-, Ground Wire -3- And Bolt -4-
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Disconnect the ground wire -3- and remove the bolt -4-.

-- Disconnect the vacuum hoses -arrows-.

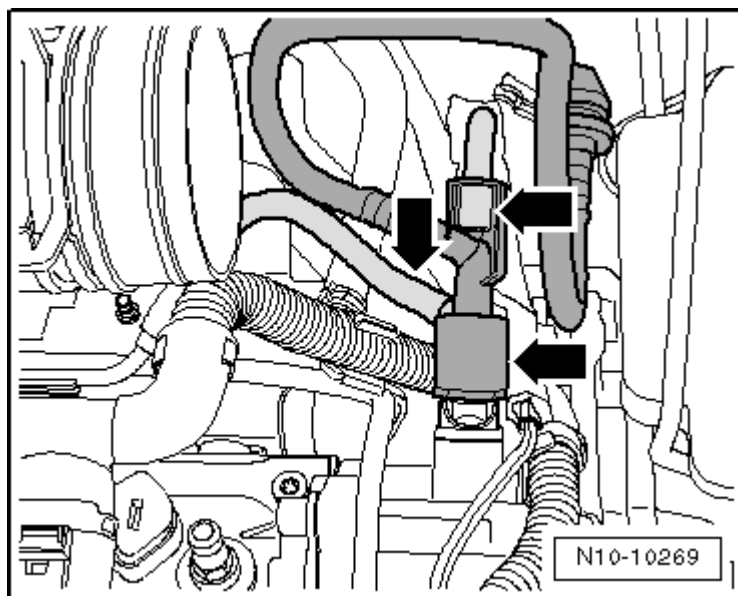


Fig. 89: Identifying Vacuum Hoses

Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Loosen the bolts -1 through 4- and remove the heat shield together with the coolant pipe.

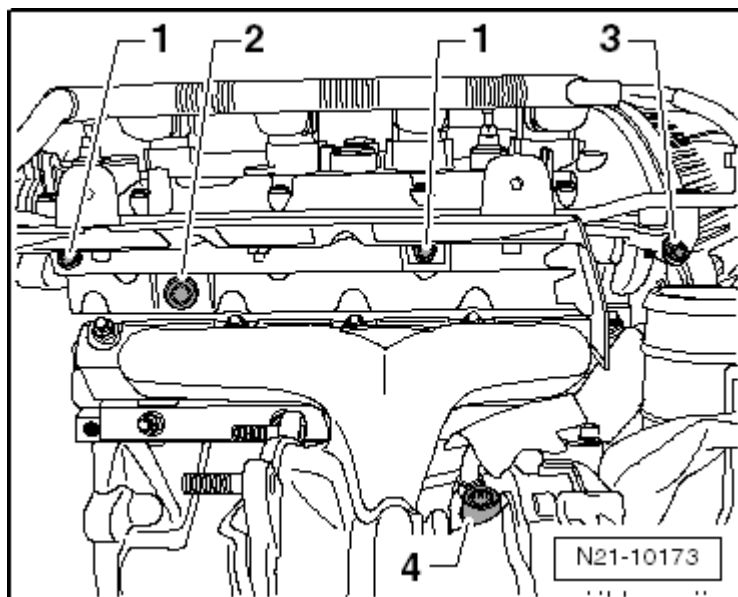
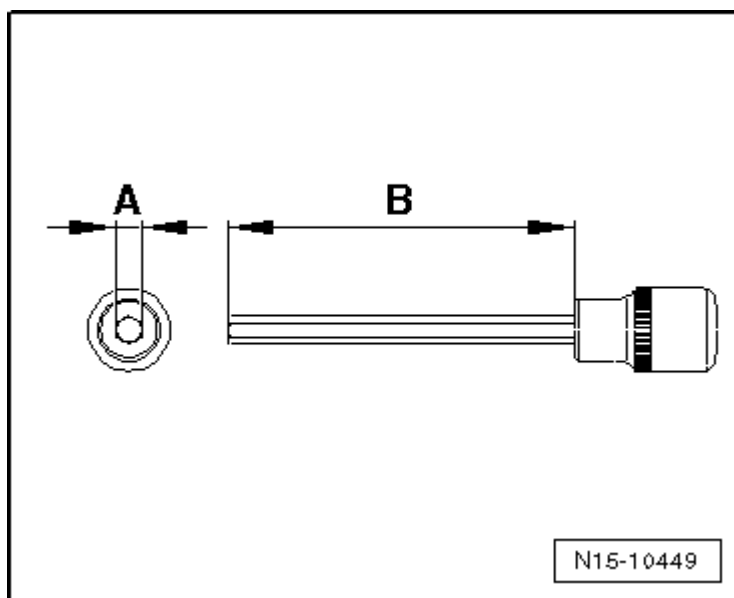


Fig. 90: Identifying Heat Shield Bolts

Courtesy of VOLKSWAGEN UNITED STATES, INC.

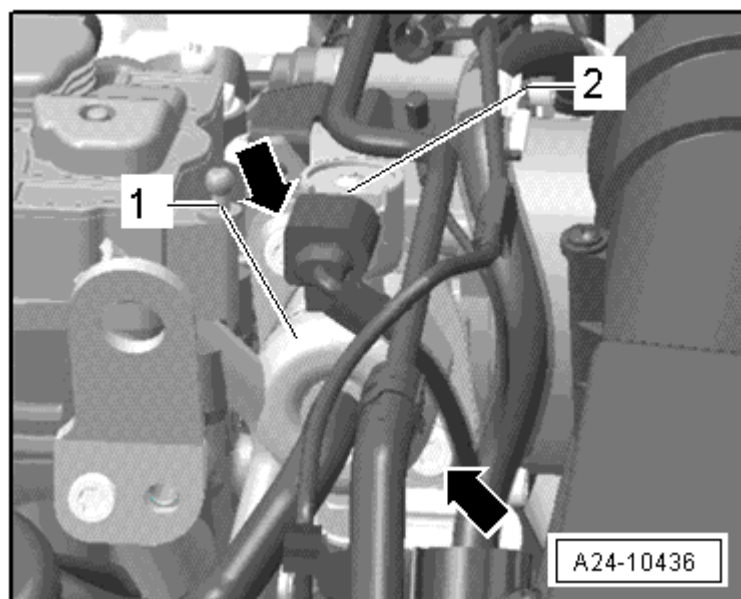
-- Disconnect the oil supply line from the turbocharger -4-.

NOTE: Remove the bolt -2- from the heat shield using a 6 mm -A- hex socket. The hex socket must be at least 5 cm -B- long. A socket that tapers to 6 mm at the tip is too wide.



**Fig. 91: Identifying 6mm Hex Socket -A-, 5cm Long -B-
Courtesy of VOLKSWAGEN UNITED STATES, INC.**

-- Disconnect the electrical connector -2- from the fuel pressure regulator valve -N276-.



**Fig. 92: Identifying High Pressure Fuel Pump And Fuel Pressure Regulator Valve Electrical Harness
Connector**

Courtesy of VOLKSWAGEN UNITED STATES, INC.

Engine Code CBFA

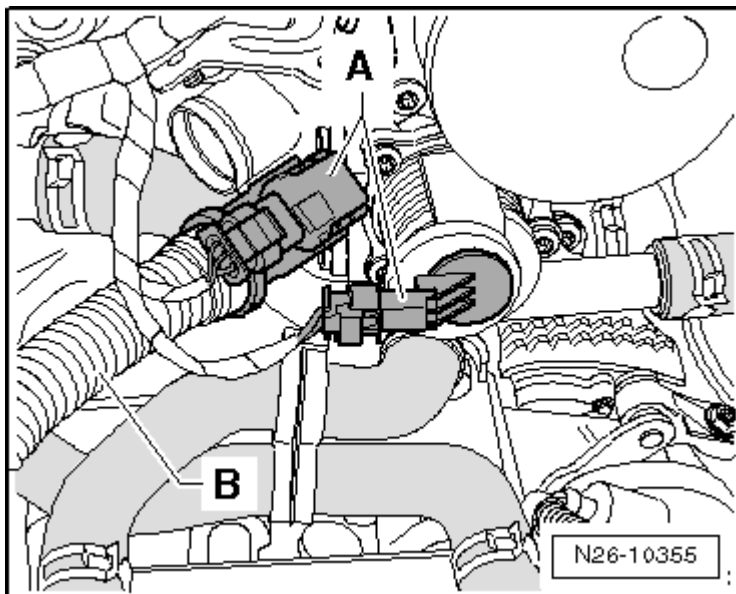


Fig. 93: Identifying Secondary Air Injection (Air) Solenoid Valve N112 Connector And Hose
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect the connector -A- and hose -B- from the secondary air injection solenoid valve -N112-.
- Loosen the coolant pipe, remove the bolts -arrows-.

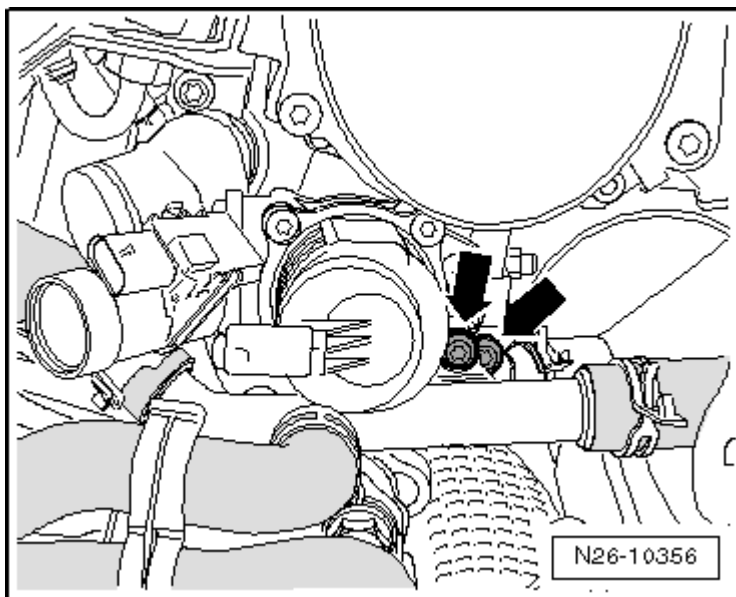


Fig. 94: Identifying Coolant Pipe And Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Continuation for all Vehicles

- Disconnect the coolant hose from the side connection on the cylinder head.

-- Disconnect the electrical connectors -1 through 4--.

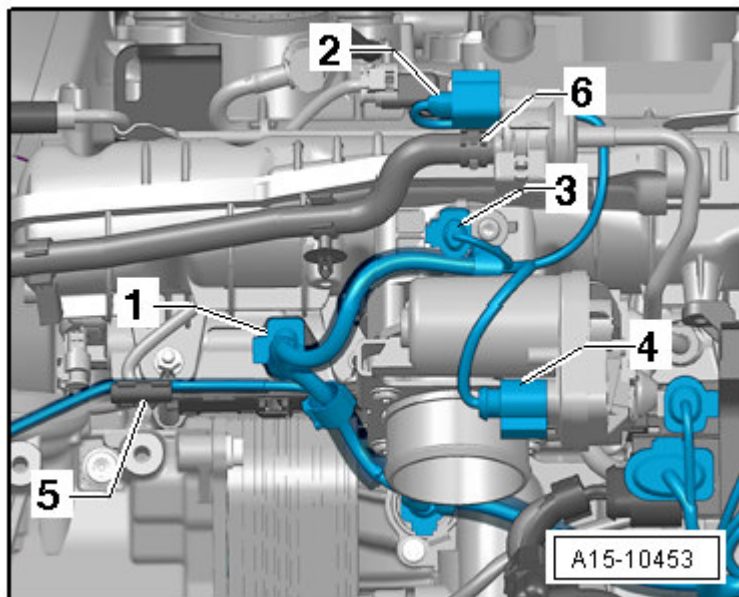


Fig. 95: Identifying EVAP Filter Vacuum Hose, Electrical Connectors And Electrical Cable
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Free up the wire -5--.

-- Disconnect the vacuum hose -6- leading to the canister.

GTI

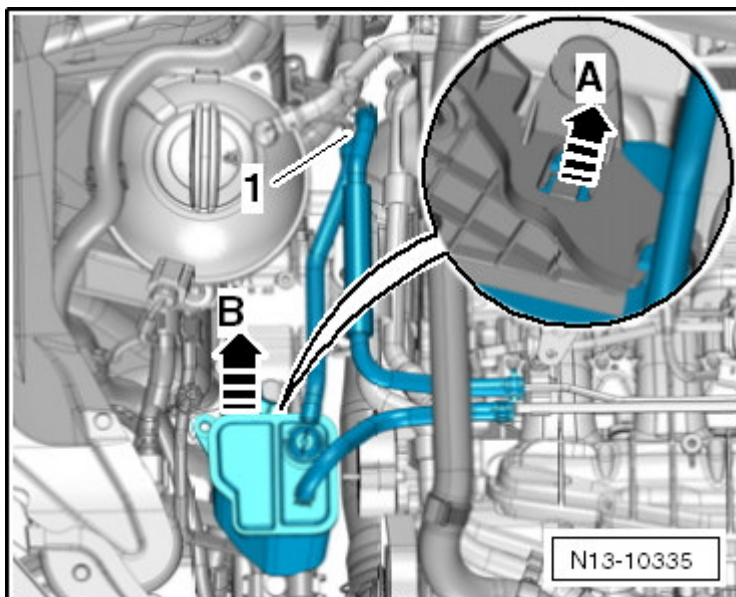


Fig. 96: Identifying Vent Line, Canister And Canister Catch
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Disconnect the vent line -1-, unlock the canister -A- and remove it -B-.

Continuation for all Vehicles

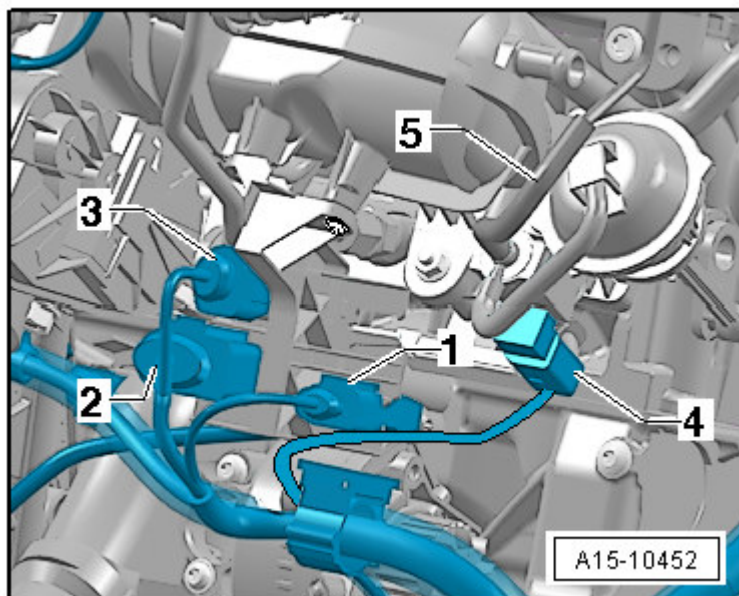


Fig. 97: Identifying Vacuum Line And Electrical Connectors
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Disconnect the electrical connectors -1 - and pull the connectors out of the retainer.

-- Disconnect the electrical connectors -2 through 4-.

-- Disconnect the coolant line from the intake manifold, when doing this, remove the bolts -arrows-.

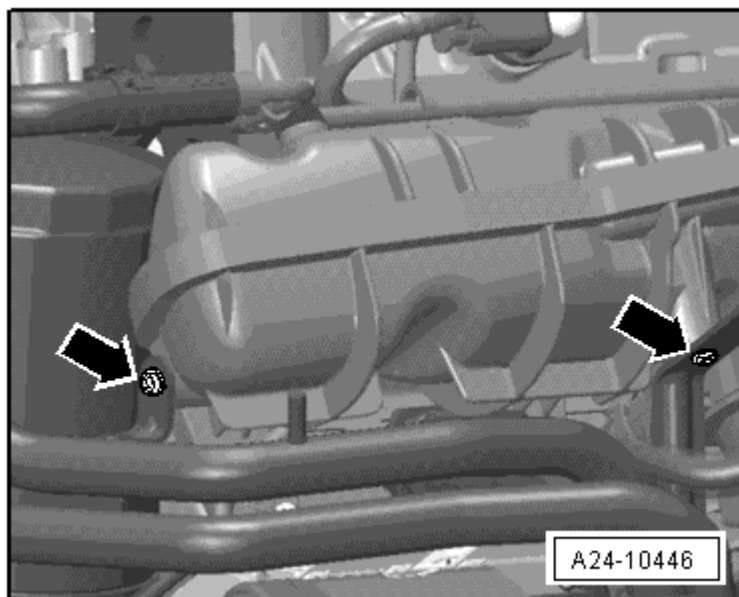


Fig. 98: Identifying Intake Manifold Coolant Line Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the intake manifold bracket by removing the nut -1- and bolt -2-.

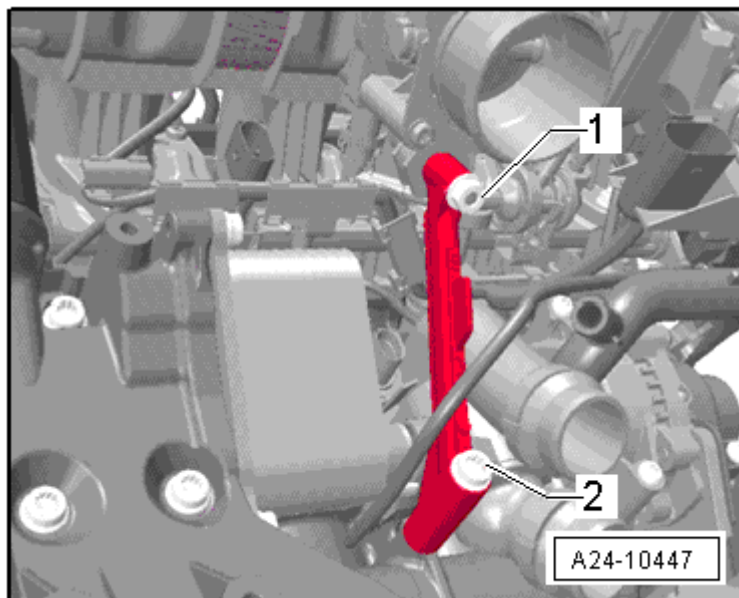


Fig. 99: Identifying Intake Manifold Bracket Mounting Nut And Bolt
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the oil filter.

-- Disconnect the coolant hoses -arrows- and move them to the side.

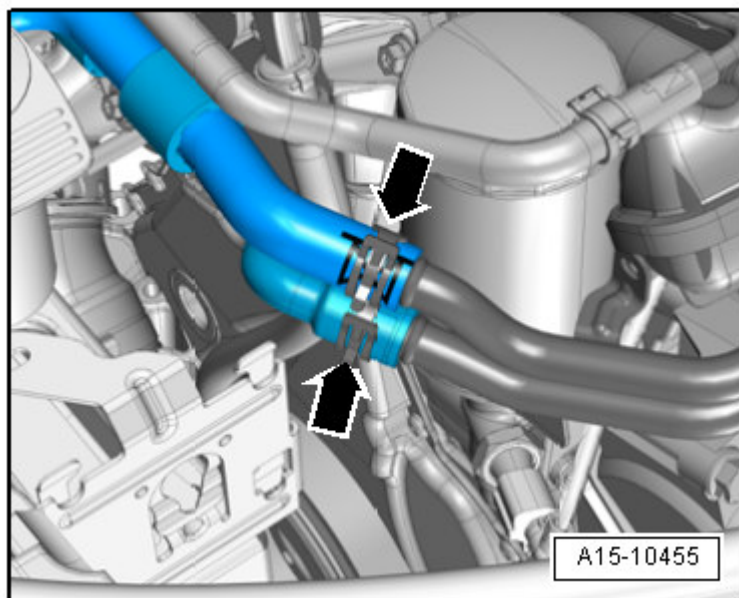


Fig. 100: Identifying Coolant Hoses

Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the bolts -arrows- and then the camshaft adjustment valve 1.

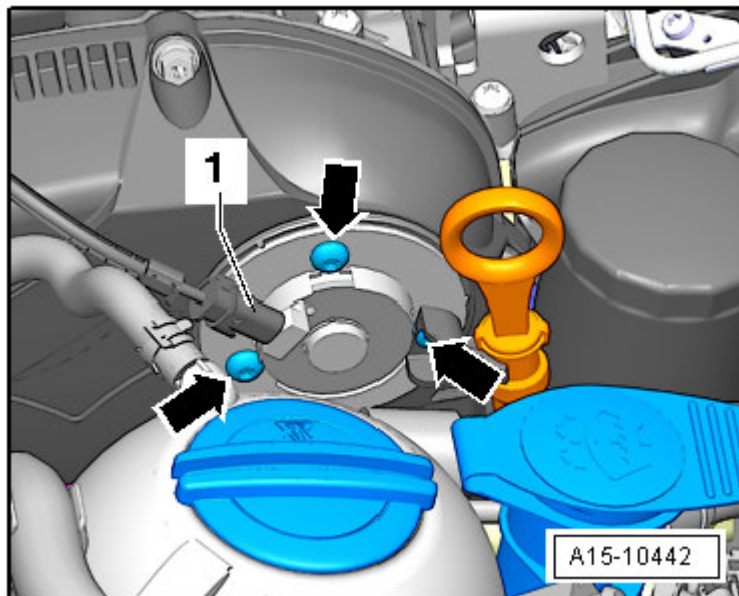


Fig. 101: Identifying Camshaft Adjustment Valve And Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the upper timing chain cover. Refer to UPPER TIMING CHAIN COVER.

CAUTION: The control valve has left hand threads.

-- Remove the control valve in the -direction of the arrow- using the assembly tool -T10352-.

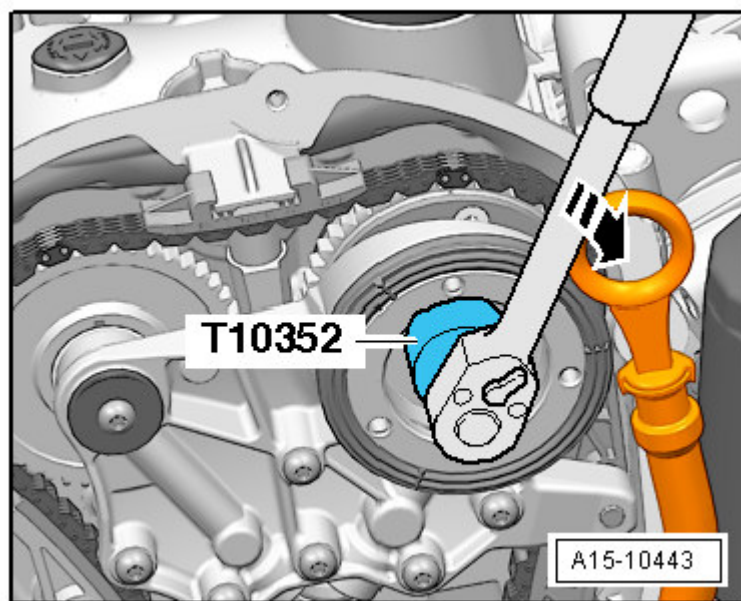


Fig. 102: Identifying Assembly Tool T10352 To Remove Control Valve
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the bolts -arrows- and remove the bearing bracket.

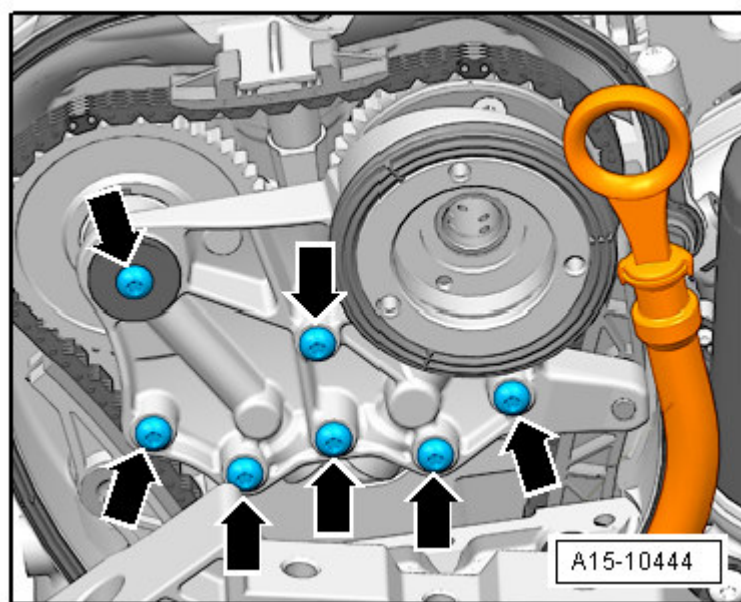


Fig. 103: Identifying Bearing Bracket Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Rotate the vibration damper to the Top Dead Center (TDC) position -arrow- using the counter hold tool - T10355-.

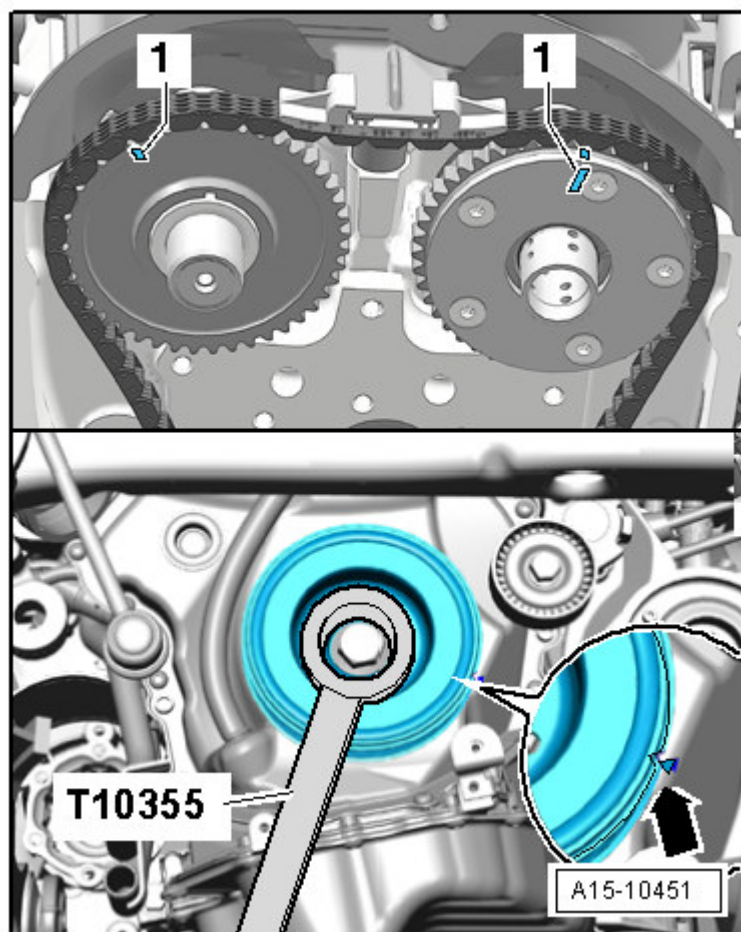


Fig. 104: Identifying Vibration Damper Rotated Into "OT" Position Using Counter Hold Tool T10355
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- The notch on the vibration damper must line up with the arrow mark -arrow- on the lower timing chain cover.
- The marks -1- on the camshafts must point upward.

-- Carefully mark the position of the drive chain to the sprockets -A arrows- with a waterproof marker. Also mark the position of the drive chain to the guide rail -B arrows-. These marks are necessary for reinstallation.

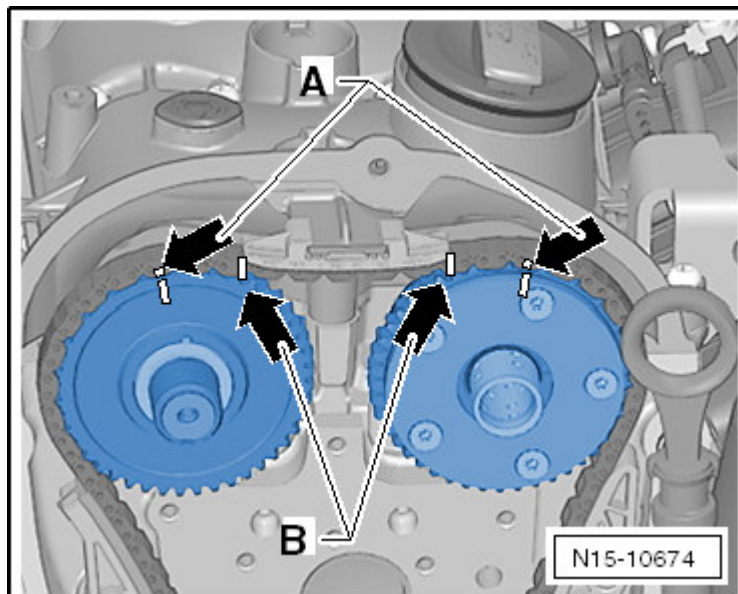


Fig. 105: Identifying Position Marks: Drive Chain To Sprockets -A- And Drive Chain To Guide Rail -B-
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the plug -arrow-.

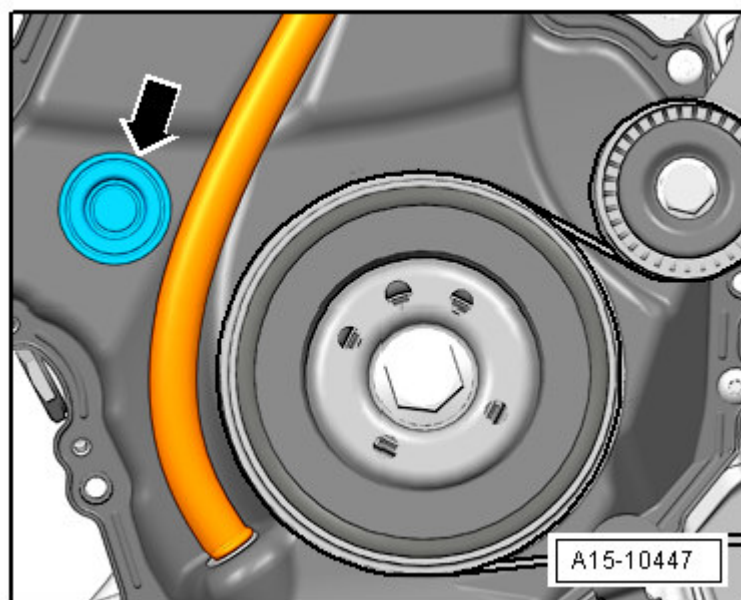


Fig. 106: Locating Plug
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

The locking wedge in the chain tensioner must be lifted in order to release the tension from the chain tensioner. Sand the end of the locking pin -T40011- down to a point. A screwdriver with a head approximately 1.5 mm wide can also be used.

CAUTION: There is a risk of damaging the chain tensioner. Proceed very carefully.

-- Insert a screwdriver in the hole on the chain tensioner in the -direction of arrow 1- and lift the locking wedge in the chain tensioner.

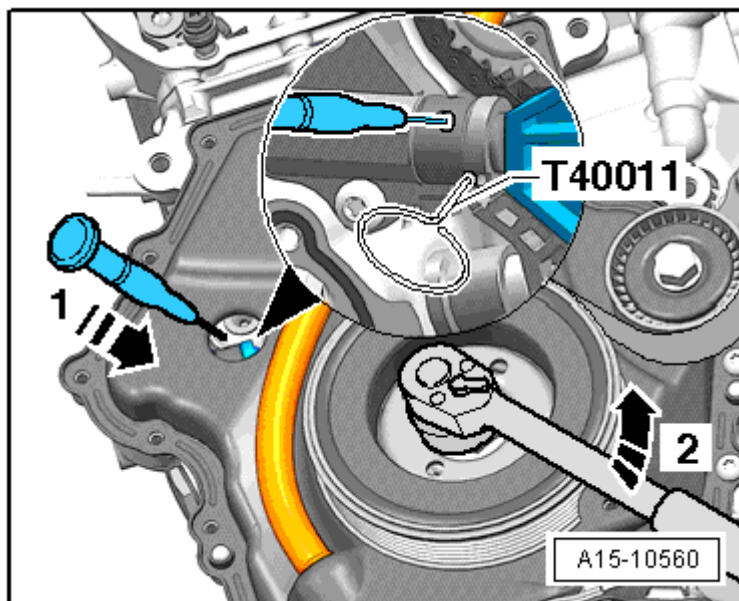


Fig. 107: Identifying Chain Tensioner Locking Wedge, Screwdriver, Crankshaft And Securing Pin T40011

Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- In order to tension the chain tensioner, rotate the crankshaft opposite the engine rotation direction in the -direction of arrow 2- and secure it using a locking pin -T40011-.

NOTE: The intake camshaft switches in the engine rotation direction.

-- Remove the guide pin -1- and guide the tensioning rail -2- downward.

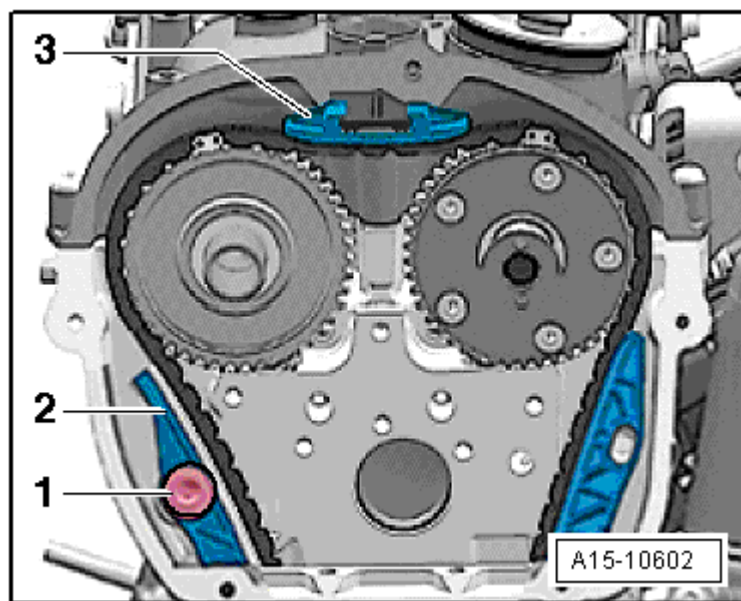


Fig. 108: Identifying Guide Tensioning Rail, Upper Guide Rai And Bolt
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the upper guide rail -3- by unlocking the latch located in the center with a screwdriver and pushing the guide rail forward.

-- Remove the camshaft timing chain from the sprockets.

CAUTION: Danger of damaging the valves, piston head and lower timing chain cover.

- If the camshaft timing chain was removed from the cylinder head, then the crankshaft may not be turned further.
- Panels are installed on the lower timing chain cover to prevent the chain from falling down. The panels can bend if the crankshaft is rotated when the chain is loose.

-- Turn the sealing plugs -arrows- counterclockwise 90° in the -direction of the arrow- and remove them.

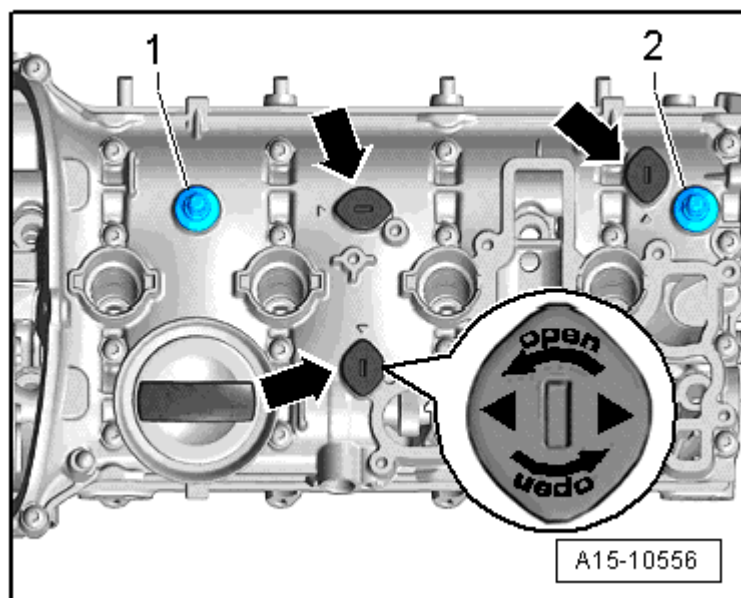


Fig. 109: Identifying Ball Head And Sealing Plug
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove the ball studs -1 and 2-
- Remove the cap.
- Remove the bolts -arrows-.

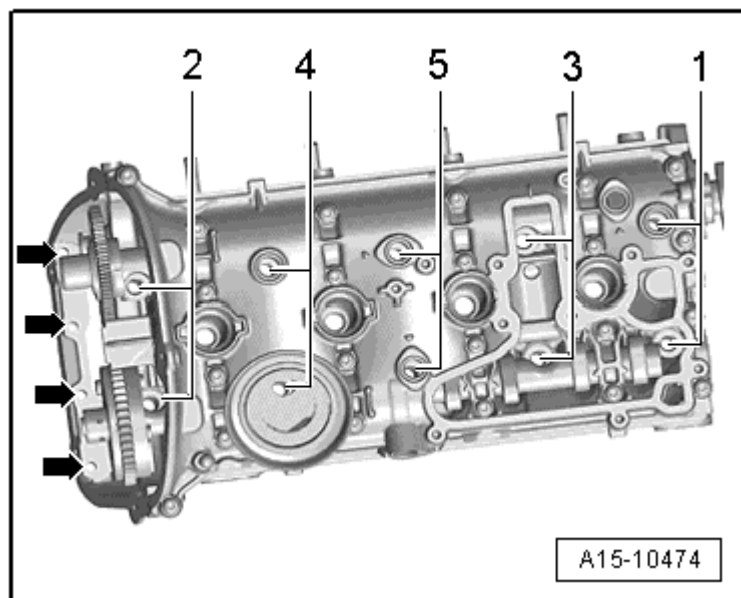


Fig. 110: Identifying Cylinder Head - Loosening Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove the cylinder head bolts in sequence -1 through 5- using the polydrive bit and drive socket -T10070-

until 2 are left.

NOTE: To remove the cylinder head bolts, rotate the camshaft with a wrench if necessary.

Make sure all wires and hoses are disconnected!

Pay attention to the tensioning and guide rails when lifting the cylinder head.

-- Install the engine support -T10014- with each of the two small and large washers as illustrated.

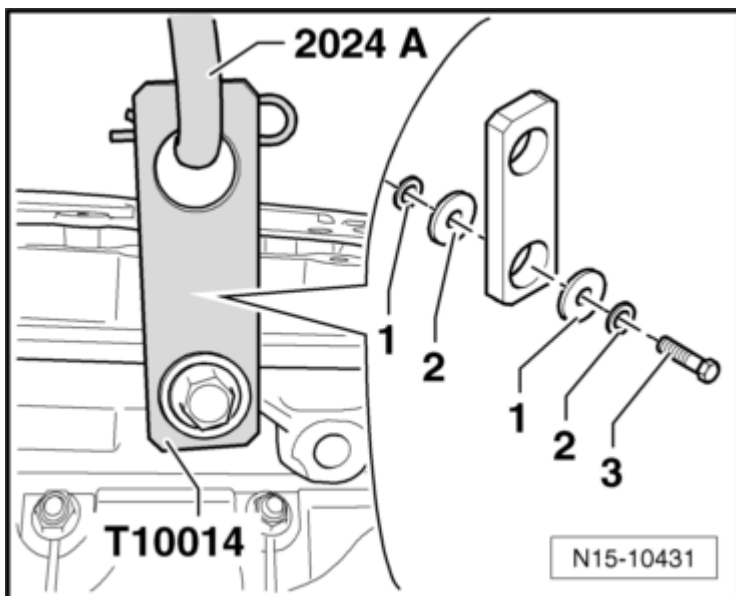


Fig. 111: Identifying Engine Support -T10014-, Washers, Bolt And Engine Sling -2024 A-
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-1- M8 washer, small.

-2- M8 washer, large. The outer diameter of the washer must be larger than the hole in the bracket.

-3- M8 x 30 bolt.

-- Install the engine sling -2024 A- to the engine support -T10014- and to the left front lifting eye on the cylinder head.

-- Secure the engine sling -2024 A- with the shop crane and gently lift the cylinder head.

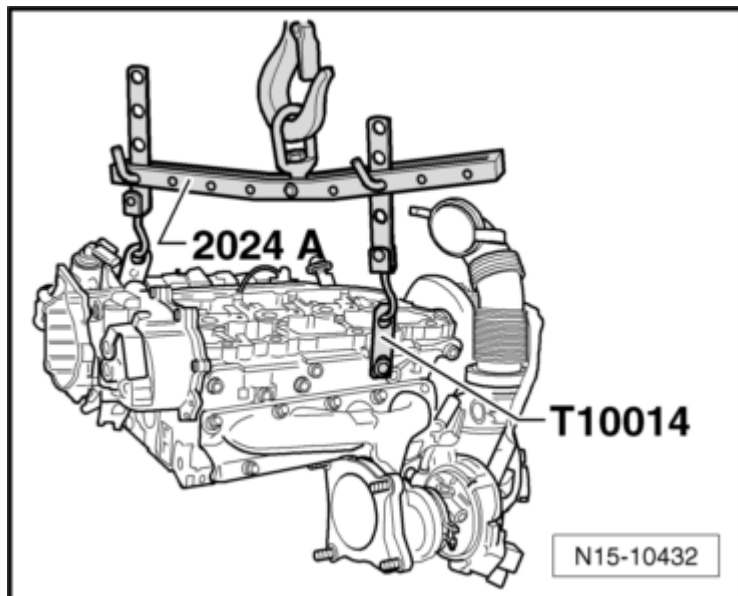


Fig. 112: Identifying Installation Of Engine Sling -2024 A- And Engine Support -T10014-
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the last two cylinder head bolts.

CAUTION:

- Carefully lift the cylinder head until the guide rail for the camshaft timing chain is free.
- The tension and guide rails must not be damaged.

-- Lay the cylinder head on a soft surface, such as foam.

Installing

- Tightening specifications, refer to CYLINDER HEAD OVERVIEW.

CAUTION: The sealing surfaces could be damaged.

- Carefully remove the sealant from the cylinder head and cylinder block.
- Make sure that no long scrapes or scratches result.

Risk of damaging the cylinder block.

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

Risk of cylinder head gasket leaking.

- Carefully remove all grinding and sanding residue.

- Only unpack new cylinder head gasket immediately prior to installation.
- To prevent the cylinder head gasket silicone layer and recessed area from being damaged, always handle the gasket extremely carefully.

Risk of damaging open valves.

- If a replacement cylinder head is installed, only remove the plastic base right before the cylinder head is installed to protect open valves.

Risk of damaging valves and piston heads after working on the valvetrain.

- To ensure valves do not strike pistons when starting, carefully rotate engine at least 2 full revolutions.

NOTE: Replace the bolts which have been tightened to a torque angle.

Replace O-rings, seals and self-locking nuts.

Note the different sealant for the cylinder head sealing surfaces and bolts.

Secure all hose connections with hose clamps appropriate for the model.

When installing a replacement cylinder head, rotate the camshaft to TDC and mark the new sprockets exactly the same as on the old sprockets (note the factory colored mark on the sprockets).

When installing a replacement cylinder head, all of the contact surfaces between the hydraulic lash adjusters, roller rocker arms and cam running surfaces on the camshaft must be lubricated before installing the cylinder head cover.

The engine oil and coolant must be changed if the cylinder head or cylinder head gasket are replaced.

-- Support the cylinder head with the shop crane and position it above the cylinder block.

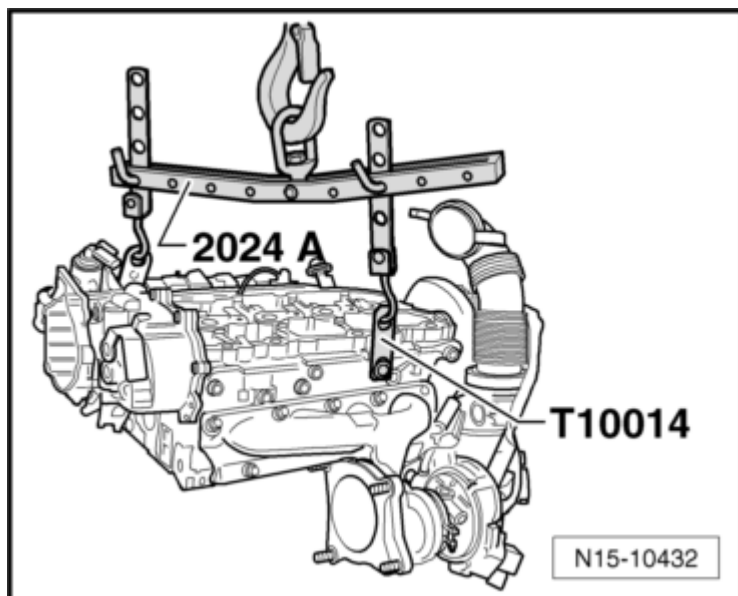


Fig. 113: Identifying Installation Of Engine Sling -2024 A- And Engine Support -T10014-
Courtesy of VOLKSWAGEN UNITED STATES, INC.

CAUTION:

- Carefully lower the cylinder head.
- The tensioning and guide rails must not be damaged.
- Pay attention to the alignment pins -arrows- in the cylinder block.

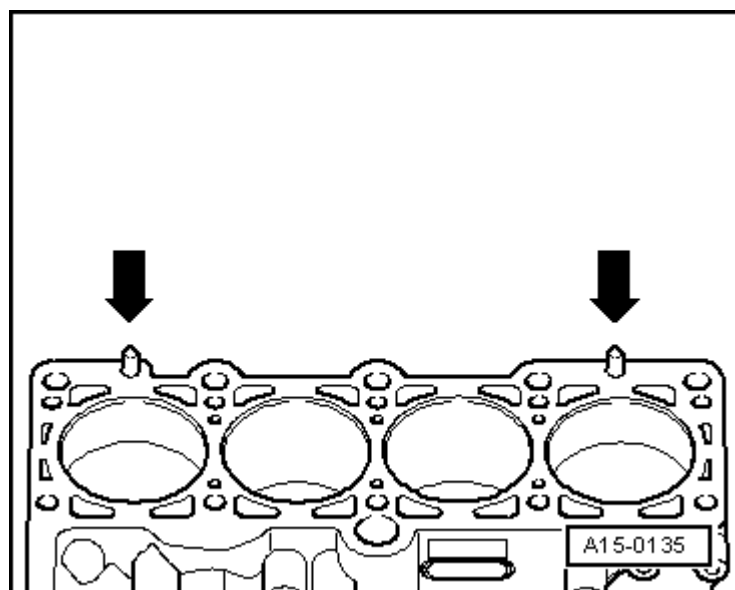


Fig. 114: Identifying Cylinder Block Centering Pins
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Observe the cylinder head gasket location, identification: The part number must be visible from the intake side.

CAUTION: When rotating the crankshaft, make sure the timing chain cannot damage any other components.

-- In the event the crankshaft has been rotated in the meantime: Set the piston for cylinder 1 to TDC and rotate the crankshaft back again slightly.

-- Set the cylinder head in place.

-- Install the cylinder head bolts and tighten them by hand.

NOTE: In order to be able to tighten the cylinder head bolts, the intake camshaft must be turned with a wrench.

There is no requirement to tighten the cylinder head bolts after repairs.

-- Cylinder head bolt tightening sequence, refer to **Fig. 4**.

CAUTION: When rotating the crankshaft, make sure the timing chain cannot damage any other components.

-- Rotate the vibration damper to the TDC position -arrow- using the counter hold tool -T10355-.

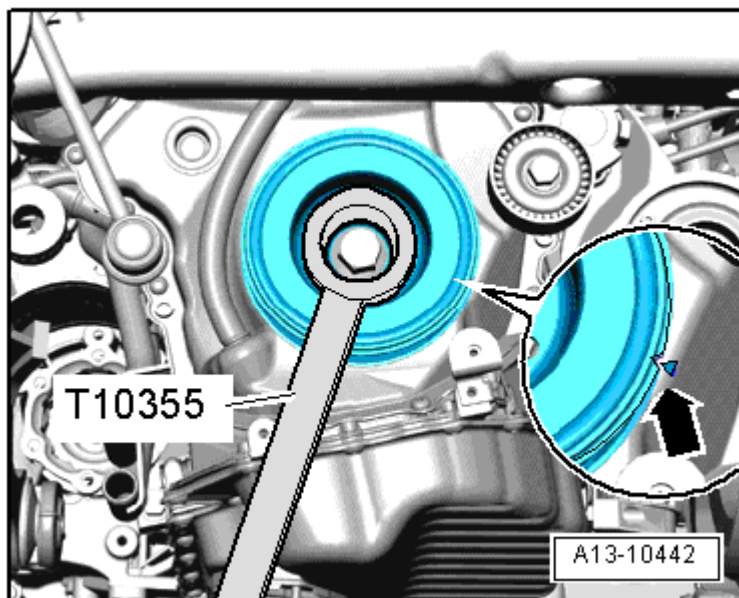


Fig. 115: Identifying Vibration Damper Rotated Into "OT" Position Using Counter Hold Tool T10355
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- The notch on the vibration damper must line up with the arrow mark -arrow- on the lower timing chain cover.

-- Mount the timing chain on the intake camshaft. The marks must align.

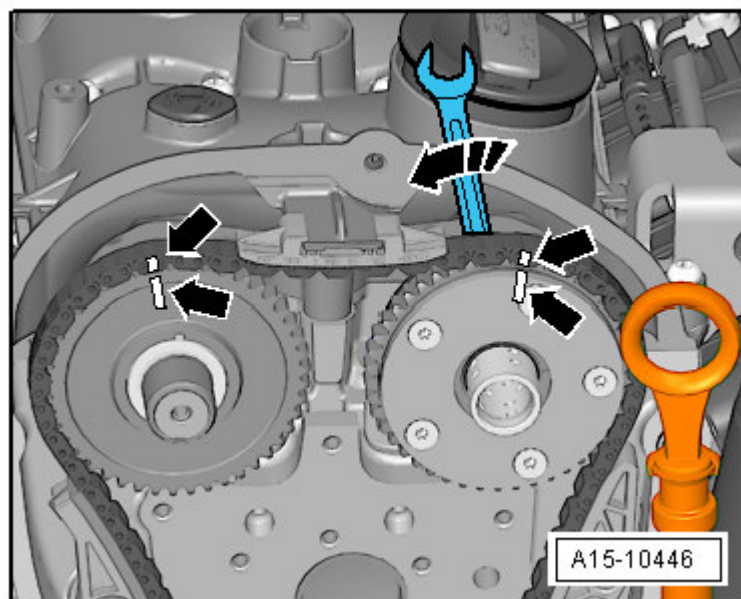


Fig. 116: Identifying Drive Chain/Chain Sprocket Markings And Turning Intake Camshaft Using Wrench

Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Turn the intake camshaft in the -direction of the arrow- with a wrench until the timing chain is >>taut<<. Hold the intake camshaft secure in this position.

-- Mount the timing chain on the exhaust camshaft: the marks on the drive chain and sprockets -arrows A- and the drive chain and guide rail -arrows B- must align.

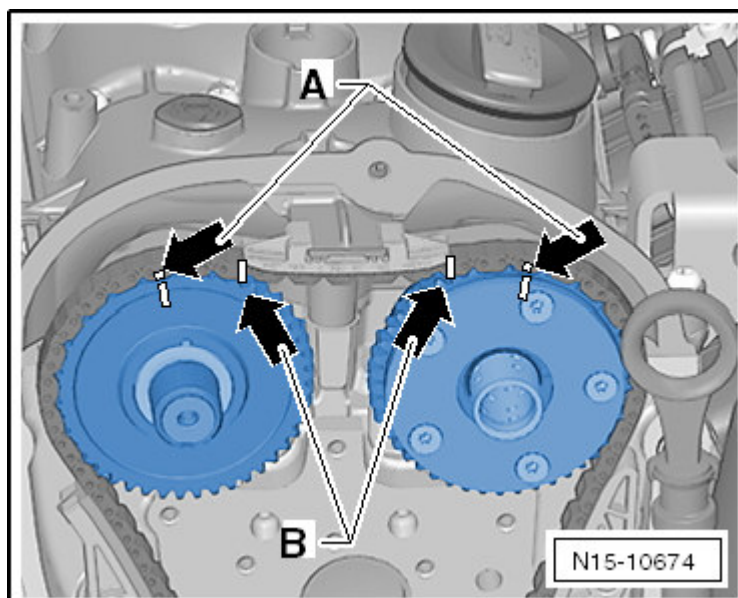


Fig. 117: Identifying Position Marks: Drive Chain To Sprockets -A- And Drive Chain To Guide Rail -B-

Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Install the upper guide rail -3-.

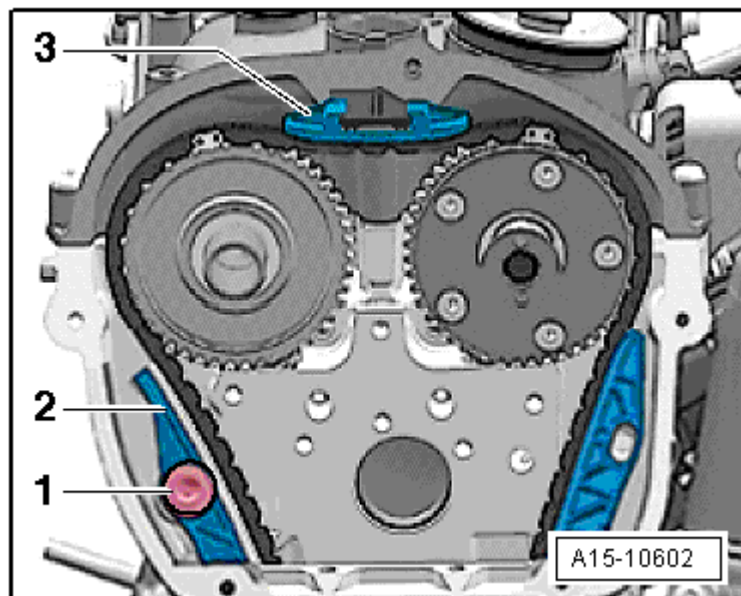
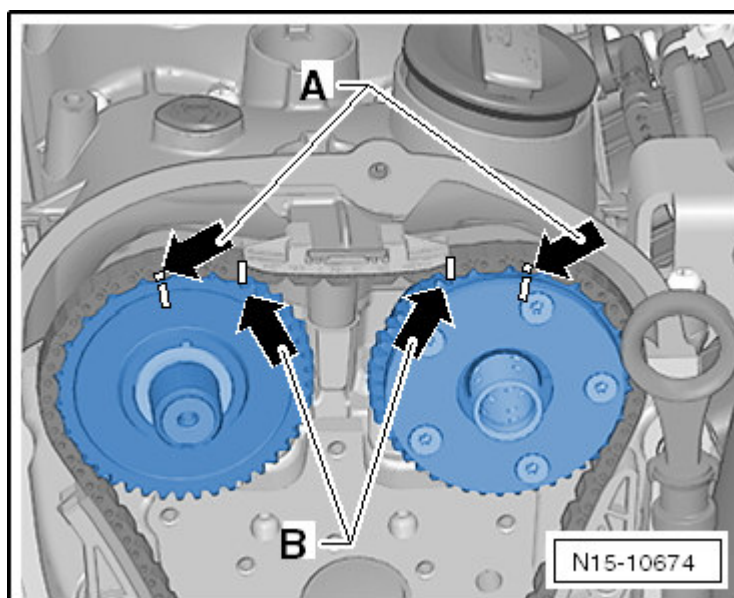


Fig. 118: Identifying Guide Tensioning Rail, Upper Guide Rai And Bolt
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Move the tensioning rail -2- up and tighten the guide pin -1-.

NOTE: If the marks on the drive chain and guide rail -B arrows- do not align even though the engine is at TDC, the drive chain has skipped on the crankshaft sprocket. Check the valve timing. Refer to VALVE TIMING, CHECKING. If the timing does not agree, the camshaft timing chain must be positioned again. Refer to CAMSHAFT TIMING CHAIN.



**Fig. 119: Identifying Position Marks: Drive Chain To Sprockets -A- And Drive Chain To Guide Rail -B-
Courtesy of VOLKSWAGEN UNITED STATES, INC.**

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

- Change the engine oil
- Replace the coolant. Refer to **DRAINING AND FILLING** .

UPPER TIMING CHAIN COVER

Special tools and workshop equipment required

- Torque Wrench (5-60 Nm) -V.A.G 1783-
- Open End Spanner Insert AF 10 -V.A.G 1783/1-

Removing

- On vehicles with a noise generator: Open the locking mechanism -1-, unclip the fuel lines -2- and loosen the bolt -3- for the canister. Move the charge air pipe aside.

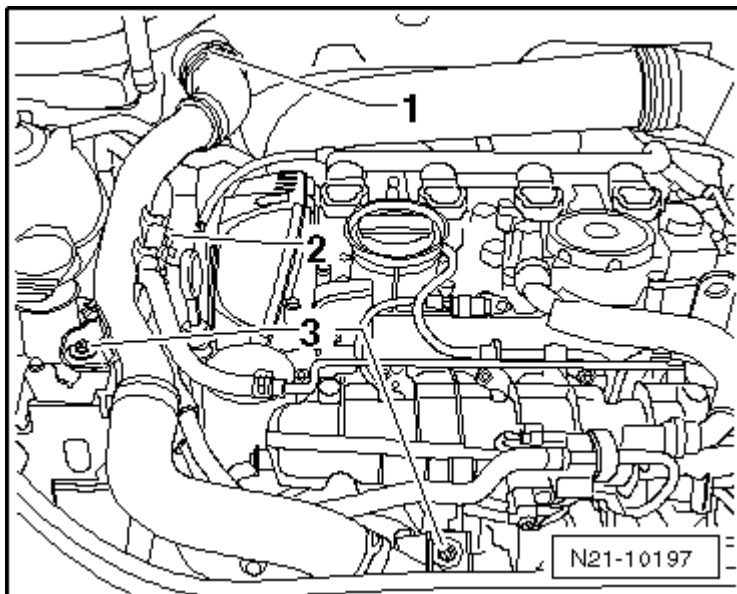


Fig. 120: Identifying Latch, Fuel Lines And Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Vehicles with the EVAP Canister in the Engine Compartment

-- Disconnect the vent line -1-, unlock the canister -A- and remove it -B-. Move the canister to the side.

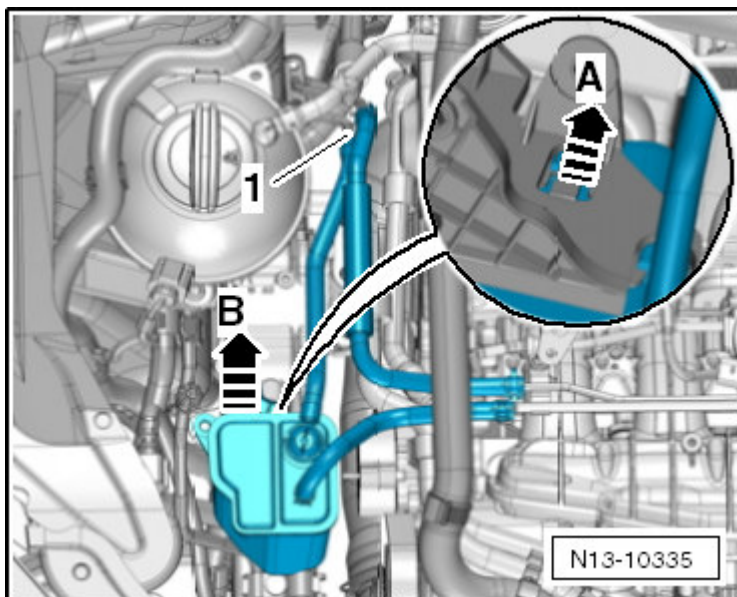


Fig. 121: Identifying Vent Line, Canister And Canister Catch
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Continuation for all Vehicles

-- Press the coolant hoses to the side and secure them with a cable tie.

-- Remove the bolts -arrows- and remove the oil dipstick guide tube from the timing chain cover.

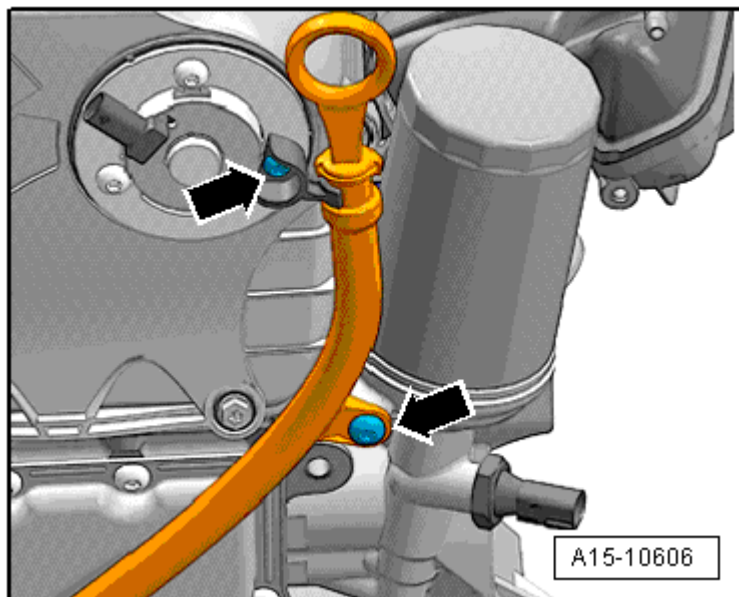


Fig. 122: Identifying Oil Dipstick Guide Tube And Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the camshaft adjustment valve 1 -N205-.

-- Remove the bolts -1 through 5- and remove the upper timing chain cover.

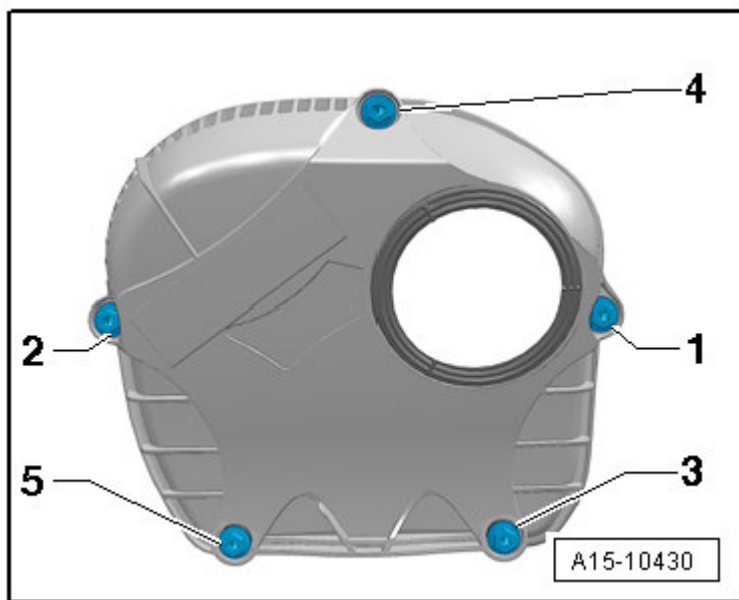


Fig. 123: Identifying Upper Timing Chain Cover - Tightening Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Installing

-- Lubricate the seal and the O-ring with engine oil.

-- Tighten the bolts -1 through 5- by hand in sequence.

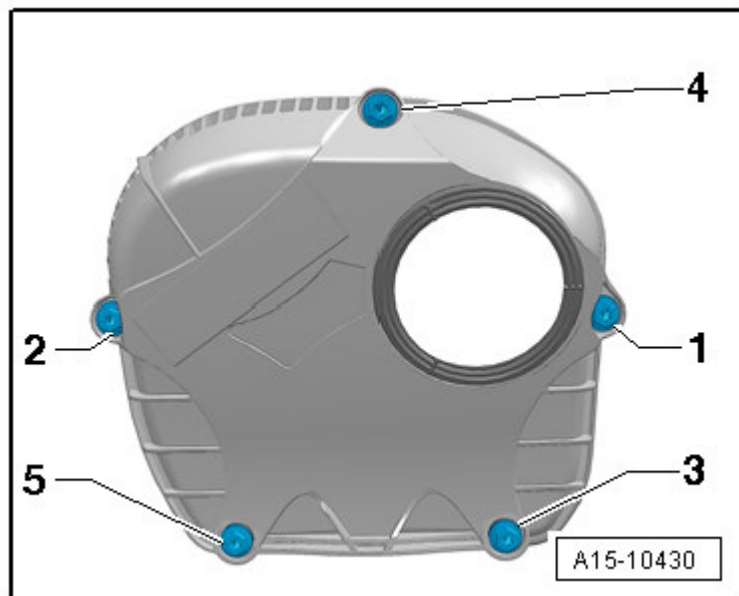


Fig. 124: Identifying Upper Timing Chain Cover - Tightening Sequence
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Tighten the bolt to 9 Nm using the torque wrench (5-60 Nm) -V.A.G 1783- and the open end spanner insert AF 10 -V.A.G 1783/1-.

- Tightening specifications, refer to **TIMING CHAIN COVERS OVERVIEW.**

The rest of the installation is basically a reverse of the removal sequence.

LOWER TIMING CHAIN COVER

Special tools and workshop equipment required

- Engine Support Bridge 10-222 A
- Bracket for Engine 10-222 A/1 (Passat only)
- Locking Pin -T10060 A-
- Counter Hold Tool -T10355-
- Thrust Piece -T10368-
- Bits -T10099-
- Shackle 10-222 A/12
- Engine Support Feet 10-222 A/8 (CC only)

Removing

- Remove the noise insulation. Refer to **Description and Operation** .
- Remove the front part of the right wheel housing liner. Refer to **Removal and Installation** .
- Drain the engine oil.

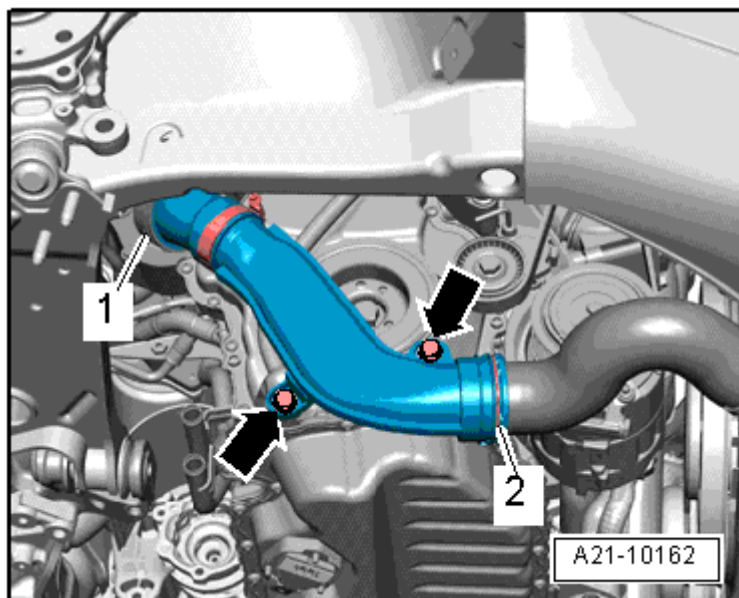


Fig. 125: Identifying Air Guide Pipe And Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove the bolts -arrows-.
- Lift the clamps -1 and 2- and remove the charge air pipe.

CAUTION: Risk of destroying due to a reversed running direction on a used ribbed belt.

- **Before removing the ribbed belt, marking the running direction with chalk or a felt tip pen for reinstallation later.**

- Loosen the clamps -arrows- and remove the right charge air hose.

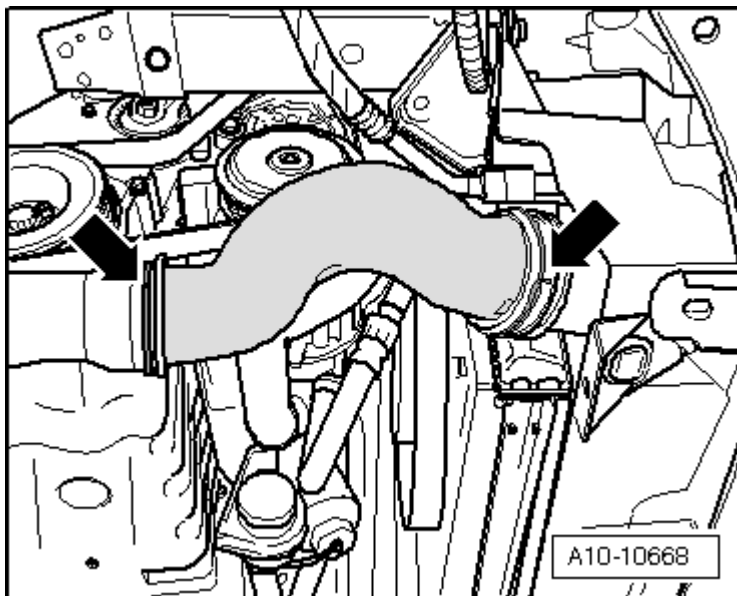


Fig. 126: Identifying Right Charge Air Guide Hose -Arrows-
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- To release the tension on the ribbed belt, rotate the tensioner in the -direction of arrow- from underneath.

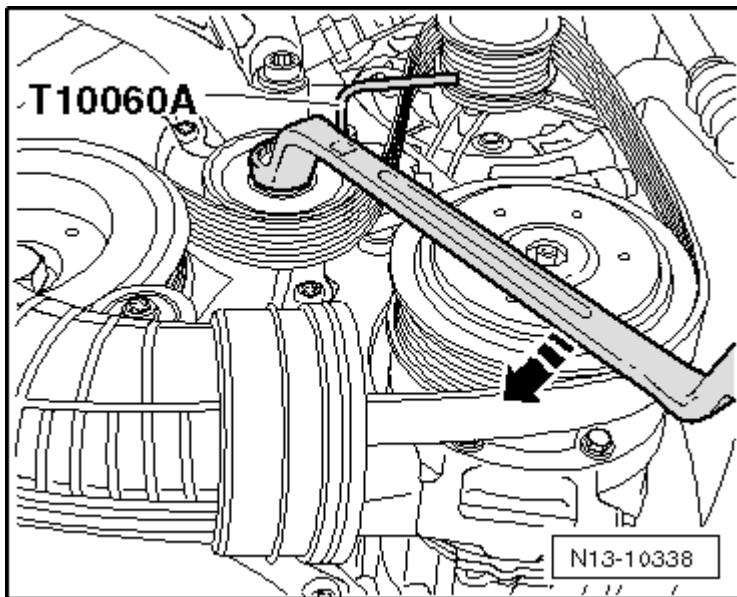


Fig. 127: Identifying Wrench And Locking Pin -T10060 A-
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Secure the tensioner using the locking pin -T10060 A-.

-- Remove the ribbed belt from the vibration damper.

-- Rotate the vibration damper to the Top Dead Center (TDC) position -arrow- using the counter hold tool -T10355-.

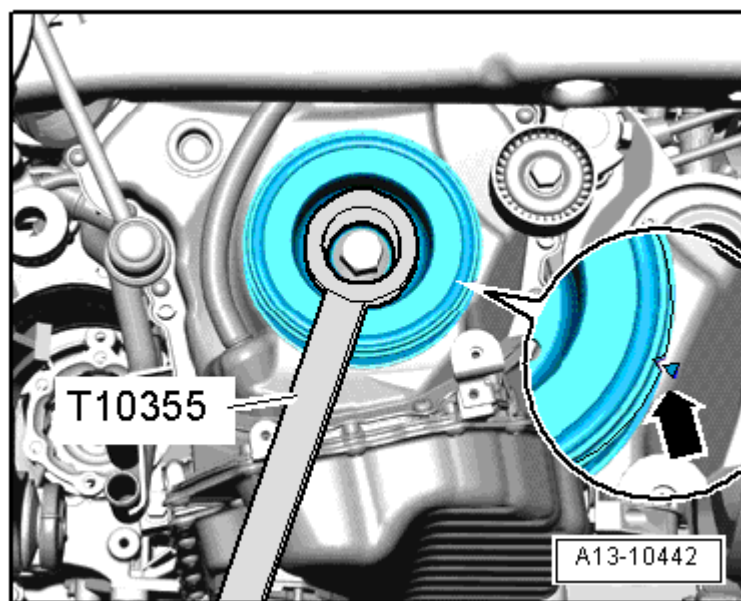


Fig. 128: Identifying Vibration Damper Rotated Into "OT" Position Using Counter Hold Tool T10355
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- The notch on the vibration damper must line up with the arrow mark -arrow- on the lower timing chain cover.

CAUTION: The engine could be destroyed.

- In order not to change the valve timing, the crankshaft must not be moved out of the TDC position when the vibration damper bolt is removed.

-- Remove the vibration damper bolt using the counter hold tool -T10355-.

-- Remove the vibration damper.

CAUTION: To avoid damaging the splines, only use the thrust piece -T10368- to install the vibration damper bolt.

-- Install the vibration damper bolt and the thrust piece -T10368- again.

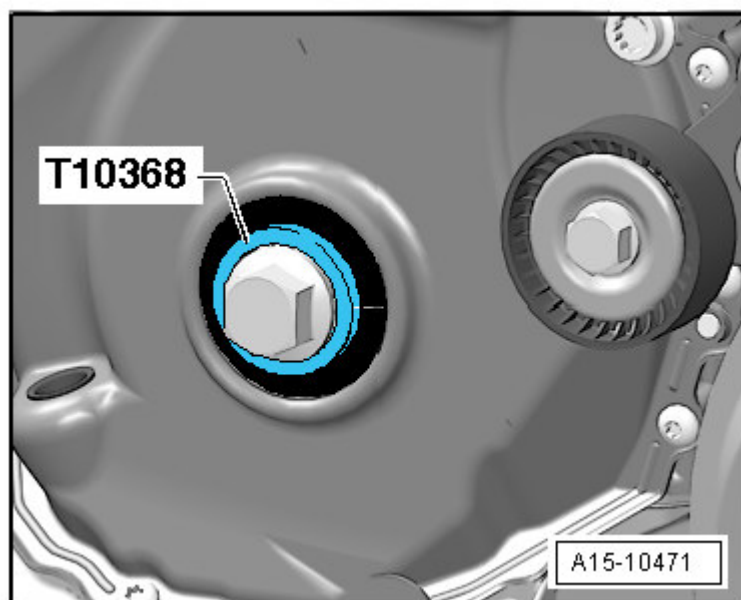


Fig. 129: Identifying Vibration Damper Bolt And Thrust Piece T10368
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Hold the engine in its installed position.

Passat

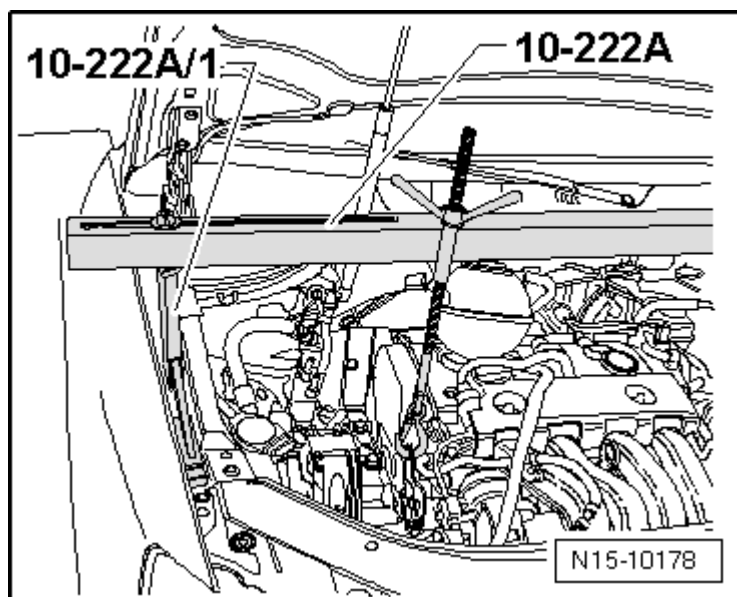


Fig. 130: Identifying Engine Support Bridge -10-222 A- And Special Tools
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Bracket for engine 10-222 A/1
- Bracket with spindle and hook 10-222 A/10
- Shackle 10-222 A/12

CC

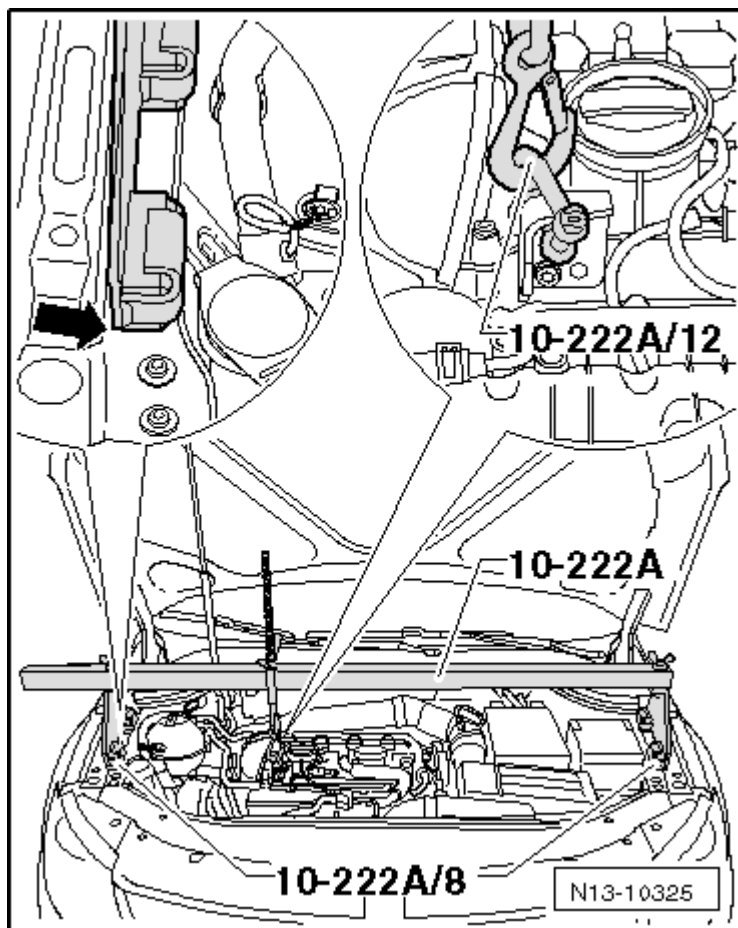


Fig. 131: Identifying Engine Support Bridge -10-222 A- And Special Tools
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Engine support feet 10-222 A/8
- Bracket with spindle and hook 10-222 A/10
- Shackle 10-222 A/12

NOTE: Do not place the engine support feet 10-222 A/8 on the fender panels. The panels will be damaged.

The shackle 10-222 A/12 is needed to make sure the engine is lifted in the installed position and not tilted.

Continuation for all Vehicles

-- Support the engine with the spindle.

-- Remove the engine mount to engine mount bracket bolts -arrows-.

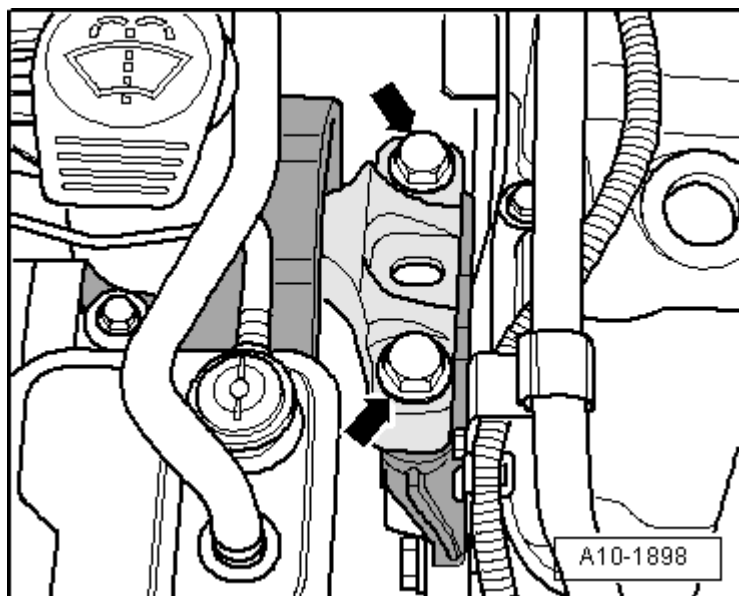


Fig. 132: Identifying Engine Mount To Engine Mount Bracket Bolts
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove the engine mount. Refer to **ENGINE AND TRANSMISSION MOUNT OVERVIEW** .
- Lift the engine approximately 50 mm and loosen the upper bolt for the engine mount bracket.
- Now, lower the engine approximately 100 mm.
- Free up the wiring harness -arrow-.

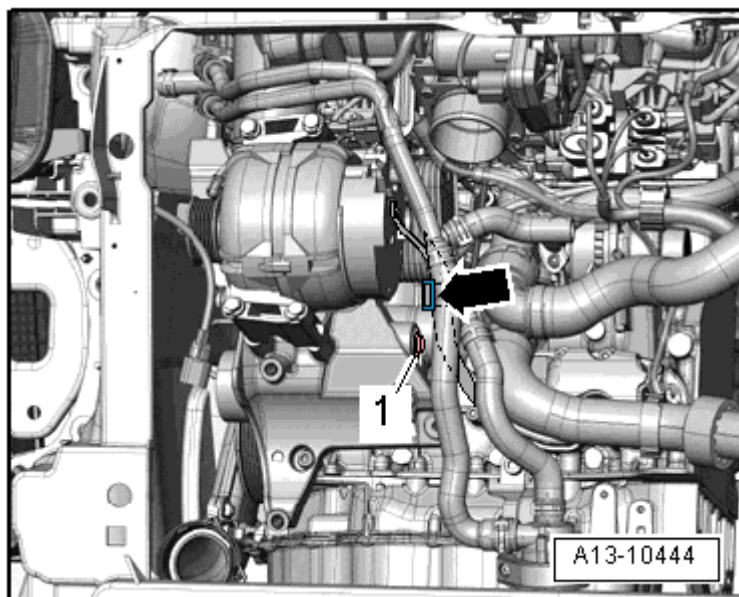


Fig. 133: Identifying Ribbed Belt Tensioner Bolt And Locating Electrical Wiring Harness
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove the bolt -1- and remove the ribbed belt tensioner from the accessory bracket.
- Remove the lower bolts for the engine mount bracket using the bits -T10099-.
- Remove the engine mount bracket and the bolts.
- Remove the bolts -arrows- and remove the oil dipstick guide tube from the timing chain cover.

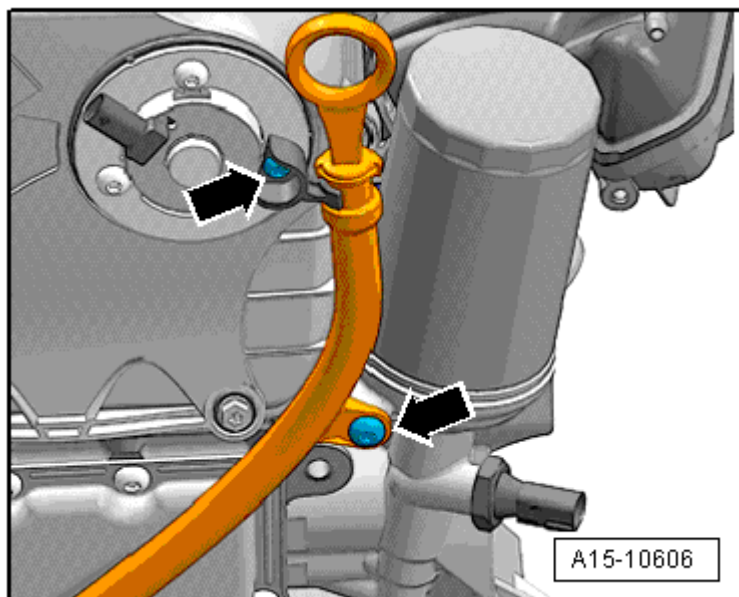


Fig. 134: Identifying Oil Dipstick Guide Tube And Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove the wastegate bypass regulator valve -N75- from the turbocharger -arrows-.

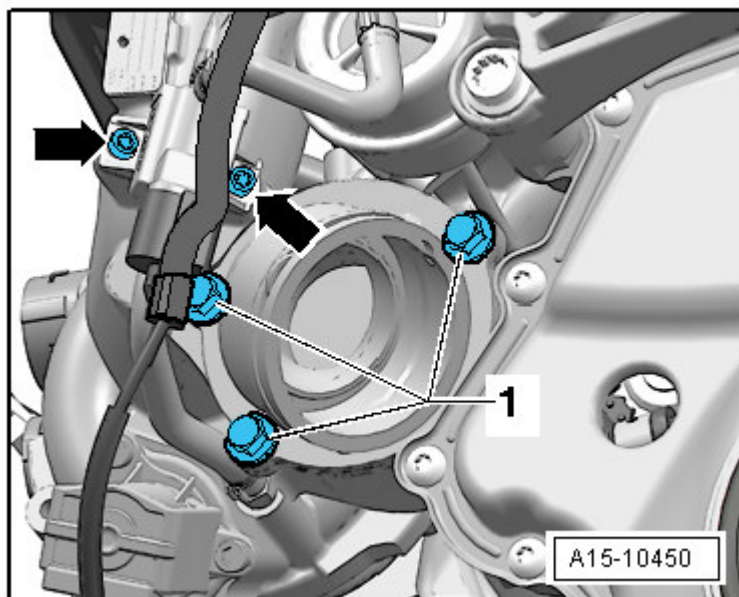
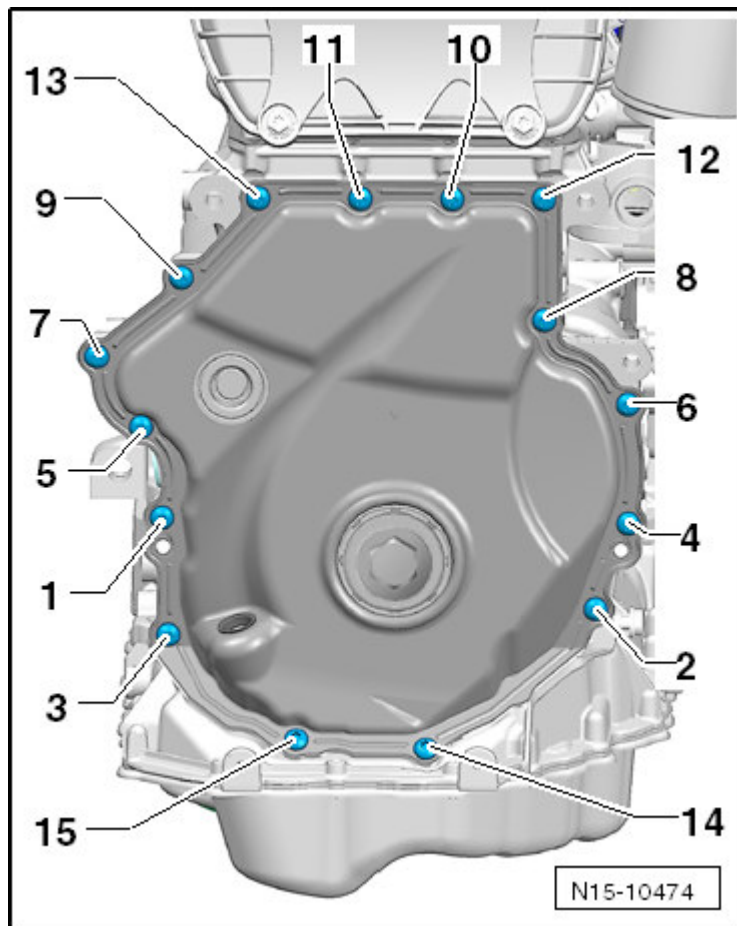


Fig. 135: Identifying Turbocharger And Supports

Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the turbocharger support -1-.

-- Remove the bolts -1 through 15-.

**Fig. 136: Identifying Lower Timing Chain Cover Bolts**

Courtesy of VOLKSWAGEN UNITED STATES, INC.

CAUTION: The lower timing chain cover could be damaged. To avoid deformation, do not hold between the bolting points.

-- Pry off the lower timing chain cover; when doing this, begin at -1 and 2-.

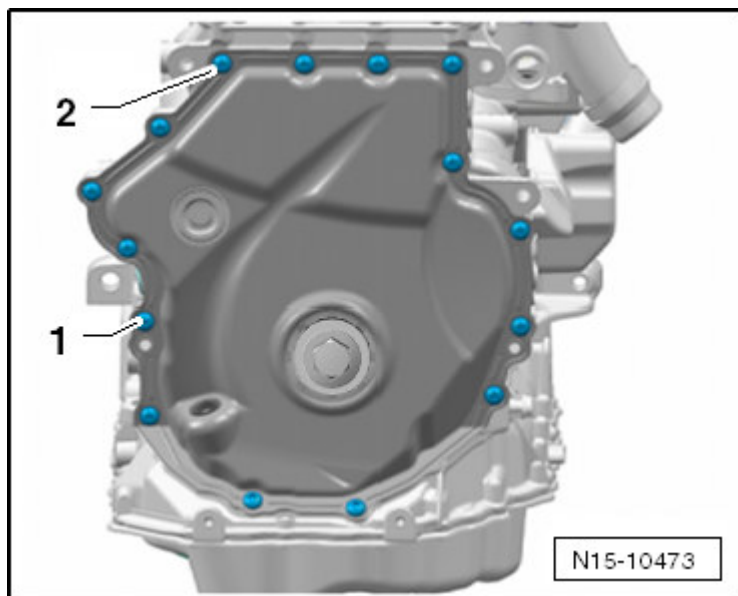


Fig. 137: Identifying Lower Timing Chain Cover And Bolt Removal Start Sequence
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Installing

- Tightening specifications, refer to **TIMING CHAIN COVERS OVERVIEW**.
- Sealant: silicone sealant -D 174 003 A2-

NOTE: Note the expiration date of the silicone sealant.

The cover must be installed within 5 minutes after application of the silicone sealant.

Replace the bolts which have been tightened to a torque angle.

Replace O-rings, seals and self-locking nuts.

-- Remove any sealant residue on the cylinder block using a flat blade scraper.

WARNING: Wear safety glasses.

-- Cover both sides of the seal with tape to prevent contamination.

-- Use a rotating plastic brush to remove any remaining sealant on the cover.

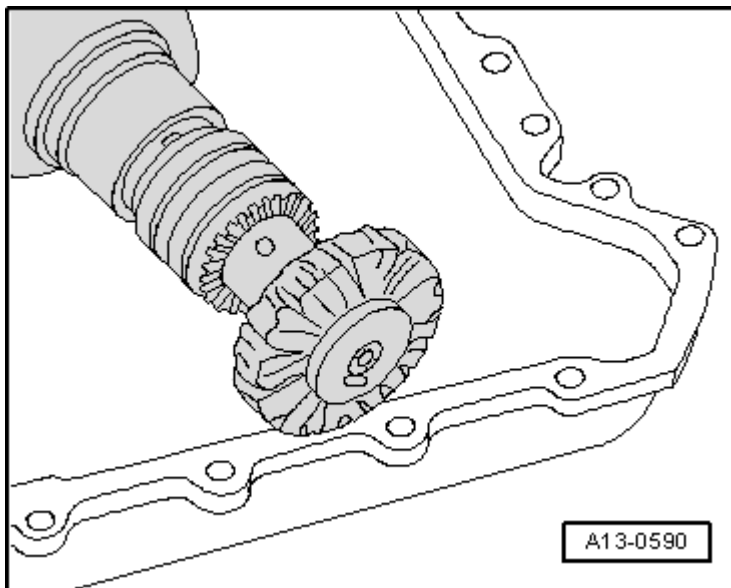


Fig. 138: Identifying Rotating Plastic Brush To Remove Sealant Residue From Sealing Flange, Cylinder Block And Upper Part Of Oil Pan

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Clean the sealing surfaces, they must be free of oil and grease.
- Install the cover using the old bolts and tighten them to 8 Nm.
- Check between the cover and housing using a feel gauge; the gap must not exceed 0.2 mm.

NOTE: **If the gap exceeds 0.2 mm, replace the cover.**

It is not possible to measure between the cover the upper oil pan, however check the sealing surface for evenness.

- Make sure both alignment sleeves -arrows- for centering the cover are present.

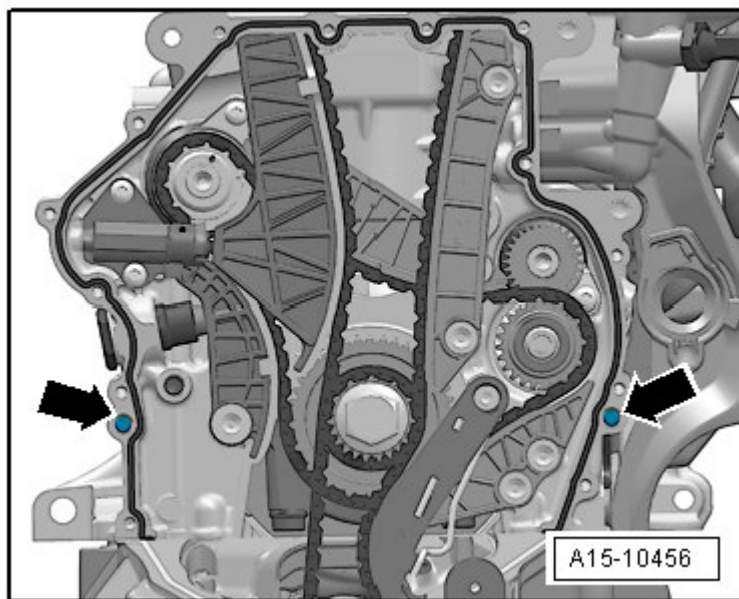


Fig. 139: Identifying Centering Cover Alignment Bushings
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Cut the sealant tube nozzle at the front mark (nozzle diameter: approximately 3 mm).

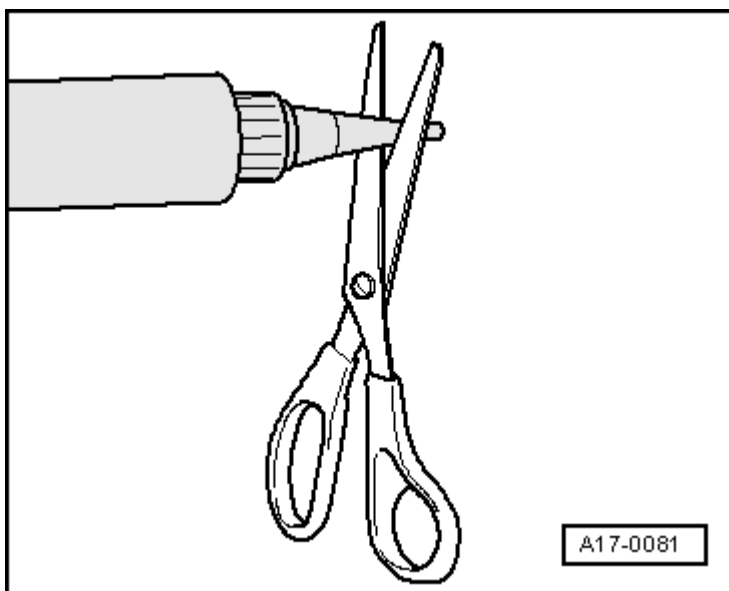


Fig. 140: Identifying Scissors To Cut Tube Nozzle At Front Marking (Nozzle Diameter Approx. 3 Mm)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Apply the silicone sealant -D 174 003 A2- on the clean sealing surface of the cover as shown in the illustration.

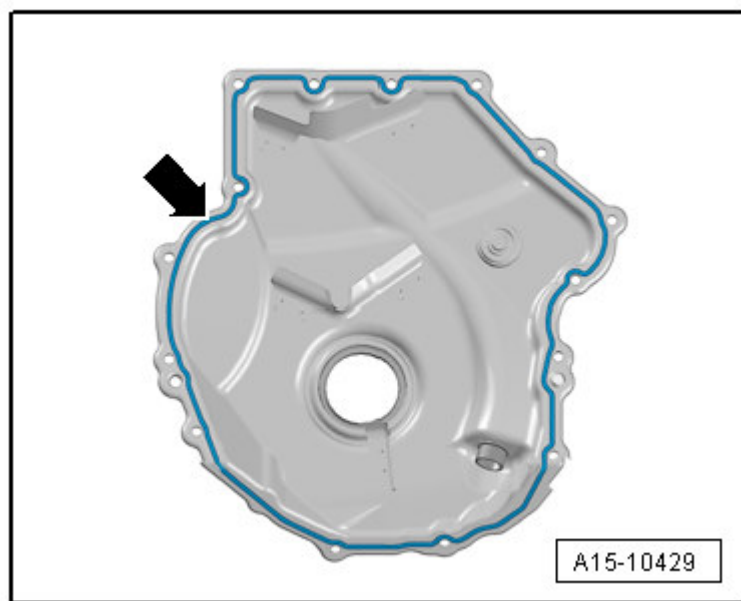


Fig. 141: Identifying Silicone Sealant Application Area For Cover Sealing Surface
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Thickness of sealant bead: 2 to 3 mm.

NOTE: **The cover must be installed within 5 minutes after application of silicone sealant.**

The sealant bead may not be thicker than specified, otherwise the excess sealant could enter the oil pan and clog the oil intake pipe.

-- Install the cover immediately and all the bolts.

TIGHTEN THE BOLTS -1 THROUGH 15- IN TWO PASSES AND IN THE FOLLOWING SEQUENCE:

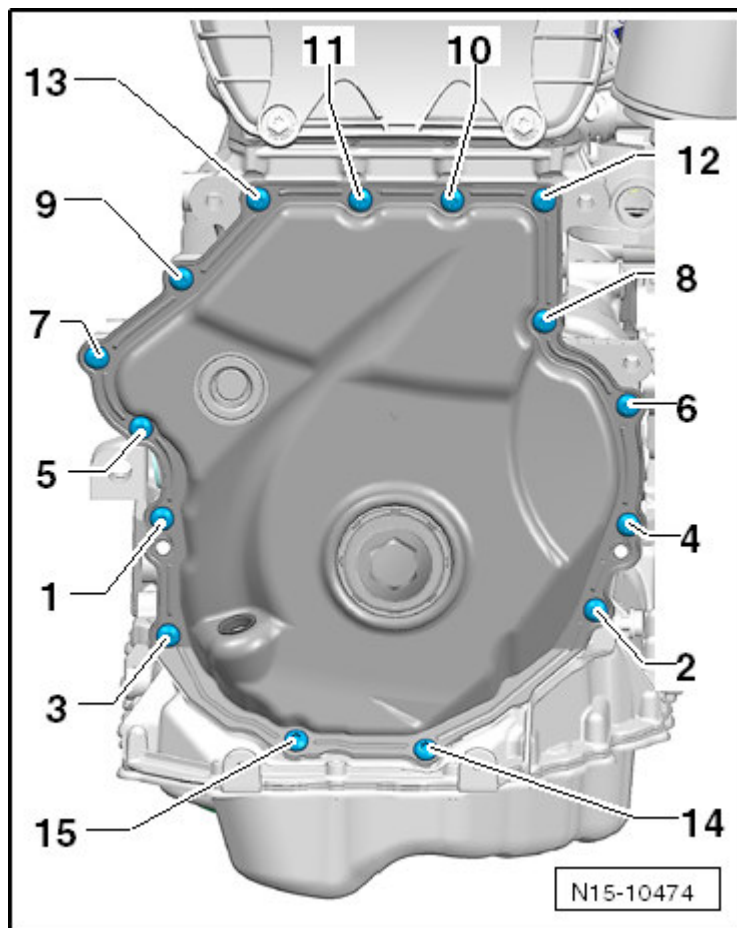


Fig. 142: Identifying Lower Timing Chain Cover Bolts
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

1. Tighten the bolts to 8 Nm
2. Tighten the bolts an additional 45° (1/8) turn

NOTE: After installing the cover, allow the sealant to dry for approximately 30 minutes. Only after then may the engine oil be added.

-- Fill the engine oil.

-- Check the oil level.

The rest of the installation is basically a reverse of the removal sequence.

VIBRATION DAMPER SHAFT SEAL

Special tools and workshop equipment required

- Thrust Piece -T10354-
- Pulling Hook -T20143/2-

Removing

-- Remove the vibration damper. Refer to **VIBRATION DAMPER** .

-- Install the thrust piece -T10368-.

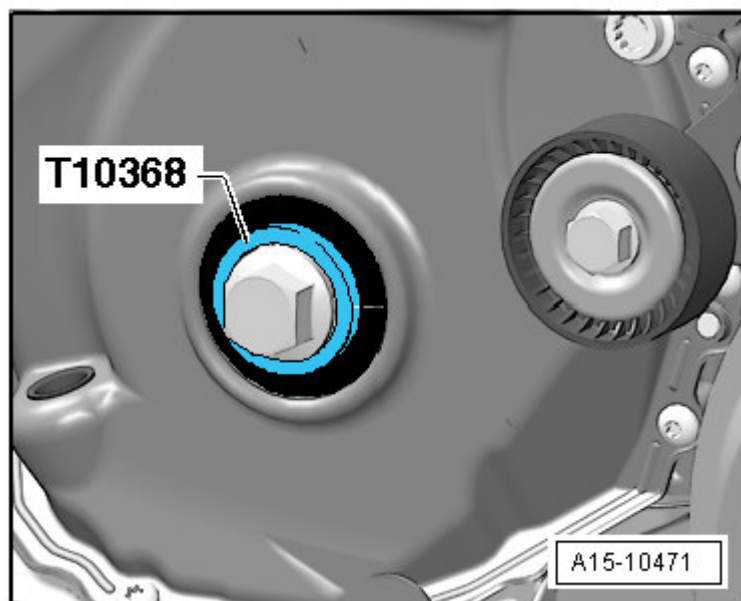


Fig. 143: Identifying Vibration Damper Bolt And Thrust Piece T10368
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the shaft seal using the pulling hook -T20143/2-.

Installing

- Tightening specifications, refer to **RIBBED BELT OVERVIEW** .

-- Clean the running and sealing surface.

-- Remove the thrust piece -T10368-.

-- Pull the seal -arrow- in all the way using the thrust piece -T10354- and the vibration damper bolt.

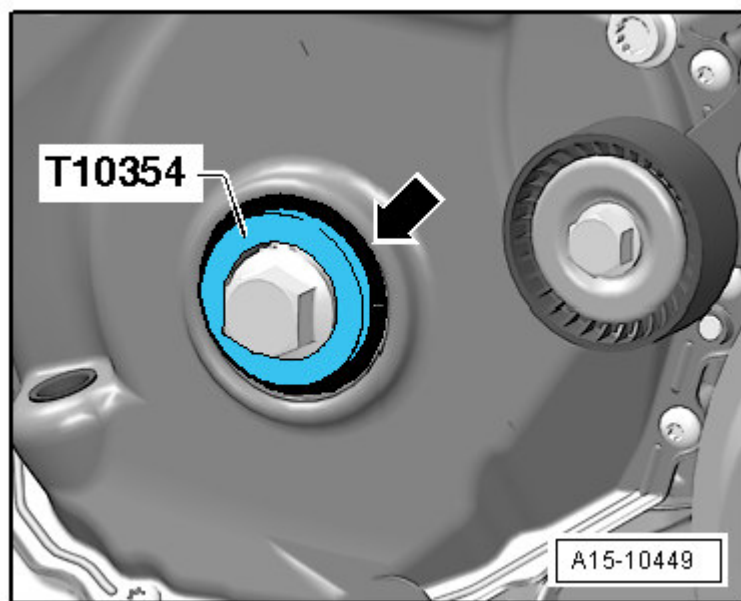


Fig. 144: Identifying Thrust Piece T10354

Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE: **Replace the vibration damper bolt**

Replace the O-ring

The rest of the installation is basically a reverse of the removal sequence.

CAMSHAFT TIMING CHAIN

Special tools and workshop equipment required

- Counter Hold Tool -T10355-
- Assembly Tool -T10352-
- Locking Pin -T40011-
- Thrust Piece -T10368-
- Torque Wrench (5-50 Nm) -V.A.G 1331-

Removing

-- Remove the upper timing chain cover. Refer to **UPPER TIMING CHAIN COVER**.

-- Rotate the vibration damper to the Top Dead Center (TDC) position -arrow- using the counter hold tool -T10355-.

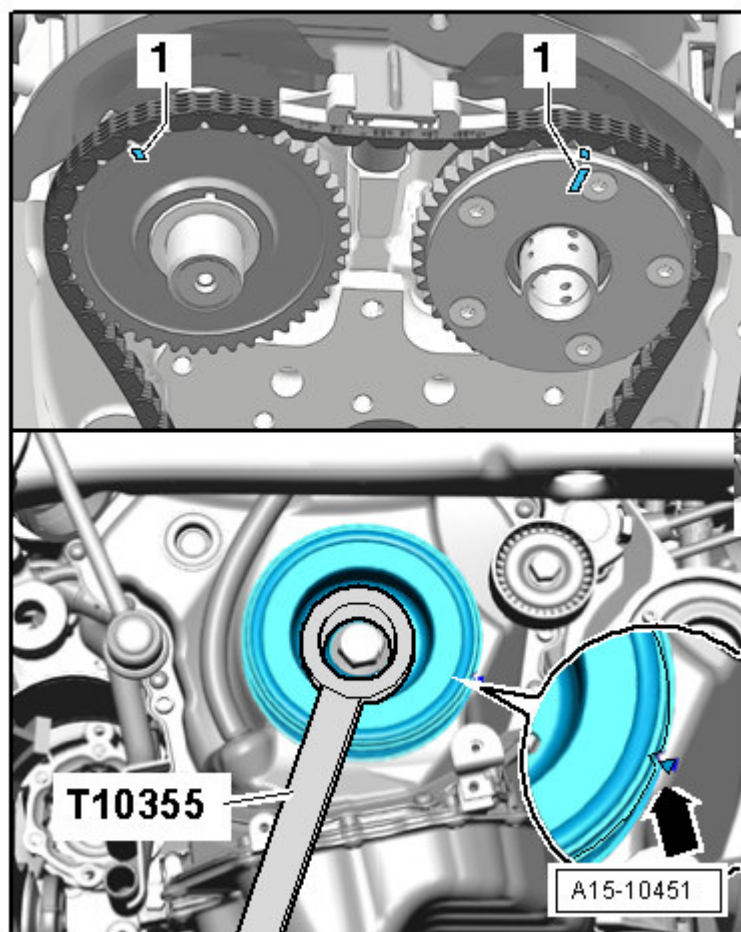


Fig. 145: Identifying Vibration Damper Rotated Into "OT" Position Using Counter Hold Tool T10355
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- The notch on the vibration damper must line up with the arrow mark -arrow- on the lower timing chain cover.
- The marks -1- on the camshafts must point upward.

-- Remove the lower timing chain cover, refer to one of the following:

- Passat and CC, refer to **LOWER TIMING CHAIN COVER**.

CAUTION: The control valve has left hand threads.

-- Remove the control valve in the -direction of the arrow- using the assembly tool -T10352-.

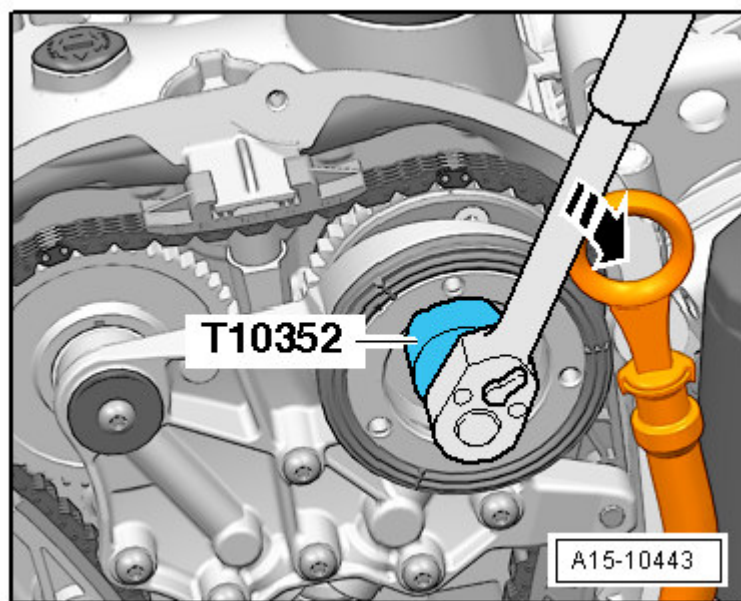


Fig. 146: Identifying Assembly Tool T10352 To Remove Control Valve
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the bolts -arrows- and remove the bearing bracket.

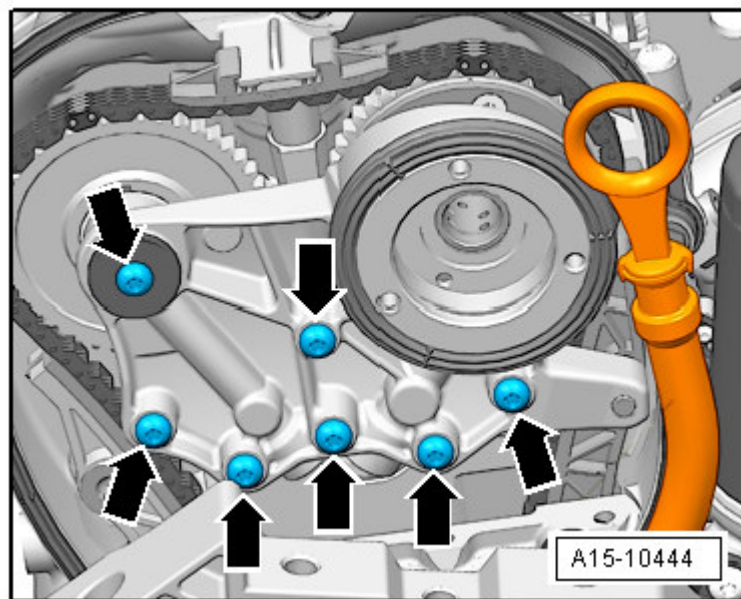


Fig. 147: Identifying Bearing Bracket Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Press the oil pump chain tensioner in the -direction of the arrow- and secure it using the locking pin -T40011-.

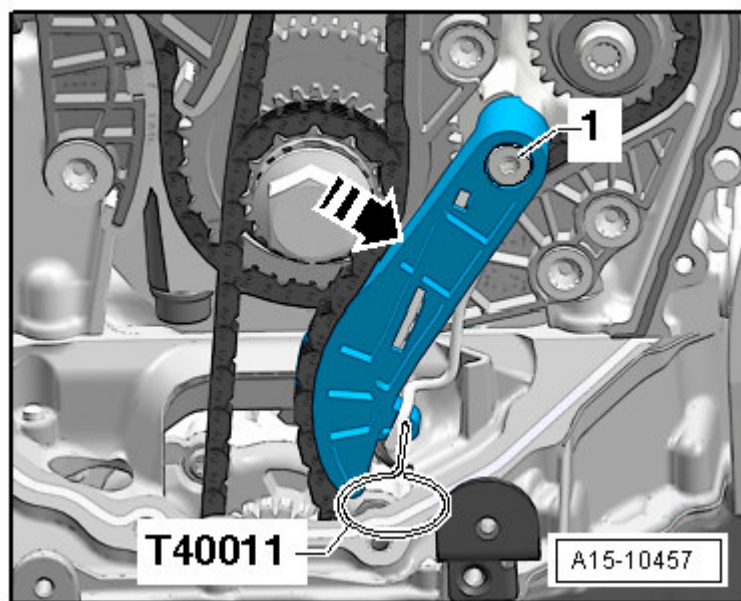


Fig. 148: Identifying Oil Pump Chain Tensioner And Locking Pin T40011
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the oil pump chain tensioner guide pin -1-.

-- Remove the oil pump chain tensioner.

The locking wedge in the chain tensioner must be lifted in order to release the tension from the chain tensioner. Sand the end of the locking pin -T40011- down to a point. A screwdriver with a head approximately 1.5 mm wide can also be used.

CAUTION: There is a risk of damaging the chain tensioner. Proceed very carefully.

-- Lift the chain tensioner locking wedge in the -direction of arrow 1-, press the timing chain tensioning rail in the -direction of arrow 2- and secure it using the locking pin -T40011-.

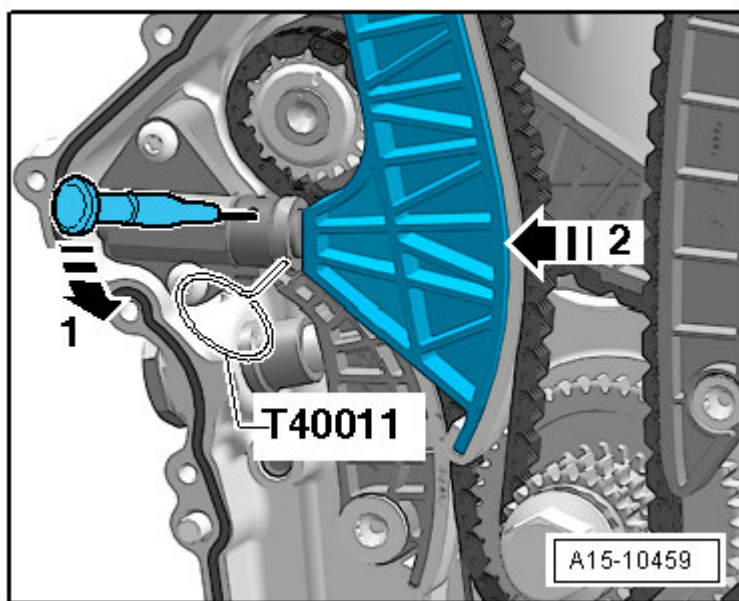


Fig. 149: Identifying Directions: (Lift) Chain Tensioner Locking Wedge And (Press) Timing Chain Tensioning Rail

Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the timing chain tensioning rail guide pin -2- and tensioning rail.

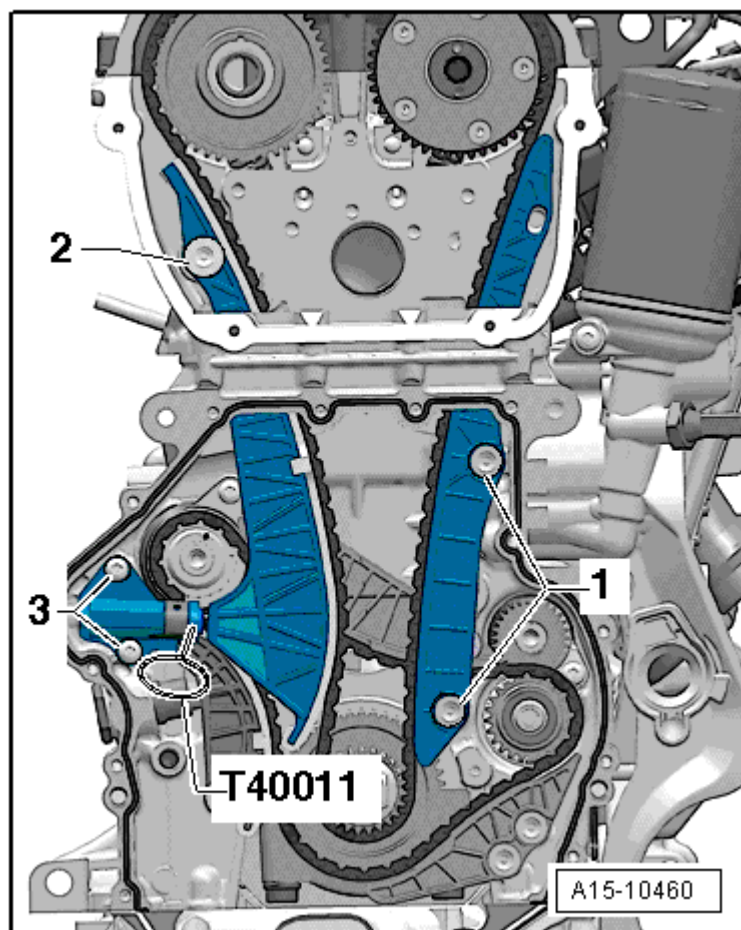


Fig. 150: Identifying Camshaft Timing Chain Tensioner Bolts, Camshaft Timing Chain Guide Rail And Guide Pins

Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE: The intake camshaft switches in the engine rotation direction.

-- Remove the timing chain guide rail guide pins -1- and guide rail.

-- Remove the timing chain.

Installing

- Tightening specifications, refer to **CAMSHAFT TIMING CHAIN OVERVIEW**.
- The chain tensioner for the tensioning rail is installed and secured with the locking pin -T40011-.
- The sprocket for the crankshaft is secured using the thrust piece -T10368-.

NOTE: The following procedure must be performed in one step. A second technician is needed.

The painted links on the timing chain must be positioned on the marks on the

sprockets.

Hold the wrench tight until the tensioning rail and guide rail are installed.

-- Position the crankshaft to TDC, as shown in the illustration. It is in TDC when the marks on the balance shafts are aligned with the balance shaft bolts.

NOTE: The marks must match up with the painted chain links each 16th turn.

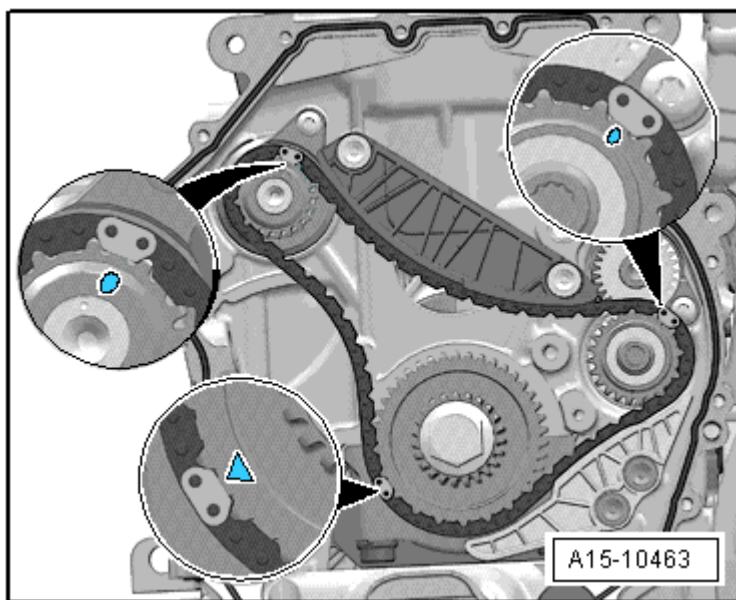


Fig. 151: Identifying Timing Chain Markings
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Mount the timing chain on the exhaust camshaft. Align the colored chain links with the marks.

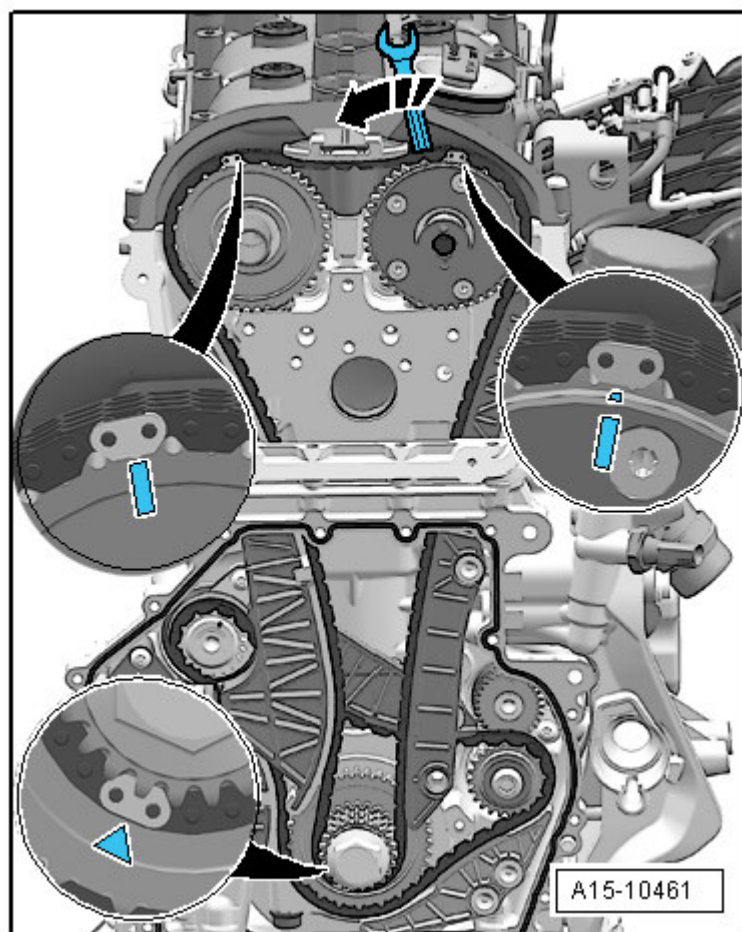


Fig. 152: Identifying Intake Camshaft Turned Using Wrench
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Mount the timing chain on the crankshaft. Align the colored chain link with the mark.
- Rotate the intake camshaft using the wrench in the -direction of the arrow- and mount the timing chain. Continue to hold the camshaft with the wrench.
- Install the timing chain tensioning rail and tighten the guide pin -2-.

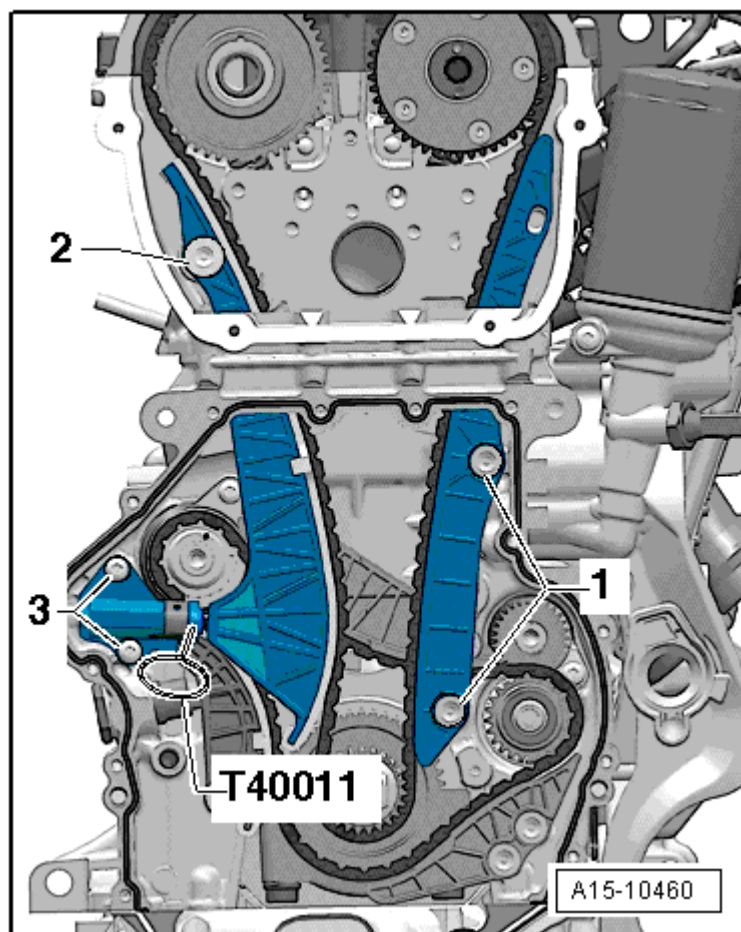


Fig. 153: Identifying Camshaft Timing Chain Tensioner Bolts, Camshaft Timing Chain Guide Rail And Guide Pins

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install the timing chain guide rail and tighten the guide pins -1-.
- Install the bearing bracket and tighten the bolts -arrows- hand tight.

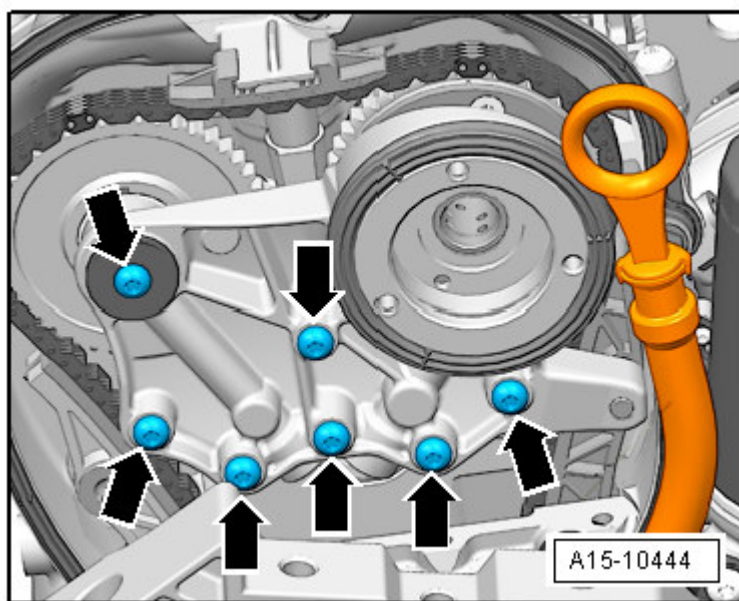


Fig. 154: Identifying Bearing Bracket Bolts

Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the locking pin -T40011- from the chain tensioner.

-- Tighten the bolts -arrows- to specification, refer to CAMSHAFT TIMING CHAIN OVERVIEW.

The rest of the installation is basically a reverse of the removal sequence.

BALANCE SHAFT TIMING CHAIN

REMOVING

-- Remove the upper timing chain cover. Refer to UPPER TIMING CHAIN COVER.

-- Remove the lower timing chain cover, refer to one of the following:

- Passat and CC, refer to LOWER TIMING CHAIN COVER.

-- Remove the camshaft timing chain. Refer to CAMSHAFT TIMING CHAIN.

-- Remove the camshaft timing chain guide rail guide pins -1-.

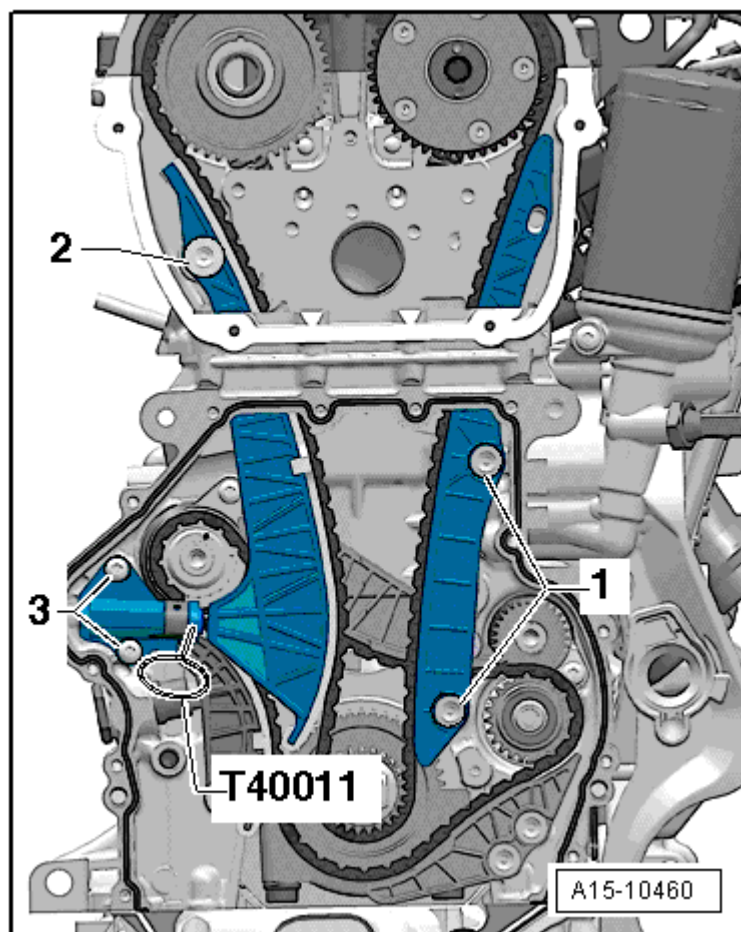


Fig. 155: Identifying Camshaft Timing Chain Tensioner Bolts, Camshaft Timing Chain Guide Rail And Guide Pins

Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Remove the camshaft timing chain tensioner bolts -3- and tensioner.

-- Remove the balance shaft chain tensioner -1-.

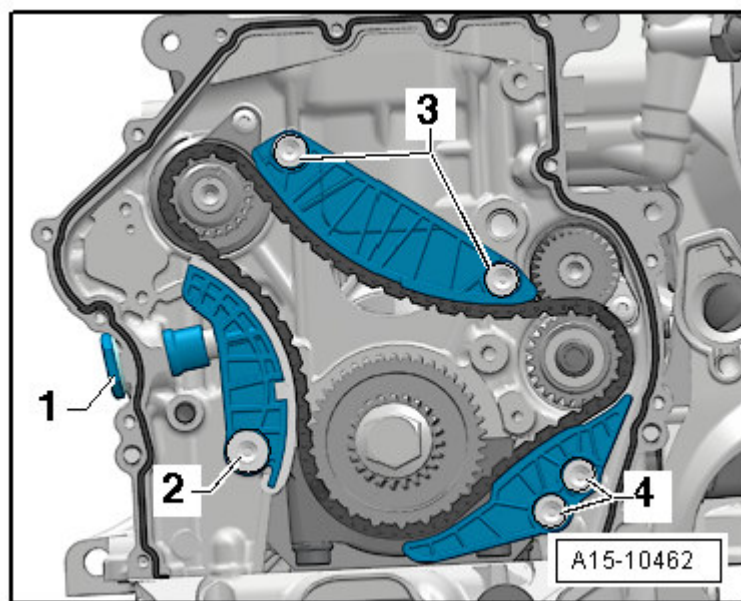


Fig. 156: Identifying Balance Shaft Timing Chain, Tensioning Rail And Guide Rails
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove the tensioning rail guide pin -2- and rail.
- Remove the guide rail guide pins -3- and rail.
- Remove the guide rail guide pins -4- and rail.
- Remove the balance shaft timing chain.

INSTALLING

- Tightening specifications, refer to **BALANCE SHAFT TIMING CHAIN OVERVIEW**.
- Rotate the intermediate shaft sprocket/balance shaft to the mark -arrow-.

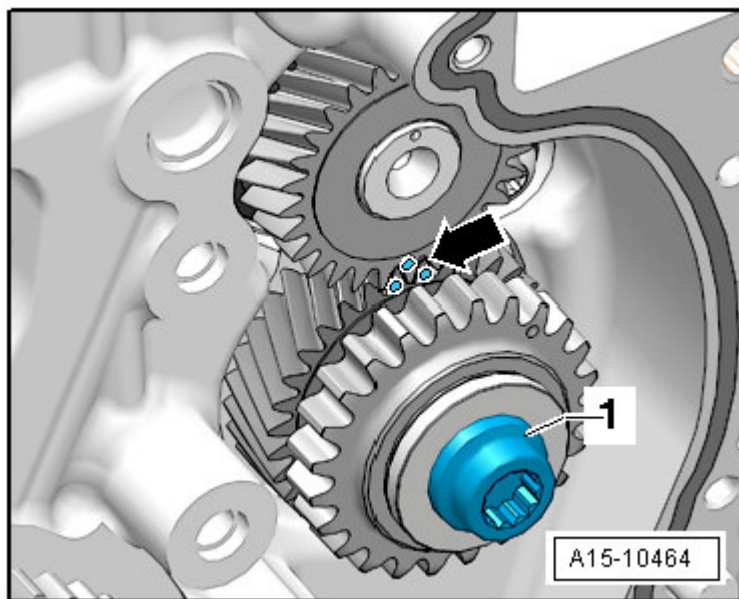


Fig. 157: Identifying Intermediate Shaft Sprocket
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE: Due to the ratio, the mark aligns only every 7th turn.

-- Mount the timing chain; the painted links of the timing chain must be positioned on the marks on the sprockets.

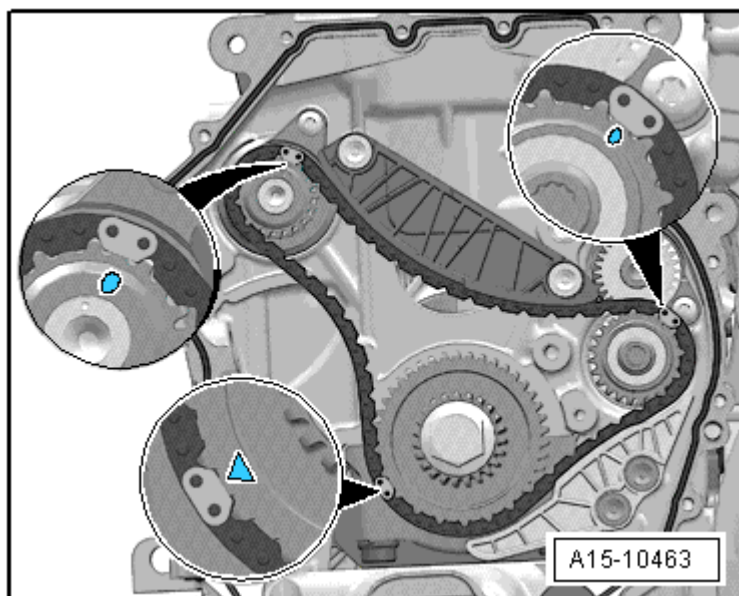


Fig. 158: Identifying Timing Chain Markings
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Install the timing chain tensioning rail and tighten the guide pin -2-.

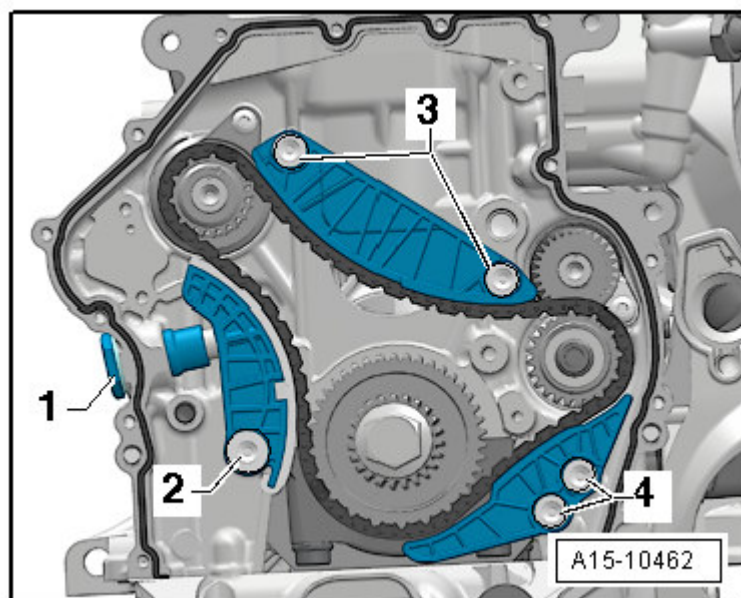


Fig. 159: Identifying Balance Shaft Timing Chain, Tensioning Rail And Guide Rails
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install the timing chain guide rail and tighten the guide pins -4-.
- Install the timing chain guide rail and tighten the guide pins -3-.
- Insert the timing chain tensioner -1- using locking compound.
- Check this adjustment one more time.

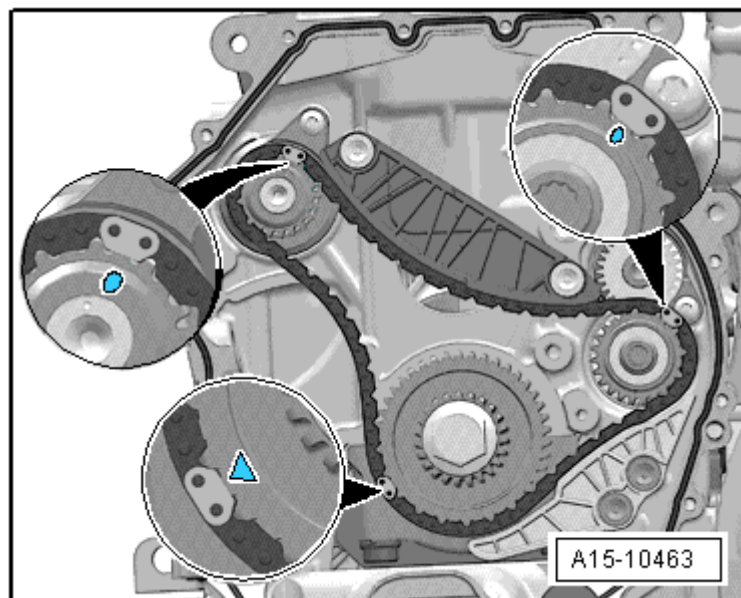


Fig. 160: Identifying Timing Chain Markings
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Check the marks on the intermediate shaft sprocket/balance shaft -arrow-.

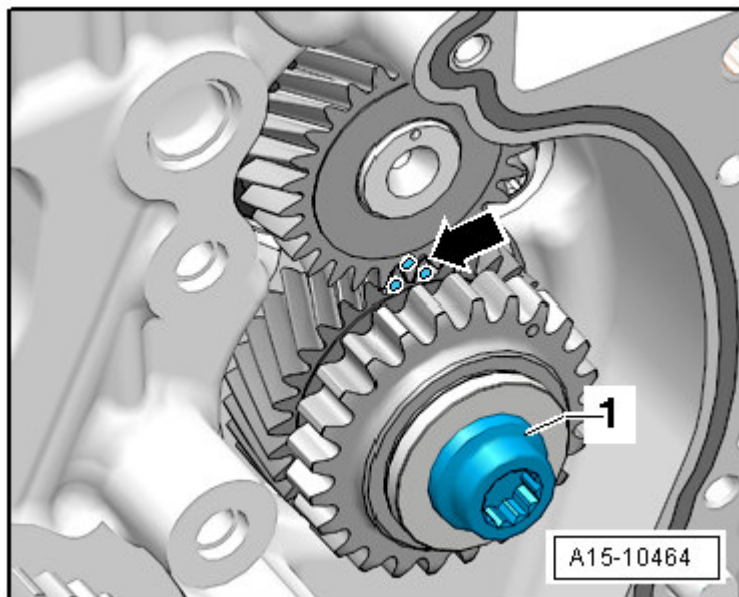


Fig. 161: Identifying Intermediate Shaft Sprocket
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE: The marks on the intermediate shaft sprocket/balance shaft are shown with the chain removed.

The rest of the installation is basically a reverse of the removal sequence.

INTAKE CAMSHAFT BALANCE SHAFT

Special tools and workshop equipment required

- Puller -T10394-
- Puller -T10055-

NOTE: Always replace the balance shaft after removing it.

Removing

- Remove the toothed belt from the coolant pump. Refer to COOLANT PUMP TOOTHED BELT .
- Remove the upper timing chain cover. Refer to UPPER TIMING CHAIN COVER.
- Remove the lower timing chain cover. Refer to one of the following:
 - Passat and CC, refer to LOWER TIMING CHAIN COVER.

- Remove the camshaft timing chain. Refer to **CAMSHAFT TIMING CHAIN**.
- Remove the balance shaft timing chain. Refer to **BALANCE SHAFT TIMING CHAIN**.
- Remove the intermediate sprocket bolt -1-.

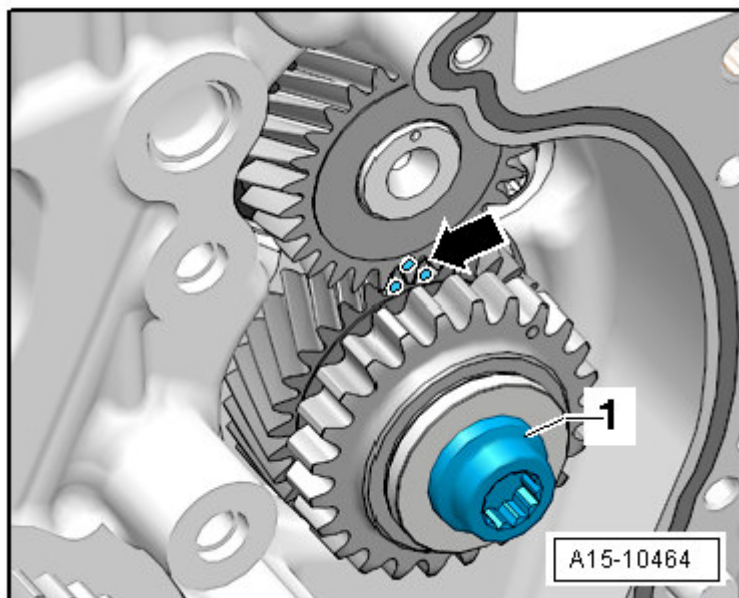


Fig. 162: Identifying Intermediate Shaft Sprocket
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove the bolt -2- for the intake camshaft balance shaft and remove the balance shaft.

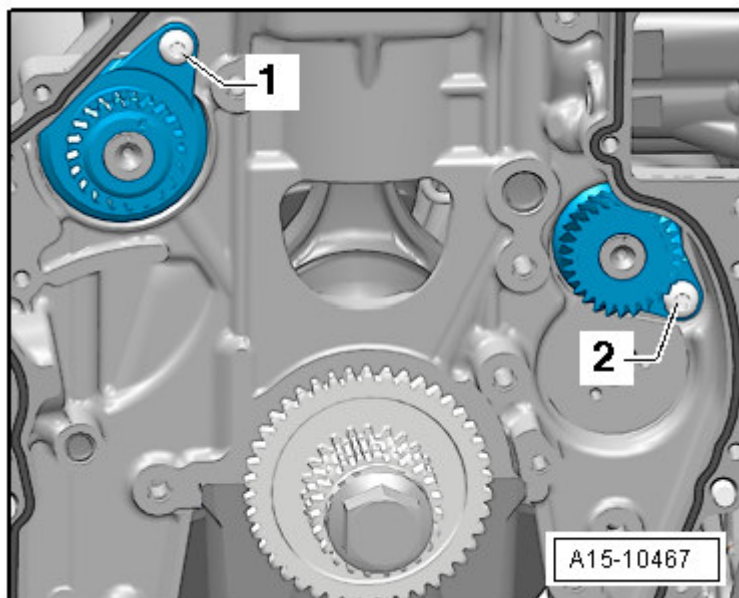


Fig. 163: Identifying Intake Camshaft Balance Shaft
Courtesy of VOLKSWAGEN UNITED STATES, INC.

If the balance shaft cannot be removed by hand, use the puller -T10394-.

-- Install the half shell -T10394/1- from the puller -T10394- and turn it upward in the -direction of the arrow-.

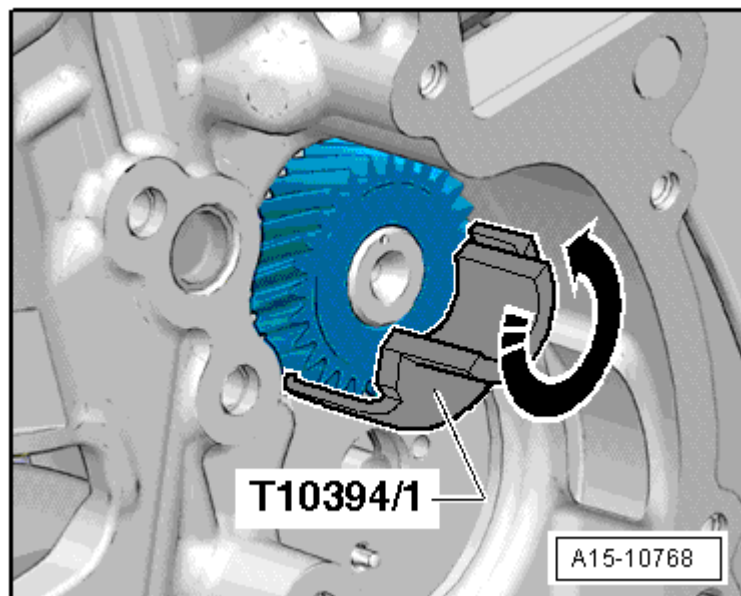


Fig. 164: Identifying Half Shell -T10394/1-
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Install the puller -T10394- and push the sliding sleeve in the -direction of the arrow-.

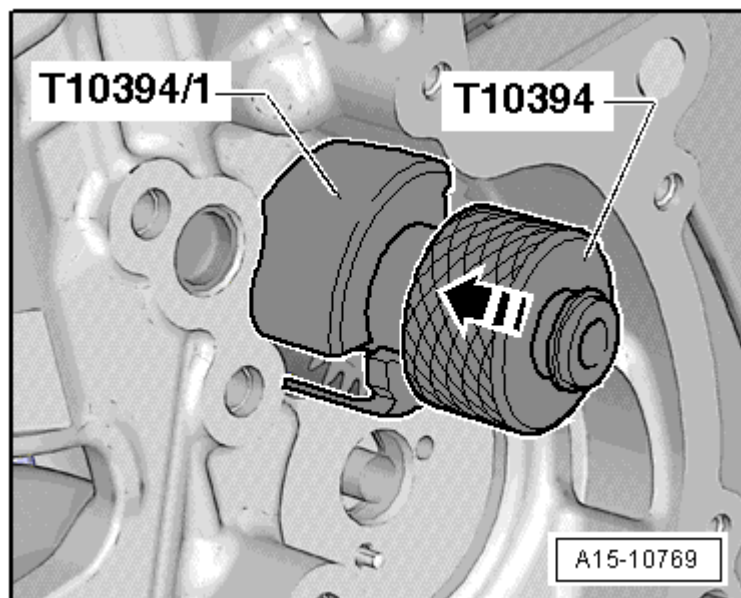


Fig. 165: Identifying Installation Of Puller Pieces -T10394- And -T10394/1-
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Install the puller -T10055- into the puller -T10394- and remove the balance shaft in the -direction of the

arrow-.

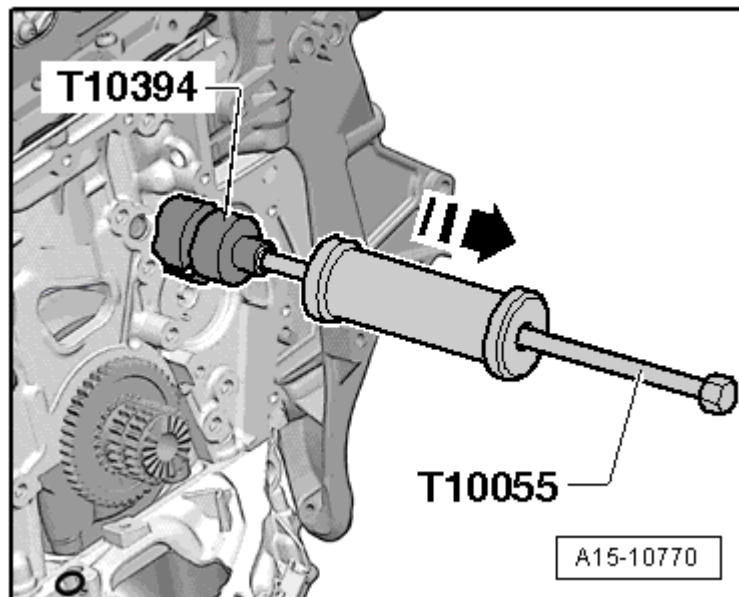


Fig. 166: Identifying Installation And Operation Of Puller -T10055-
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Installing

NOTE: Because of the small clearance between the balance shaft and the cylinder block, the balance shaft may need to be cooled in order to install it. Check if the balance shaft can be installed into the cylinder block without forcing it in. If it cannot, the balance shaft must be cooled before installing it.

- Tightening specifications, refer to **BALANCE SHAFT TIMING CHAIN OVERVIEW.**

- Place the new balance shaft in a freezer for 30 minutes or spray it with commercially available cooling spray.
- Lubricate the balance shaft bearing with engine oil.
- Install the intake camshaft balance shaft and tighten the bolt -2-.

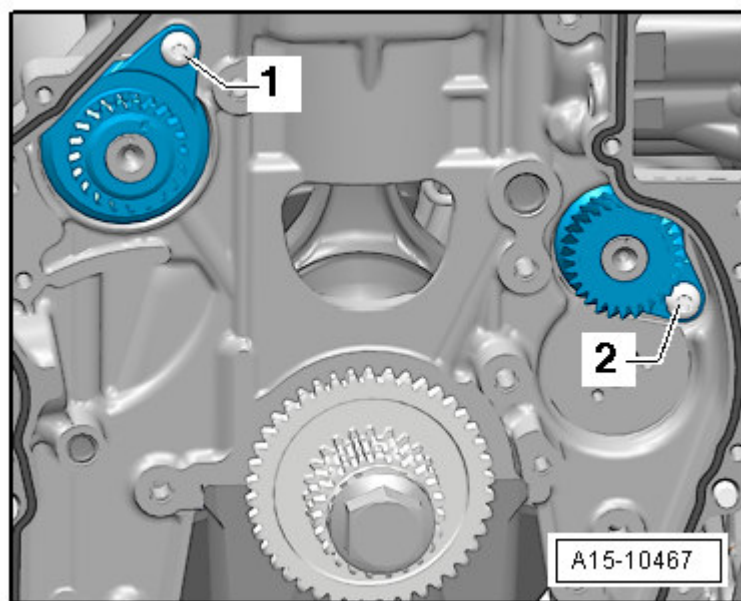


Fig. 167: Identifying Intake Camshaft Balance Shaft
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Replace the O-ring -1- and lubricate it with engine oil.

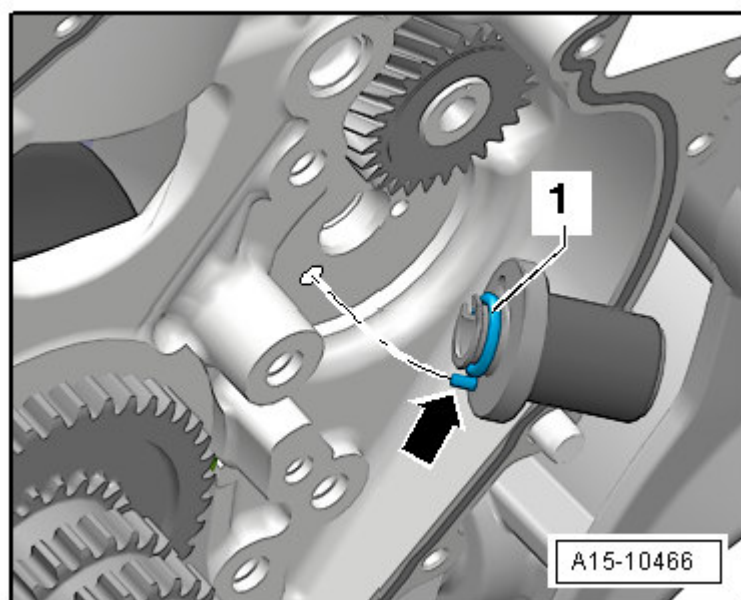


Fig. 168: Identifying Bearing Pins, Installation Position
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Lubricate the bearing pin with engine oil and install it; the pin -arrow- must engage in the hole in the cylinder block.

CAUTION: Always replace the intermediate shaft sprocket. Otherwise the backlash

will not adjust itself and it could result in engine damage. The new intermediate shaft sprocket has an anti-friction coating that wears off after a short period of use, which automatically adjusts the backlash.

-- Mark the tooth face on the intermediate sprocket -arrows-.

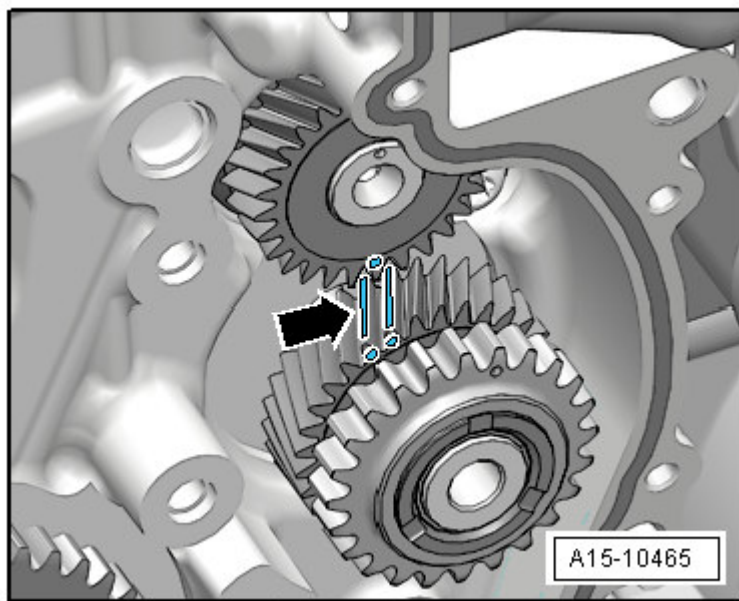


Fig. 169: Identifying Tooth Face On Intermediate Shaft Sprocket Marked With Paint
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Install the intermediate sprocket; the mark on the balance shaft must be between the marks on the tooth faces.

-- Tighten the sprocket bolt -1-, refer to **Fig. 17**.

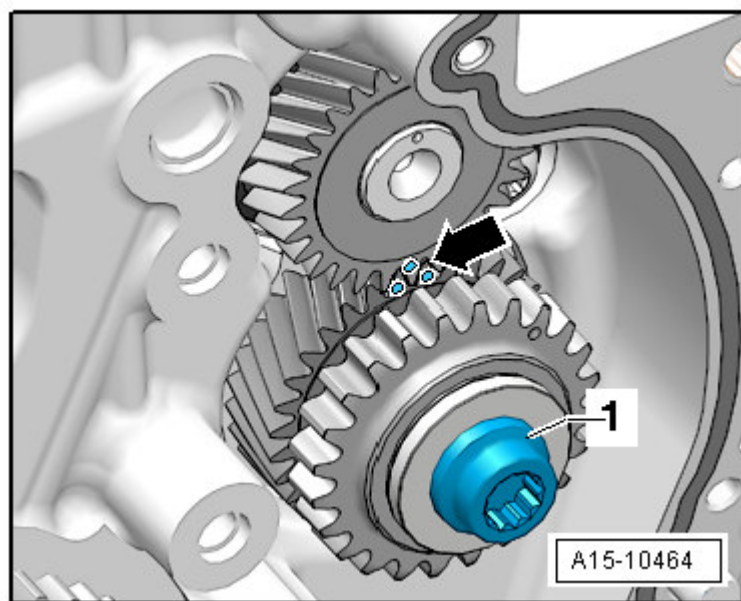


Fig. 170: Identifying Intermediate Shaft Sprocket
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Check the marks on the intermediate shaft sprocket/balance shaft -arrow-.

NOTE: Due to the ratio, the marks align only every 7th turn.

-- Install the balance shaft timing chain. Refer to Installing.

The rest of the installation is basically a reverse of the removal sequence; when doing this, note the following:

-- Replace the coolant pump drive seal. Refer to COOLANT PUMP DRIVESHAFT SEAL .

EXHAUST CAMSHAFT BALANCE SHAFT

Special tools and workshop equipment required

- Puller -T10394-
- Puller -T10055-

NOTE: Always replace the balance shaft after removing it.

Removing

-- Remove the upper timing chain cover. Refer to UPPER TIMING CHAIN COVER.

-- Remove the lower timing chain cover. Refer to one of the following:

- Passat and CC, refer to LOWER TIMING CHAIN COVER.

- Remove the camshaft timing chain. Refer to **CAMSHAFT TIMING CHAIN**.
- Remove the balance shaft timing chain. Refer to **BALANCE SHAFT TIMING CHAIN**.
- Remove the bolt -1- and the balance shaft.

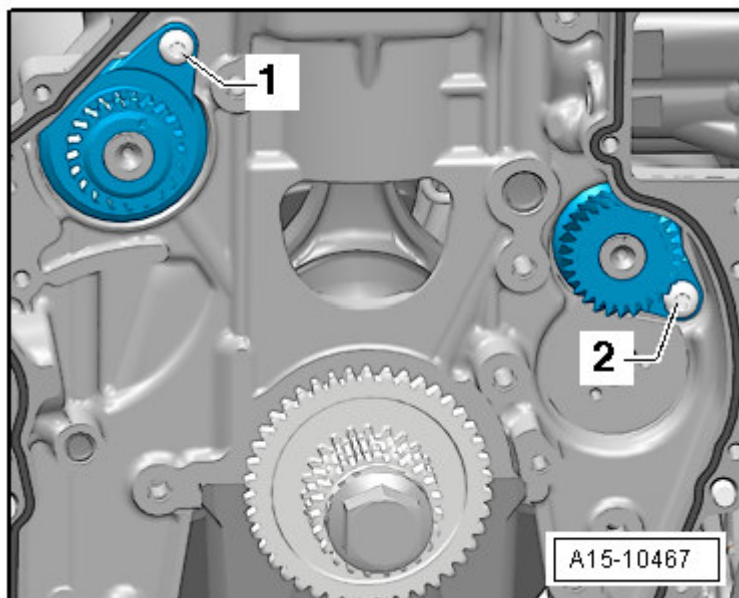


Fig. 171: Identifying Intake Camshaft Balance Shaft
Courtesy of VOLKSWAGEN UNITED STATES, INC.

If the balance shaft cannot be removed by hand, use the puller -T10394-.

- Install the half shell -T10394/1- from the puller -T10394-.

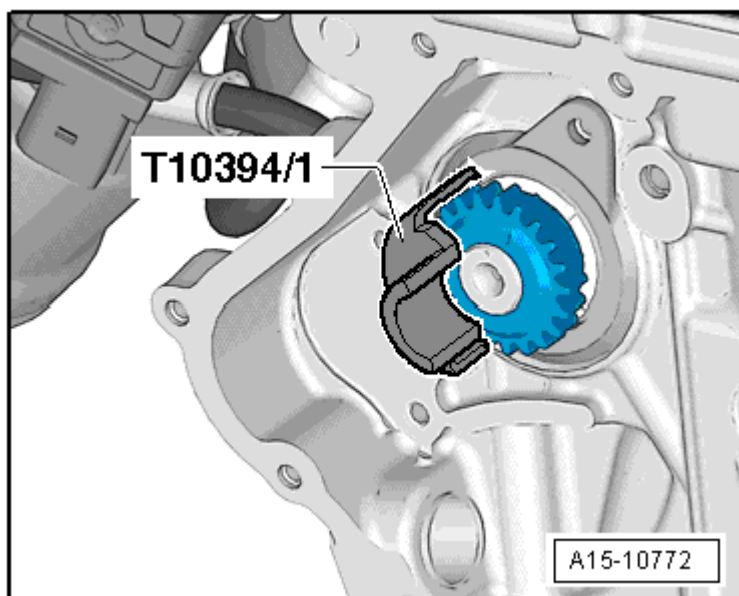


Fig. 172: Identifying Half Shell -T10394/1-
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Install the puller -T10394- and push the sliding sleeve in the -direction of the arrow-.

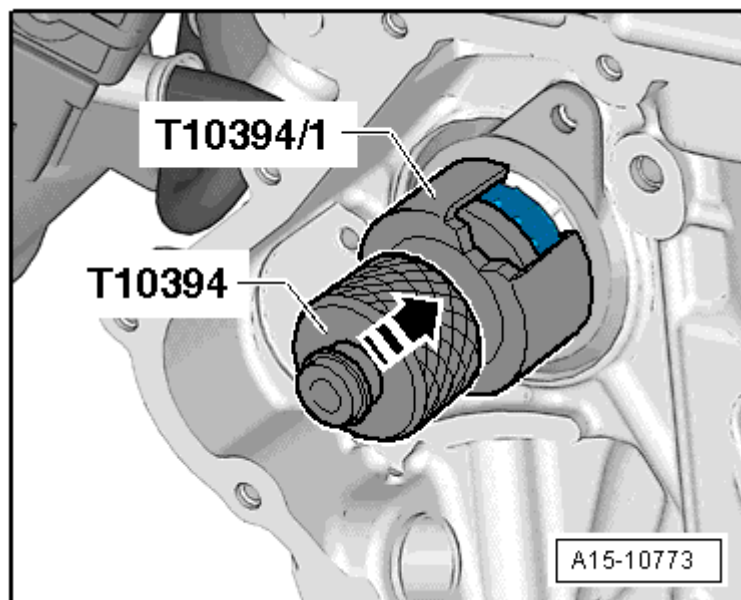


Fig. 173: Identifying Installation Of Puller Pieces -T10394- And -T10394/1-
Courtesy of VOLKSWAGEN UNITED STATES, INC.

-- Install the puller -T10055- into the puller -T10394- and remove the balance shaft.

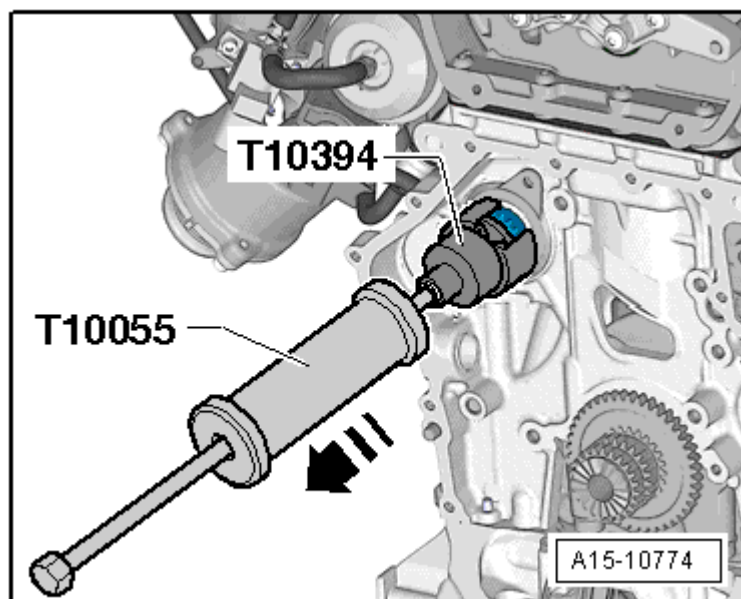


Fig. 174: Identifying Installation And Operation Of Puller -T10055-
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Installing

NOTE: Because of the small clearance between the balance shaft and cylinder block, the balance shaft may need to be cooled in order to install it. Check if the balance shaft can be installed into the cylinder block without forcing it in. If it cannot, the balance shaft must be cooled before installing it.

- Tightening specifications, refer to BALANCE SHAFT TIMING CHAIN OVERVIEW.

-- Check the installed position of the pipe for the balance shaft -arrow-.

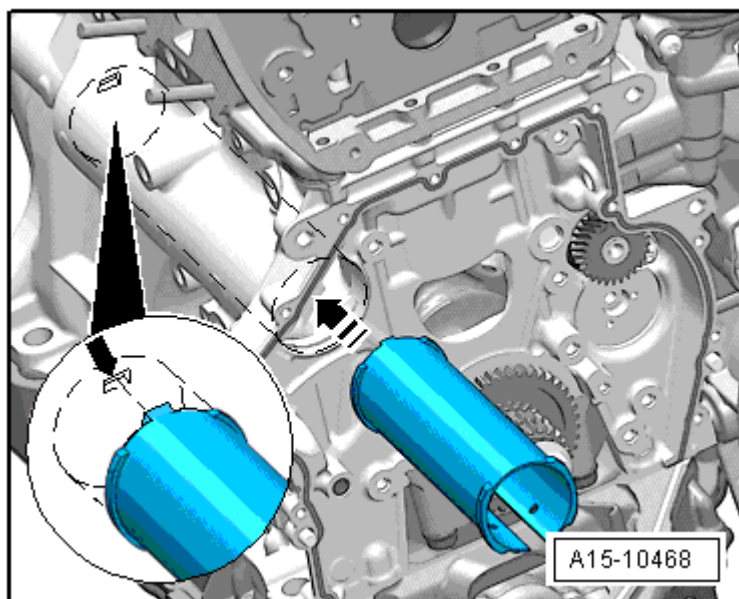


Fig. 175: Identifying Pipe For Balance Shaft - Installation Position
Courtesy of VOLKSWAGEN UNITED STATES, INC.

The pin -arrow- must engage in the groove.

NOTE: Press the pipe together slightly to position it in the installed position.

Press the pipe into the crankcase and bend both halves one time to the inside.

- Place the new balance shaft in a freezer for 30 minutes or spray it with commercially available cooling spray.
- Lubricate the balance shaft bearing with engine oil.
- Install the exhaust camshaft balance shaft.
- Before tightening the bolt -1- make sure the balance shaft lies level with the crankshaft.

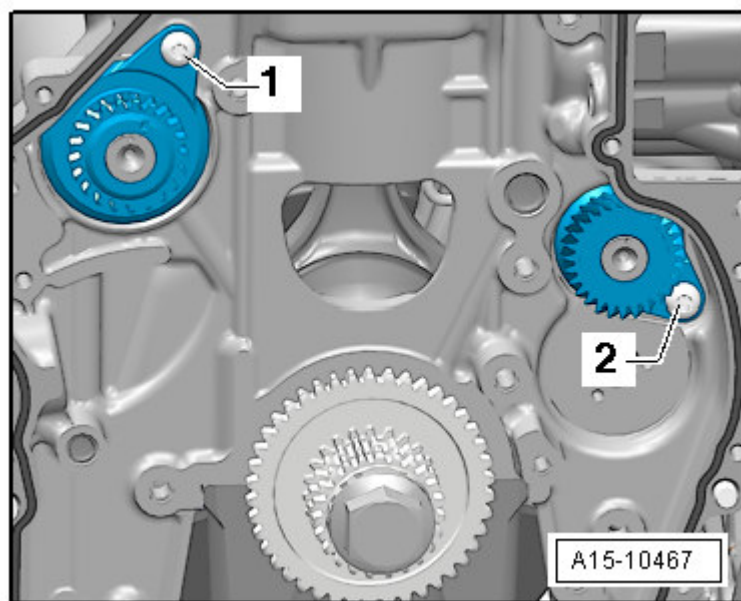


Fig. 176: Identifying Intake Camshaft Balance Shaft
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE: If the balance shaft is not level, then the pipe for the balance shaft must be installed again.

-- Install the balance shaft timing chain. Refer to **Installing**.

The rest of the installation is basically a reverse of the removal sequence.

SPECIAL TOOLS

Special tools and workshop equipment required

- Open End Spanner Insert AF 10 -V.A.G 1783/1-
- Compression Tester -V.A.G 1763-
- Spark Plug Removal -Tool 3122 B-
- Valve Seal Removal -Tool 3364-
- Valve Stem Seal Driver -3365-
- Adapter -T40012-
- Valve Cotters Asm/Disasm Device -VAS 5161-
- Guide Plate for FSI Engine -VAS 5161/19B-
- Engine Sling -2024 A-
- Engine Support -T10014-
- Torque Wrench (40-200 Nm) -V.A.G 1332-
- Shop Crane - Load Cap = 700-1200KG -VAS 6100-

- Engine Bung Set -VAS 6122-
- Drip Tray for -VAS 6100- -VAS 6208-
- Polydrive Bit and Drive Socket -T10070-
- Engine Support Bridge 10-222 A
- Bracket for Engine 10-222 A/1 (Passat only)
- Locking Pin -T10060 A-
- Thrust Piece -T10368-
- Bits -T10099-
- Shackle 10-222 A/12
- Dial Gauge Holder -VW 387-

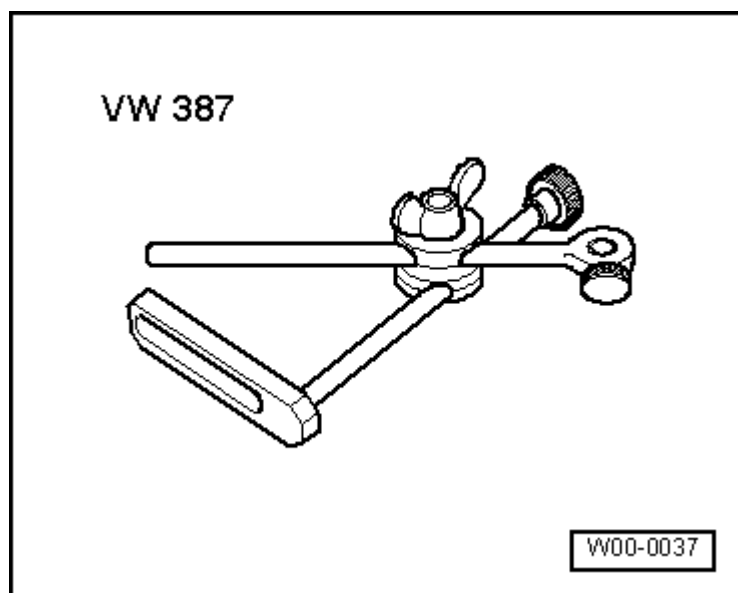


Fig. 177: Identifying Dial Gauge Holder VW 387
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Dial Gauge 0-10 mm -VAS 6079-

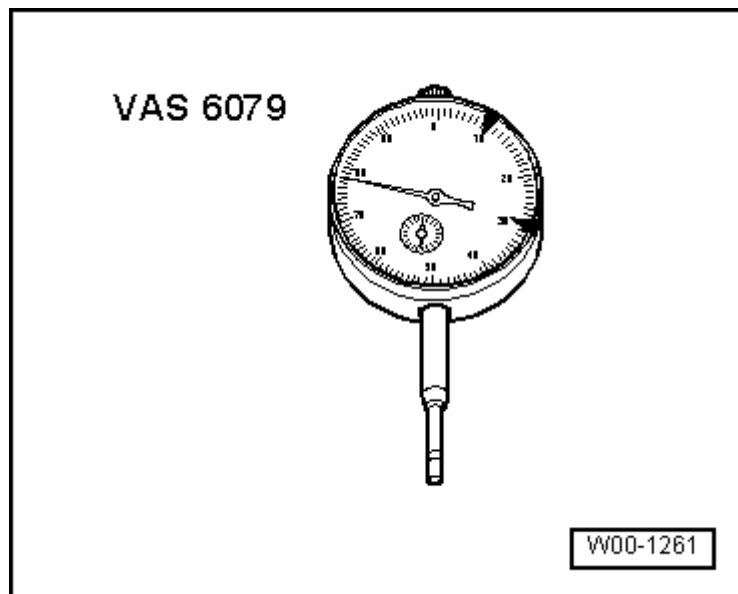


Fig. 178: Identifying Dial Gauge VAS 6079
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Torque Wrench (5-60 Nm) -V.A.G 1783-

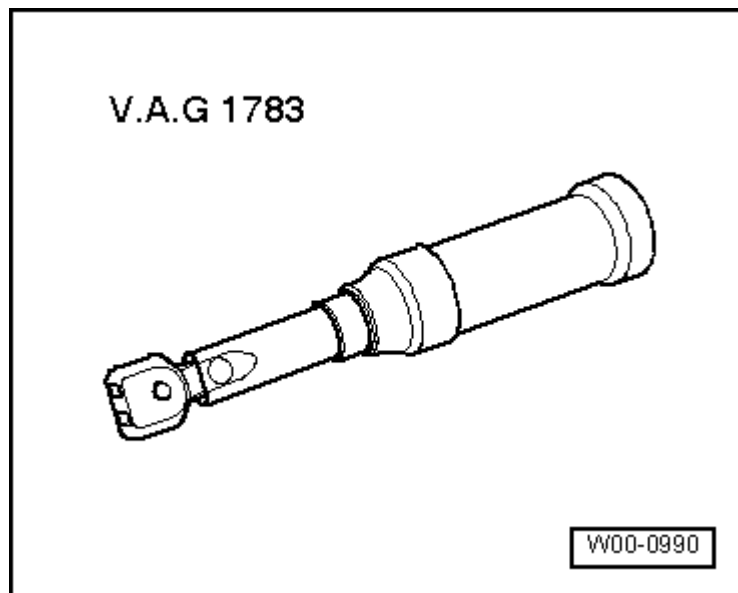


Fig. 179: Identifying Torque Wrench V.A.G 1783
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Engine Support Feet 10-222 A/8 (CC only)

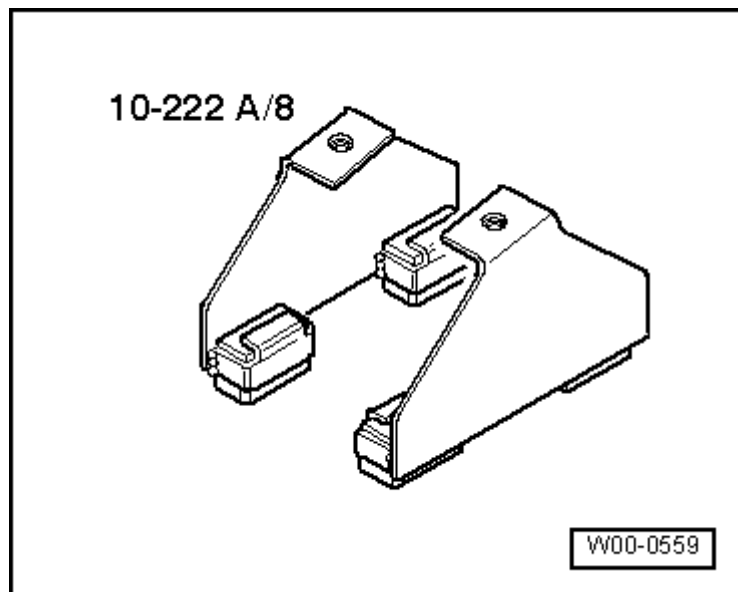


Fig. 180: Identifying Engine Support Feet 10-222 A/8
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Thrust Piece -T10354-

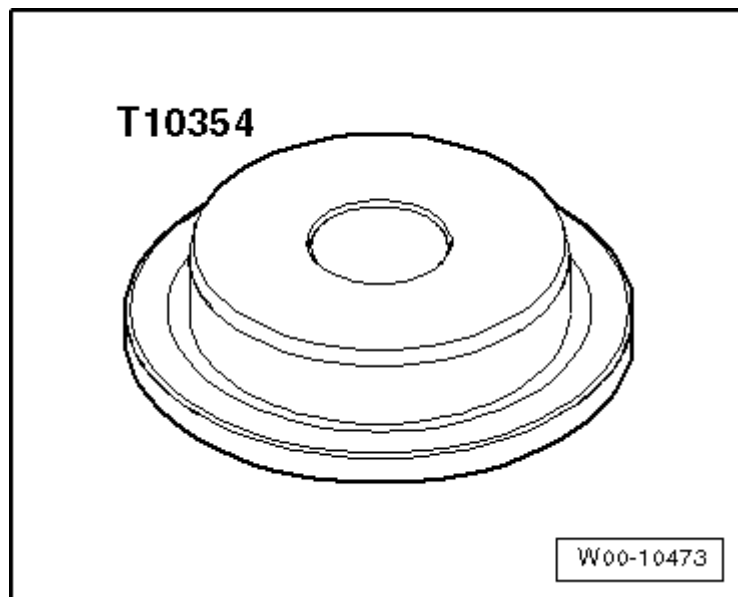


Fig. 181: Identifying Thrust Piece T10354
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pulling Hook -T20143/2-

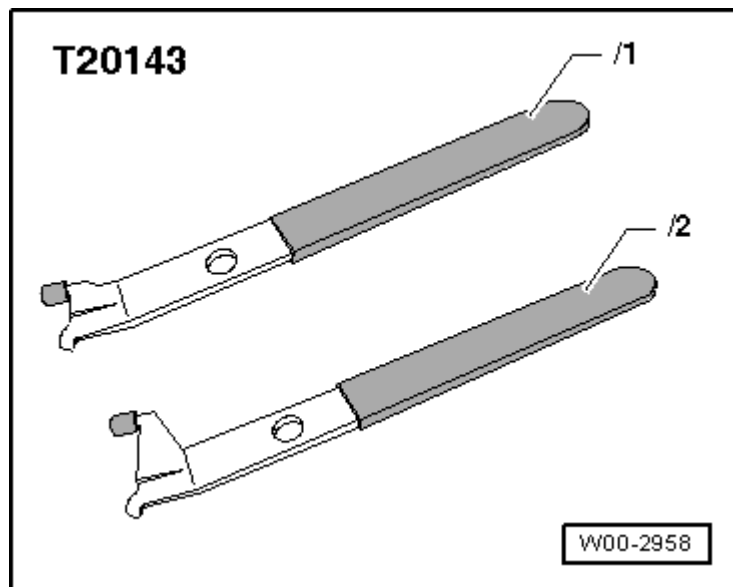


Fig. 182: Identifying Extractor Hook T20143
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Puller -T10394-

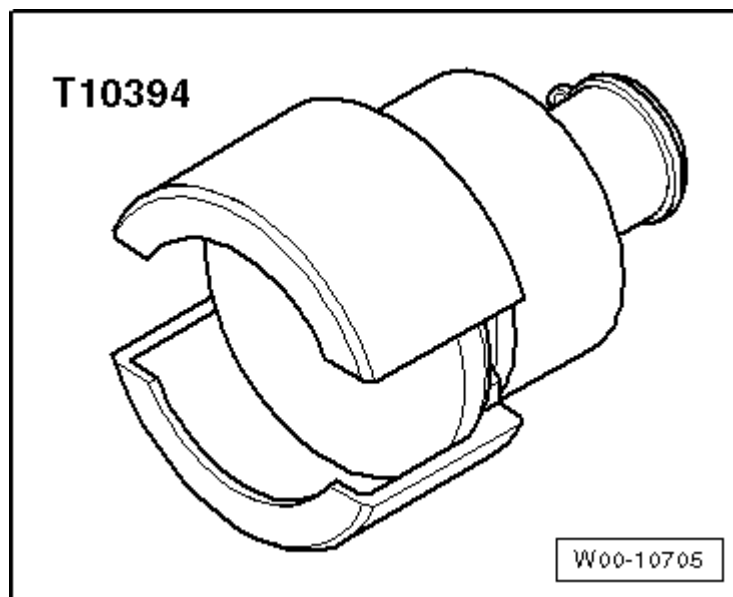


Fig. 183: Identifying Puller T10055
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Puller -T10055-

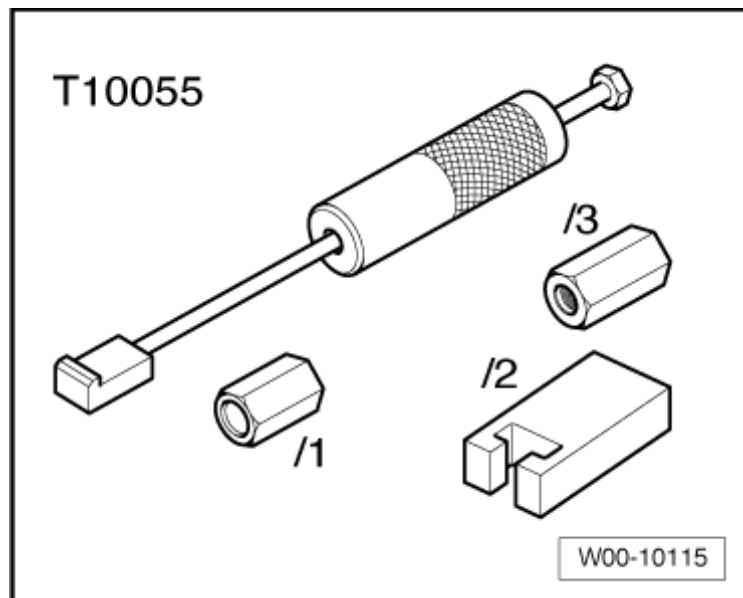


Fig. 184: Identifying Puller T10055 With Adapter T10055/3
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Adapter for the Dial Gauge -T10170- or -T10170 A-

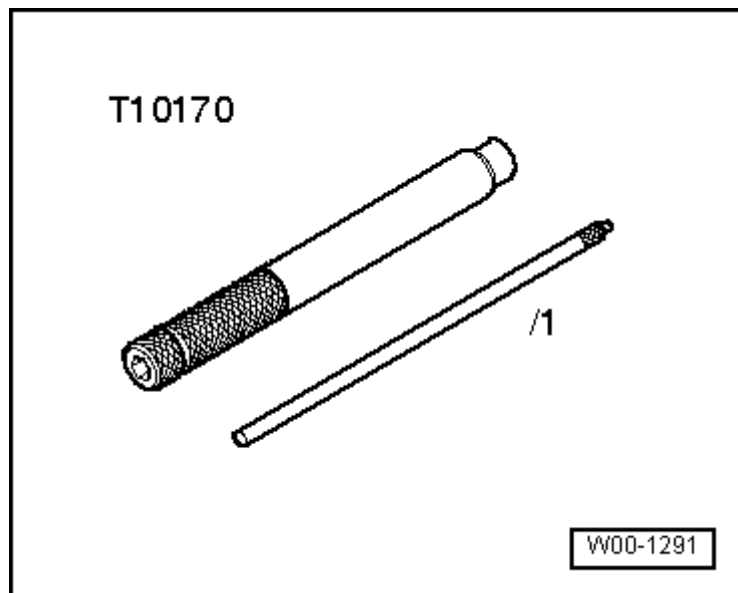
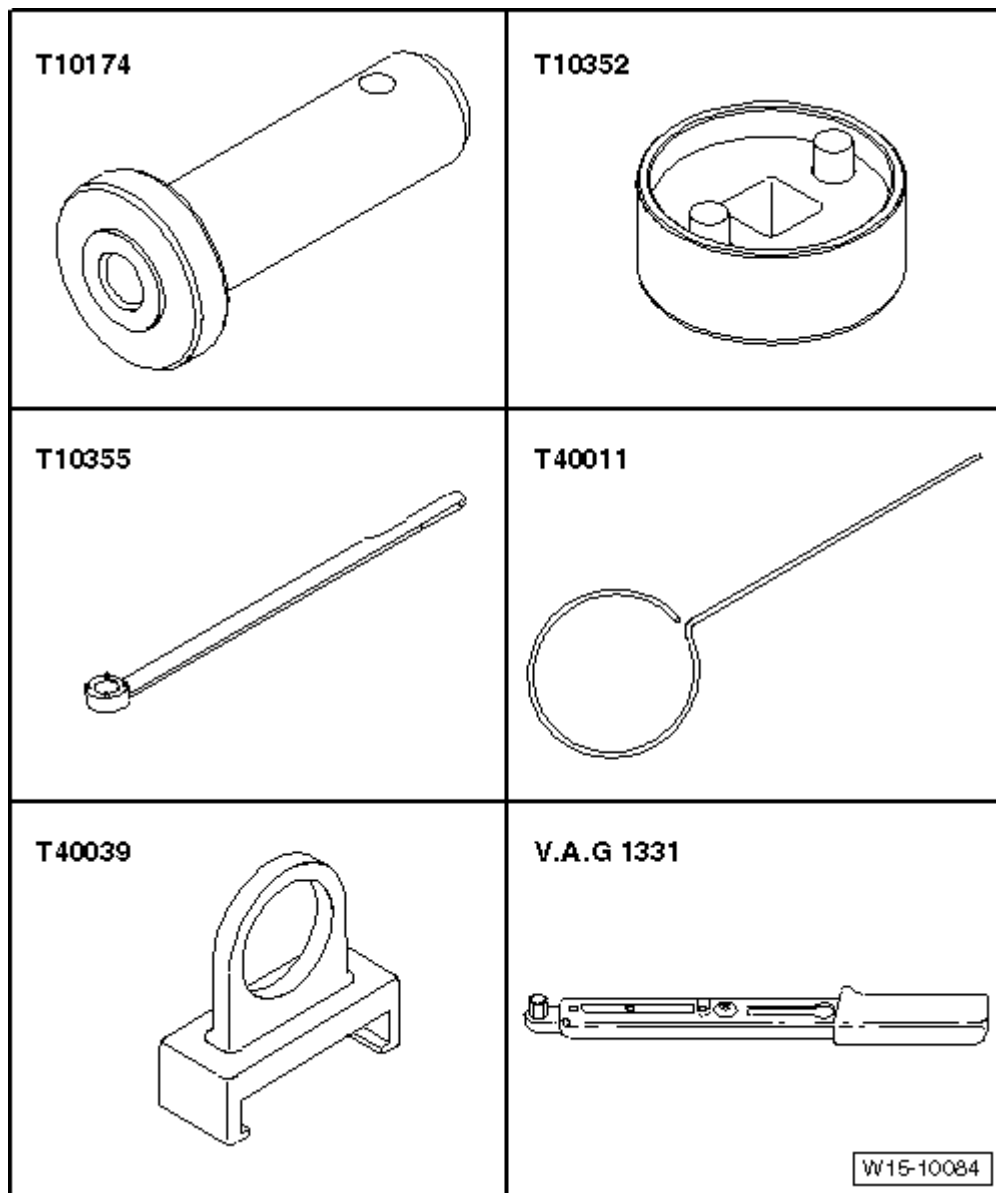


Fig. 185: Identifying Dial Gauge Adapter -T10170- or -T10170 A-
Courtesy of VOLKSWAGEN UNITED STATES, INC.



**Fig. 186: Identifying Thrust Piece -T10174-, Torque Wrench -V.A.G 1331- And Special Tools
Courtesy of VOLKSWAGEN UNITED STATES, INC.**

Special tools and workshop equipment required

- Thrust Piece -T10174-
- Assembly Tool -T10352-
- Counter Hold Tool -T10355-
- Locking Pin -T40011-
- Ignition Coil Puller -T40039-
- Torque Wrench (5-50 Nm) -V.A.G 1331-