ENGINE

3.0 Liter - Crankshaft, Cylinder Block - Engine Code(s): CATA

13 CRANKSHAFT, CYLINDER BLOCK

DESCRIPTION AND OPERATION

ENGINE COMPONENT OVERVIEW

CAUTION: If large quantities of metal particles or other deposits such as those caused by partial seizure of the crankshaft or connecting rod are found in the engine oil, clean the oil passages thoroughly and replace the engine oil cooler to prevent further damage.

The engine must not be set down on the oil pan, because the sealant between the lower and upper oil pans is otherwise damaged.

NOTE: Secure the engine to the engine and transmission holder VAS 6095 using the universal mounting VAS 6095/1 and the bracket for V6 TDI engine VAS 6095/1-4 when performing assembly work.

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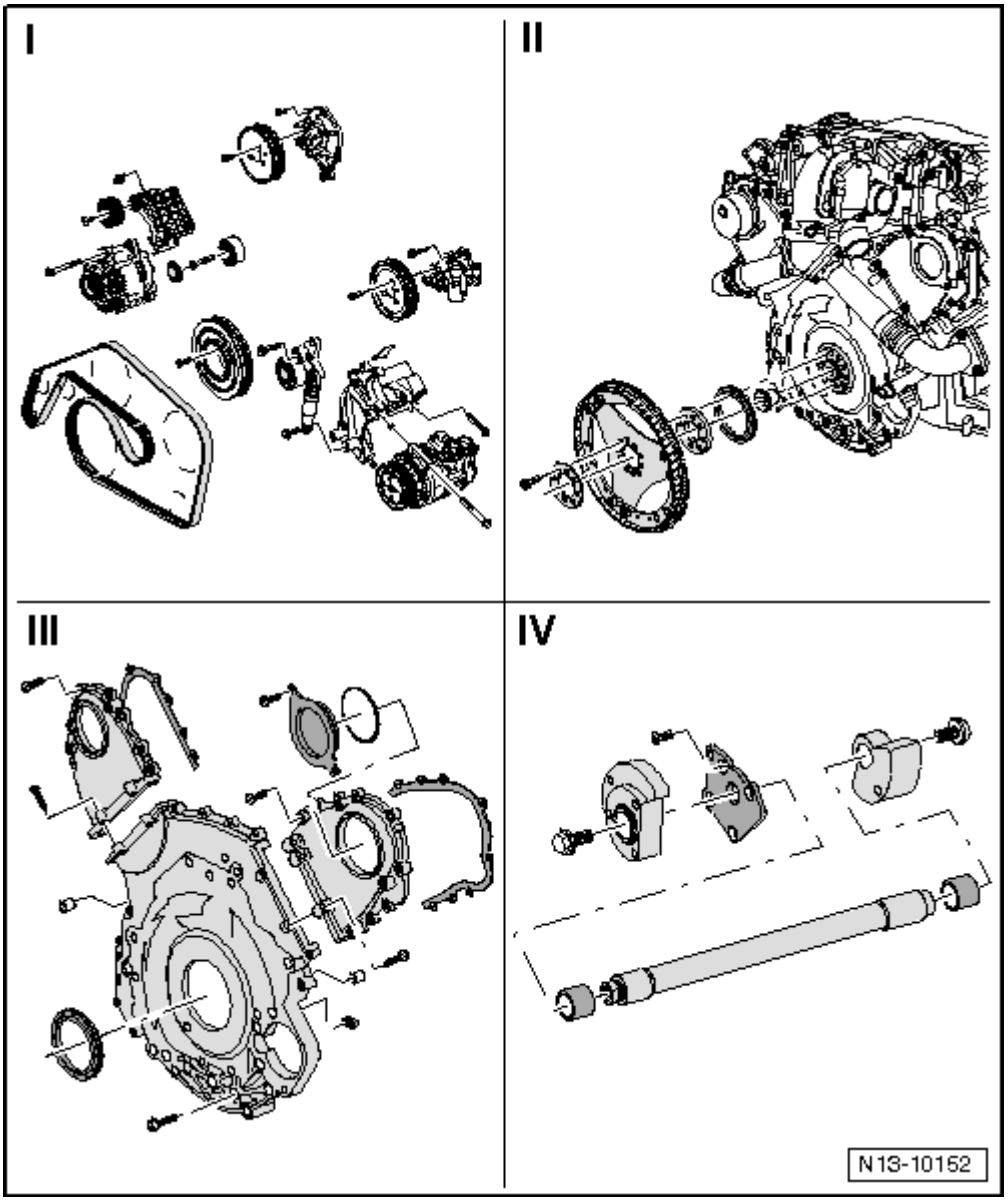


Fig. 1: Identifying Engine Components Overview
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. I - Refer to **RIBBED BELT**
2. II - Refer to **DRIVE PLATE**
3. III - Refer to **TIMING CHAIN COVERS**
4. IV - Refer to **BALANCE SHAFT**

RIBBED BELT DRIVE OVERVIEW

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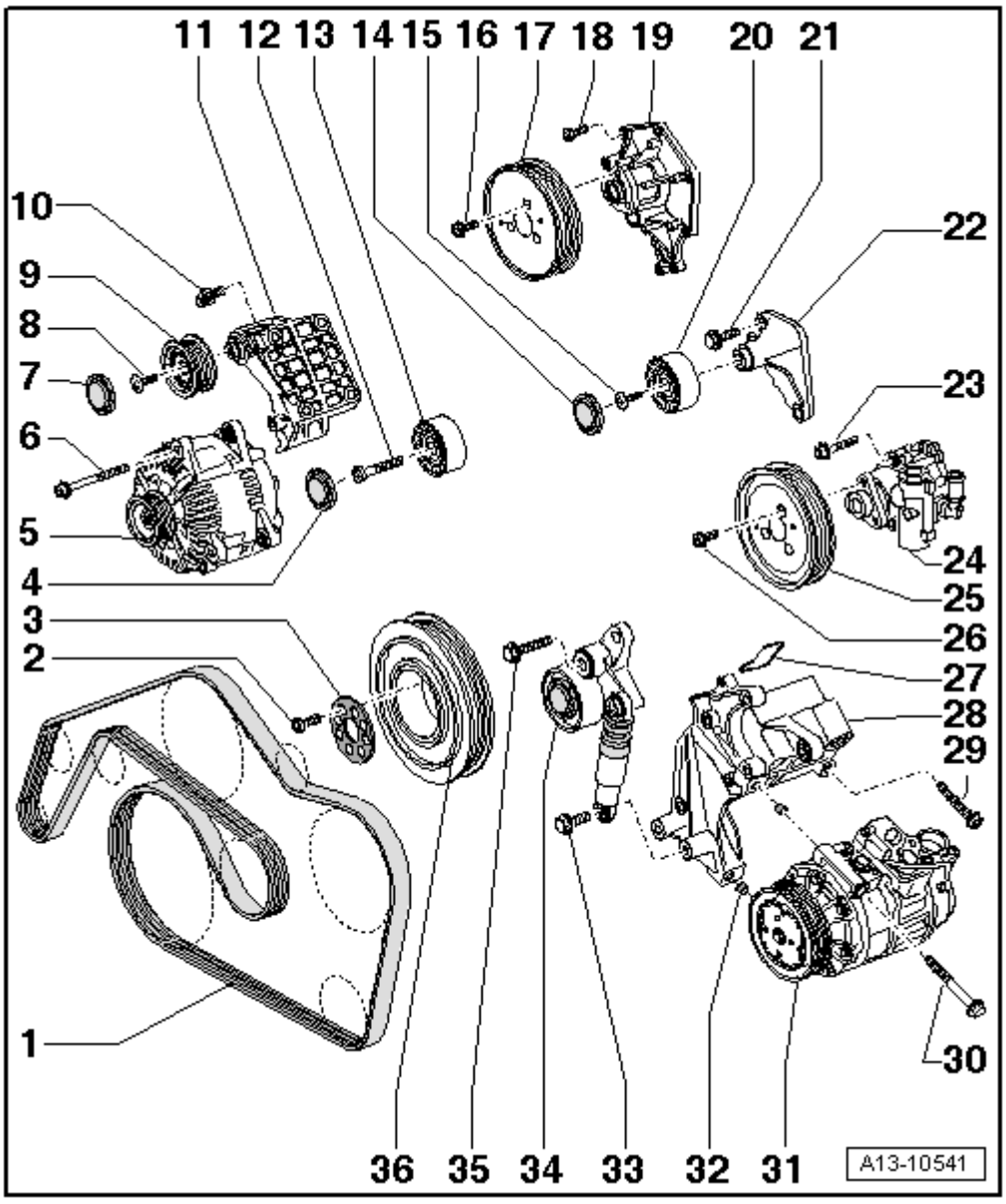


Fig. 2: Identifying Ribbed Belt Drive Overview
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Ribbed Belt
   - Mark the running direction before removing. Reversing the running direction on a used belt can destroy it.
   - Check for wear.
   - When installing, make sure it is seated correctly on the pulleys.
   - **Removing and installing** , refer to **RIBBED BELT**.
2. Bolt
   - **20 Nm + 90° (1/4) additional turn**
   - Always replace.

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- Use a shim, refer to **Fig. 4**.

3. Shim
   - Always replace.
4. Dust Cap
5. Generator
   - **Removing and installing** , refer to **Removal and Installation** .
   - To make it easier to position the generator, drive the threaded bushing for the generator bolt back slightly.
6. Bolt
   - **22 Nm**
7. Dust Cap
8. Bolt
   - **25 Nm**
9. Idler Pulley
   - Pay attention to the installed position.
10. Bolt
    - **40 Nm**
11. Generator Bracket
    - Tightening specification and sequence, refer to **Fig. 3**.
12. Bolt
    - **22 Nm**
13. Idler Pulley, Right
    - Pay attention to the installed position.
14. Dust Cap
    - Only on vehicles with an additional idler pulley.
15. Bolt
    - **22 Nm**
    - Only on vehicles with an additional idler pulley.
16. Bolt
    - **22 Nm**
17. Coolant Pump Pulley
    - Installed position: The writing "front" indicates the direction of travel.
    - Counter hold using the spanner wrench 3212 to remove.
18. Bolt
    - **9 Nm**
19. Coolant Pump
    - **Removing and installing** , refer to **COOLANT PUMP** .
20. Idler Pulley, Left

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- Only on vehicles with an additional idler pulley.
- Pay attention to the installed position.

21. Bolt
    - **22 Nm**
    - Only on vehicles with an additional idler pulley.
22. Idler Pulley Bracket
    - Only on vehicles with an additional idler pulley.
23. Bolt
    - **22 Nm**
24. Power Steering Pump
    - **Removing and installing** , refer to **Removal and Installation** .
    - Installed position: The writing "front" indicates the direction of travel.
25. Power Steering Pump Pulley
    - Counter hold using the spanner wrench 3212 to remove.
26. Bolt
    - For the correct tightening specification, refer to **Specifications** .
27. Gasket
    - Always replace.
28. Accessory Bracket
29. Bolt
    - **40 Nm**
30. Bolt
    - **25 Nm**
    - Check for washers
31. A/C Compressor
    - **Removing and installing** , refer to **Removal and Installation** .
    - Observe the alignment bushings **RIBBED BELT** when installing.
32. Alignment Bushing
    - Ensure they are seated correctly in the bracket.
33. Bolt
    - **25 Nm**
34. Ribbed Belt Tensioner

CAUTION: Depending on the vehicle equipment level, the hole in the cylinder block for the belt tensioner can be designed to use a M10 or M11 bolt. The bolt, belt tensioner and hole in the cylinder block must absolutely be perfectly allocated.

- Pivot using a T60 TORX® bit socket.

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35. Bolt
    - M10: **50 Nm + 90° (1/4) additional turn** .
    - M11: **60 Nm + 90° (1/4) additional turn** .

CAUTION: Differing threads in the cylinder block.

Before assembling, check whether the threads are M10 or M11.

Use the proper side bolt. The engine could be damaged.

The bolt, belt tensioner and hole in the cylinder block must absolutely be perfectly allocated.

36. Vibration Damper
    - Mark the vibration damper installed position.

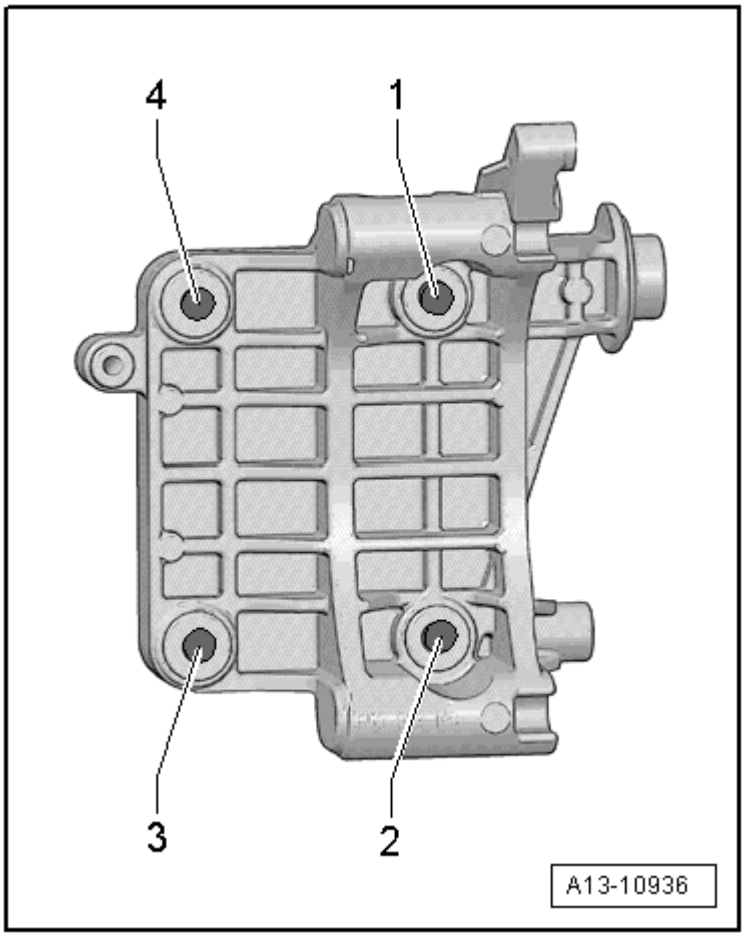


Fig. 3: Identifying Generator Bracket Bolt Tightening Sequence and Specification
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-- Install and tighten the bolts in sequence -1 through 4- to 40 Nm.

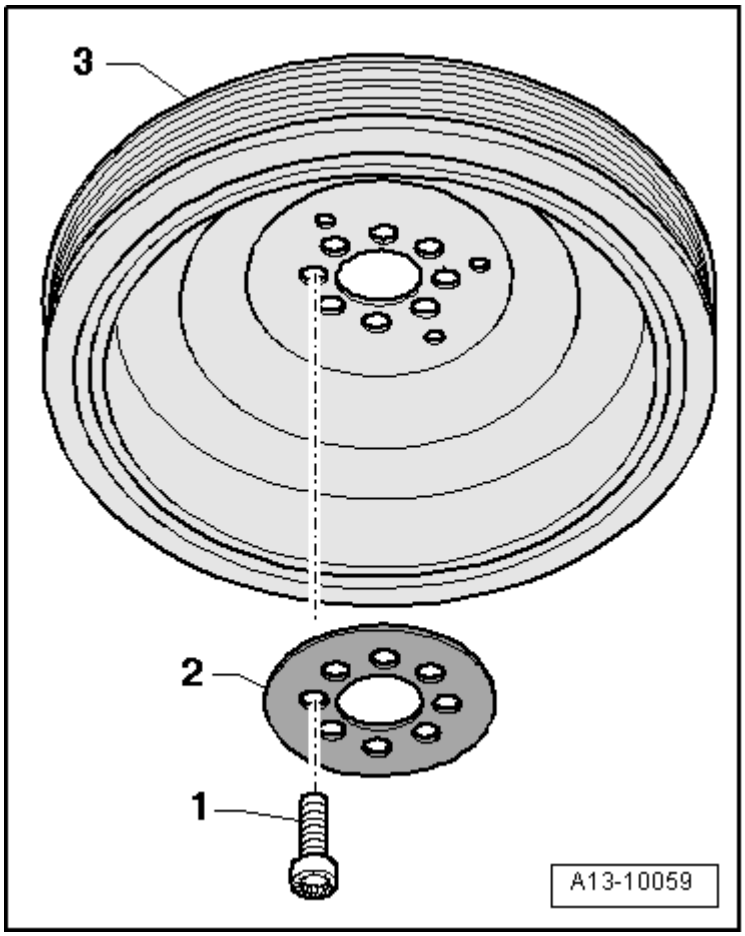


Fig. 4: Identifying Vibration Damper Connection
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1 - Bolt, **20 Nm + 90° (1/4) additional turn** . Always replace.

2 - Shim, replace

3 - Vibration damper

DRIVE PLATE OVERVIEW

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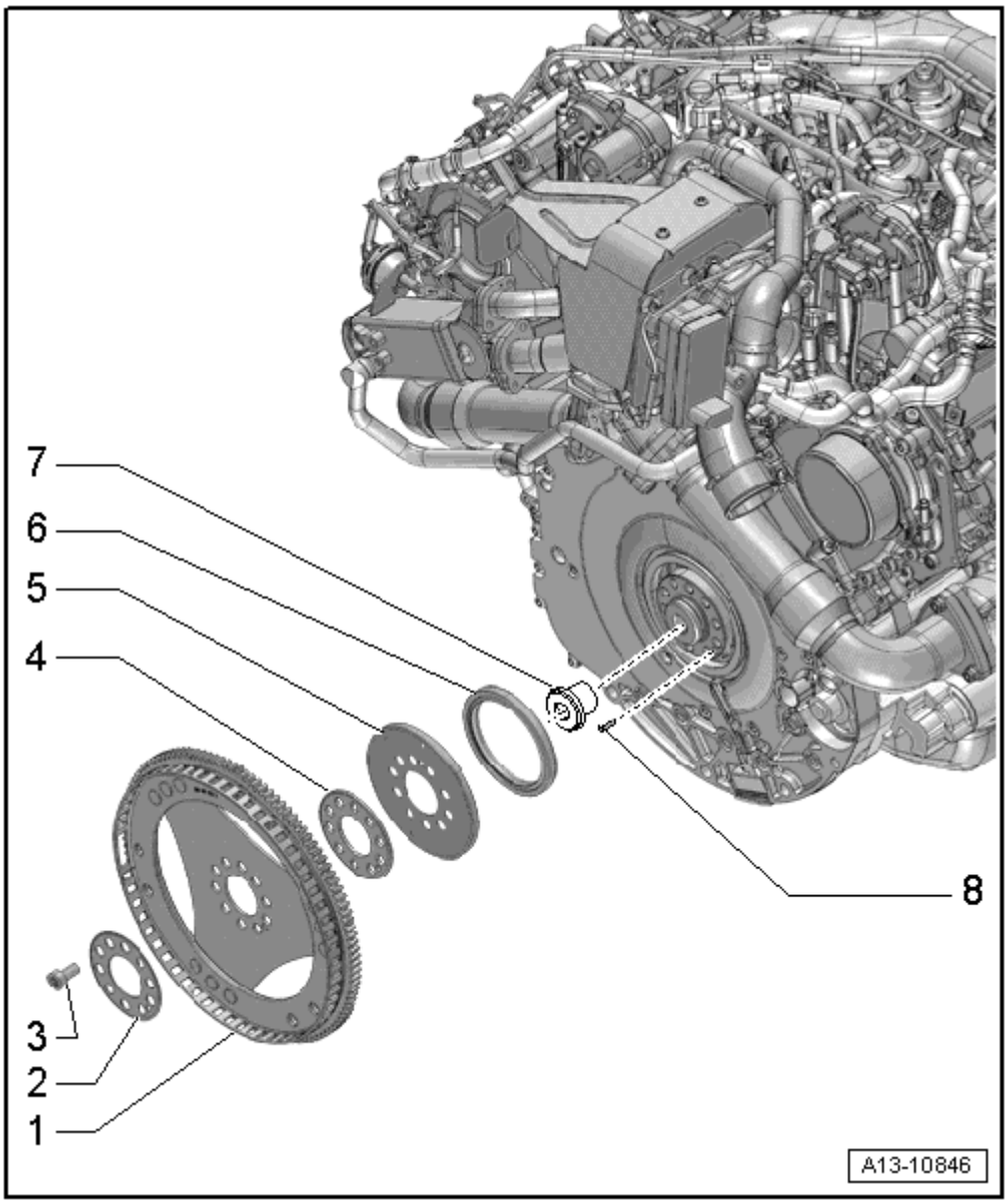


Fig. 5: Identifying Drive Plate Overview
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Drive Plate
   - **Removing and installing** , refer to **DRIVE PLATE**.
2. Washer
3. Bolt
   - **30 Nm + 90° (1/4) additional turn** .
   - Always replace.
4. Washer
5. Sensor Wheel
   - For the engine speed sensor.

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- Engine speed sensor removing and installing. Refer to **Engine Speed Sensor -G28-**.

6. Crankshaft Seal, Timing Chain Side
   - **Removing and installing** , refer to **CRANKSHAFT SEAL, TIMING CHAIN SIDE**.
7. Torque Converter Centering Bushing
   - Installed in the crankshaft.
8. Alignment Bushing

TIMING CHAIN COVER OVERVIEW

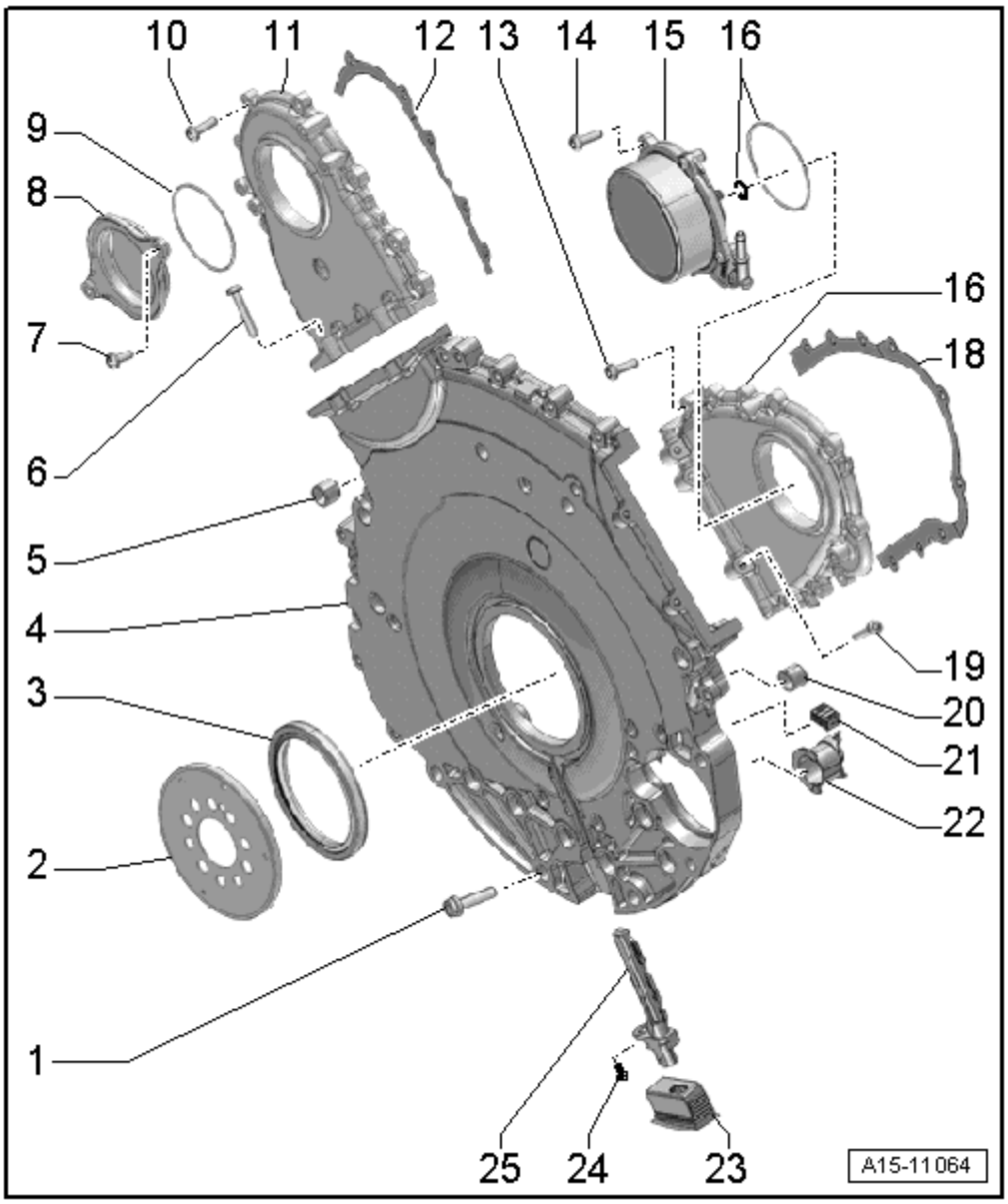


Fig. 6: Identifying Timing Chain Cover Overview
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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1. Bolt
   - **9 Nm**
   - Note the tightening sequence, refer to **TIMING CHAIN COVERS**.
2. Sensor Wheel
   - For the engine speed sensor.
3. Crankshaft Seal, Timing Chain Side
   - **Removing and installing** , refer to **CRANKSHAFT SEAL, TIMING CHAIN SIDE**.
4. Lower Timing Chain Cover
   - **Removing and installing** . Refer to **TIMING CHAIN COVERS**.
5. Alignment Bushing
   - Quantity: 2
6. Bolt
   - Note the tightening sequence, refer to **Fig. 72**.
7. Bolt
   - **9 Nm**
8. Cap
9. O-ring
   - Always replace.
10. Bolt
    - Always replace.
    - Tightening specification and sequence, refer to **Fig. 72**.
11. Left Timing Chain Cover
    - **Removing and installing** , refer to **TIMING CHAIN COVERS**.
12. Gasket
    - Always replace.
13. Bolt
    - **9 Nm**
    - Note the tightening sequence, refer to **Fig. 69**.
14. Bolt
    - **9 Nm**
15. Vacuum Pump
16. O-rings
    - Always replace.
17. Right Timing Chain Cover
    - **Removing and installing** , refer to **TIMING CHAIN COVERS**.
18. Gasket
    - Always replace.
19. Bolt

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- Note the tightening sequence, refer to **Fig. 69**.

20. Alignment Bushing
    - Quantity: 2
21. Seal
    - Quantity: 2
22. Cover
    - For the starter.
23. Cover
    - For the engine speed sensor.
24. Bolt
    - **9 Nm**
25. Engine Speed Sensor -G28-
    - **Removing and installing** , refer to **Engine Speed Sensor -G28-**.

BALANCE SHAFT OVERVIEW

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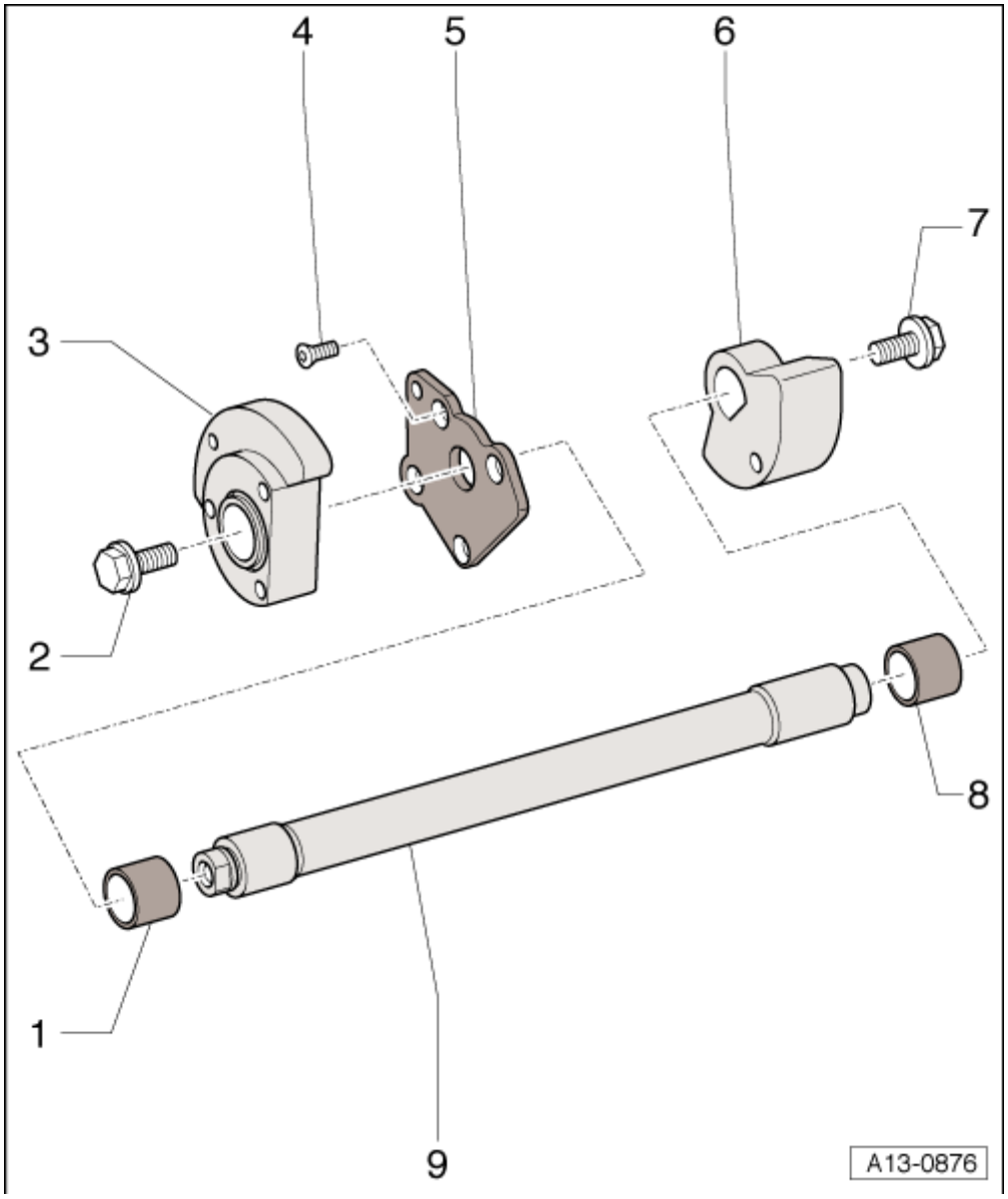


Fig. 7: Identifying Balance Shaft Overview
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Needle Bearing
2. Bolt
   - **60 Nm**
   - When loosening or tightening, use the diesel injection pump locking pin 3359 as a counter hold tool.
3. Balance Weight (Timing Chain Side)
4. Bolt
   - **9 Nm**
5. Bearing End Bracket

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6. Balance Weight (Belt Pulley Side)
7. Bolt
    - **60 Nm**
    - When loosening or tightening, us the diesel injection pump locking pin 3359 as a counter hold tool.
8. Needle Bearing
9. Balance Shaft
    - **Removing and installing** , refer to **BALANCE SHAFT**.

TIMING MECHANISM DRIVE CHAIN OVERVIEW

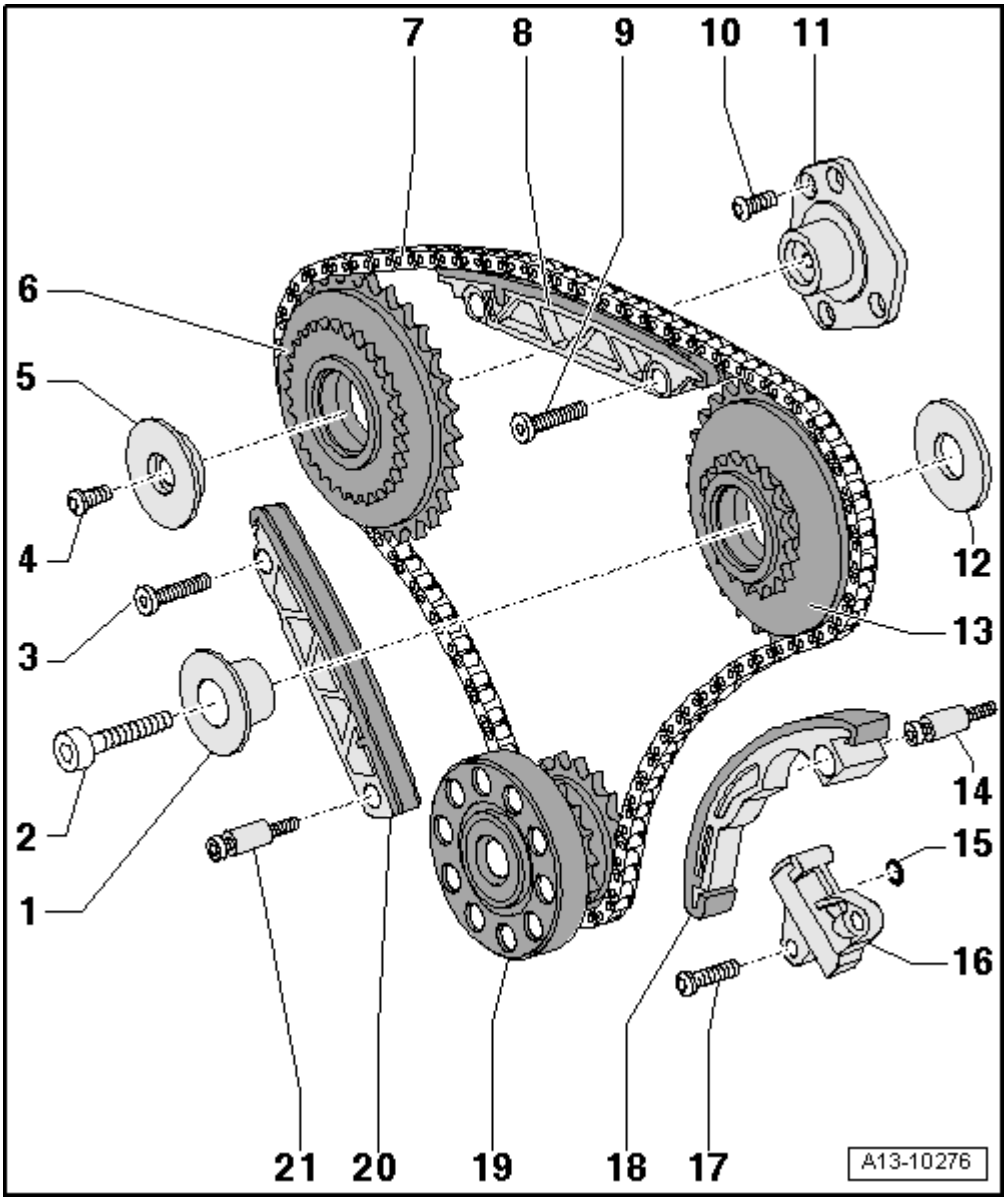


Fig. 8: Identifying Timing Mechanism Drive Chain Overview
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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1. Pin
2. Bolt
   - **45 Nm**
3. Bolt
   - **5 Nm + 90° (1/4) additional turn.**
   - Always replace.
4. Bolt
   - **5 Nm + 90° (1/4) additional turn.**
   - Always replace.
5. Thrust Washer
6. Drive Sprocket
7. Timing Chain
   - Before removing, mark the direction of rotation with paint.
   - **Removing and installing** , refer to **TIMING MECHANISM DRIVE CHAIN**.
8. Guide Rail
   - Pay attention to the installed position.
9. Bolt
   - **5 Nm + 90° (1/4) additional turn**
   - Always replace.
10. Bolt
    - **5 Nm + 90° (1/4) additional turn**
    - Always replace.
11. Sprocket Pin
12. Thrust Washer
13. Drive Sprocket
14. Pivot Pin
    - **12 Nm**
    - Install using locking fluid.
15. O-ring
    - Always replace.
16. Chain Tensioner
17. Bolt
    - **12 Nm**
18. Tensioning Rail
19. Crankshaft
    - With the sprocket.
20. Guide Rail
21. Pivot Pin

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- **12 Nm**
- Install using locking fluid.

BALANCE SHAFT AND OIL PUMP TIMING CHAIN OVERVIEW

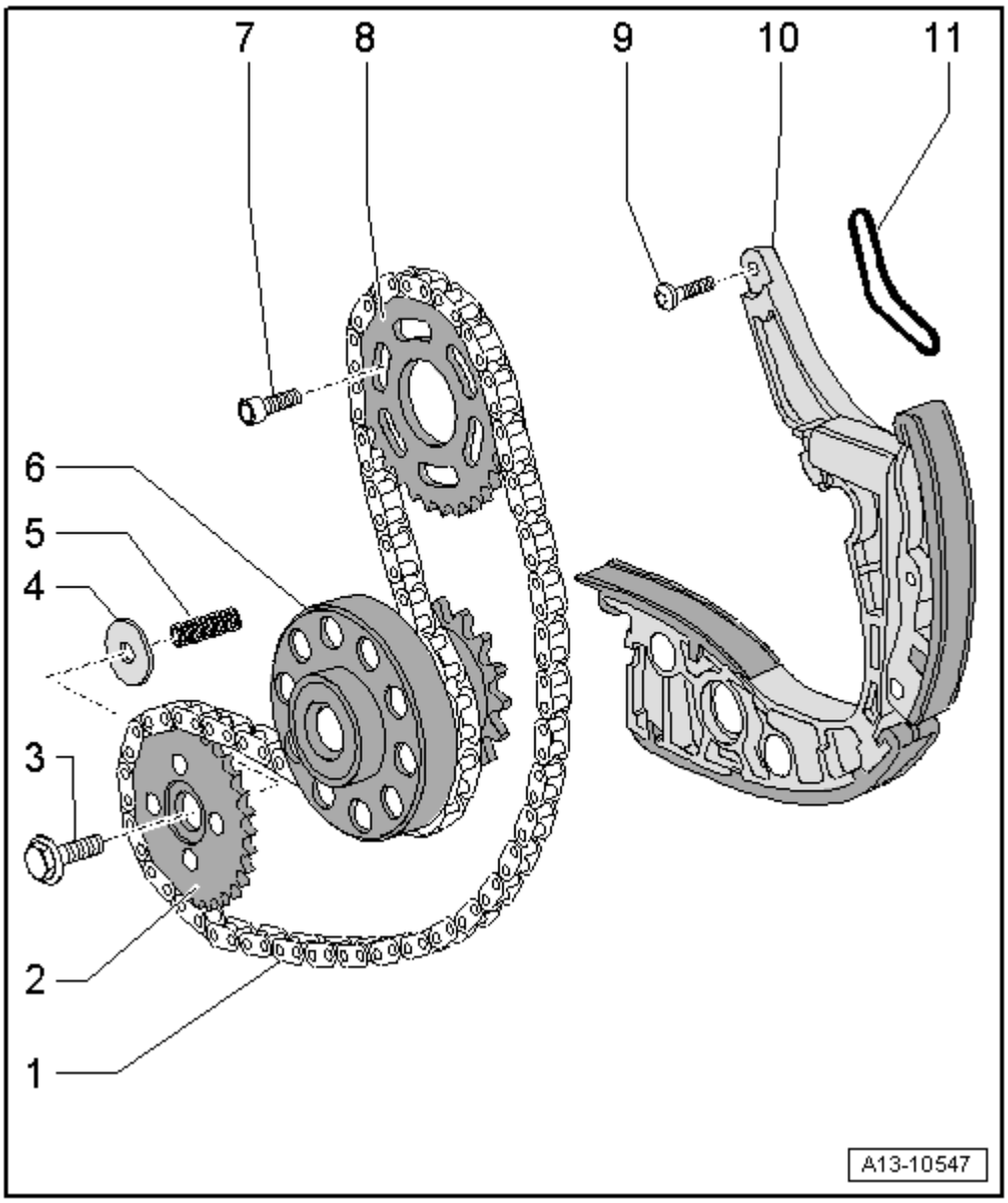


Fig. 9: Identifying Balance Shaft And Oil Pump Timing Chain Overview
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Timing Chain
   - **Removing and installing** , refer to **BALANCE SHAFT AND OIL PUMP CHAIN**.
2. Drive Sprocket
   - For the oil pump.

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- Installed position: The labeled side faces the engine.

3. Bolt
   - **62 Nm**
   - If it is not possible to tighten the bolt to the specification, remove the lower oil pan and the oil baffle and counter hold the bolt with an open end wrench on the oil pump driveshaft.
4. Thrust Washer
5. Spring
6. Crankshaft
7. Bolt
   - **23 Nm**
8. Balance Shaft Sprocket
   - Installed position: The labeled side faces the transmission.
9. Bolt
   - **9 Nm**
   - Quantity: 4
10. Chain Tensioner
    - With the guide rail.
11. Gasket
    - Always replace.

CRANKSHAFT OVERVIEW

CAUTION: If large quantities of metal particles or other deposits such as those caused by partial seizure of the crankshaft or connecting rod damage are found in the engine oil, clean the oil channels thoroughly and replace the engine oil cooler to prevent further damage. Engine must not be set down on oil pan, because the fluid seal between lower and upper oil pan is otherwise damaged.

NOTE: Secure the engine to the engine and transmission holder VAS 6095 using the universal mounting VAS 6095/1 and the bracket for V6 TDI engine VAS 6095/1-4 when performing assembly work.

Lubricate all bearing and contact surfaces before assembly work.

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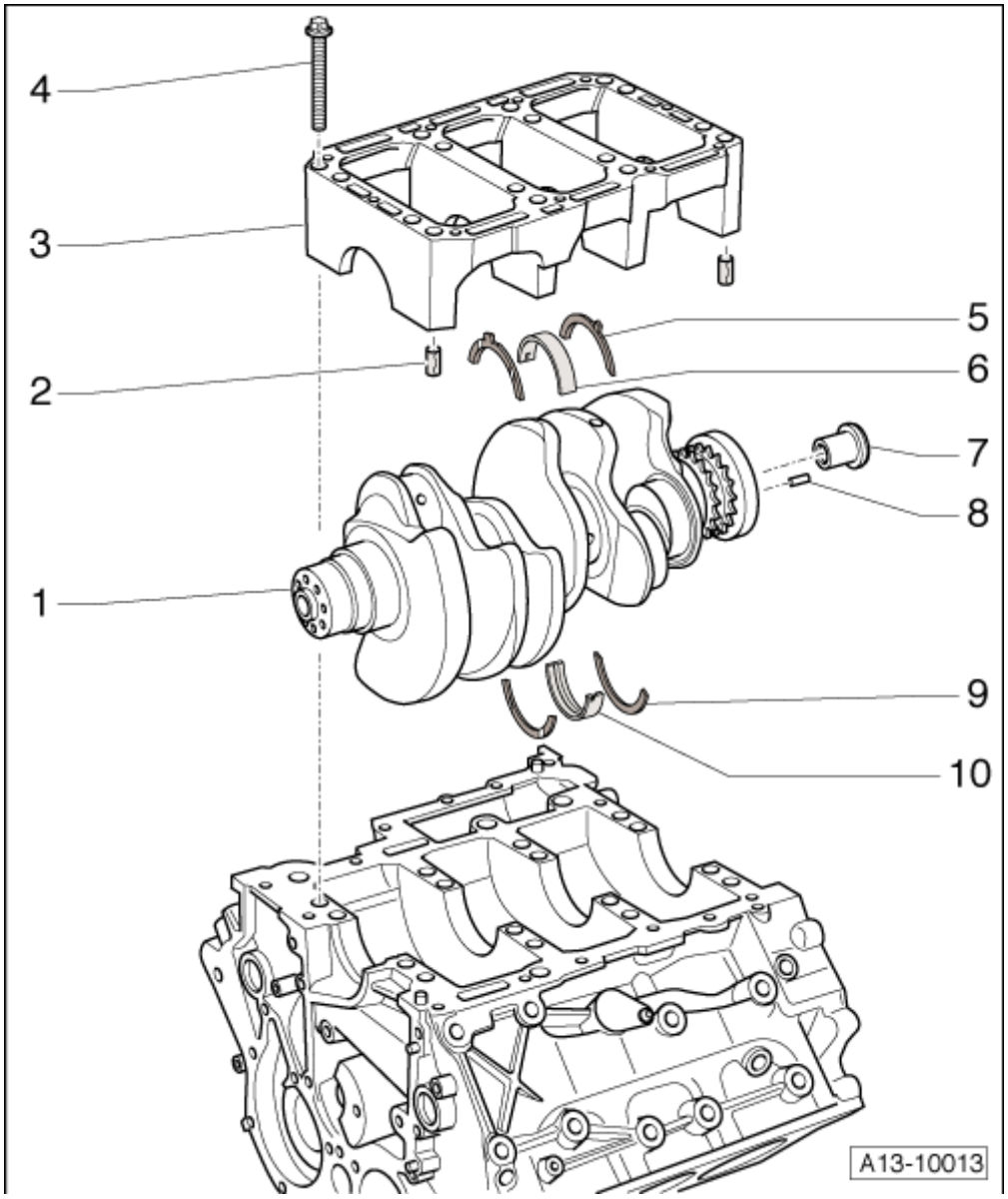


Fig. 10: Identifying Crankshaft Overview
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Crankshaft
   - Measuring the axial play. Refer to **CRANKSHAFT AXIAL CLEARANCE, MEASURING**.
   - Measuring the radial clearance. Refer to **CRANKSHAFT RADIAL CLEARANCE, MEASURING**.
   - Do not rotate the crankshaft when measuring the radial play.
   - Crankshaft dimensions, refer to **CRANKSHAFT DIMENSIONS**.
2. Alignment Bushing
   - Quantity: 2
   - Inserted in the cylinder block.

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3. Guide Frame
    - **Installing** , refer to **Fig. 11**.
4. Bolt
    - Always replace.
    - Tightening sequence, refer to **Fig. 11**.
5. Thrust Washer
    - Only on the 3rd crankshaft bearing.
    - Lubricating grooves face outward.
    - Observe the locating point.
    - Measuring the crankshaft axial clearance. Refer to **CRANKSHAFT AXIAL CLEARANCE, MEASURING**.
6. Bearing Shell
    - For the guide frame.
    - Do not interchange used bearing shells (mark them).
    - Bearing shells that are worn down to the nickel layer must be replaced.
    - Install new bearing shells for the guide frame with the proper colored mark. Refer to **Fig. 13**.
7. Torque Converter Centering Bushing
    - for information regarding the centering bushing, refer to **Fig. 14**.
8. Alignment Pin
    - Make sure it fits the crankshaft correctly.
9. Thrust Washer
    - Only on the 3rd crankshaft bearing,
    - Lubricating grooves face outward.
    - Observe the locating point.
    - Measuring the crankshaft axial clearance. Refer to **CRANKSHAFT AXIAL CLEARANCE, MEASURING**.
10. Bearing Shell
    - For the cylinder block, with a oil groove.
    - Do not interchange used bearing shells (mark them).
    - Insert new bearing shells for the cylinder block with the proper colored mark. Refer to **Fig. 12**.

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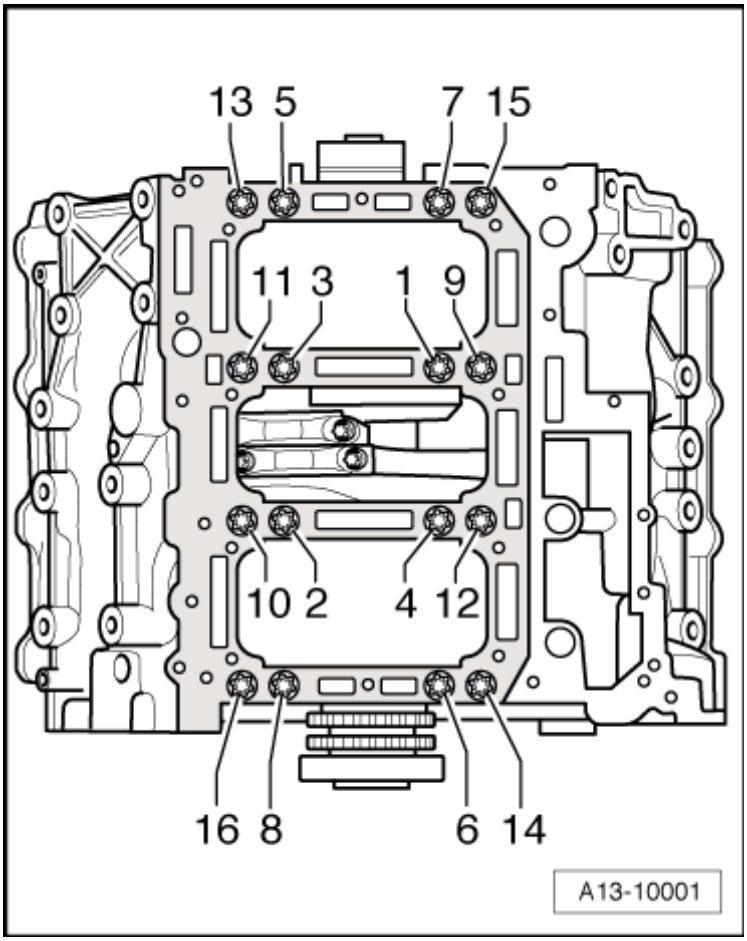


Fig. 11: Identifying Guide Frame, Installation Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Replace the bolts -1 through 16-.

-- Insert the alignment bushings in the guide frame.

-- Tighten the guide frame bolts in the following sequence:

-- Tighten the bolts -1 through 16- to 30 Nm using a torque wrench.

-- Tighten the bolts -1 through 16- to 50 Nm using a torque wrench.

-- Tighten the bolts -1 through 16- an additional 90° (1/4) turn using a ratchet.

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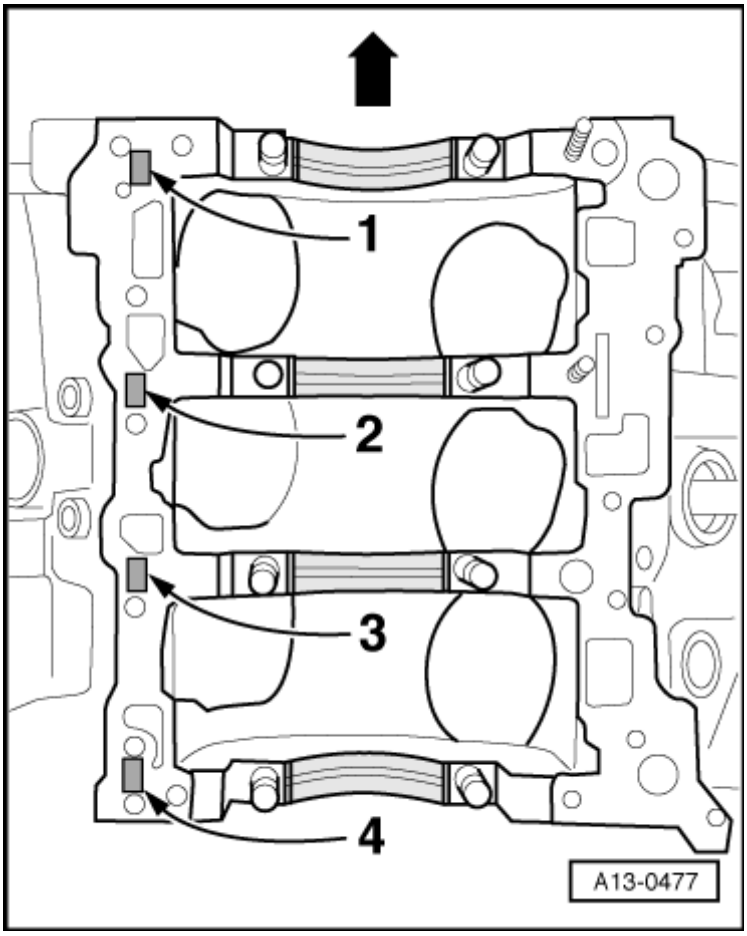


Fig. 12: Applying Crankshaft Bearing Shells For Cylinder Block
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Bearing shells with the correct thickness are allocated to the cylinder block by the factory. Colored dots on the bearing shells serve for identifying the bearing shell thickness.

- The -arrow- points to the belt pulley side.

Allocation of bearing shells to the cylinder block is identified with a letter by each bearing.

Letter on Cylinder Block	Colored Dot on Bearing
R =	Red
G =	Yellow
B =	Blue

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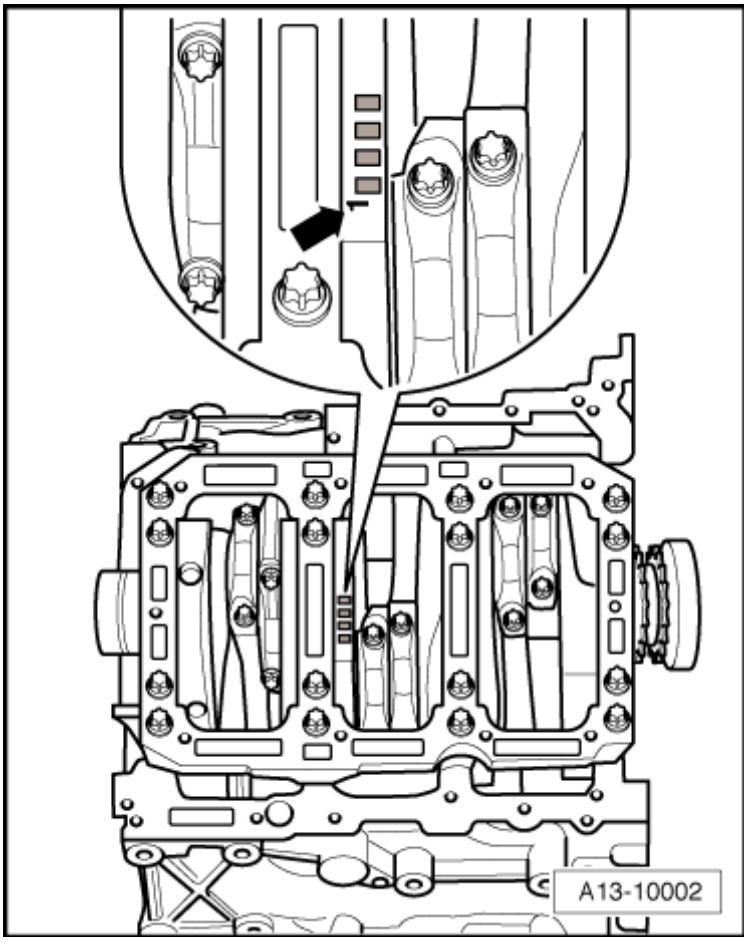


Fig. 13: Identifying Allocation Of Crankshaft Bearing Shells For Guide Frame
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Bearing shells with the correct thickness are allocated to the bearing cap by the factory. Colored dots on the bearing shells serve for identifying the bearing shell thickness.
- Allocation of bearing shells to the crankshaft is identified with sequence of letters on the crankshaft side. The prefix "1" -arrow- indicates color code for bearing 1.

Letter on Crankshaft	Colored Dot on Bearing
R =	Red
G =	Yellow
B =	Blue

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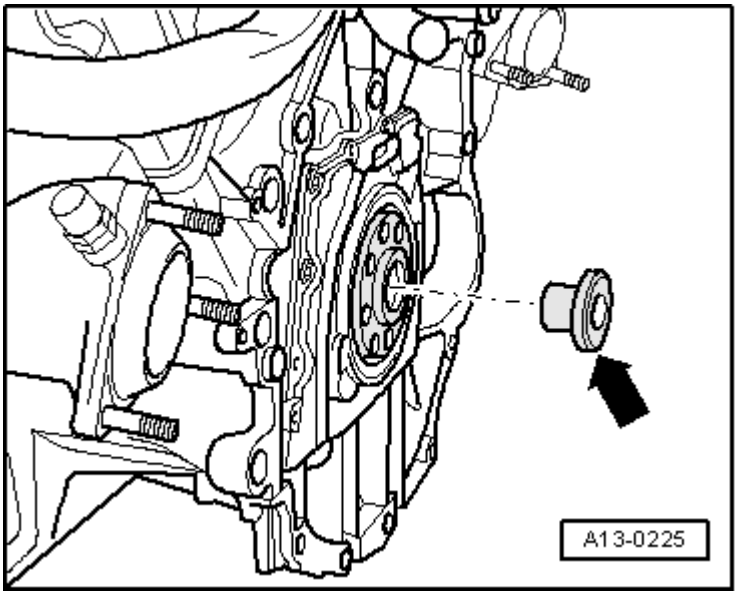


Fig. 14: Identifying Torque Converter Centering Bushing
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

NOTE: Partial and replacement engines, new as well as replacement crankshafts are delivered without the bushing -arrow-. The bushing must be installed before installing the drive plate.

PISTONS AND CONNECTING ROD OVERVIEW

NOTE: Lubricate all bearing and contact surfaces before assembly work.

Oil spray jet for piston cooling, refer to Fig. 16.

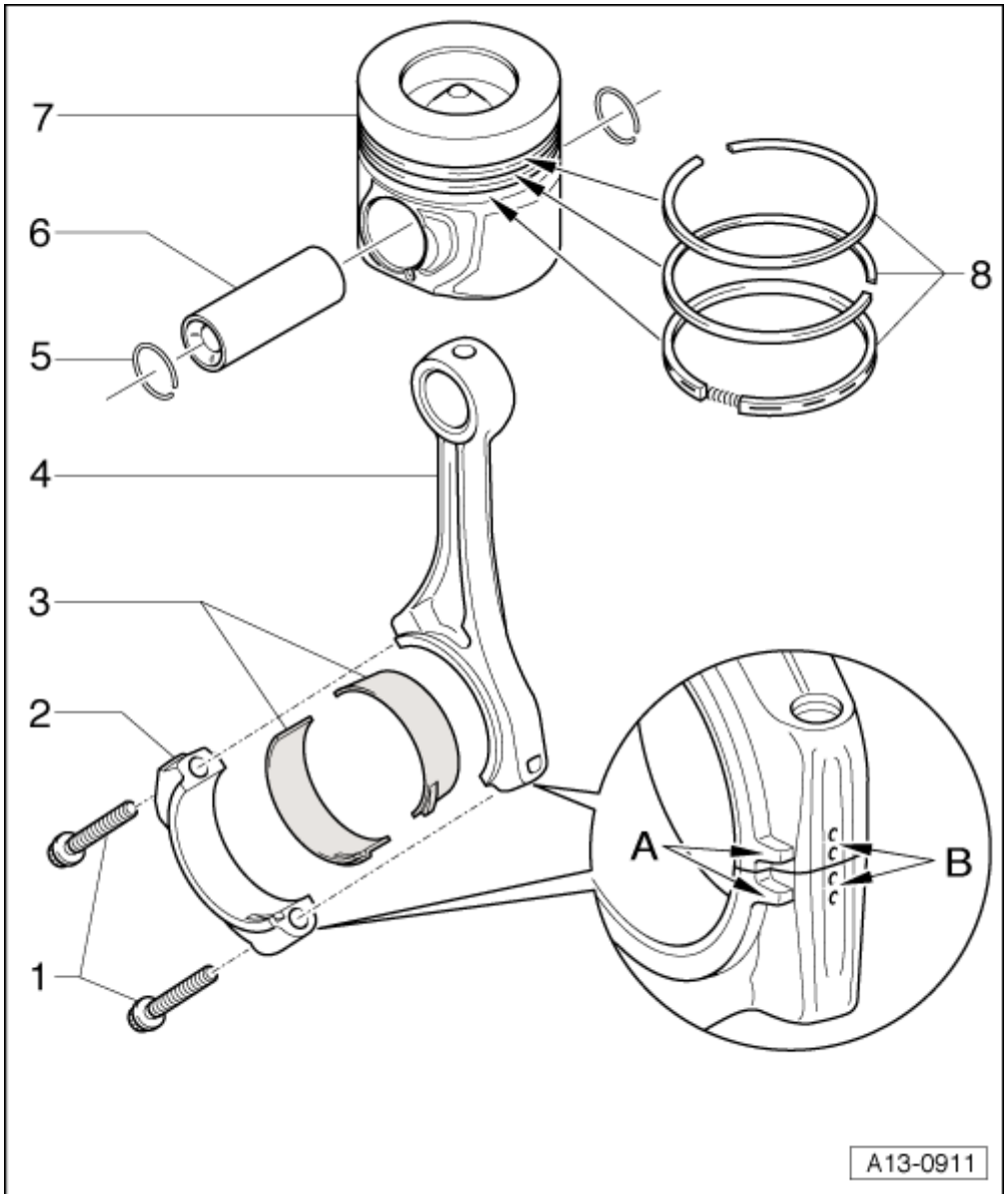


Fig. 15: Identifying Pistons And Connecting Rod Overview
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Bolt
   - **30 Nm + 90° (1/4) additional turn**
   - Always replace.
   - Lubricate the threads and contact surface.
   - Tighten to 30 Nm to measure radial play, do not tighten further.
   - Measuring the radial clearance. Refer to **CONNECTING ROD RADIAL CLEARANCE, MEASURING**.
2. Connecting Rod Bearing Cap
   - Do not interchange.

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- Mark the cap -B- to identify with connecting rod it belongs to. Refer to **Fig. 22**.
- Installed position: Note the casting marks -A-.

3. Bearing Shells
   - Pay attention to the installed position.
   - Do not interchange used bearing shells (mark them).
   - Bearing shells that are worn down to the nickel layer must be replaced.
   - Measuring the radial clearance. Refer to **CONNECTING ROD RADIAL CLEARANCE, MEASURING**.
   - When measuring the radial clearance, tighten the bolts **PISTONS AND CONNECTING ROD OVERVIEW** to 30 Nm but do not tighten them further.
4. Connecting Rod
   - Only replace as a set.
   - Mark the cap -B- to identify which cap it belongs to. Refer to **Fig. 22**.
   - Installed position: Note the casting marks -A-.
   - Axial play for each new connecting rod pair: 0.20 ••• 0.44 mm.
5. Circlip
6. Piston Pin
   - If tight, heat the piston to 60 °C (140 °F).
   - Remove and install using the pilot drift VW 222 A.
7. Piston
   - With the combustion chamber.
   - Mark the installed position and cylinder allocation. Refer to **Fig. 21**.
   - Checking, refer to **Fig. 19**.
   - Install using a piston ring compressor.
   - Replace if there are cracks on the piston shaft.
   - For the correct piston and cylinder dimensions, refer to **PISTON AND CYLINDER DIMENSIONS**.
   - Checking piston projection in Top Dead Center (TDC). Refer to **PISTON PROJECTION IN TDC, CHECKING**.
   - Checking the cylinder bore. Refer to **Fig. 20**.
8. Piston Rings
   - Offset the gaps by 120°
   - Use piston ring pliers for removal and installation.
   - The mark "TOP" must face toward the piston head.
   - Checking the ring gap. Refer to **Fig. 17**.
   - Checking the piston ring groove clearance. Refer to **Fig. 18**.

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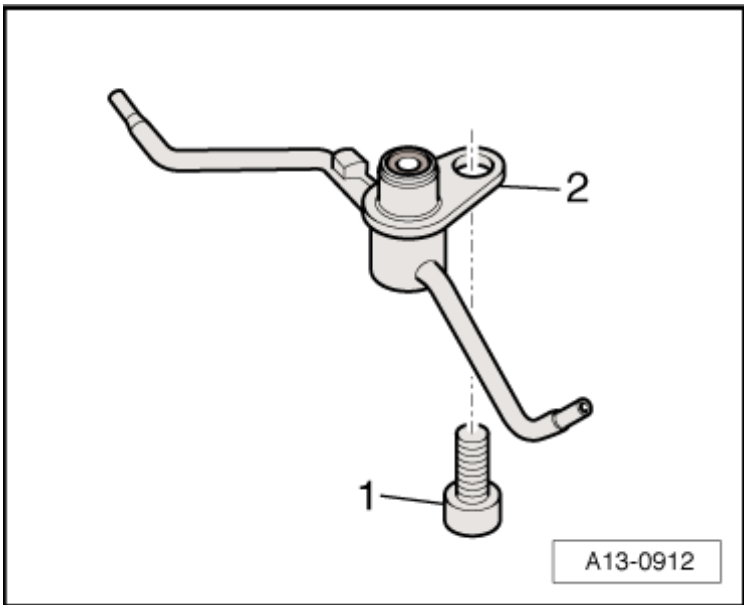


Fig. 16: Identifying Oil Spray Jet for Piston Cooling
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Bolt - 9 Nm
2. Oil spray jet for cooling the piston and spray jet valve

- Opening pressure 1.3 bar.

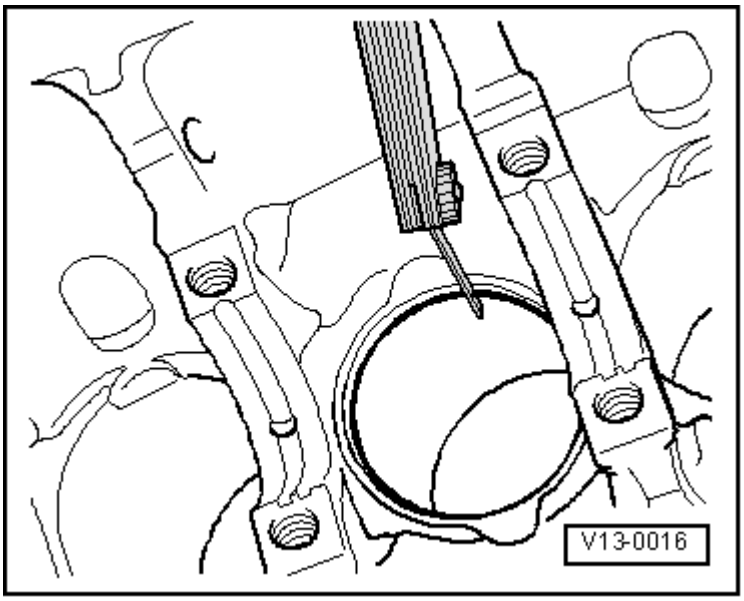


Fig. 17: Checking Piston Ring Gap
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- 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.

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Piston Ring Dimensions in mm	New	Wear Limit
1. Compression ring	0.25 ••• 0.38	0.80
2. Compression ring	0.70 ••• 0.90	1.30
Oil scraping ring	Max. 0.40	0.70

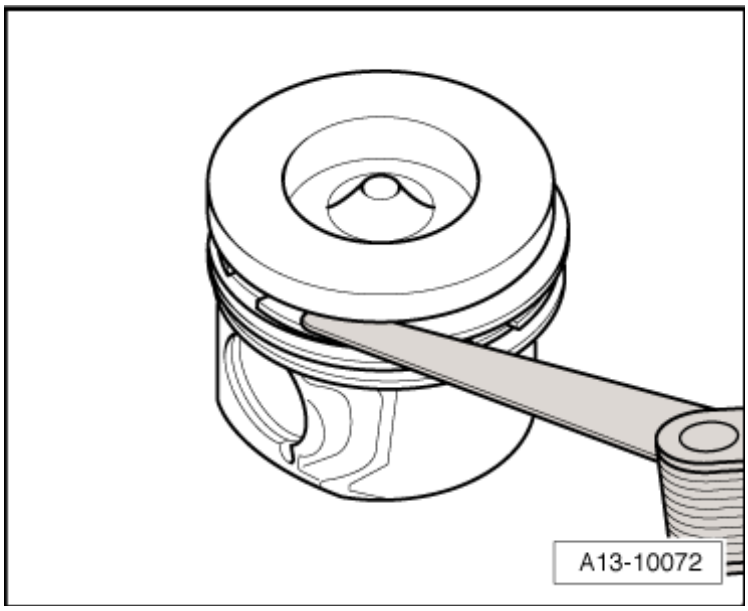


Fig. 18: Checking Piston Ring Groove Clearance
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Clean the ring groove of piston before checking.

Piston Ring Dimensions in mm	New	Wear Limit
1. Compression ring	0.120 ••• 0.160	0.175
2. Compression ring	0.020 ••• 0.090	0.115
Oil scraping ring	0.020 ••• 0.090	0.115

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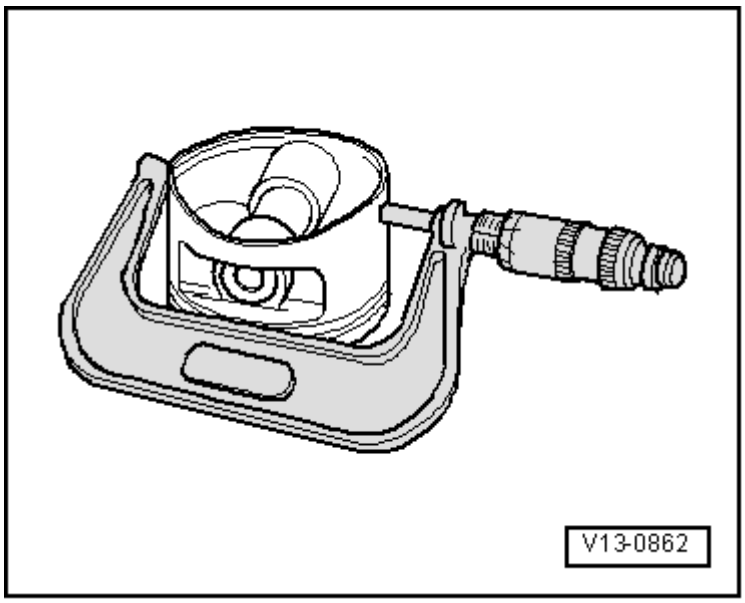


Fig. 19: Checking Piston
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Measure approximately 10 mm from the lower edge at a 90° angle to the piston pin axis using an external micrometer 75 to 100 mm.

- Maximum deviation from nominal dimension: 0.05 mm.

Nominal dimension, refer to **PISTON AND CYLINDER DIMENSIONS**.

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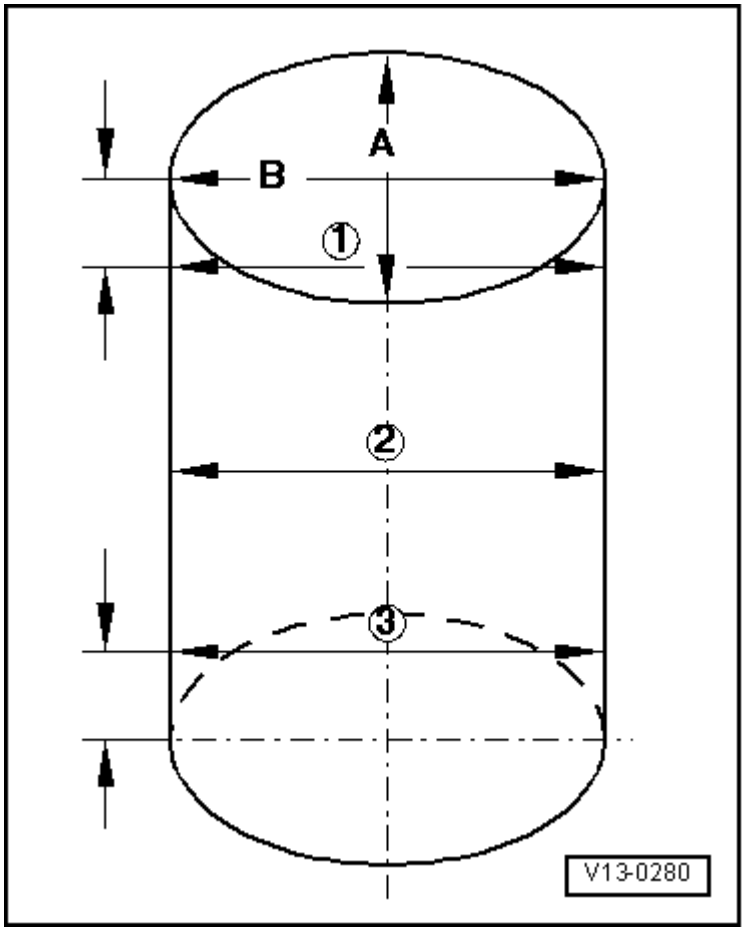


Fig. 20: Checking Cylinder Bores
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Using an internal dial gauge 50 to 100 mm, measure at 3 points in a diagonal sequence horizontally -A- and vertically -B-.

- Maximum deviation from nominal dimension: 0.08 mm.

Nominal dimension, refer to **PISTON AND CYLINDER DIMENSIONS**.

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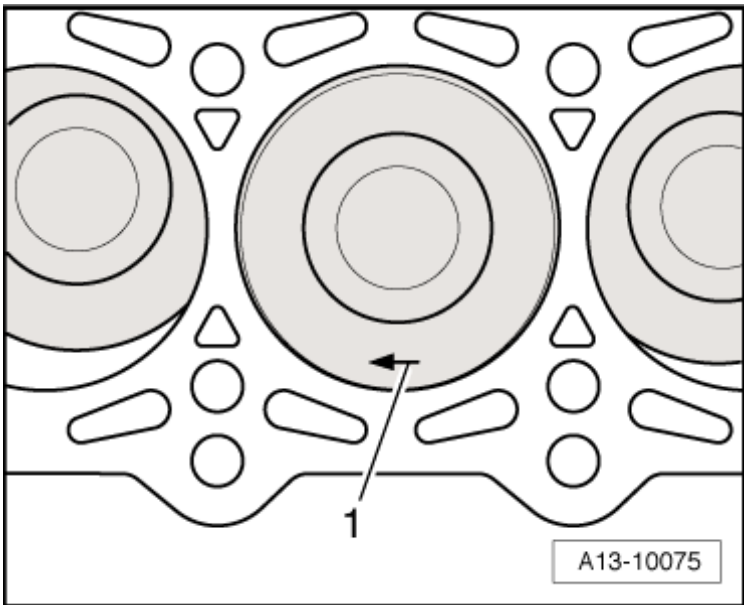


Fig. 21: Identifying Piston, Installed Position
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Installed position: The arrow -item 1- on the piston crown faces the belt pulley side.

NOTE: Mark the installed location and assignment to the cylinder on the piston crown of used pistons with chalk or a waterproof felt-tip pen so they can be installed again.

Do not use a center punch or scribe, since the piston head coating will be damaged.

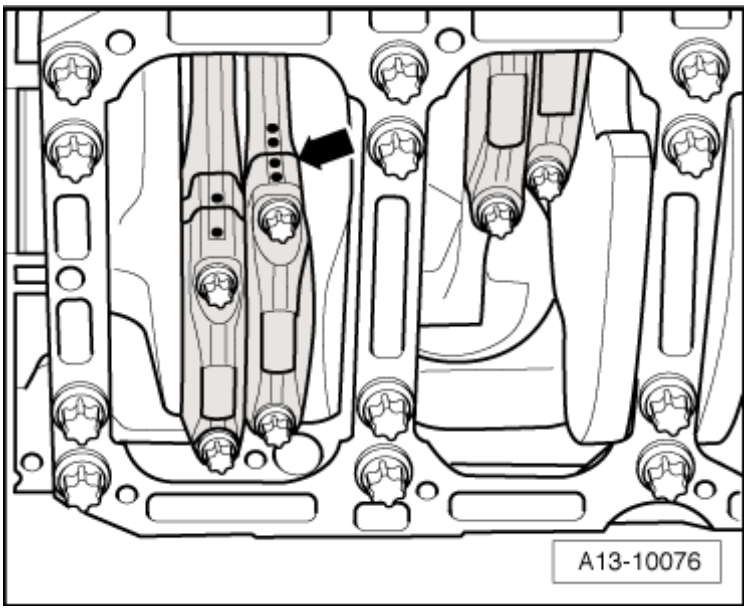


Fig. 22: Identifying Connecting Rod, Marking

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Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Mark the connecting rod and connecting rod bearing cap in relation to each other before removing -arrow-.

NOTE: Only replace the connecting rod and cap as a set.

Do not interchange the connecting rod bearings.

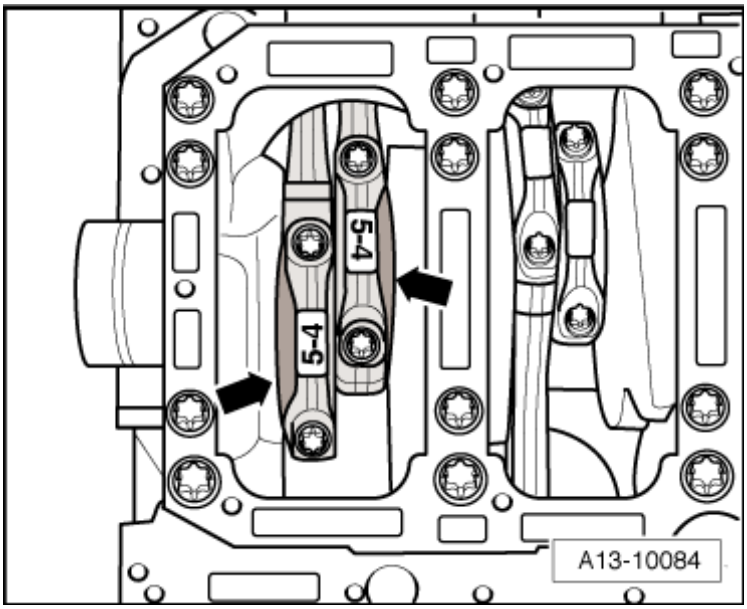


Fig. 23: Identifying Connecting Rod, Installed Position
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

The larger thrust flange on the connecting rod -arrow- faces the adjacent crankshaft bearing.

NOTE: The illustration shows the front connecting rod pair.

SPECIFICATIONS

CRANKSHAFT DIMENSIONS

Reconditioning Dimension in mm	Crankshaft Bearing Journal Diameter	Connecting Rod Journal Diameter
Basic dimension	65.00 - 0.022 - 0.042	60.00 - 0.022 - 0.042

PISTON AND CYLINDER DIMENSIONS

Reconditioning Dimension in mm	Piston Diameter	Cylinder Bore Diameter
Basic dimension	82.939 ••• 82.951 (1)	83.006 ••• 83.014

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Repair stage	82.979 ••• 82.991 (1)	83.046 ••• 83.054

(1) Measurements are without the graphite coating (thickness = 0.02 mm). The graphite coating wears off.

FASTENER TIGHTENING SPECIFICATIONS

Component	Fastener Size	Nm
Accessory Bracket to Cylinder Block Bolt	-	40
Air Conditioning Compressor to Accessory Bracket Bolt	-	25
Balance Shaft and Oil Pump Chain Tensioner to Cylinder Block Bolt	-	9
Balance Shaft Sprocket to Balance Shaft Bolt	-	23
Balance Weight to Balance Shaft Bolt	-	60
Bearing End Bracket to Cylinder Block Bolt	-	9
Belt Tensioner Bolt		
-- Lower Bolt	-	25
-- Upper Bolt	M10	50 + 90°
-- Upper Bolt	M11	60 + 90°
Cap to Upper Left Timing Chain Cover Bolt	-	9
Connecting Rod Bearing Cap to Connecting Rod Bolt (1)	-	30 + 90°
Coolant Pump to Cylinder Block Bolt	-	9
Coolant Pump Pulley to Coolant Pump Bolt	-	22
Drive Plate to Crankshaft Bolt (1)	-	30 + 90°
Engine Speed Sensor to Lower Timing Chain Cover Bolt	-	9
Front Sealing Flange to Cylinder Block Bolt (3)	-	9
Generator to Generator Bracket Bolt	-	22
Guide Rail to Cylinder Block Bolt (1)	-	5 + 90°
Guide Rail to Cylinder Block Pivot Pin(2)	-	12
Idler Pulley Bracket to Cylinder Block Bolt	-	22
Idler Pulley to Generator and Idler Pulley Bracket Bolt	-	25
Idler Pulley to Idler Pulley Bracket Bolt	-	22
Idler Pulley to Sealing Flange Bolt	-	22
Oil Pump Sprocket to Oil Pump Bolt	-	62
Oil Spray Jet (for piston cooling) Bolt	-	9
Pin to Cylinder Block Bolt	-	45
Power Steering Pump to Cylinder Block Bolt	-	22
Sprocket Pin to Cylinder Block Bolt (1)	-	5 + 90°
Tensioning Rail to Cylinder Block Pivot Pin	-	12
Thrust Washer to Pin Bolt (1)	-	5 + 90°

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Timing Mechanism Chain Tensioner to Cylinder Block Bolt	-	12
Vacuum Pump to Upper Right Timing Chain Cover Bolt	-	9
Vibration Damper to Crankshaft Bolt (1)	-	20 + 90°
(1) Always replace (2) Insert using locking compound, refer to the Parts Catalog (3) Tighten the bolts in a diagonal sequence and in stages.		

Generator Bracket Bolt Tightening Sequence and Specification

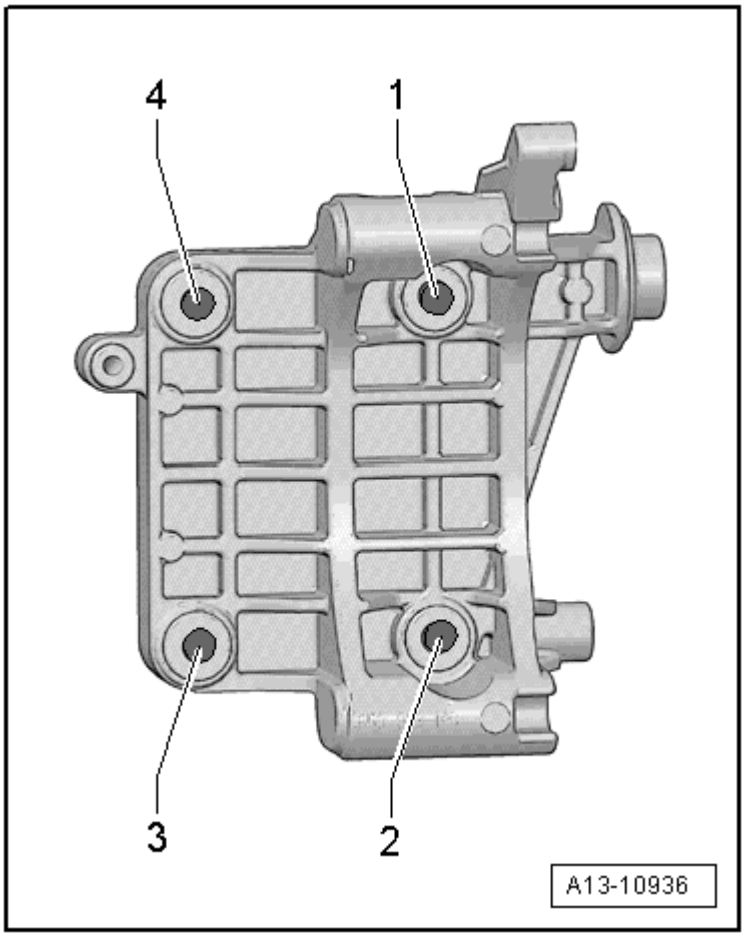


Fig. 24: Identifying Generator Bracket Bolt Tightening Sequence and Specification
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Install and tighten the bolts in sequence -1 through 4- to 40 Nm.

Guide Frame Bolt Tightening Sequence and Specification

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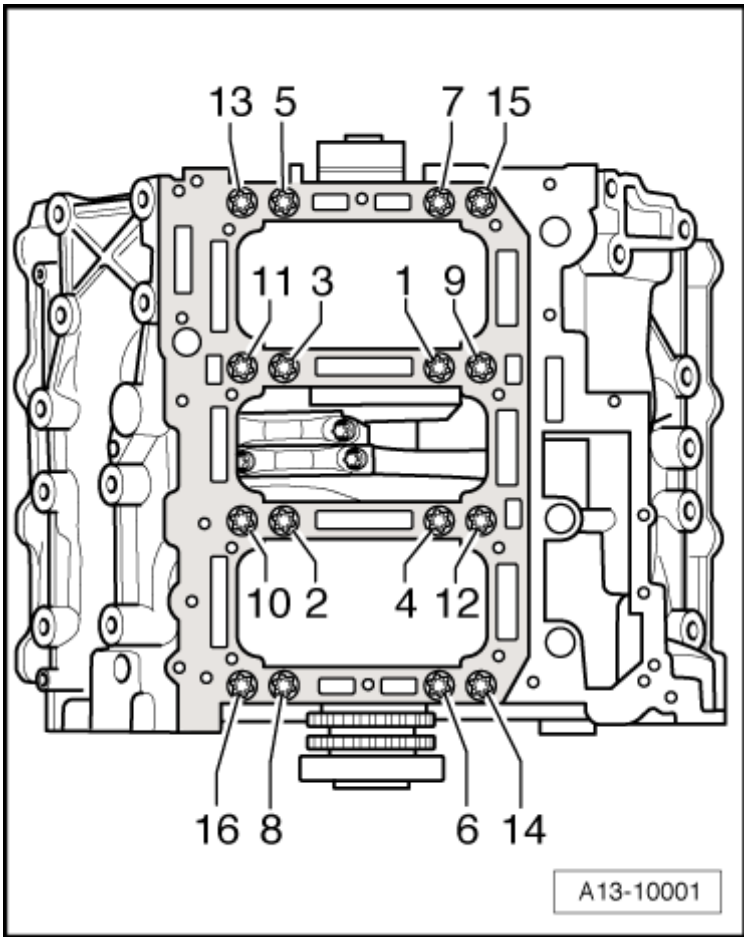


Fig. 25: Identifying Guide Frame, Installation Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Replace the bolts -1 through 16-.

-- Tighten the guide frame bolts in the following sequence:

-- Tighten the bolts -1 through 16- to 30 Nm.

-- Tighten the bolts -1 through 16- to 50 Nm.

-- Tighten the bolts -1 through 16- an additional 90° (1/4) turn.

Lower Timing Chain Cover Bolt Tightening Sequence and Specification

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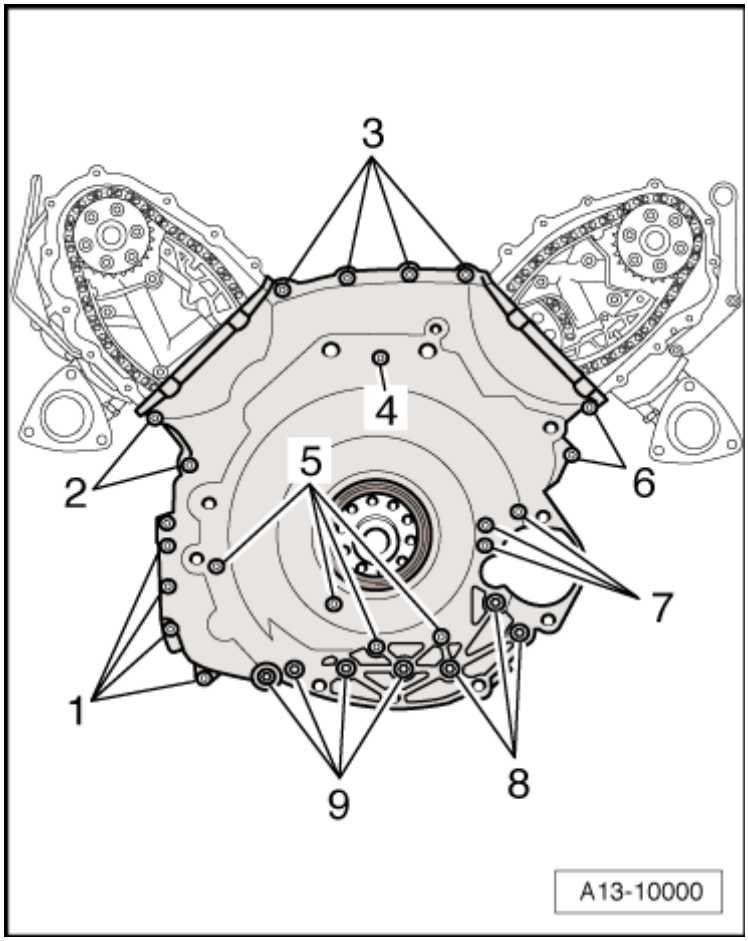


Fig. 26: Identifying Lower Timing Chain Cover Bolt Tightening Sequence and Specification
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Tighten the bolts in 3 steps according to the tightening sequence:

Step	Bolts	Tightening Specifications
1.	-1 through 9-	5 Nm working from the inside toward the outside and diagonally
2.	-1 through 7-	9 Nm working from the inside toward the outside and diagonally
3.	-8 and 9-	23 Nm

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Left Timing Chain Cover, Bolt Tightening Sequence and Specification

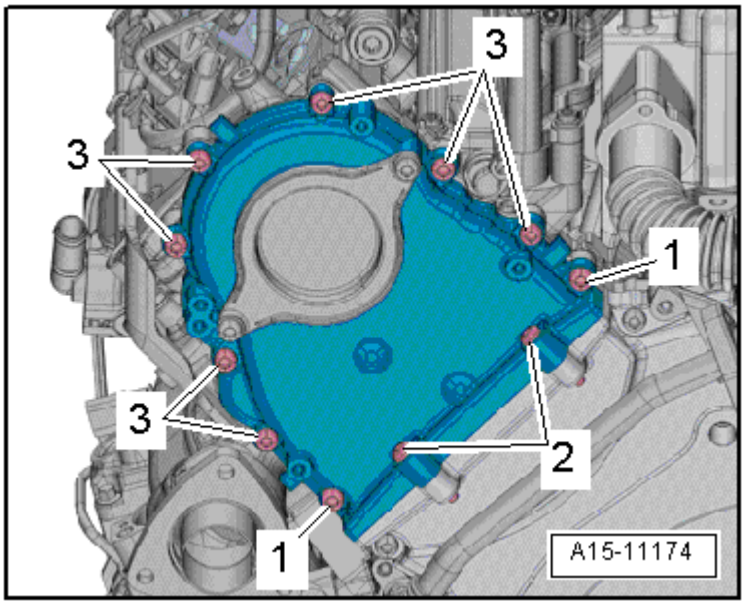


Fig. 27: Identifying Left Timing Chain Cover
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

NOTE: Replace bolts which have been tightened to an additional torque angle.

-- Tighten the bolts in 4 steps according to the tightening sequence:

Step	Bolt	Tightening Specification
1.	-1-	3 Nm
2.	-2-	9 Nm
3.	-1-	9 Nm
4.	-3-	9 Nm in a diagonal sequence

Right Timing Chain Cover, Bolt Tightening Sequence and Specification

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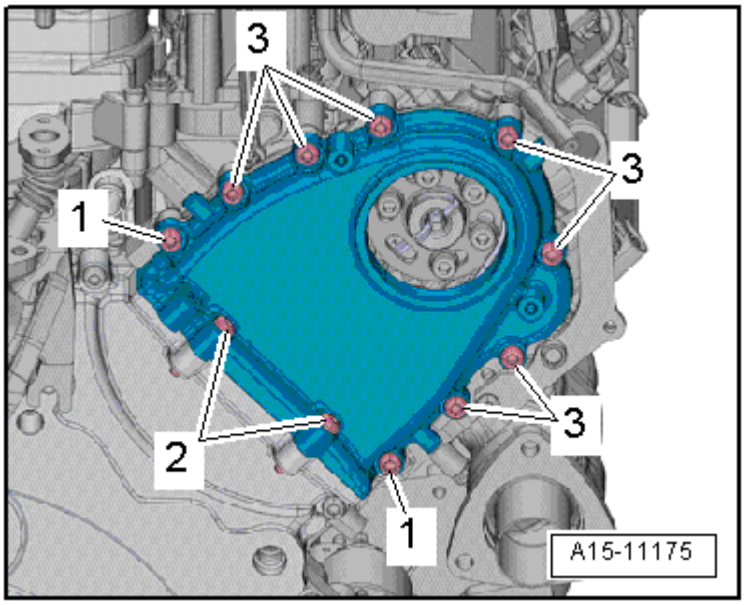


Fig. 28: Identifying Right Timing Chain Cover, Tightening Specifications And Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Step	Bolt	Tightening Specification
1.	-1-	3 Nm
2.	-2-	9 Nm
3.	-1-	9 Nm
4.	-3-	9 Nm in a diagonal sequence

DIAGNOSIS AND TESTING

CRANKSHAFT AXIAL CLEARANCE, MEASURING

Special tools and workshop equipment required

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

Test Sequence

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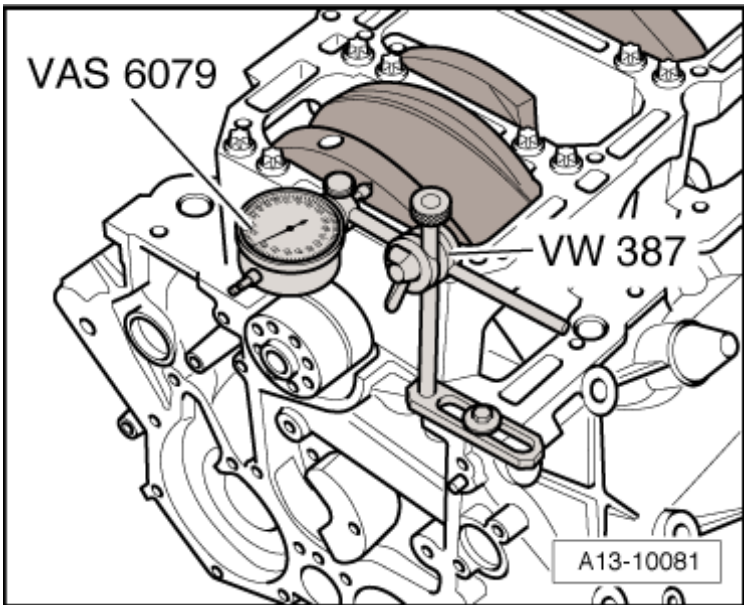


Fig. 29: Attaching Dial Indicator VAS 6079 Together With Dial Gauge Holder VW 387 To Cylinder Block And Setting Indicator Against Crankshaft Counterweight
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Install the dial gauge to the cylinder block using the dial gauge holder VW 387 and position it against the crankshaft counterweight.

-- Press the crankshaft against the dial indicator by hand, set the indicator to "0".

-- Press the crankshaft off the dial indicator and read the value:

- Axial play new: 0.090 to 0.215 mm.
- Axial play wear limit: 0.011 in.

CRANKSHAFT RADIAL CLEARANCE, CHECKING

Special tools and workshop equipment required

- Plastigage

Procedure

NOTE: Do not interchange used bearings

Bearing shells that are worn down to the nickel layer must be replaced.

-- Remove the guide frame and clean the journals.

-- Place the Plastigage over the entire width of the bearing journal or in the bearing shell.

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- The Plastigage must rest in the center of the bearing shell.

-- Install the guide frame and tighten the bolts to 30 Nm. Do not rotate the crankshaft.

-- Remove the guide frame again.

-- Compare the width of the Plastigage with the measuring scale:

- Radial clearance, new: 0.018 to 0.045 mm.
- Radial clearance wear limit: 0.10 mm.

PISTON PROJECTION IN TDC, CHECKING

Special tools and workshop equipment required

- Measuring Bar VW 382/7
- Magnetic Plate 50 mm Dia.VW 385/17
- Dial Gauge 0-10 mm VAS 6079

Test Sequence

-- Install the dial gauge 0-10 mm VAS 6079 with the magnetic plate 50 mm dia.VW 382/7 and the measuring bar VW 385/17.

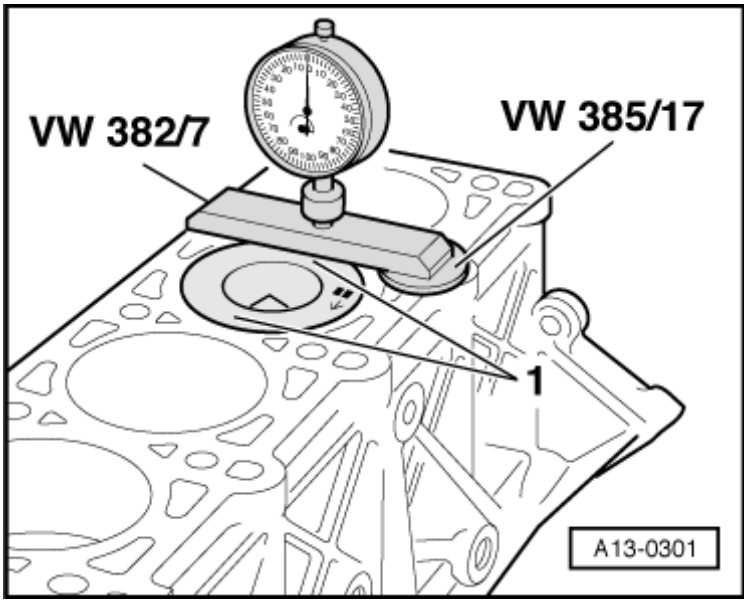


Fig. 30: Identifying VW 382/7 And Measuring Bar VW 385/17
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Measure the projection of each piston at two points -1-.

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Piston Projection above the Cylinder Block Upper Edge	Identification Holes
0.39 to 0.49 mm	1
0.49 to 0.54 mm	2
0.54 ••• 0.65 mm	3

Cylinder Head Gasket Identification

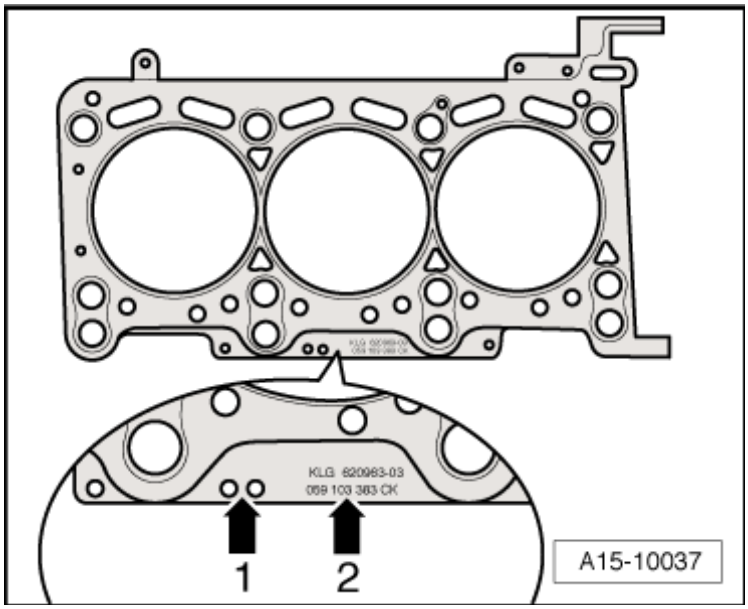


Fig. 31: Identifying Cylinder Head Gasket Identification
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-Arrow 1- : Holes

-Arrow 2- : Part number:

NOTE: The cylinder head gaskets for the left and right cylinder head cannot be interchanged because they each have a different shape.

CONNECTING ROD RADIAL CLEARANCE, MEASURING

Special tools and workshop equipment required

- Plastigage

Test Sequence

-- Remove the connecting rod bearing cap. Clean the bearing cap and journal.

-- Place the Plastigage over the entire width of the bearing journal or in the bearing shell.

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-- Install the connecting rod bearing cap and tighten the bolts to 30 Nm. Do not rotate the crankshaft.

-- Remove the connecting rod cap again.

-- Compare the width of the Plastigage with the measuring scale:

- Radial clearance, new: 0.015 to 0.062 mm.
- Radial clearance wear limit: 0.12 mm.

-- Replace the connecting rod cap bolts.

REMOVAL AND INSTALLATION

RIBBED BELT

Removing

NOTE: Mark the rotation direction of the used ribbed belt using chalk or a felt-tip marker before removing. Running a used belt in the opposite direction could destroy it.

-- Disconnect the electrical connectors -2 and 3-.

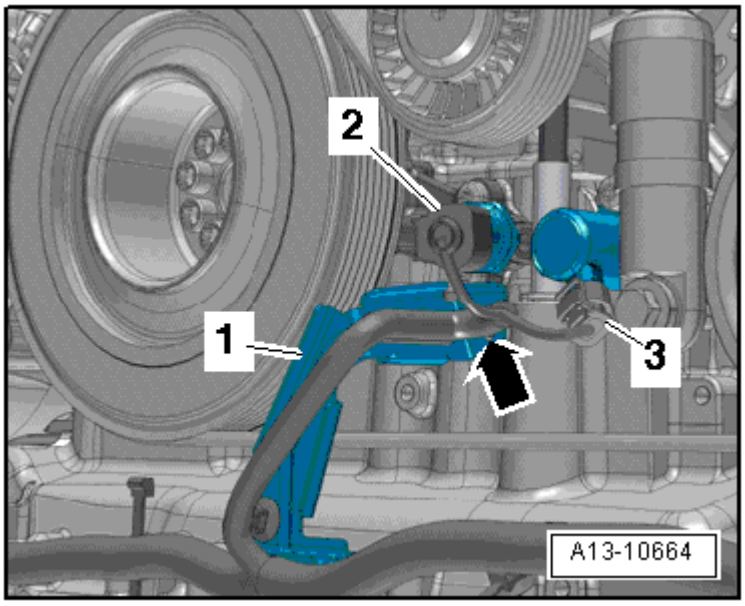


Fig. 32: Identifying Bracket & Connectors
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the bracket -1- and move it to the side along with the wiring harness.

NOTE: Ignore the -arrow-.

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-- Pivot the tensioner in the -direction of the arrow- using a ratchet with a T60 TORX® bit socket to release the tension from the ribbed belt.

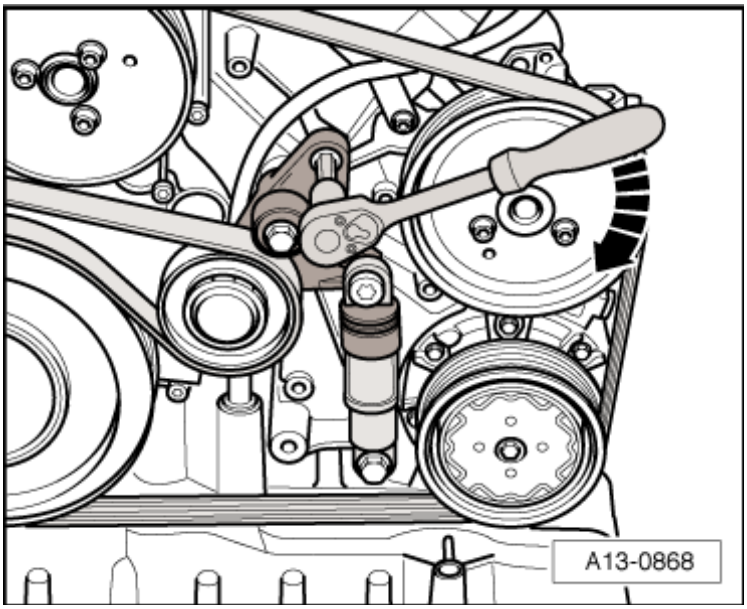


Fig. 33: Rotating Belt Tensioner In -Direction Of Arrow-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the ribbed belt from the belt tensioner.

Installing

NOTE: Ensure, before installing the ribbed belt, that all ancillaries (generator, Air Conditioning (A/C) compressor, power steering pump) are secured.

Check the idler pulleys for ease of movement

Note the previously marked direction of rotation and be sure that it is seated correctly on the pulley, if reinstalling the old belt.

-- Pivot the tensioner in the -direction of the arrow- using a ratchet with a T60 TORX® bit socket.

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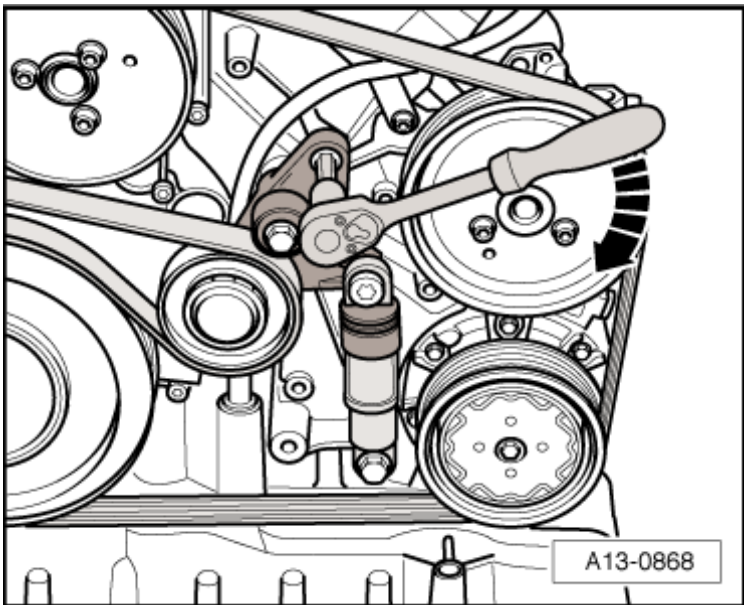


Fig. 34: Rotating Belt Tensioner In -Direction Of Arrow-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Route the ribbed belt as shown.

Vehicles with an Additional idler Pulley

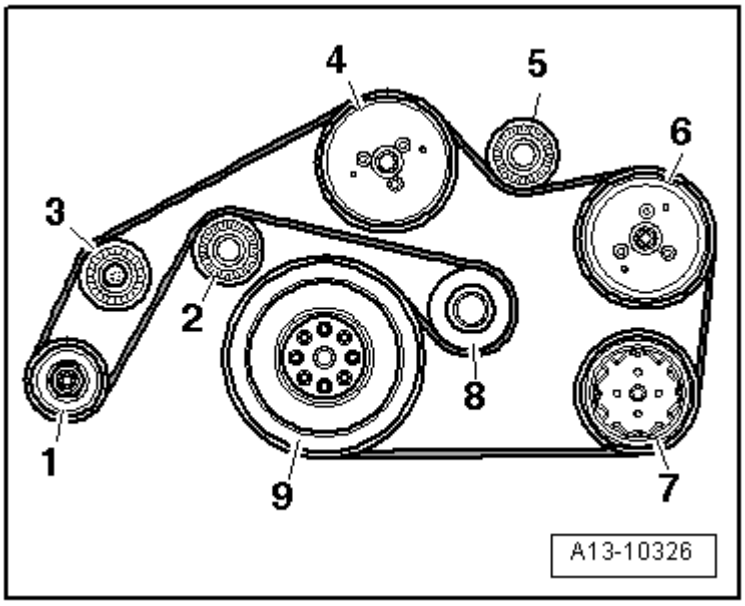


Fig. 35: Identifying Ribbed Belt Components With An Additional Idler Pulley
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Generator
2. Idler pulley
3. Idler pulley

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4. Coolant pump
5. Idler pulley
6. Power steering pump
7. A/C compressor
8. Belt tensioner
9. Vibration damper

Vehicles without an Additional Idler Pulley

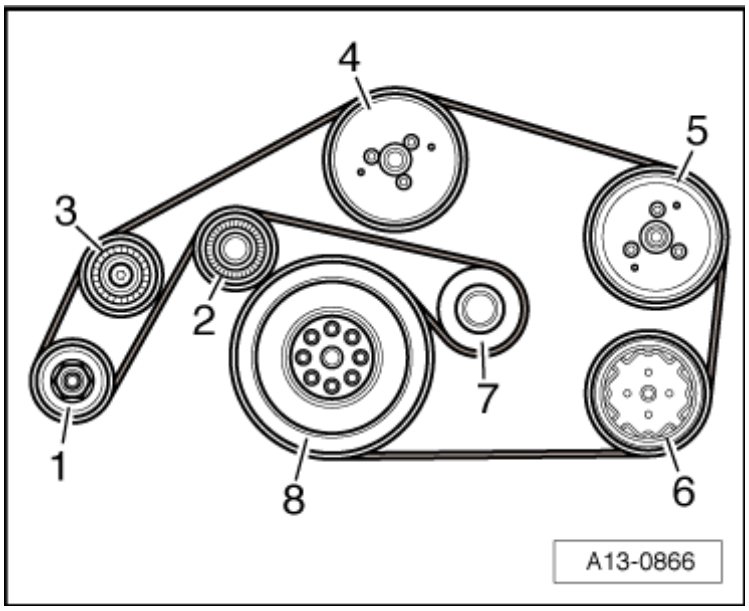


Fig. 36: Identifying Ribbed Belt Components
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Generator
2. Idler pulley
3. Idler pulley
4. Coolant pump
5. Power steering pump
6. A/C compressor
7. Belt tensioner
8. Vibration damper

Continuation for all Vehicles

After the belt is installed, always perform the following:

-- Start the engine and check the belt running.

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CRANKSHAFT SEAL, BELT PULLEY SIDE

Special tools and workshop equipment required

- Oil Seal Extractor T40019
- Assembly Device T40048

Removing

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

-- Remove the vibration damper.

-- Place the inner part of the oil seal extractor T40019 flush with the outer part and secure it using the knurled thumb screw.

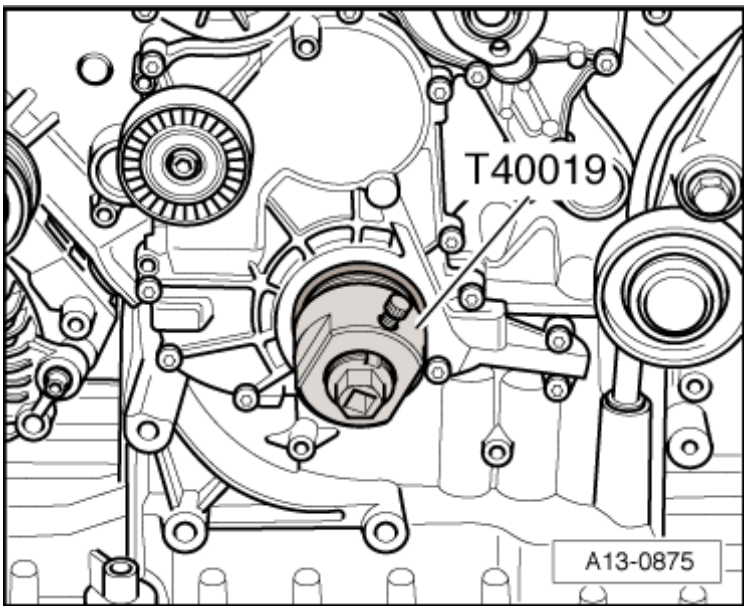


Fig. 37: Identifying Inner Part Of Oil Seal Extractor T40019, Installing
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Lubricate the threaded head of the oil seal extractor, place it against the seal, and with strong force, screw it into the seal as far as possible.

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

-- Secure the oil seal extractor in a vice on the flat spots. Remove the seal using pliers

-- Clean the running and sealing surface.

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

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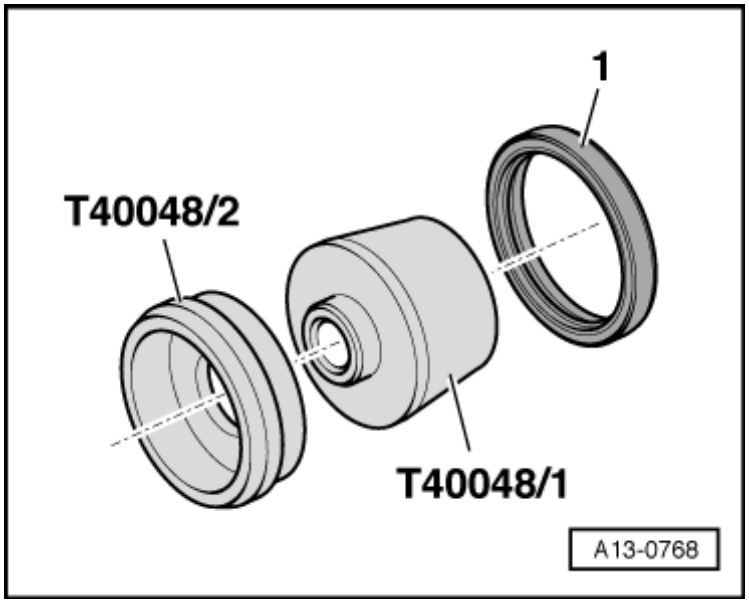


Fig. 38: Inserting Assembly Device T40048/1 Onto Pull Sleeve T40048/2 And Slide Seal Onto Pull Sleeve
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the assembly device.

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

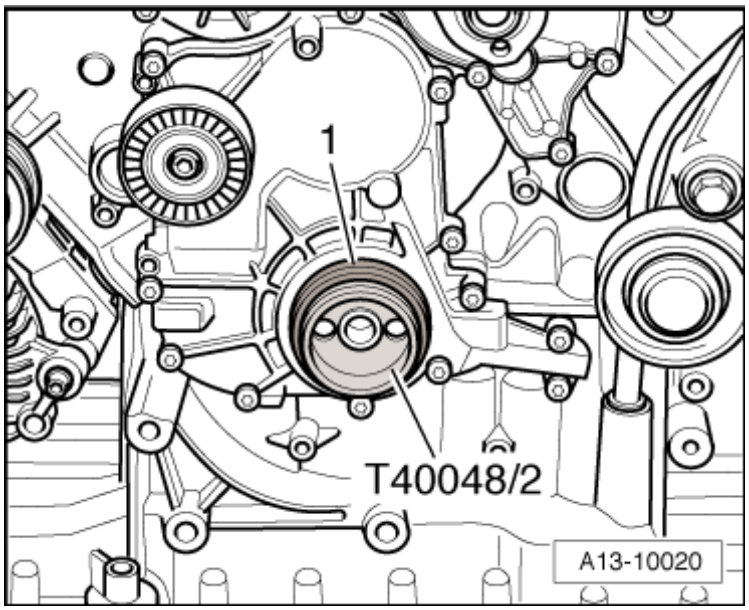


Fig. 39: Placing Pull Sleeve T40048/2 On Crankshaft And Slide Seal -1- Into Sealing Surface On Engine
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

NOTE: The pull sleeve T40048/2 remains on the crankshaft for installation.

-- Position the assembly adapter T40048/4 (installation depth: 5 mm) on the crankshaft with two M8 x 55 mm bolts -arrows-.

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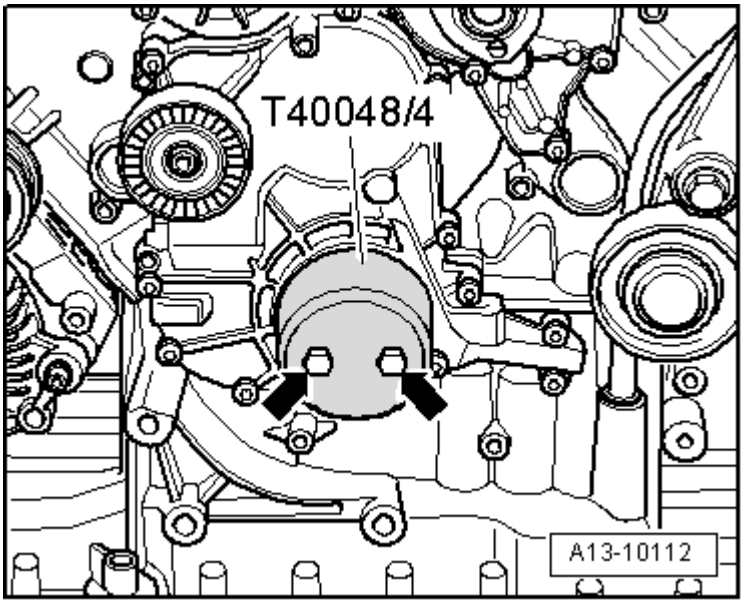


Fig. 40: Positioning Assembly Adapter T40048/4 On Crankshaft With 2 - M8 x 55 mm Bolts -Arrows-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Install the bolts by hand.

-- Tighten the bolts a 1/2 turn each, alternating sides to press in the seal until it is seated

-- Install the vibration damper.

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

FRONT SEALING FLANGE

Special tools and workshop equipment required

- Spanner Wrench 3212
- Hand Drill with Plastic Brush Attachment
- Protective Eyewear
- Silicone Sealant D176 404 A2

Removing

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

-- Remove the vibration damper.

-- Remove the coolant pump pulley. When loosening the bolts -arrows- use the spanner wrench 3212 to counter hold the pulley.

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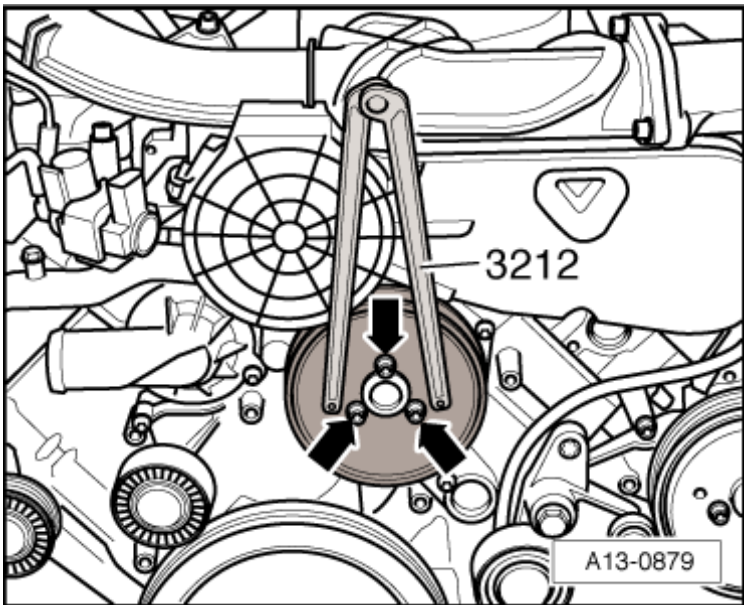


Fig. 41: Identifying Spanner Wrench 3212 And Bolts -Arrows-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Pry the dust cap off the idler pulley.

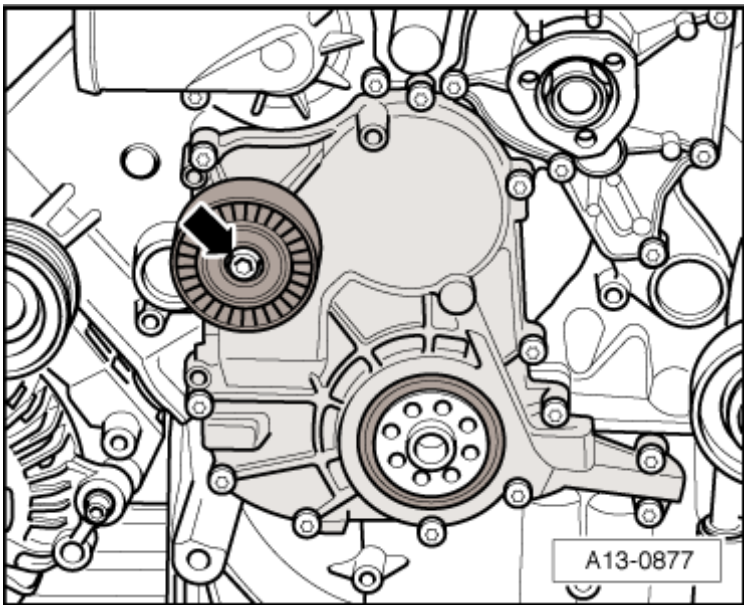


Fig. 42: Identifying Bolt -Arrow- And Idler Pulley
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the bolt -arrow- and remove the idler pulley from the sealing flange.

-- Remove the noise insulation retainers -arrows- and insulation from the front sealing flange.

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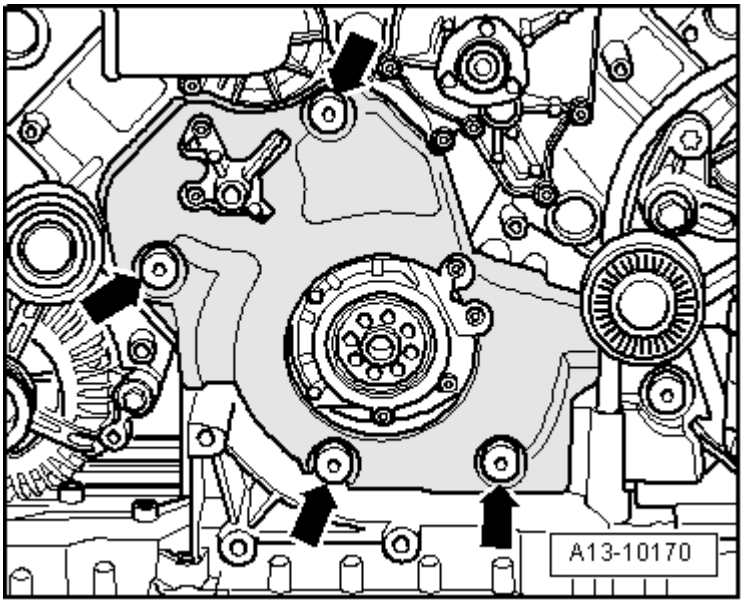


Fig. 43: Identifying Noise Insulation Retainers
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Loosen the nut on the coolant pipe.

-- Pry the tab upward out of the coolant pipe.

-- Remove the sealing flange bolts.

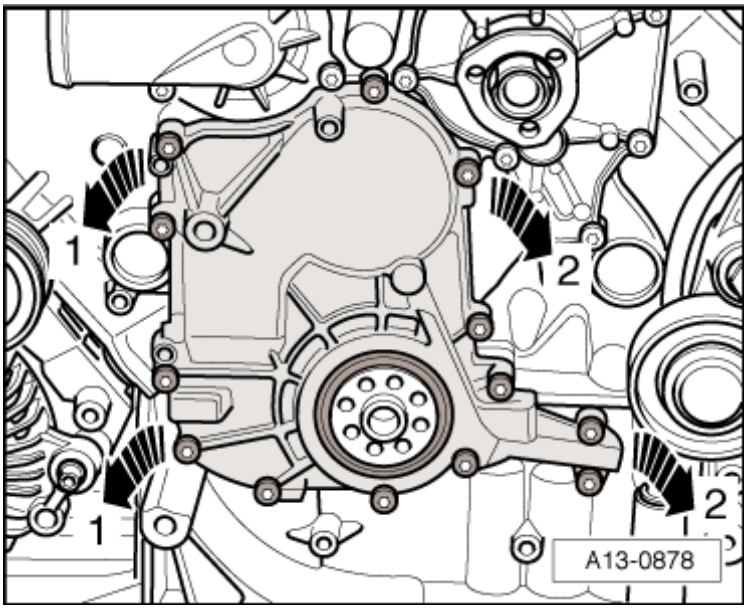


Fig. 44: Identifying Removal Of Front Sealing Flange Sequence -- At Right -Arrows 1- Then At Left -Arrows 2-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the sealing flange at the right first -arrow 1-, then at the left -arrow 2-.

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-- Drive out the seal from the removed sealing flange.

Installing

NOTE: Replace gaskets and O-rings.

-- Remove the sealant from the groves on the sealing flange and from the sealing surfaces.

WARNING: Wear safety glasses.

-- Remove the sealant residue from the sealing flange and the cylinder block or upper oil pan with a rotating plastic brush.

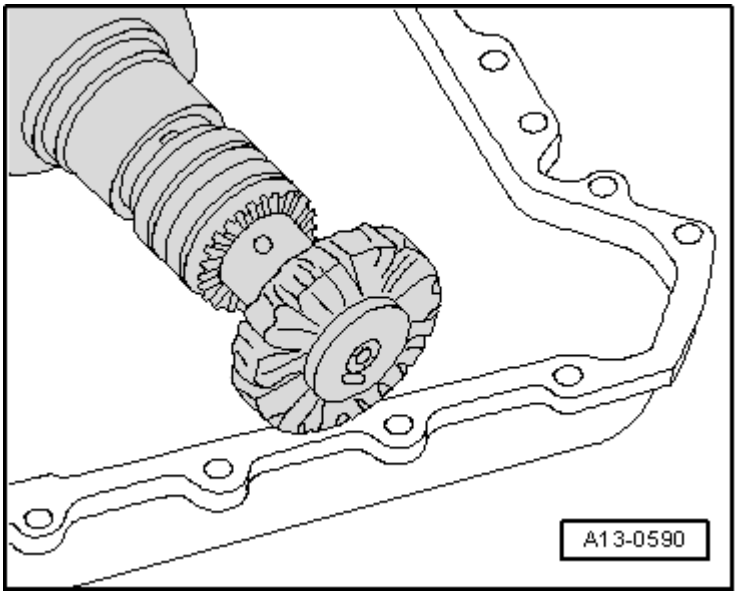


Fig. 45: Identifying Rotating Plastic Brush To Remove Sealant Residue From Sealing Flange, Cylinder Block And Upper Part Of Oil Pan
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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

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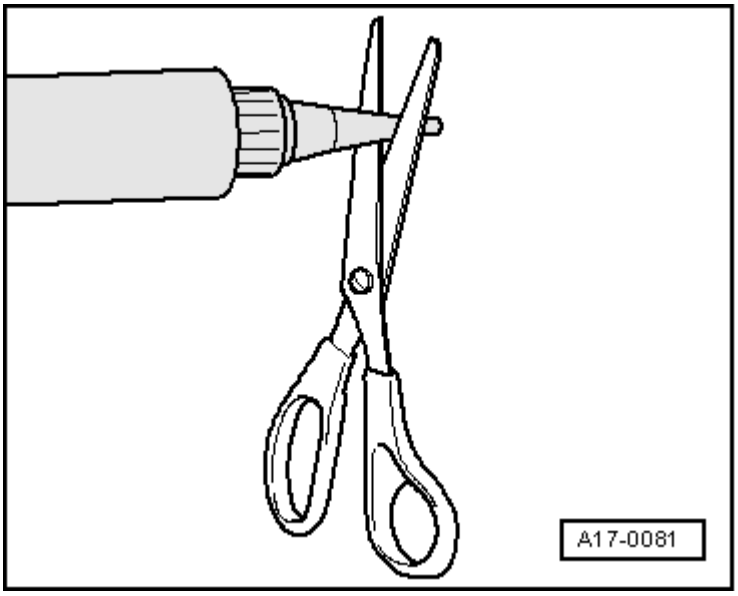
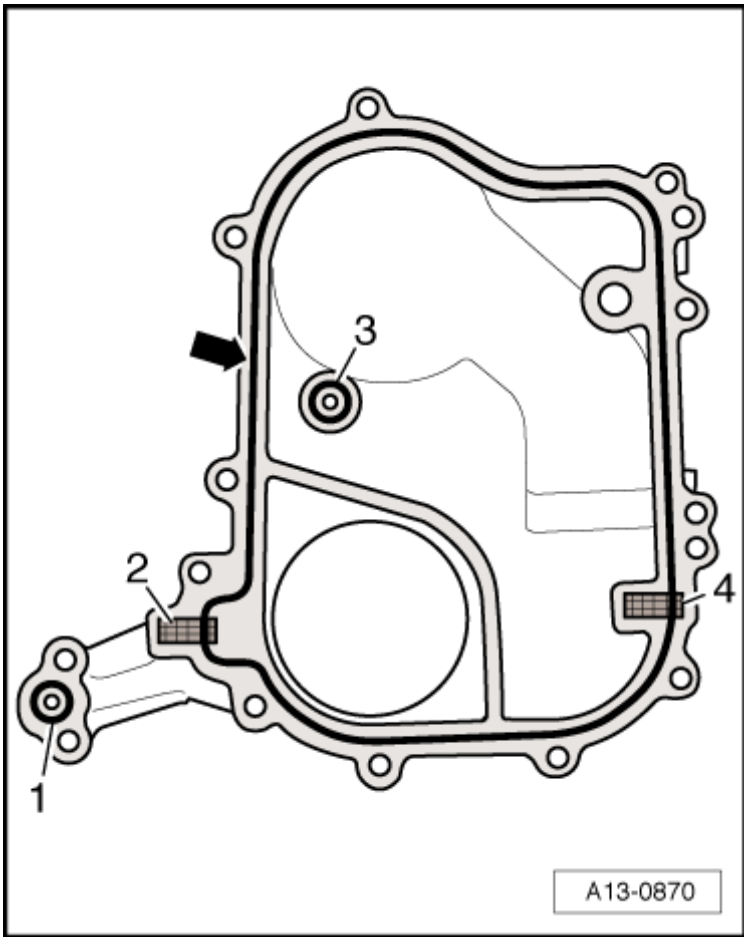


Fig. 46: Cutting Tube Nozzle At Front Marking (Nozzle Diameter Approx. 2 mm)
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Insert the seals -2 and 4- and the O-rings -1 and 3-.



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Fig. 47: Identifying Seals -2 & 4-, O-rings -1 & 3- And Sealant Bead
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Apply a sealant bead -arrow- to the clean sealing surfaces on the sealing flange as illustrated.

- The sealant bead must be 1.5 to 2.0 mm above the sealing surface.

NOTE: The sealant bead must not be thicker than specified, otherwise the excess sealant could get into the oil pan and clog the oil pump strainer.

The front sealing flange must be installed within 5 minutes of being applied with sealant.

-- Tighten the sealing flange bolts in a diagonal sequence and is stages. Tightening specification: 9 Nm.

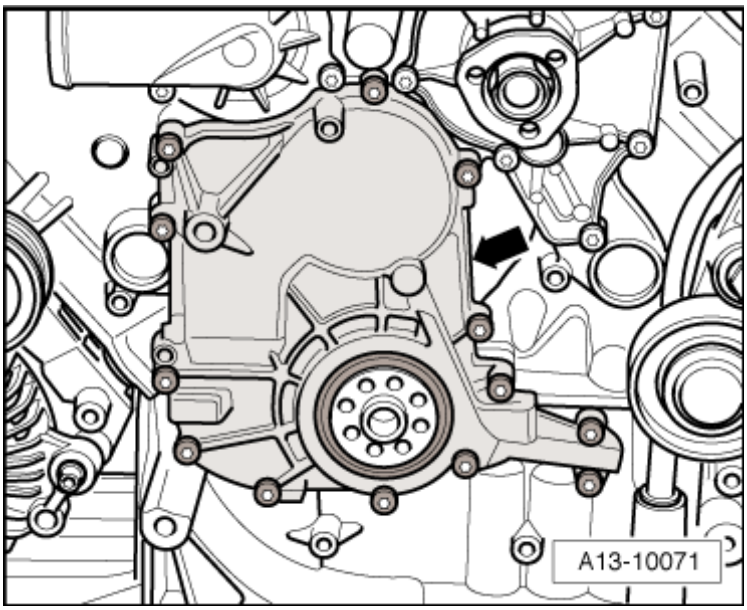


Fig. 48: Identifying Sealing Flange -Arrow- Bolts -- Tighten Diagonally
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Install the new seal. Refer to **CRANKSHAFT SEAL, BELT PULLEY SIDE**.

Further installation is performed in reverse order of removal.

ENGINE SPEED SENSOR -G28-

Removing

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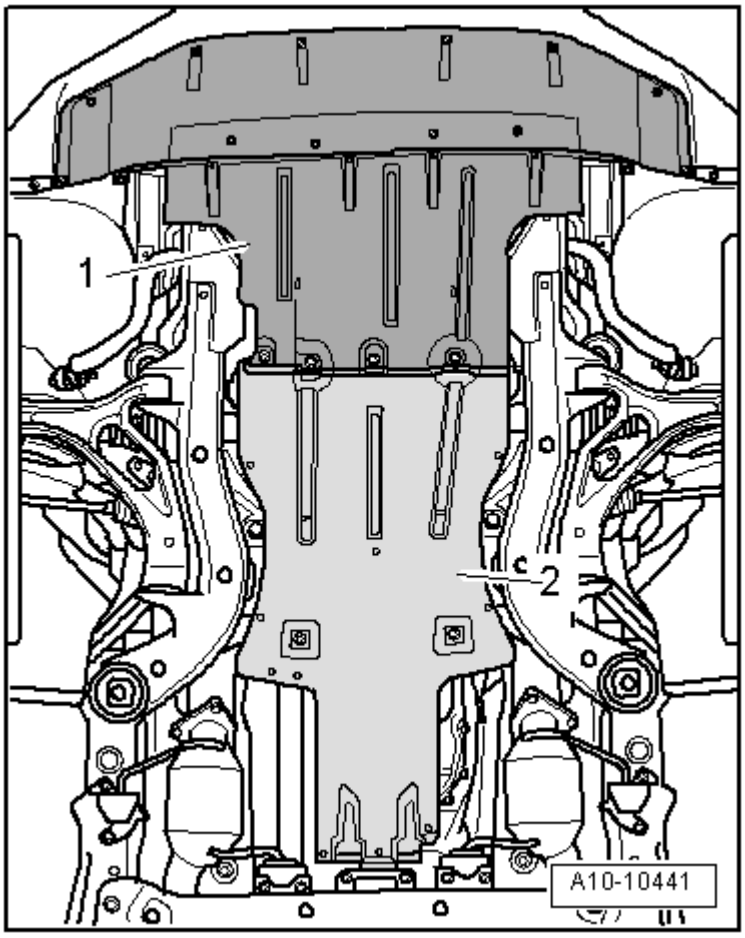


Fig. 49: Identifying Front/Rear Noise Insulation
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the bolts and the rear noise insulation -2-.

-- Disconnect the connector -2-.

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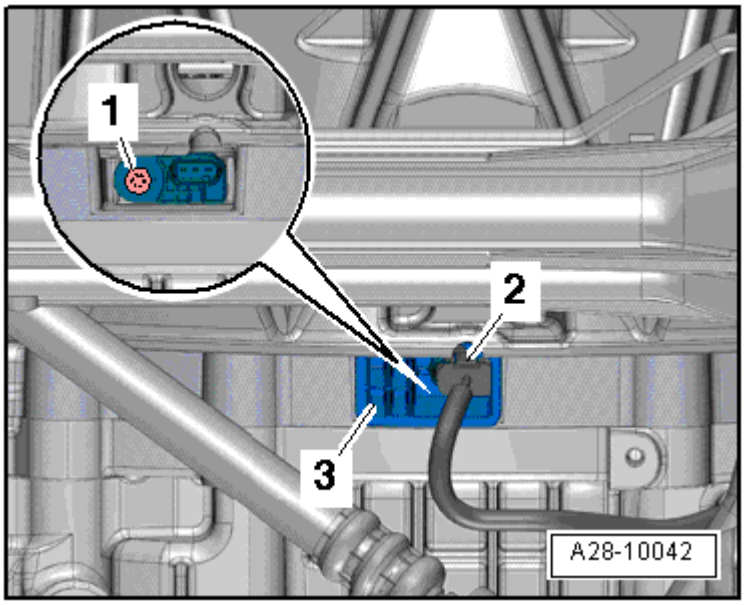


Fig. 50: Identifying Engine Speed Sensor
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the bolt -1- and the engine speed sensor.

Installing

Install in reverse order of removal. Note the following:

- **Tightening specification: 9 Nm**

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

DRIVE PLATE

Special tools and workshop equipment required

- Counter Hold Tool 10-201

Removing

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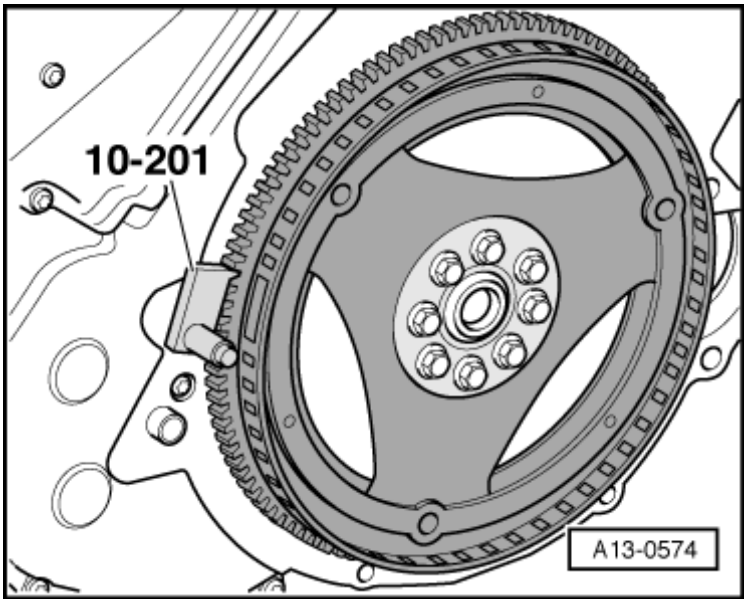


Fig. 51: Inserting Counter Hold Tool 10-201 To Loosen Bolts
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- The engine or transmission is removed.

-- Mark the drive plate to the engine.

-- Install the counter hold tool 10-201 to loosen the bolts.

-- Remove the drive plate.

-- Remove the shim behind it.

Installing

Installation is carried out in the reverse order while noting the following:

-- Place the 1.5 mm shim on the crankshaft.

-- Install the drive plate with 3.4 mm washer.

-- Secure with new bolts.

-- Reposition the counter hold tool10-201 to tighten the bolts. Tightening specification: 30 Nm + 90° (1/4) additional turn.

CRANKSHAFT SEAL, TIMING CHAIN SIDE

Special tools and workshop equipment required

- Assembly Tool T10122

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- Pulling Hook T20143/2

Replacing

- The engine or transmission is removed.

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

-- Pry out the seal using the pulling hook T20143/2.

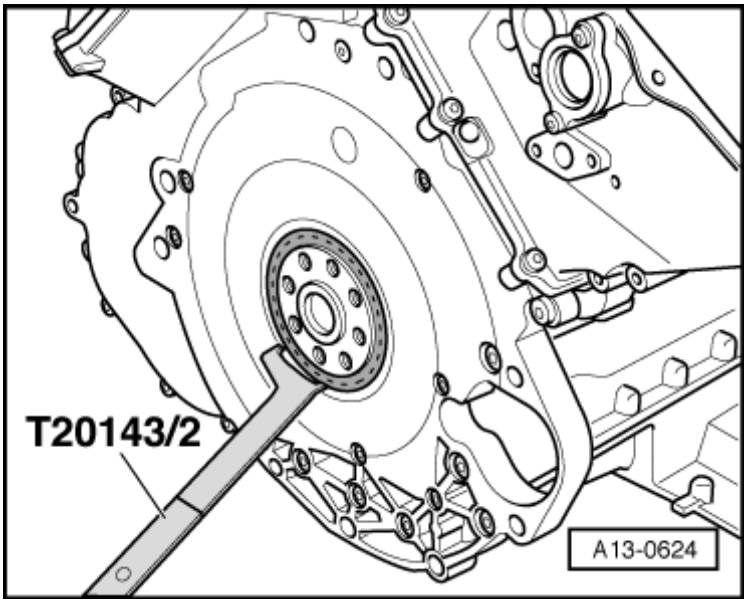


Fig. 52: Prying Out Sealing Ring Using Extractor Lever T20143/2
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Drill a 8 mm hole -arrow 2- in the guide sleeve T10122/2 for the alignment pin.

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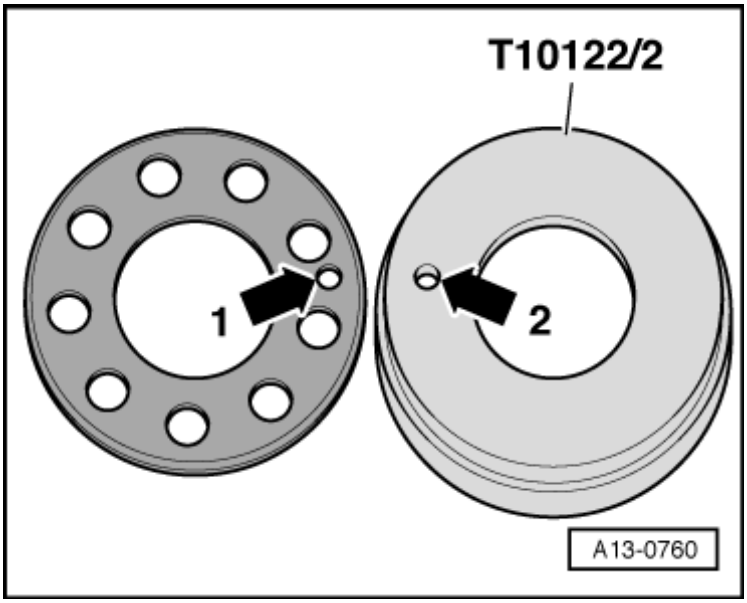


Fig. 53: Identifying 8 mm Drill Hole -Arrow 2- In Guide Sleeve T10122/2 For Alignment Sleeve
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Use the hole -arrow 1- in the washer as a template when drilling.

-- Clean the running and sealing surfaces.

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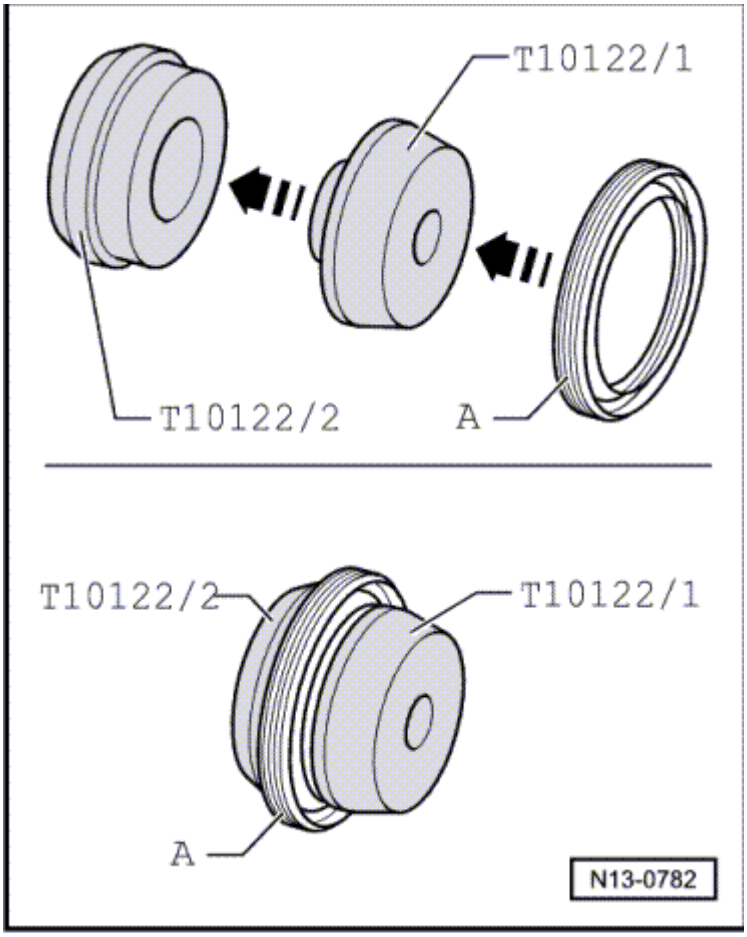


Fig. 54: Identifying Seal, Sleeve T10122/1 And Assembly Tool T10122/2
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Place the assembly device T10122/1 on the pull sleeve T10122/2 and slide the seal -A- onto the pull sleeve.

-- Remove the guide sleeve.

-- Position the pull sleeve with the seal on the crankshaft.

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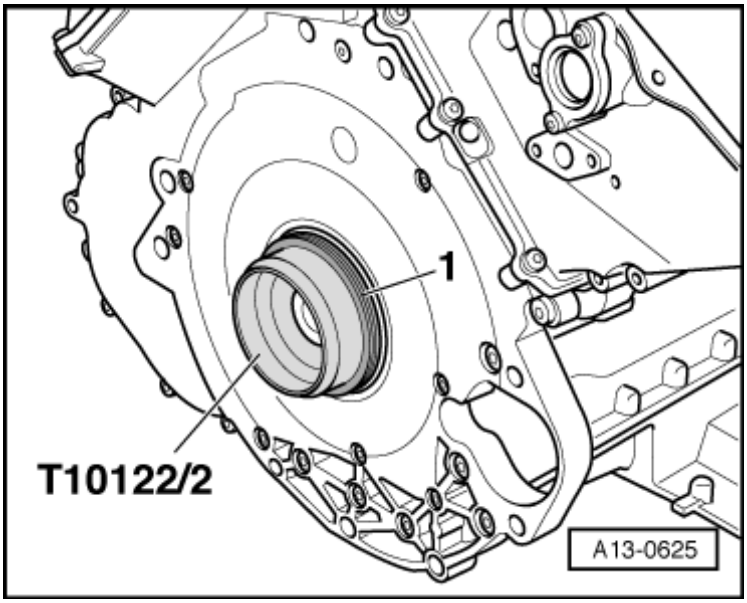


Fig. 55: Identifying Pull Sleeve T10122/2 With Sealing Ring On Crankshaft
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Press in the seal all around evenly and flush using the pressure sleeve T10122/3.

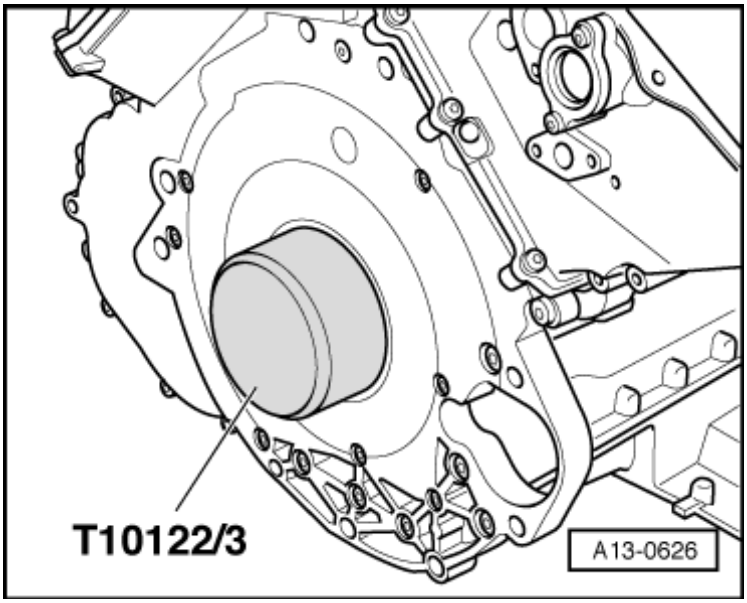


Fig. 56: Pressing In Seal Evenly All Around Until It Reaches Stop Using T10122/3
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

TIMING CHAIN COVERS

Special tools and workshop equipment required

- Counter Hold Tool 10-201
- Used Oil Collecting and Extracting Device V.A.G 1782
- Hand Drill with Plastic Brush Attachment
- Protective Eyewear
- Sealant

Removing

NOTE: All wire ties opened or cut off during engine removal must be reinstalled in the same location during installation.

-- Drain the engine oil.

-- Remove the engine. Refer to **ENGINE, REMOVING** .

-- Separate the engine and transmission. Refer to **ENGINE, REMOVING FROM THE Scissor Type Assembly Platform (US) VAS 6131 A** .

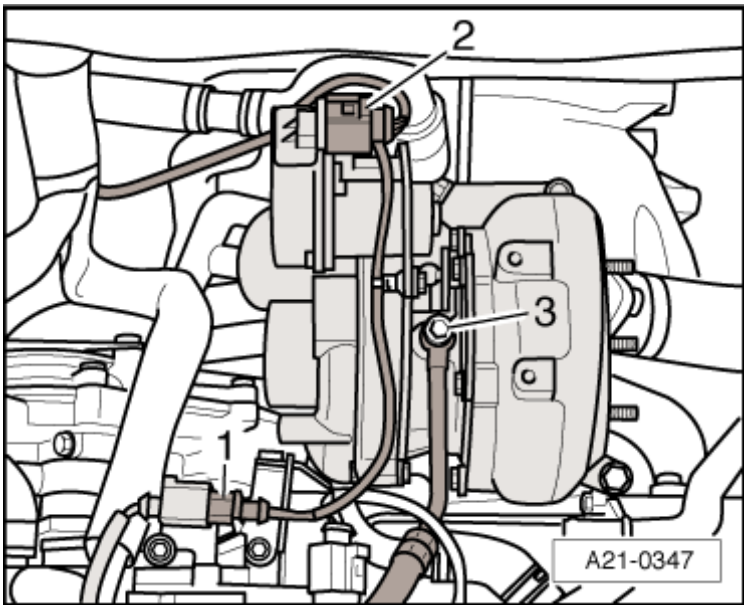
-- Secure the engine to the engine and transmission holder. Refer to **ENGINE, SECURING TO THE Engine and Transmission Holder VAS 6095** .

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

-- Remove the shim behind it.

-- Remove the charge air pipe with the crankcase ventilation connecting hose.

-- Disconnect the connectors -1 and 2-.



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Fig. 57: Disconnecting Connectors -1 And 2-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

-- Disconnect the connector -4-.

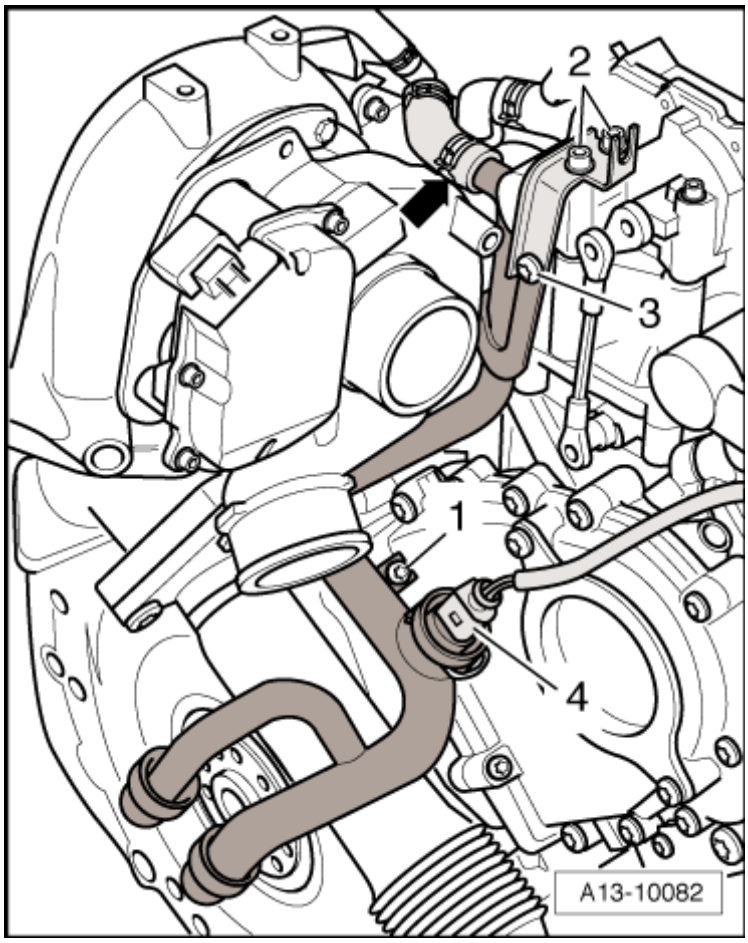


Fig. 58: Identifying Bolts -2 & 3- And Bracket
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the bolts -2 and 3- and the bracket.

-- Remove the bolt -1-.

-- Disconnect the rear coolant pipe from the coolant hose -1-.

-- Remove the turbocharger upper oil return line, -item 26- in: **TURBOCHARGER COMPONENT OVERVIEW** .

-- Remove the left intermediate pipe nuts and bolts -arrows- and the pipe.

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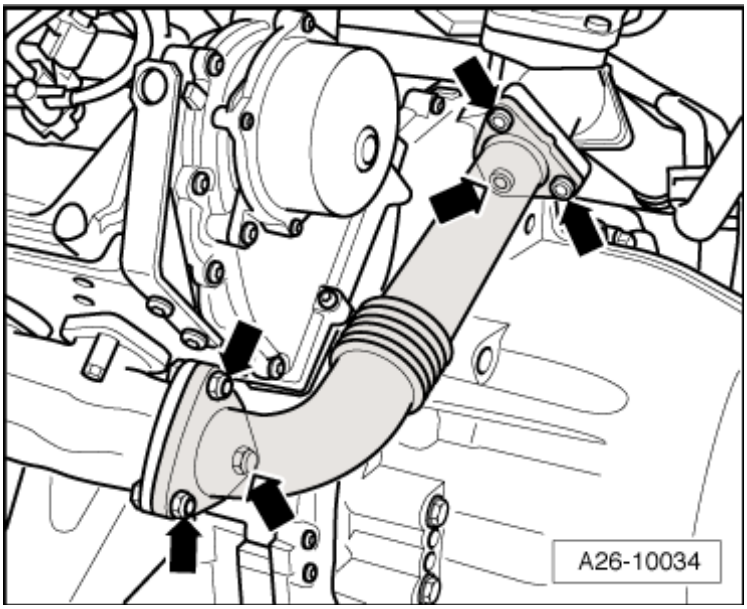


Fig. 59: Identifying Nuts And Bolts -Arrows-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the right intermediate pipe bolts and nuts -1 through 4- and the pipe.

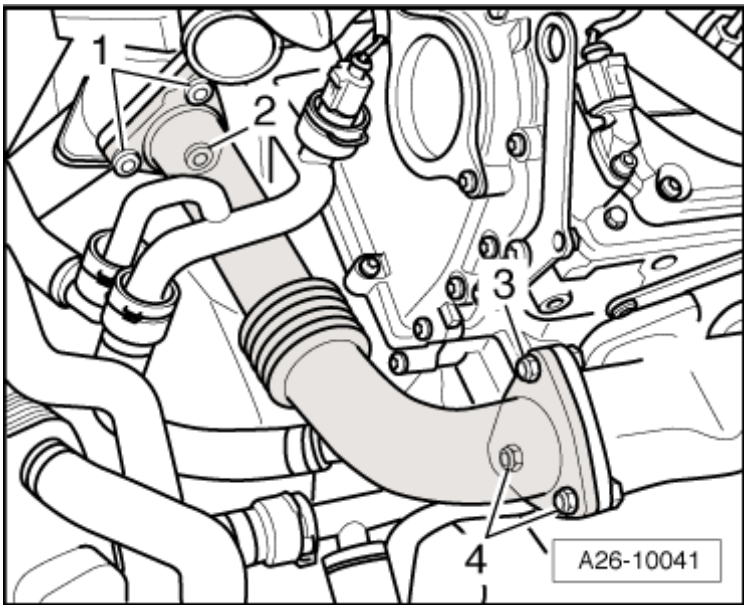


Fig. 60: Identifying Bolts And Nuts -1 Through 4-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the turbocharger bolts -arrows- and the turbocharger.

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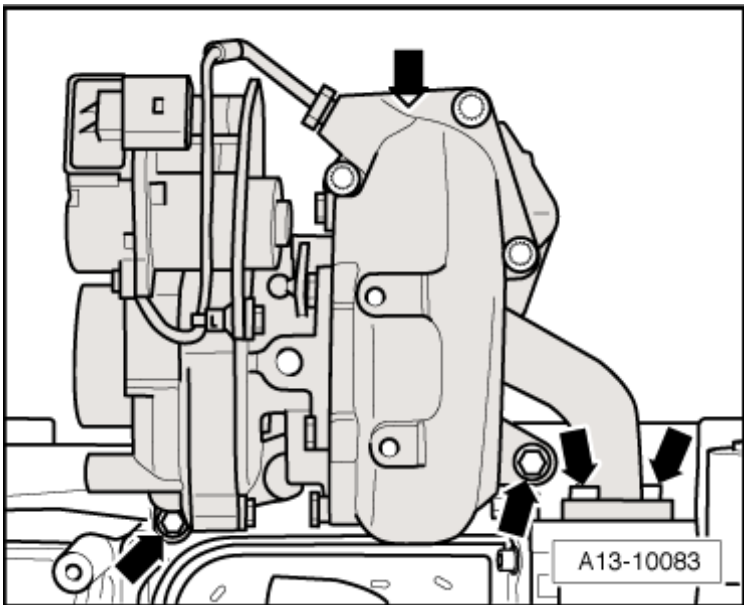


Fig. 61: Remove The Bolts -Arrows- And The Turbocharger.
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the vacuum pump bolt -arrows- and the vacuum pump.

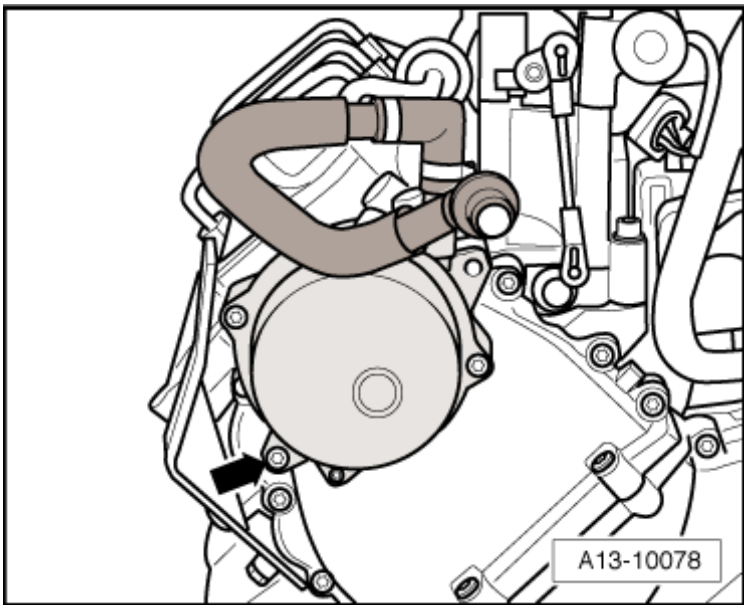


Fig. 62: Identifying The Bolt -Arrow- And Vacuum Pump
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

NOTE: The vacuum pump is installed on cylinder bank 1 (right side).

-- Remove the Exhaust Gas Recirculation (EGR) auxiliary cooler. Refer to **EGR SYSTEM AUXILIARY COOLER** .

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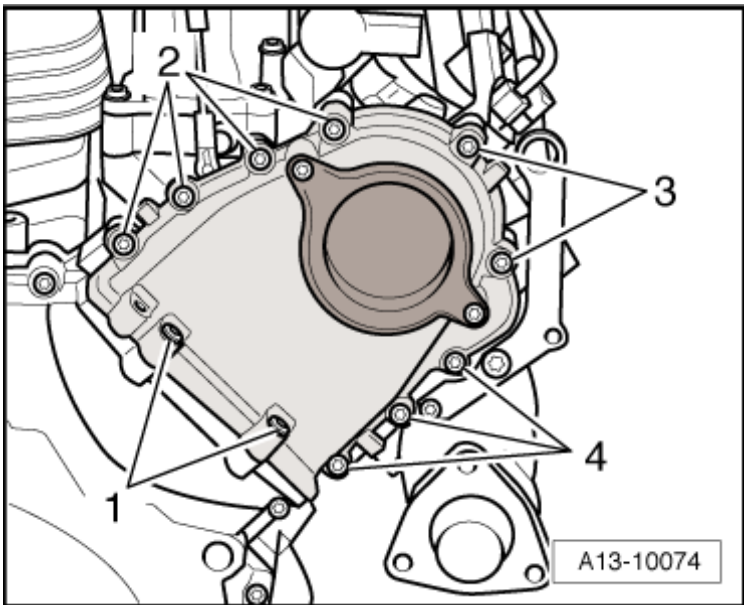


Fig. 63: Identifying Bolt Tightening Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the bolts -1 through 4- and the right timing chain cover.

-- Remove the bolts -1 through 4- and the left timing chain cover.

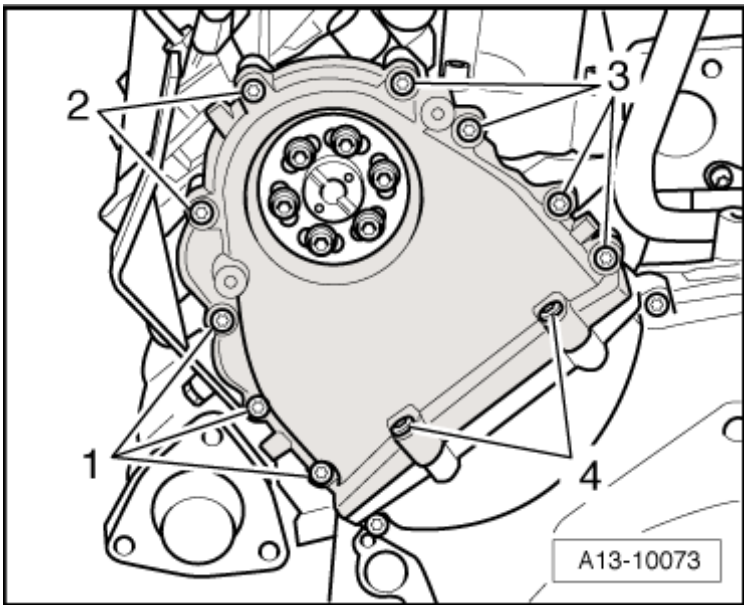


Fig. 64: Identifying Bolt Tightening Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the bolts -1 through 9- and the lower timing chain cover.

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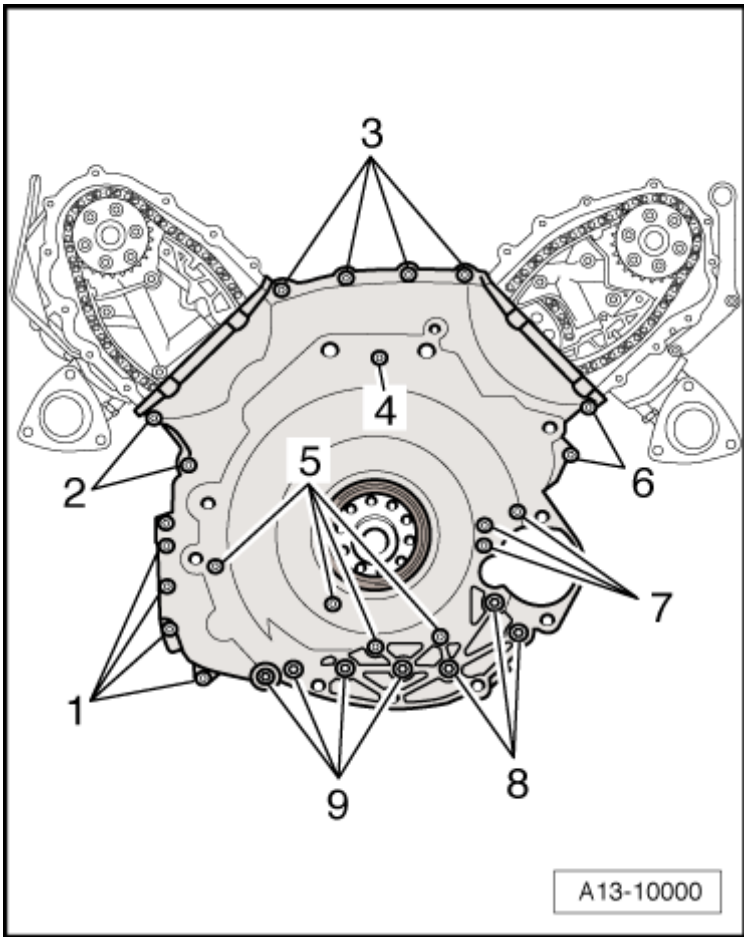


Fig. 65: Identifying Lower Timing Chain Cover Bolt Tightening Sequence and Specification
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Press the seal for crankshaft out of the cover.

Installing

NOTE: Replace gaskets, seals and O-rings.

During installation, all wire ties must be installed again at the same location.

-- Remove the old sealant from the grooves in the timing chain covers and from the sealing surfaces.

WARNING: Wear safety glasses.

-- Remove the sealant residue from the timing chain covers and the cylinder block or cylinder head with a rotating plastic brush.

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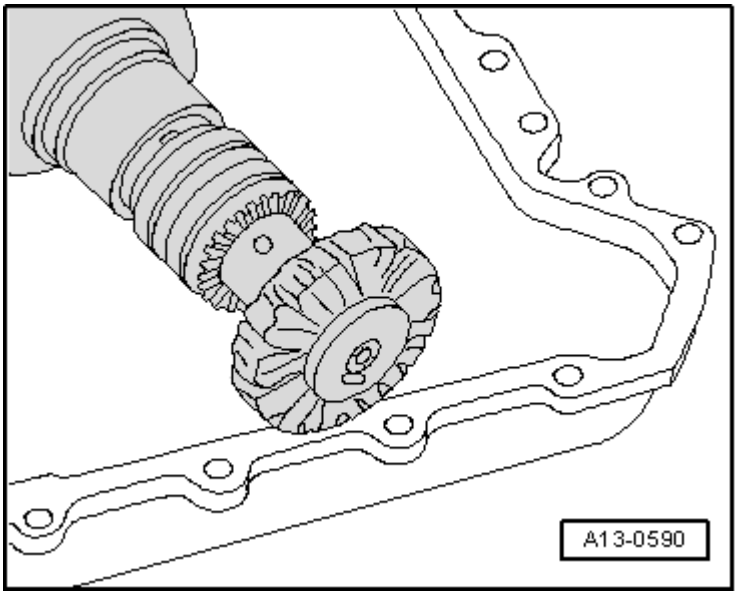


Fig. 66: Identifying Rotating Plastic Brush To Remove Sealant Residue From Sealing Flange, Cylinder Block And Upper Part Of Oil Pan
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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

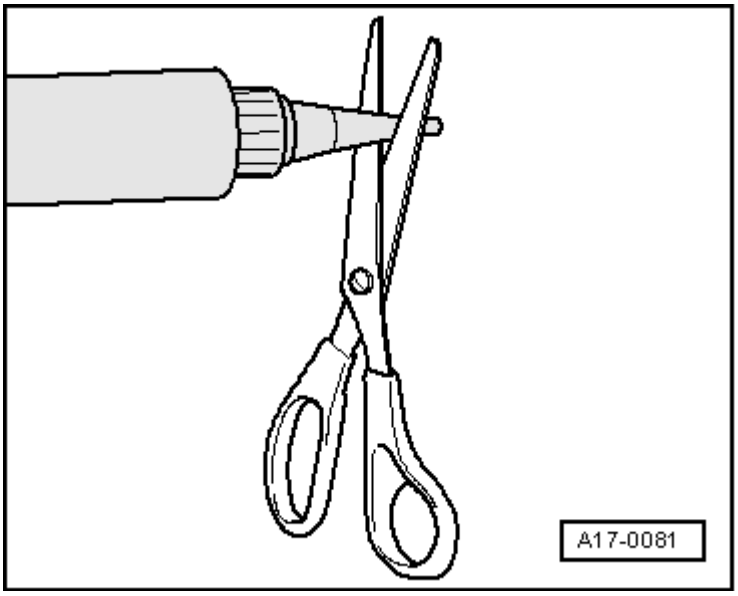


Fig. 67: Cutting Tube Nozzle At Front Marking (Nozzle Diameter Approx. 2 mm)
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

NOTE: The sealant bead must not be thicker than specified or excess sealant could enter the oil pan and clog the oil pump strainer.

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The timing chain covers must be installed within 5 minutes after applying the sealant.

-- Insert the seals -2 and 5-.

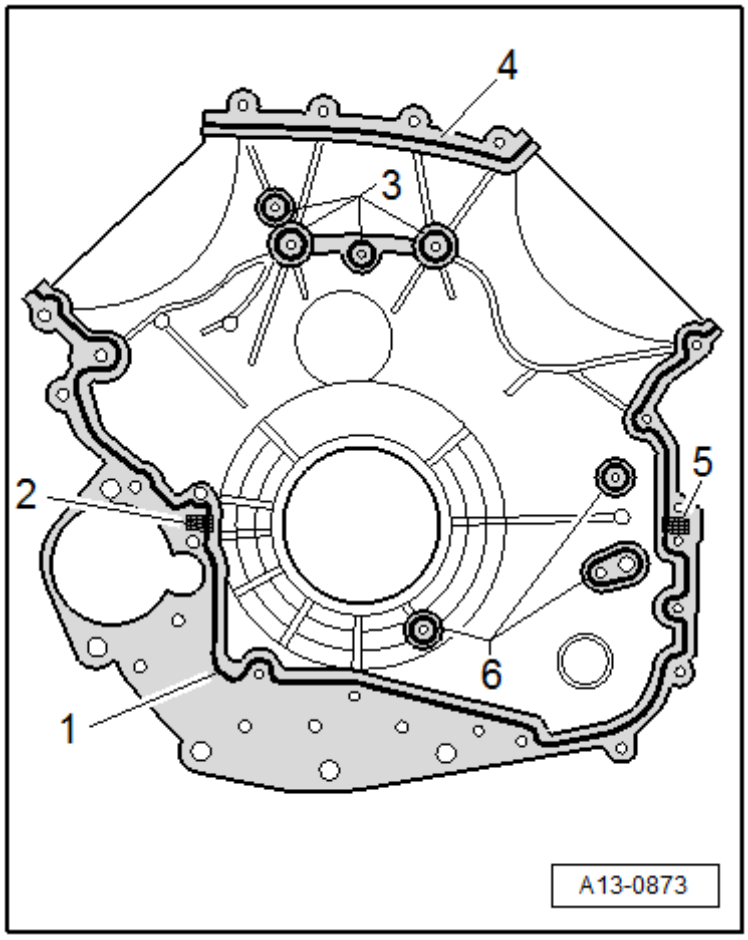


Fig. 68: Installing Seals -2 And 5-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Apply the sealant beads -1 and 4- to the clean sealing surfaces of the lower timing chain cover as illustrated.

- Completely fill the grooves on the sealing surfaces with sealant.
- The sealant bead must be 1.5 to 2.0 mm above the sealing surface.
- The bead of sealant around the holes - 3 and 6- must be 1.5 to 2.0 mm thick.

-- Check whether the 2 alignment bushings are present in the cylinder block, install them if necessary.

-- Position the lower timing chain cover and tighten bolts as follows.

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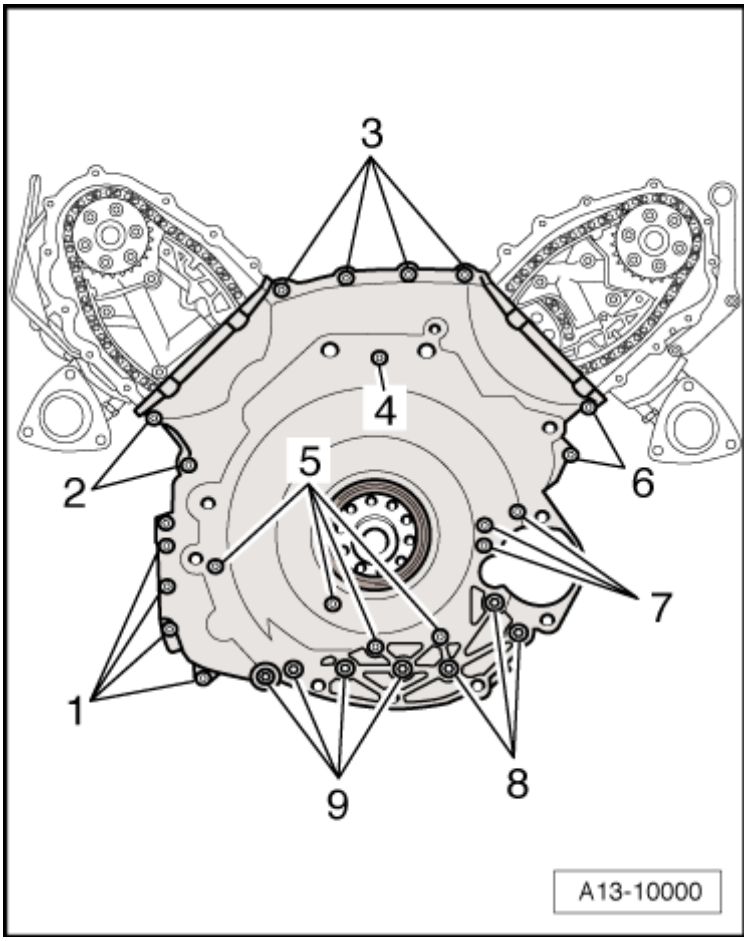


Fig. 69: Identifying Lower Timing Chain Cover Bolt Tightening Sequence and Specification
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Tighten the bolts in 3 steps according to the tightening sequence:

Step	Bolts	Tightening Specification
1.	-1 through 9-	5 Nm working from the inside toward the outside and diagonally
2.	-1 through 7-	9 Nm working from the inside toward the outside and diagonally

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3.	-8 and 9-	23 Nm

-- Apply the sealant bead to the clean sealing surfaces of the left timing chain cover as illustrated.

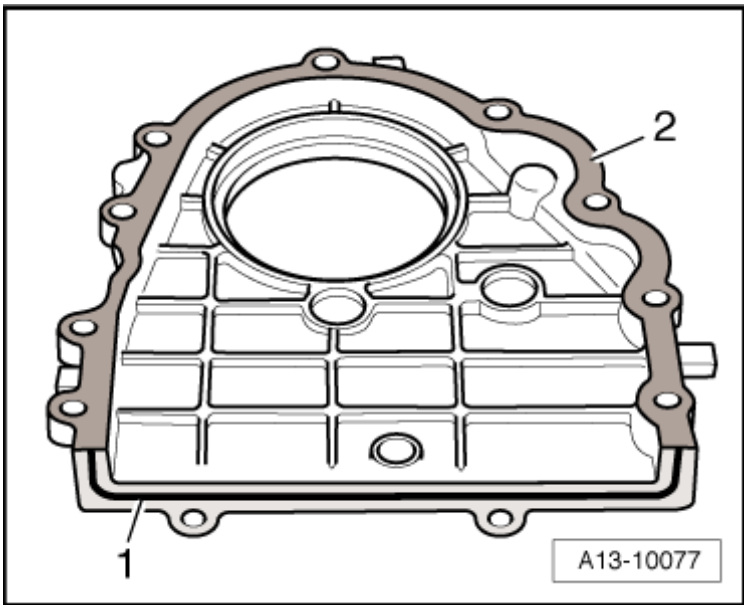


Fig. 70: Applying Sealant Bead To Clean Sealing Surfaces
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- The groove -1- in the sealing surface must be completely filled with sealant.
- The sealant bead must be 1.5 to 2.0 mm above the sealing surface.

-- Install the gasket -2-.

-- Apply a sealant bead with a 3 mm diameter to the transitions between the cylinder head and lower timing chain cover -arrows- as illustrated.

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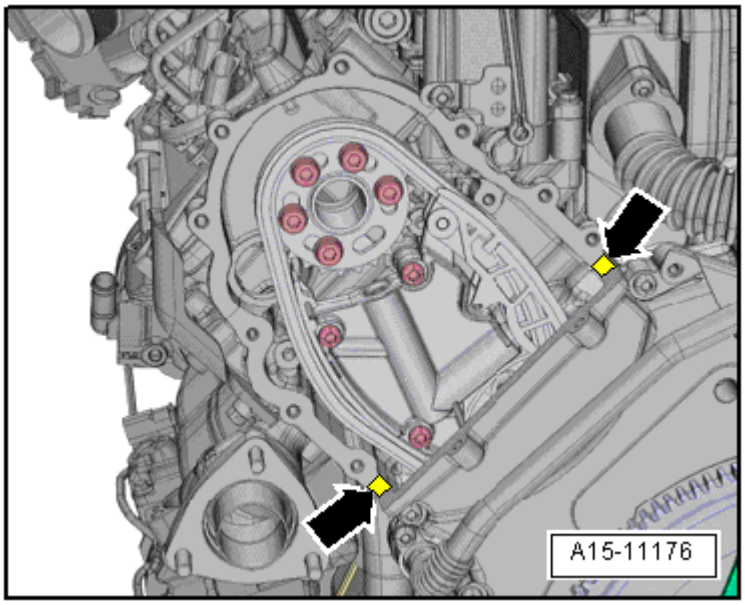


Fig. 71: Applying Sealant Bead
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CAUTION: The lubrication system could be plugged with excess sealant.

- **Do not apply the sealant bead thicker than specified.**

-- Install the left timing chain cover and tighten the bolts as follows:

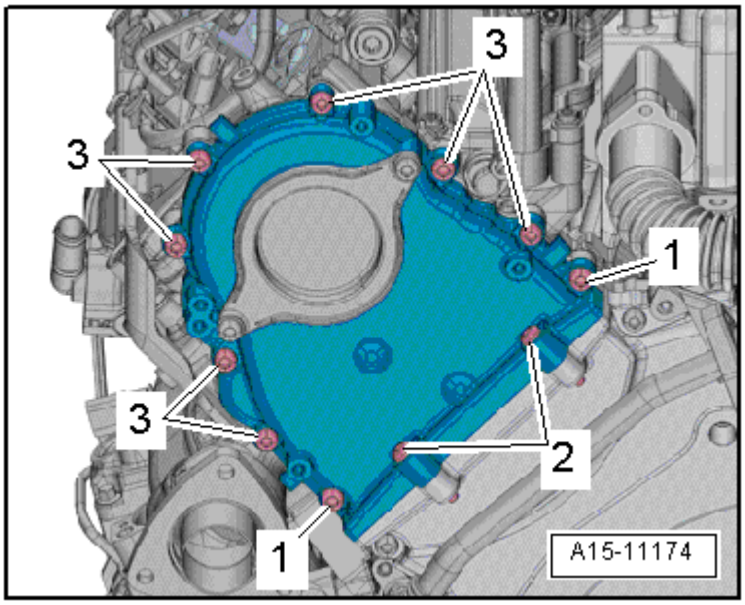


Fig. 72: Identifying Left Timing Chain Cover
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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-- Tighten the bolts in 4 steps according to the tightening sequence:

Step	Bolt	Tightening Specifications
1.	-1-	3 Nm
2.	-2-	9 Nm
3.	-1-	9 Nm
4.	-3-	9 Nm in a diagonal sequence

-- Apply the sealant bead to the clean sealing surfaces of the right timing chain cover as illustrated.

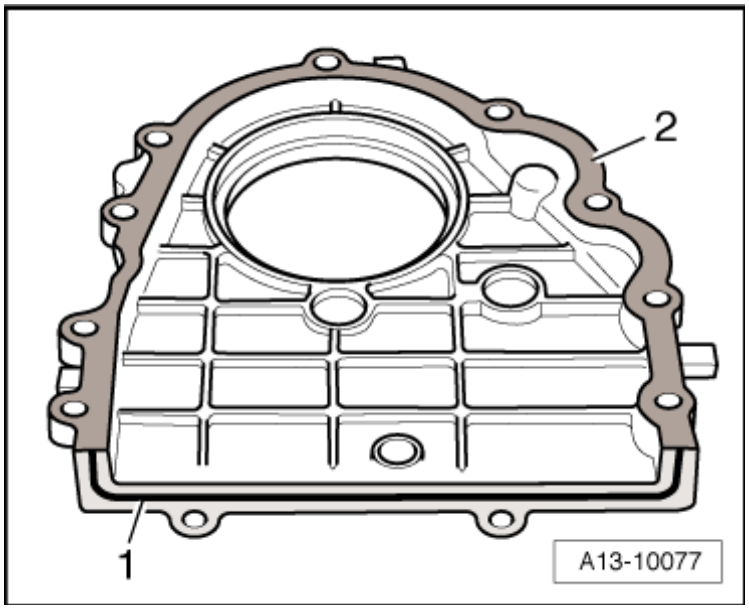


Fig. 73: Applying Sealant Bead To Clean Sealing Surfaces
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- The groove -1- of the sealing surface must be completely filled with sealant.
- The sealant bead must be 1.5 to 2.0 mm above the sealing surface.

-- Install the gasket -2-.

-- Apply a sealant bead with a 3 mm diameter to the transitions between the cylinder head and lower timing chain cover -arrows- as illustrated.

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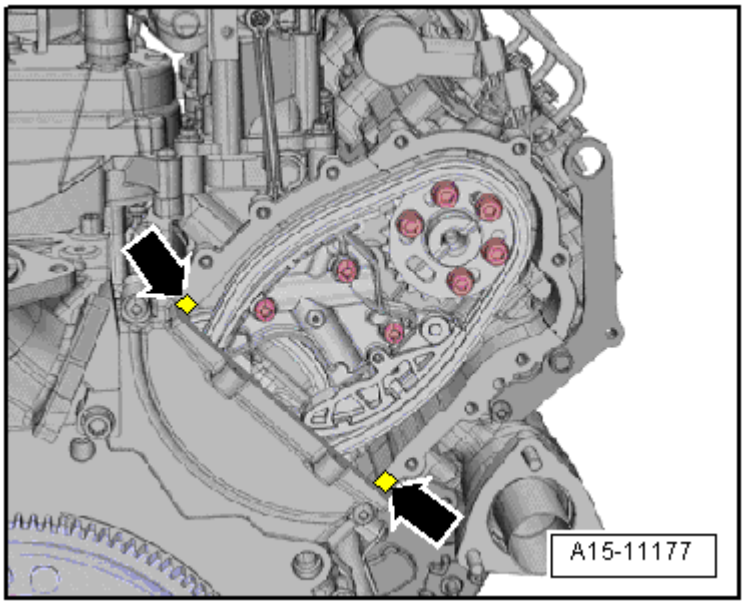


Fig. 74: Applying Sealant Bead
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CAUTION: The lubrication system could be plugged with excess sealant.

- **Do not apply the sealant bead thicker than specified.**

-- Install the right timing chain cover and tighten the bolts as follows:

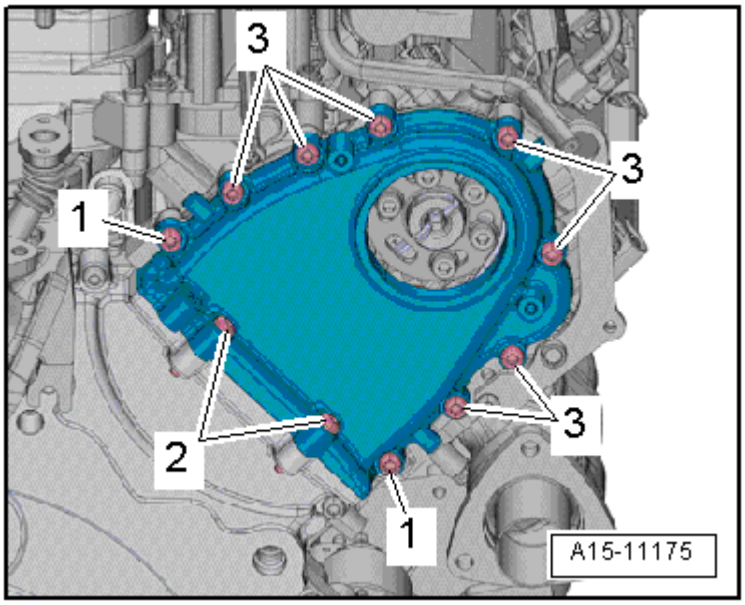


Fig. 75: Identifying Right Timing Chain Cover, Tightening Specifications And Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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-- Tighten the bolts in 4 steps according to the tightening sequence:

Step	Bolt	Tightening Specifications
1.	-1-	3 Nm
2.	-2-	9 Nm
3.	-1-	9 Nm
4.	-3-	9 Nm in a diagonal sequence

Further installation is performed in reverse order.

BALANCE SHAFT

Special tools and workshop equipment required

- Used Oil Collecting and Extracting Device V.A.G 1782
- Diesel Injection Pump Locking Pin 3359
- Crankshaft Holder 3242
- Key T40049

Removing

-- Drain the engine oil.

-- Remove the engine. Refer to **ENGINE, REMOVING** .

-- Separate the engine and transmission. Refer to **ENGINE, REMOVING FROM THE Scissor Type Assembly Platform (US) VAS 6131 A** .

-- Secure the engine to the engine and transmission holder. Refer to **ENGINE, SECURING TO THE Engine and Transmission Holder VAS 6095** .

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

-- Remove the shim behind it.

-- Remove the timing chain covers. Refer to **TIMING CHAIN COVERS**.

-- Remove front sealing flange. Refer to **FRONT SEALING FLANGE**.

-- Install the key T40049 to the rear of the crankshaft with two used drive plate bolts.

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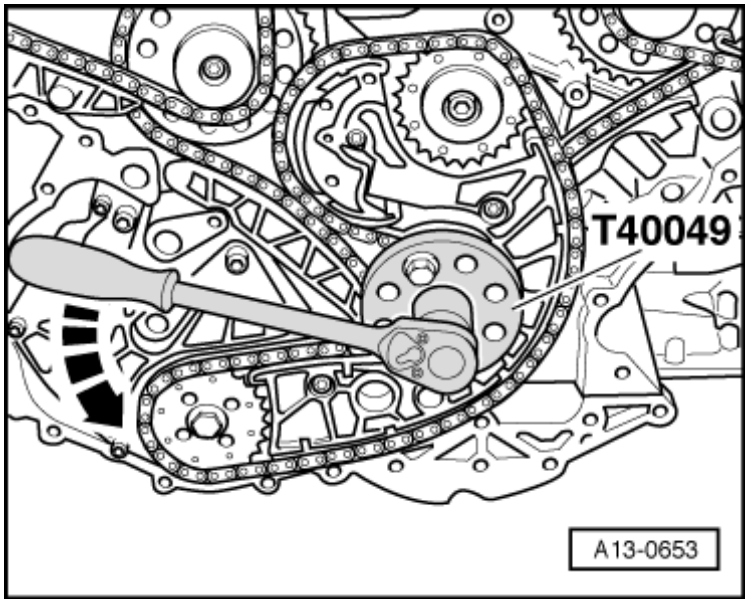


Fig. 76: Rotating Crankshaft To TDC Ignition Timing
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Lay a cloth under the upper oil pan to collect any leaking engine oil.

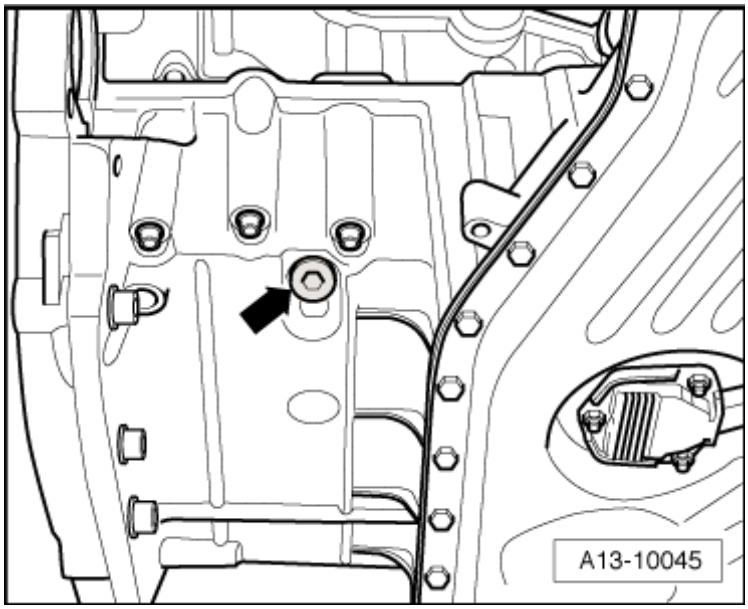


Fig. 77: Identifying Locking Bolt Of Upper Part Of Oil Pan
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the plug -arrow - from the upper oil pan.

WARNING: Do not rotate the crankshaft while touching the Top Dead Center (TDC) opening with a finger or injury could result.

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-- Install the crankshaft holder 3242 in the hole and tighten it to 20 Nm. Rotate the crankshaft -1- back and forth slightly, if necessary to center the holder completely.

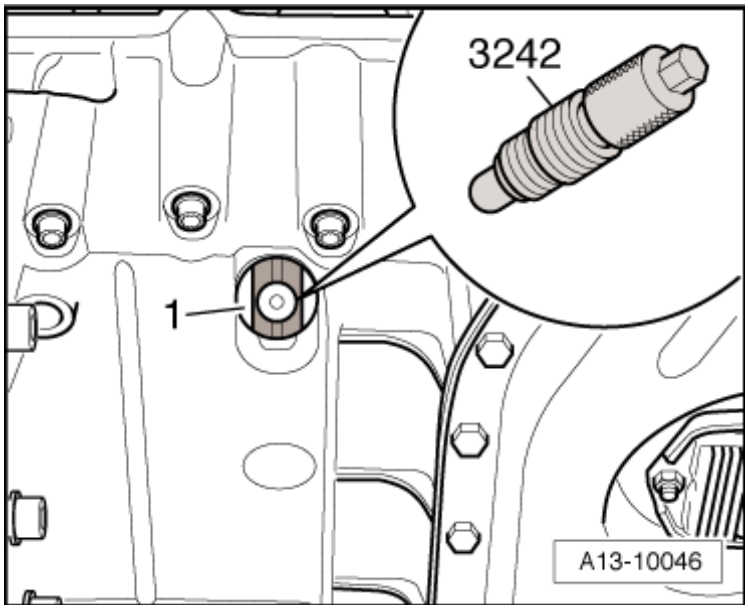


Fig. 78: Identifying Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Secure the balance shaft on the front of the engine using the diesel injection pump locking pin 3359.

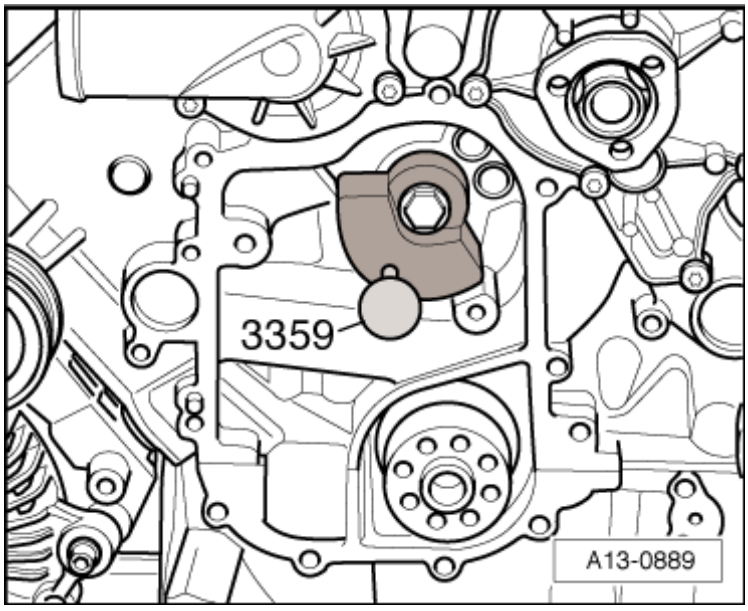


Fig. 79: Securing Balance Shaft Using Diesel Injection Pump Locking Pin 3359
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the bolt and the balance weight from the balance shaft.

-- Secure the balance shaft on the rear of the engine using the diesel injection pump locking pin 3359.

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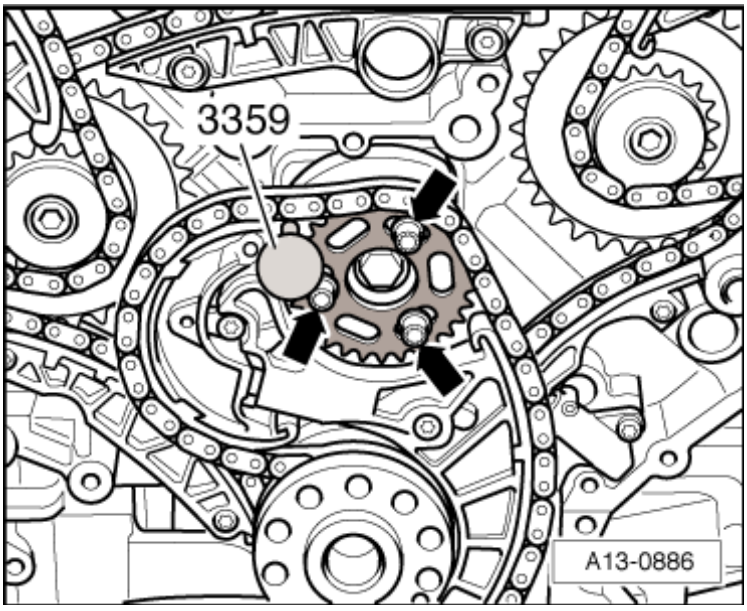


Fig. 80: Securing Balance Shaft At Rear Of Engine Using Diesel Injection Pump Locking Pin 3359
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the bolts -arrows- and the sprocket from the balance weight.

-- Remove the bolt -arrow- and the balance weight from the balance shaft.

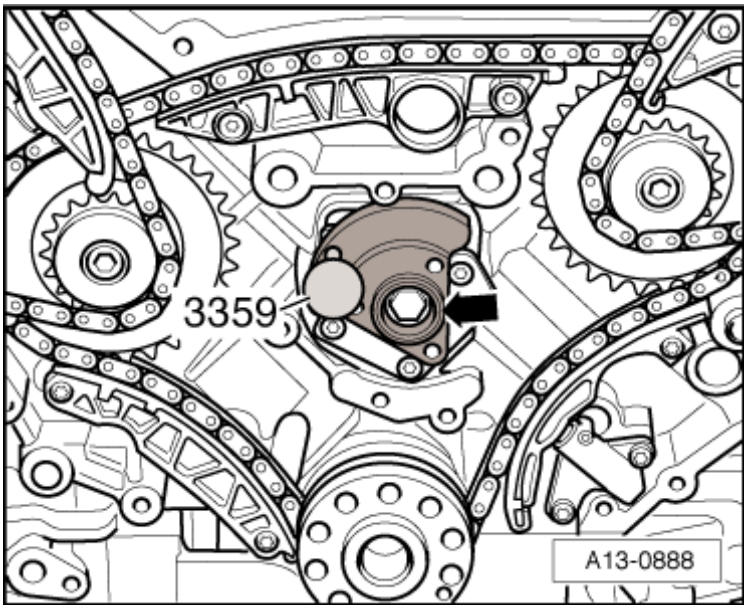


Fig. 81: Locking Rear Balance Shaft -Arrow- To Engine Using Diesel Injection Pump Locking Pin 3359
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the bolts -arrows- and remove the balance shaft bearing end bracket.

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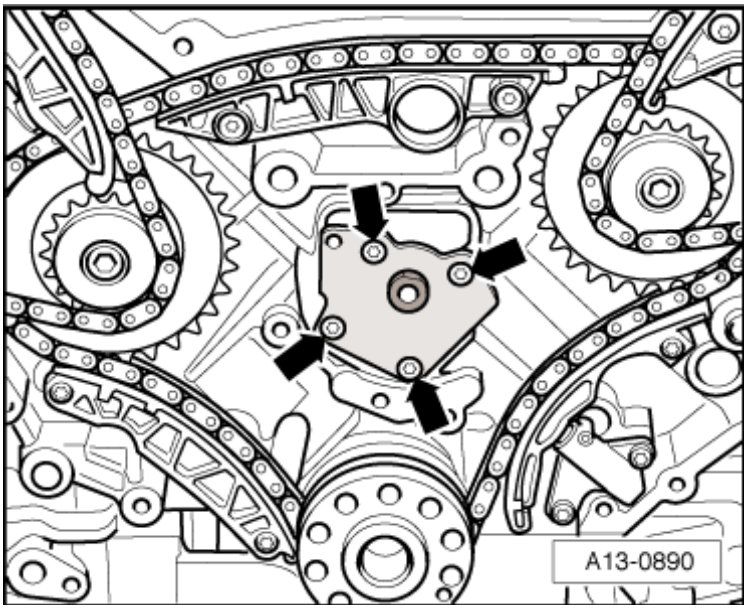


Fig. 82: Identifying Bolts -Arrows- And Balance Shaft Bearing End Bracket
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the balance shaft from the cylinder block.

Installing

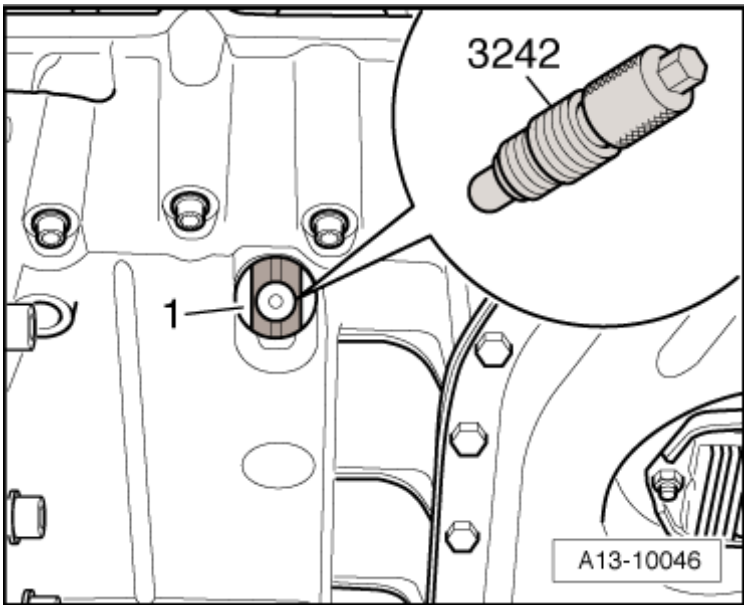


Fig. 83: Identifying Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Secure the crankshaft in the TDC position using the crankshaft holder 3242.

Install in reverse order of removal.

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TIMING MECHANISM DRIVE CHAIN

Special tools and workshop equipment required

- Locking Pin T40071

Removing

- Transmission is removed.

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

-- Remove the timing chain covers. Refer to **TIMING CHAIN COVERS**.

-- Remove the camshaft timing chains. Refer to **CAMSHAFT TIMING CHAINS** .

-- Remove the balance shaft and oil pump chain. Refer to **BALANCE SHAFT AND OIL PUMP CHAIN**.

-- Press the drive chain tensioning rail in the -direction of the arrow- and secure the chain tensioner using a locking pin T40071.

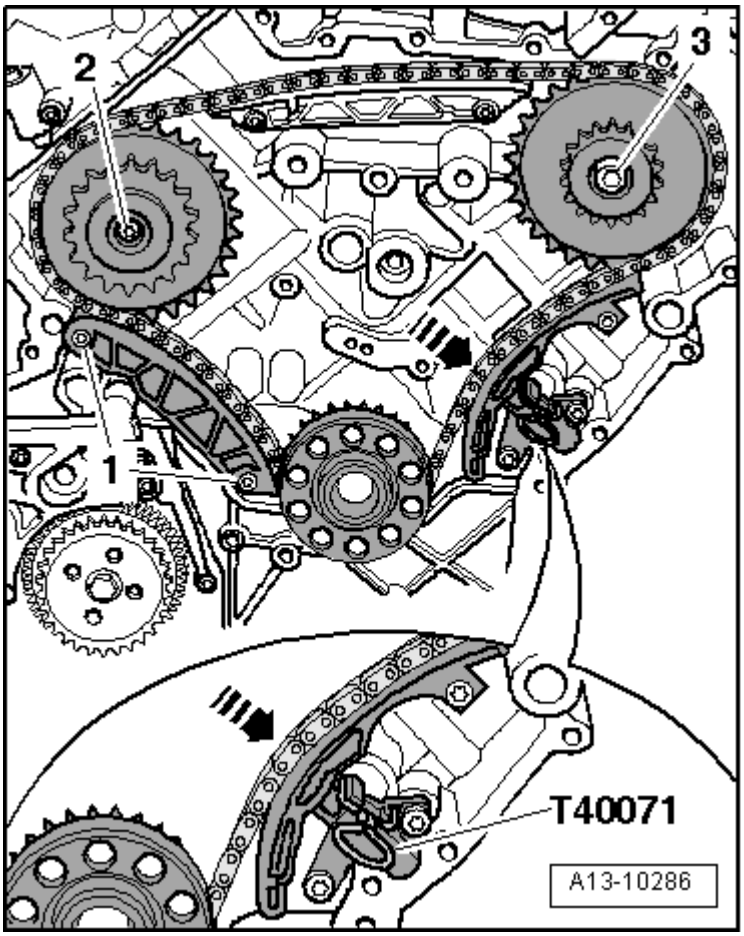


Fig. 84: Pressing And Securing Drive Chain Tensioner Rail Using Locking Pin T40071

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Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CAUTION: Risk of destroying due to reversed running direction of a used drive chain.

- **Mark the drive chain running direction with arrows using paint for reinstallation later.**

-- Remove the bolt and pivot pin -1- and the guide rail.

-- Remove the bolts -2 and 3- and remove the drive sprockets and timing chain.

Installing

- For the correct tightening specifications, refer to **TIMING MECHANISM DRIVE CHAIN OVERVIEW**.

Install in reverse order of removal. Note the following:

-- Install the balance shaft and oil pump chain. Refer to **BALANCE SHAFT AND OIL PUMP CHAIN**.

-- Install the camshaft timing chains. Refer to **CAMSHAFT TIMING CHAINS** .

-- Install the timing chain covers. Refer to **TIMING CHAIN COVERS**.

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

-- Fill the oil and then check the level.

BALANCE SHAFT AND OIL PUMP CHAIN

Special tools and workshop equipment required

- Crankshaft Holder 3242
- Diesel Injection Pump Locking Pin 3359
- Key T40049
- 3.3 mm Diameter Drill Bit

Removing

- Transmission is removed.

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

-- Remove the timing chain covers. Refer to **TIMING CHAIN COVERS**.

-- Install the key T40049 to the rear of the crankshaft using two used drive plate bolts -arrows-.

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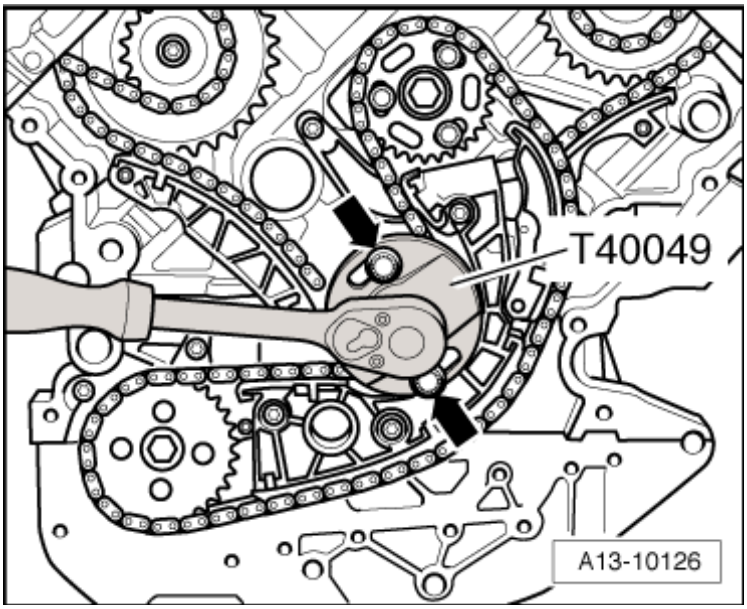


Fig. 85: Identifying Key T40049 At Rear On Crankshaft And 2 Old Bolts For Dual-Mass Flywheel
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the plug -arrow- from the upper oil pan.

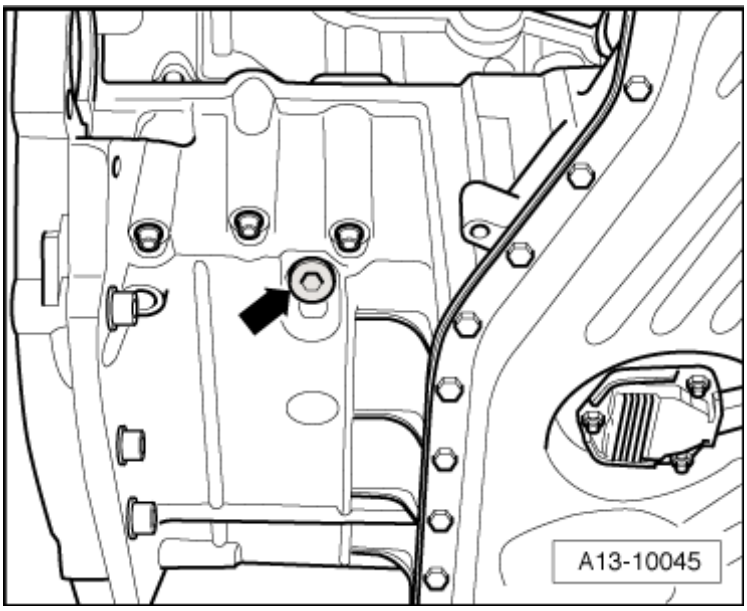


Fig. 86: Identifying Locking Bolt Of Upper Part Of Oil Pan
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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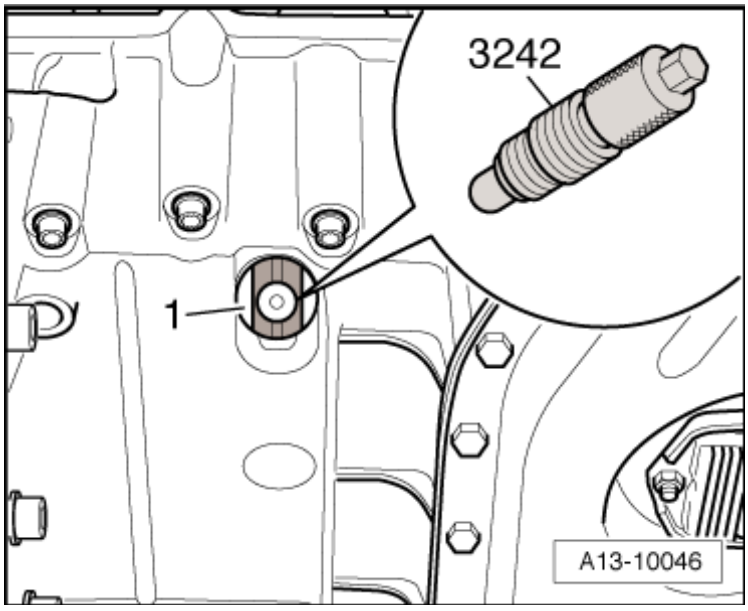


Fig. 87: Identifying Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

WARNING: Risk of injury when touching the Top Dead Center (TDC) hole with finger.

- **Do not rotate the crankshaft -1-.**

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

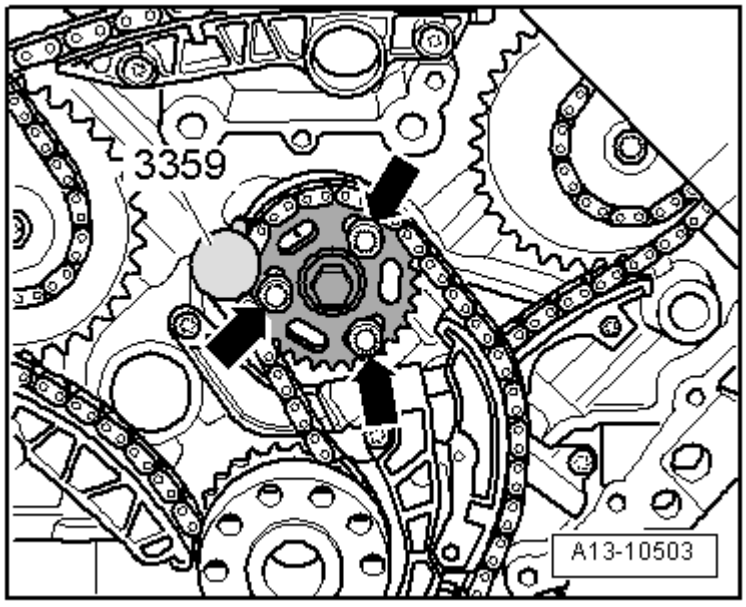


Fig. 88: Rotating Crankshaft Back And Forth Slightly To Center Crankshaft Holder 3242
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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CAUTION: Reversing the running direction of a used balance shaft and oil pump chain can destroy it.

- **Paint arrows to mark the running direction of the balance shaft and oil pump chain so it can be reinstalled later.**

-- Lock the rear balance shaft on the engine using the diesel injection pump locking pin 3359 and loosen the bolts -arrows- for balance shaft sprocket.

-- To protect against cuts, wrap the point and the cutting edges of a 3.3 mm drill bit with insulating tape.

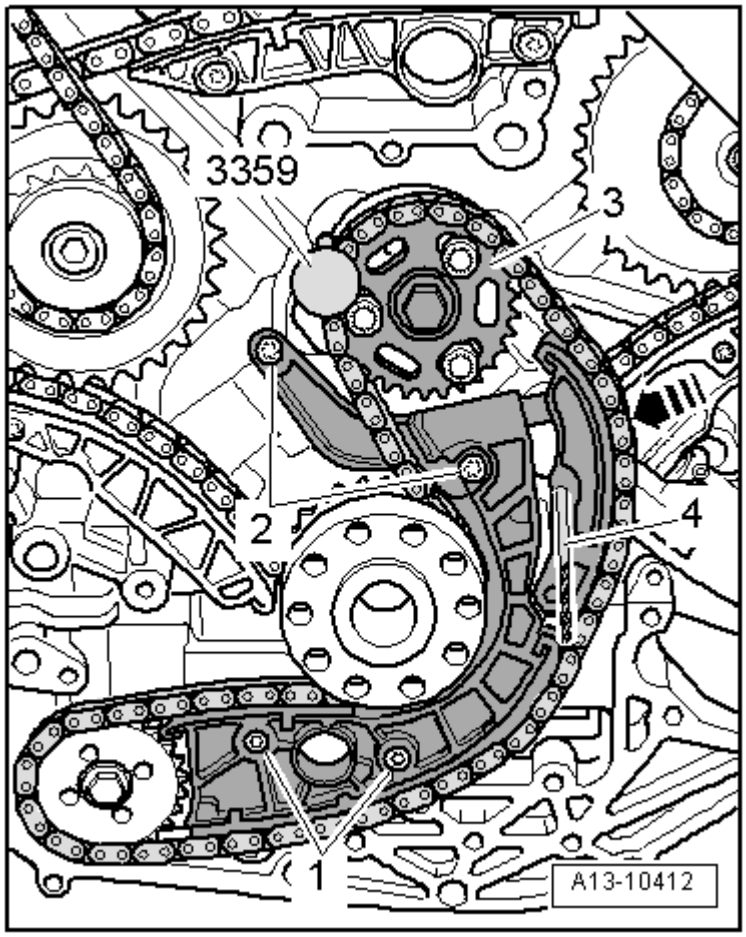


Fig. 89: Locking Pin 3359 And Loosening Bolts
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Push the guide rail for the chain tensioner in the -direction of the arrow- and then lock the chain tensioner using the a 3.3 mm drill bit -4-.

-- Remove the bolts -1 and 2- and remove the chain tensioner, sprocket -3- and chain.

Installing

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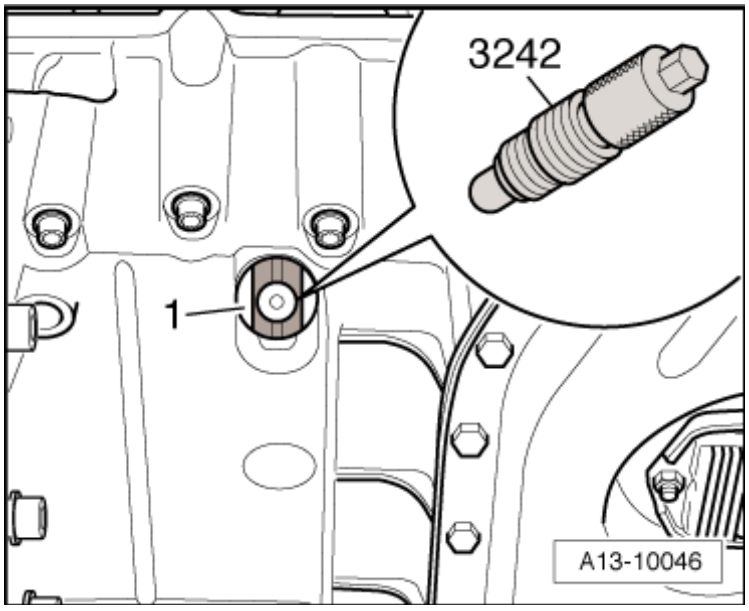


Fig. 90: Identifying Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- For the correct tightening specifications, refer to **BALANCE SHAFT AND OIL PUMP CHAIN OVERVIEW**.
- Secure the crankshaft -1- in the TDC position using the crankshaft holder 3242.

-- Lock the rear balance shaft -arrow- to the engine using the diesel injection pump locking pin 3359.

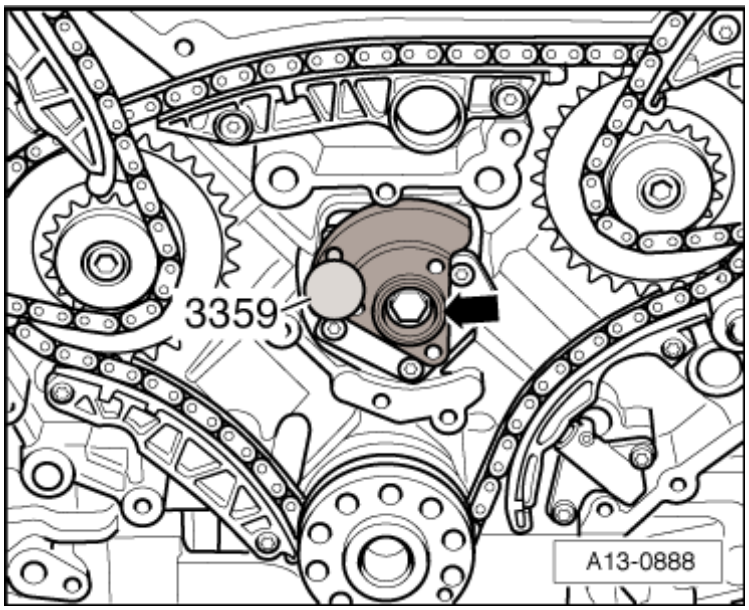


Fig. 91: Locking Rear Balance Shaft -Arrow- To Engine Using Diesel Injection Pump Locking Pin 3359
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Install the chain tensioner with the chain and the balance shaft sprocket.

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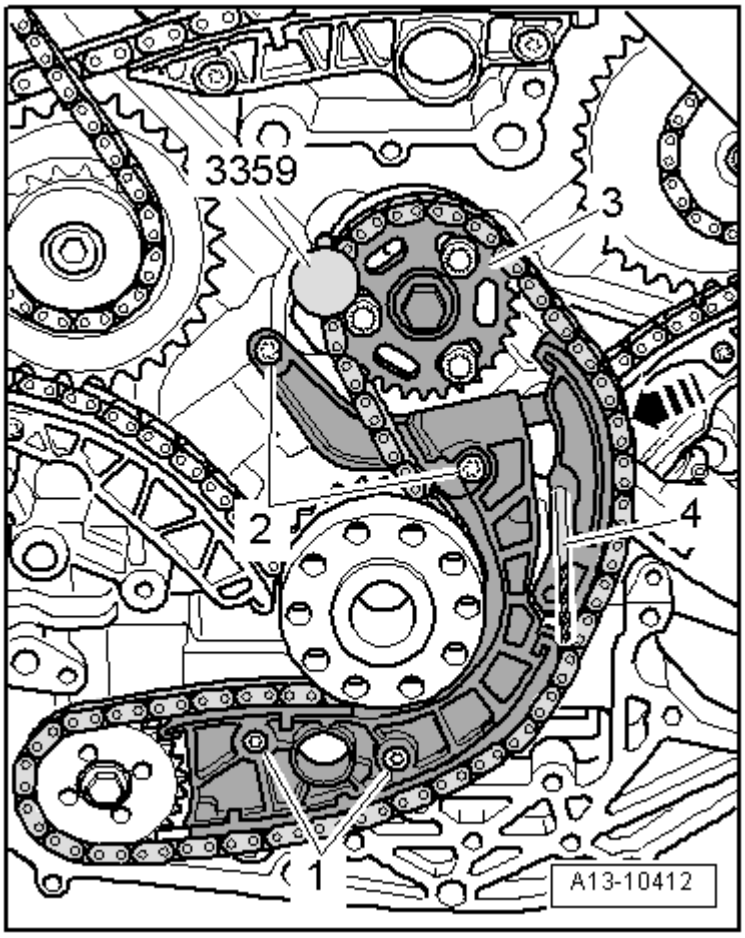


Fig. 92: Locking Pin 3359 And Loosen Bolts
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- The slots in the sprocket -3- must be in the center position to the threaded holes in the balance shaft.

-- Tighten the chain tensioner bolts -1 and 2-.

NOTE: Ignore -item 4- and the -arrows-.

-- Install the chain sprocket bolts -arrows- loosely.

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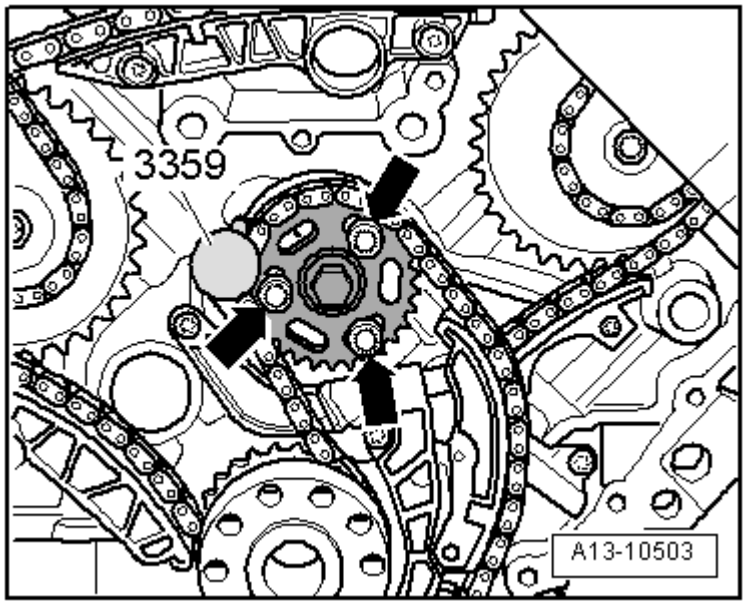


Fig. 93: Rotating Crankshaft Back And Forth Slightly To Center Crankshaft Holder 3242
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- It must still be possible to rotate the chain sprocket on the balance shaft and it must not tilt.

-- Remove the drill bit from the chain tensioner hole.

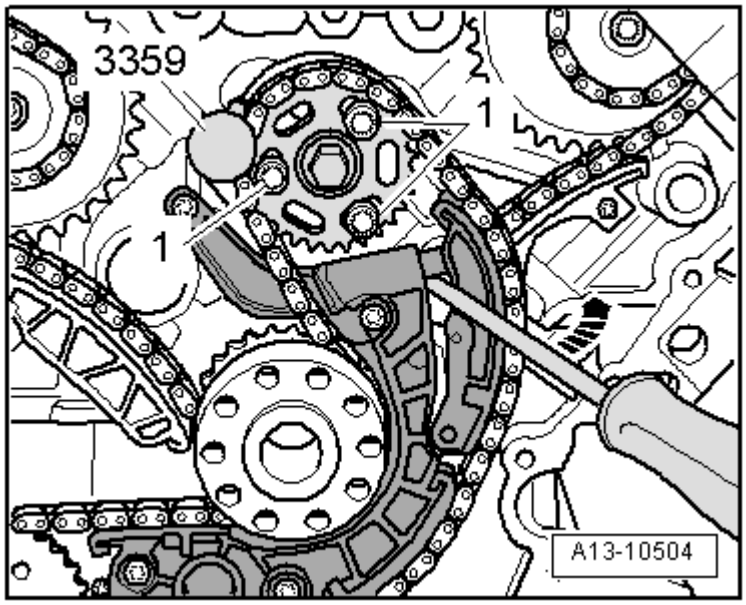


Fig. 94: Pushing Screwdriver In -Direction Of Arrow-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Push a screwdriver in the -direction of the arrow- against the chain tensioner guide rail while tightening the sprocket bolts -1-.

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-- Remove the diesel injection pump locking pin 3359 from the balance shaft.

Install in reverse order of removal. Note the following:

-- Install the timing chain covers. Refer to **TIMING CHAIN COVERS**.

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

-- Fill the oil and then check the level.

SPECIAL TOOLS

Special tools and workshop equipment required

- Dial Gauge Holder VW 387

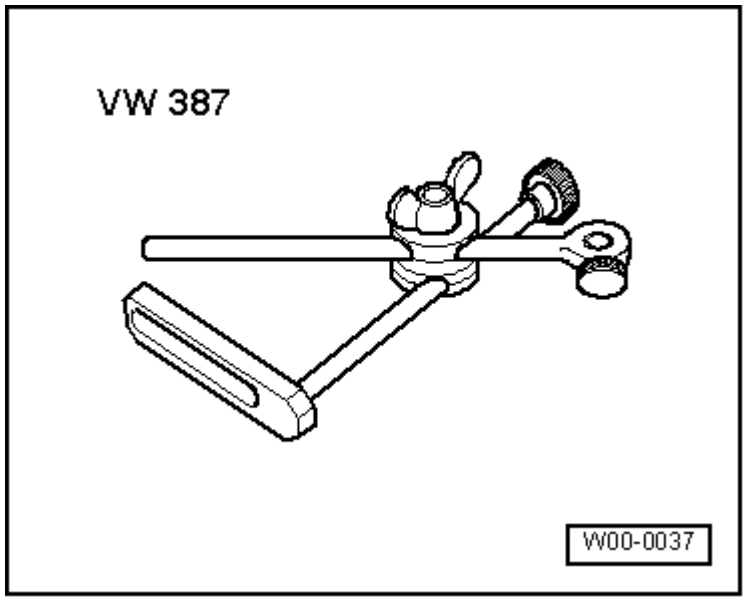


Fig. 95: Identifying Dial Gauge Holder VW 387
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Oil Seal Extractor T40019

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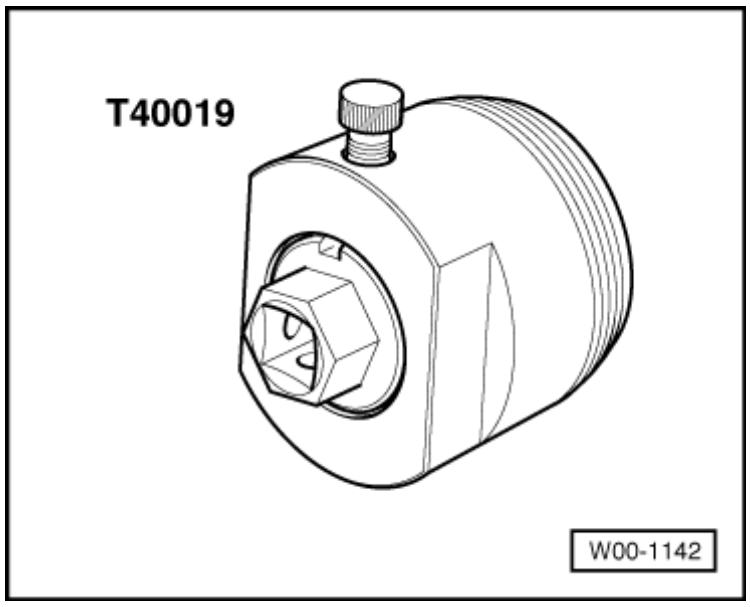


Fig. 96: Oil Seal Extractor T40019
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Assembly Device T40048

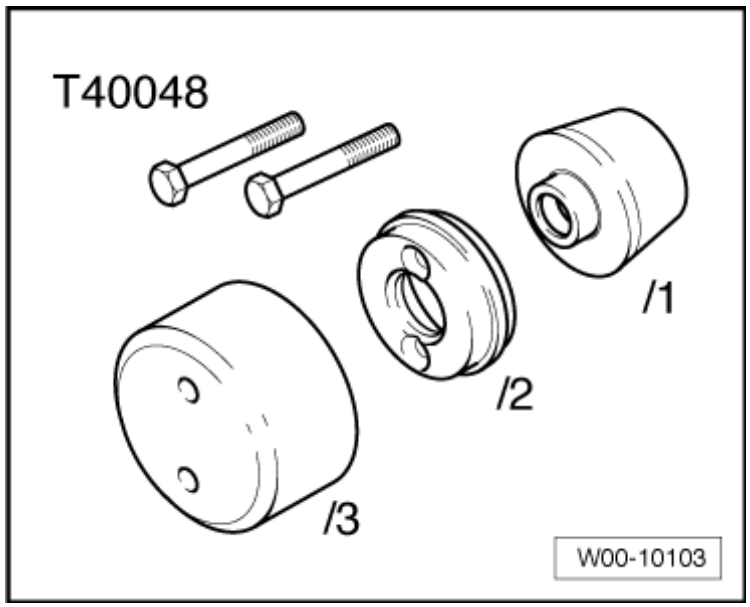


Fig. 97: Identifying Assembly Tool T40048
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Spanner Wrench 3212

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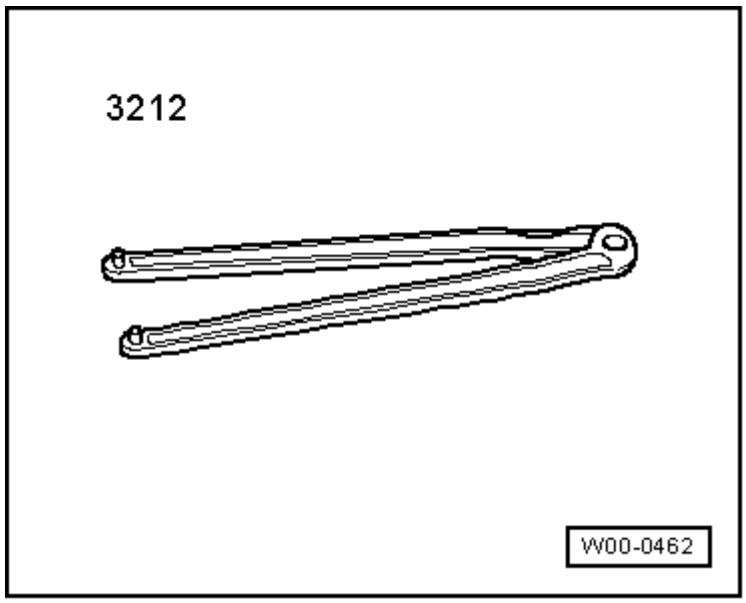


Fig. 98: Identifying Special Tool - Spanner Wrench 3212
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Counter Hold Tool 10-201

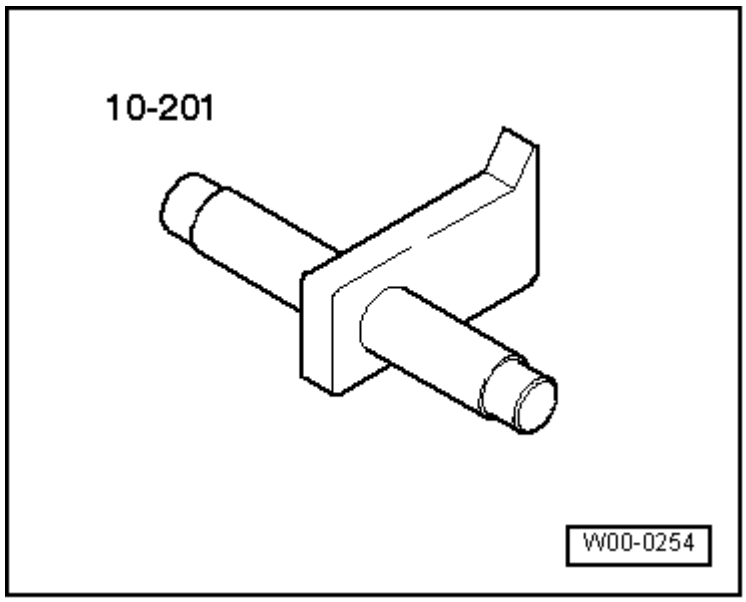


Fig. 99: Identifying Counter-Holder Tool 10 - 201
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Assembly Tool T10122

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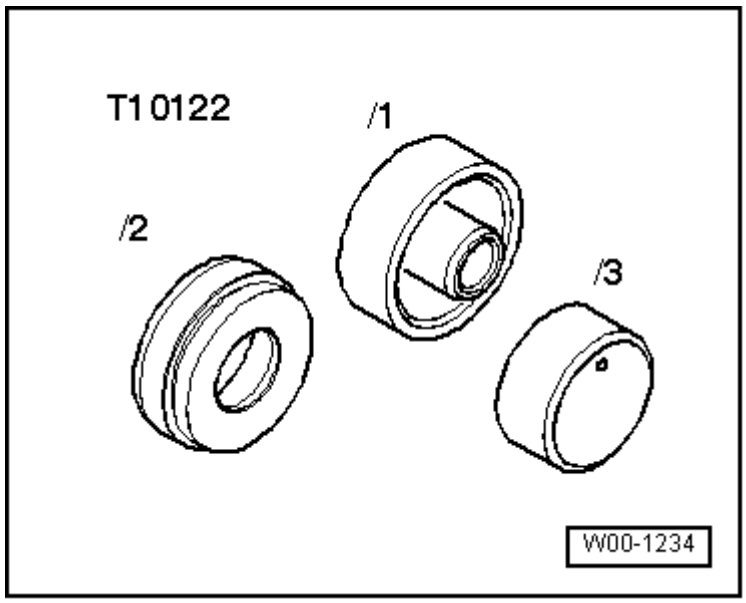


Fig. 100: Identifying Installation Tool T10122
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Pulling Hook T20143/2

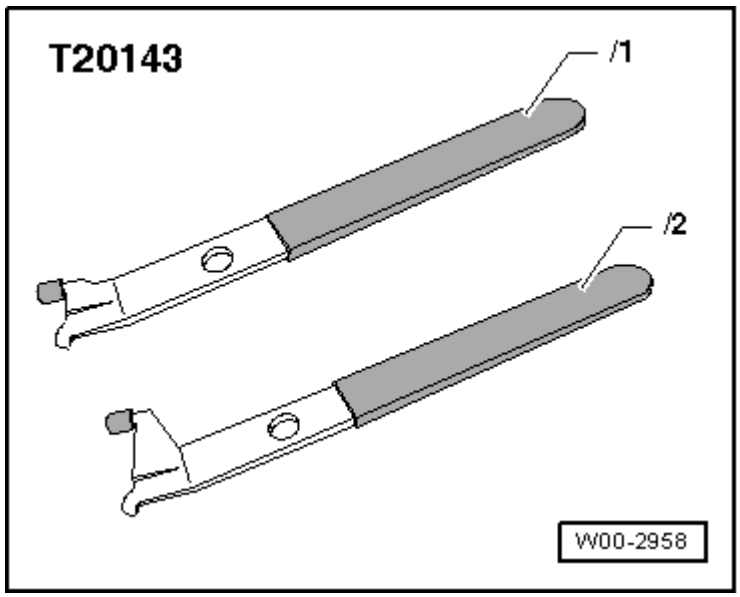


Fig. 101: Identifying Extractor Hook T20143
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Used Oil Collecting and Extracting Device V.A.G 1782

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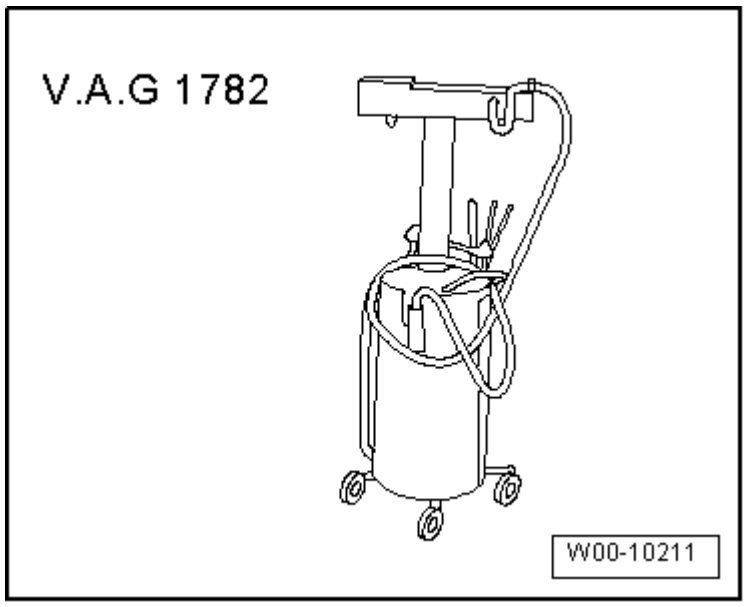


Fig. 102: Identifying Oil Extractor V.A.G 1782
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Locking Pin T40071

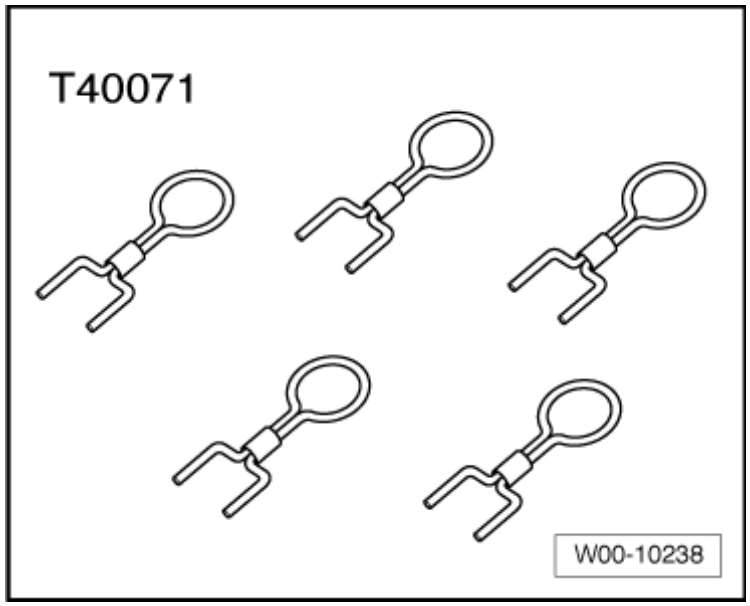


Fig. 103: Identifying Securing Pin T40071
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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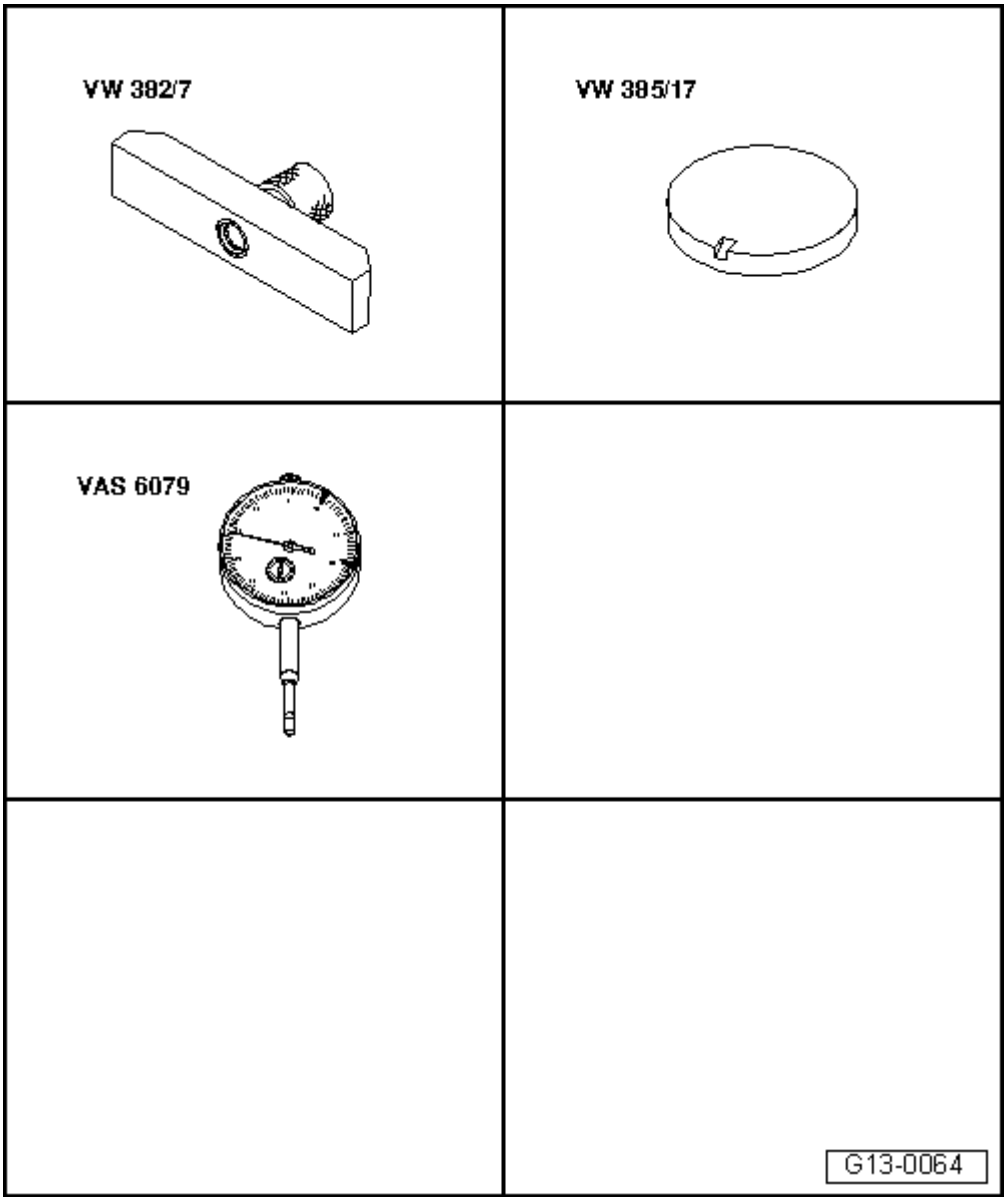


Fig. 104: Identifying VW 382/7, VW 385/17 And VAS 6079
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Special tools and workshop equipment required

- Measuring Bar VW 382/7
- Magnetic Plate 50 mm Dia. VW 385/17
- Dial Gauge 0-10 mm VAS 6079

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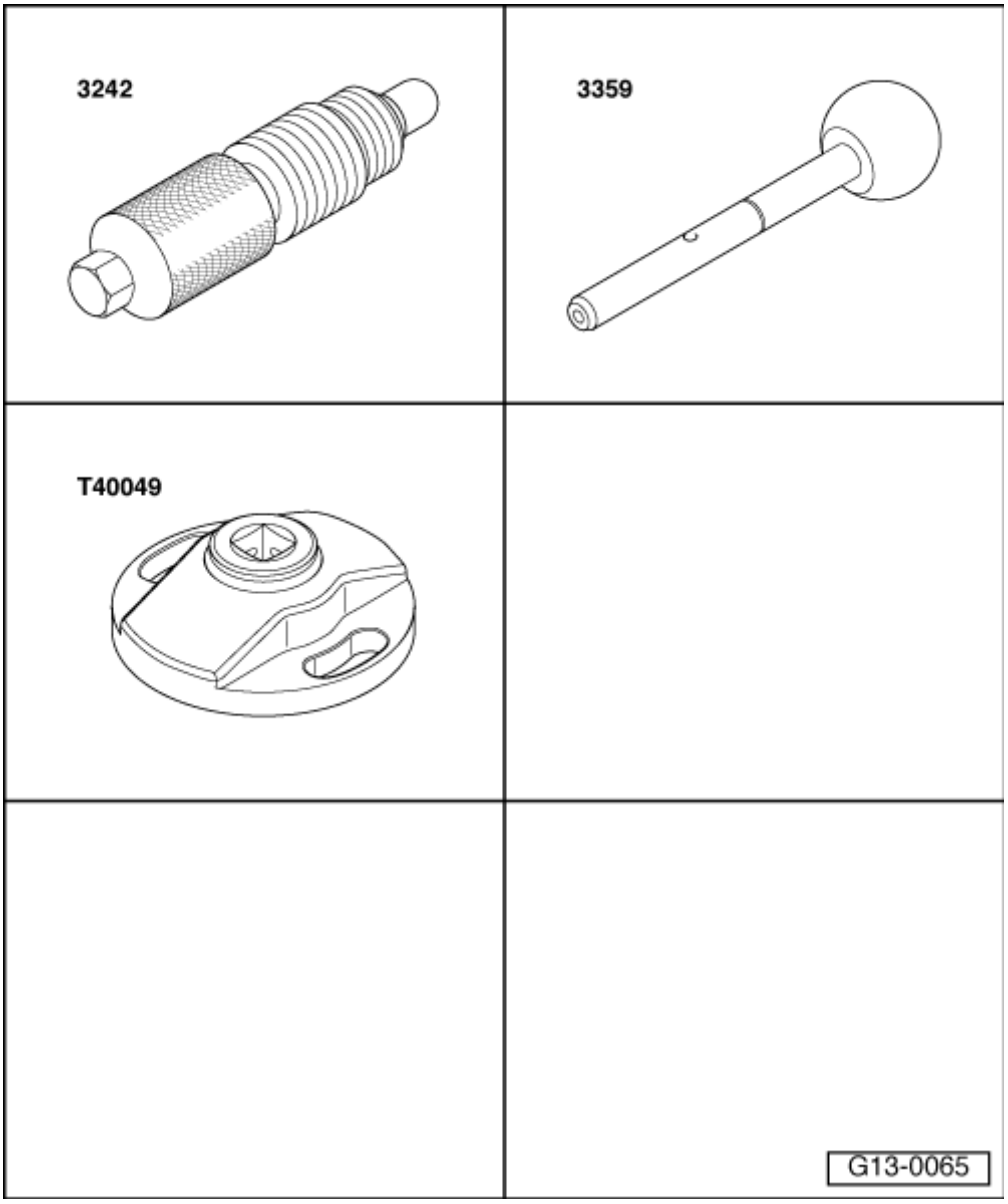


Fig. 105: Identifying Holder 3242, Pin 3359 And Key T40049
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Special tools and workshop equipment required

- Crankshaft Holder 3242
- Diesel Injection Pump Locking Pin 3359
- Key T40049

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ENGINE

3.0 Liter - Cylinder Head, Valvetrain - Engine Code(s): CATA

15 CYLINDER HEAD, VALVETRAIN

DESCRIPTION AND OPERATION

CYLINDER HEAD COVER OVERVIEW

NOTE: The illustration shows the cylinder head cover for cylinder bank 2 (left side).

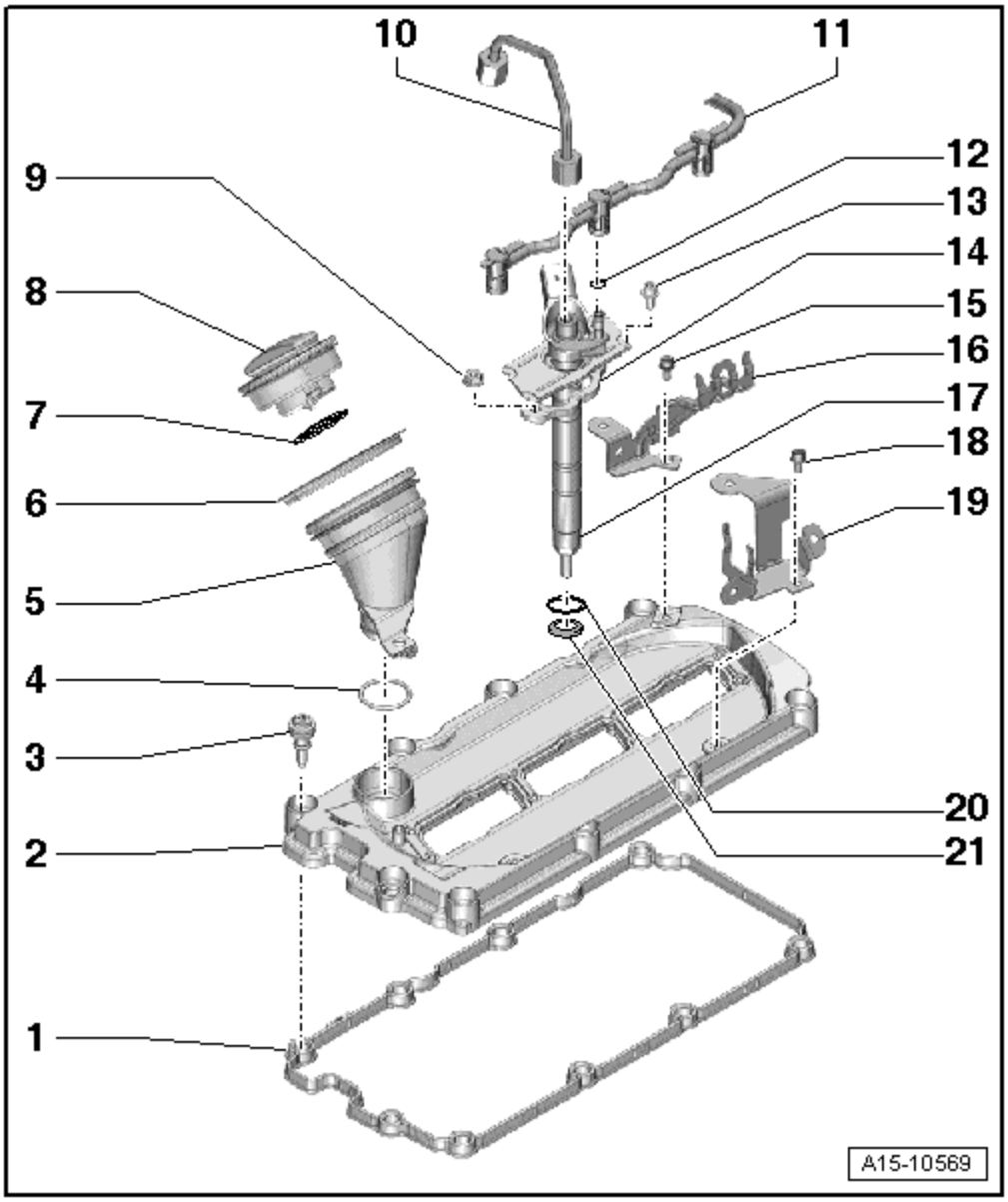


Fig. 1: Identifying Cylinder Head Cover Overview

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Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Cylinder Head Cover Gasket
   - Replace if damaged or leaking.
2. Cylinder Head Cover
   - **Removing and installing** , refer to **CYLINDER HEAD COVER**.
3. Bolt
   - **9 Nm**
   - Replace if damaged or leaking.
   - Tighten diagonally starting from the inside and working toward the outside in steps.
4. O-ring
   - Always replace.
5. Oil Filler Neck
   - To remove, lift the tab, turn the oil filler neck to the left and remove it.
6. Seal
   - Replace if damaged or leaking.
7. Seal
   - Replace if damaged or leaking.
8. Cap
9. Nut
   - **10 Nm**
   - For the tensioning plate.
10. High Pressure Line
    - Note the rules of cleanliness. Refer to **CLEAN WORKING CONDITIONS AND FUEL SYSTEM WORK INSTRUCTIONS** .
    - Mark the assignment of the high pressure lines to the injectors.
    - Do not change the angles of the high pressure lines.
    - Tighten the high pressure line to the fuel rail using a 19 mm wrench. Refer to **Fig. 3**.
    - Tighten the high pressure line to the fuel rail using a 14 mm wrench. Refer to **Fig. 2**.
    - Tighten the high pressure line to the injector. Refer to **Fig. 4**.
11. Fuel Return Line
    - Note the rules of cleanliness. Refer to **CLEAN WORKING CONDITIONS AND FUEL SYSTEM WORK INSTRUCTIONS** .
12. O-ring
    - Always replace.
13. Bolt
    - **5.5 Nm**
    - Sealing cap to cylinder head cover.
14. Tensioning Plate

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- Injectors and tensioning plates that have been removed and are being reinstalled may only be installed in the same cylinder.
- If the injector is being replaced, then the tensioning plate must also be replaced.

15. Bolt
    - **9 Nm**
16. Bracket
    - For the electrical connectors.
    - Different versions are available
17. Injector
    - Note the rules of cleanliness. Refer to **CLEAN WORKING CONDITIONS AND FUEL SYSTEM WORK INSTRUCTIONS** .
    - **Removing and installing** , refer to **CYLINDER HEAD COVER**.
    - The high pressure line and tensioning plate must be replaced, when replacing the injector.
18. Bolt
    - **9 Nm**
19. Bracket
    - For the electrical wiring harness.
20. O-ring
    - Always replace.
21. Copper Sealing Ring
    - Always replace.

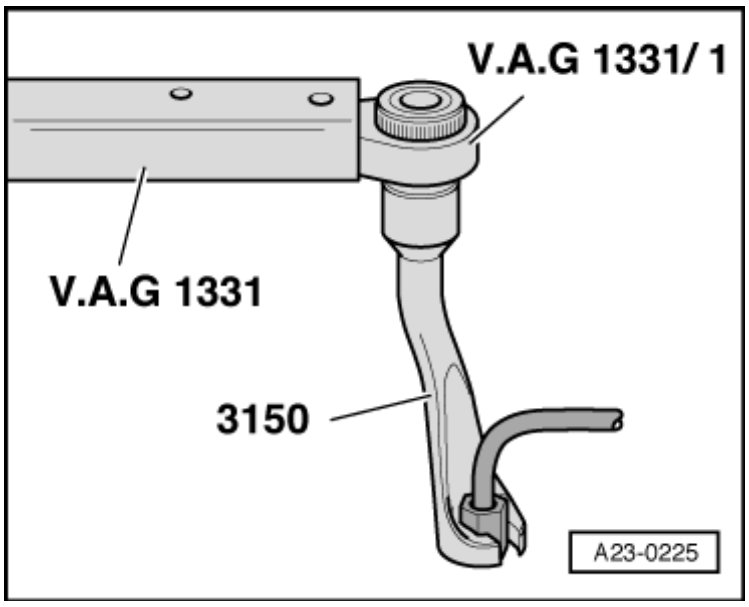


Fig. 2: Fastening High-Pressure Line (14 mm) At High Pressure Pump Using Torque Wrench V.A.G 1331 With Ratchet V.A.G 1331/1 And Socket 14 mm 3150
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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-- Tighten the union nut for the high pressure line by hand.

-- Make sure the high pressure line is seated free of stress.

-- Tighten the high pressure line using the torque wrench (5-50 Nm) V.A.G 1331 and socket 14 mm 3150.

- **Tightening specification: 28 Nm.**

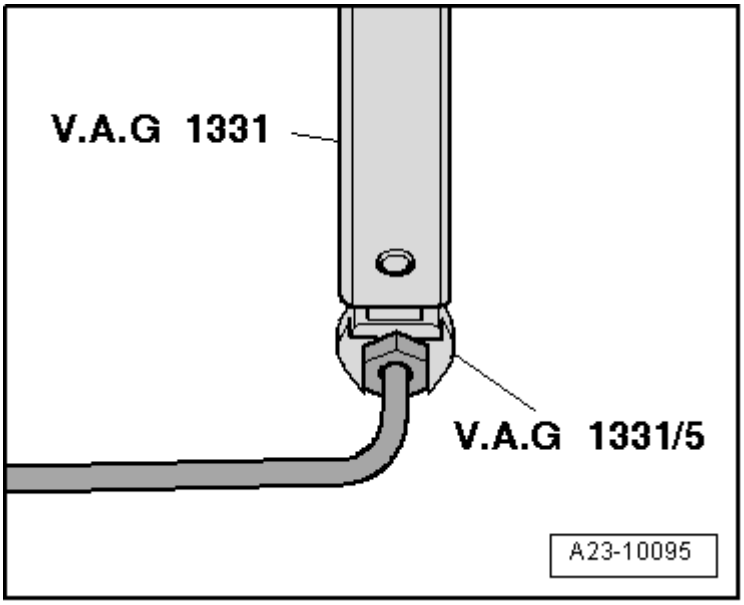


Fig. 3: Tightening High Pressure Line To Fuel Rail Using 19Mm Wrench
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Tighten the union nut for the high pressure line by hand.

-- Make sure the high pressure line is seated free of stress.

-- Tighten the high pressure line using the torque wrench (5-50 Nm) V.A.G 1331 and tool insert AF 19 V.A.G 1331/5.

- **Tightening specification: 28 Nm.**

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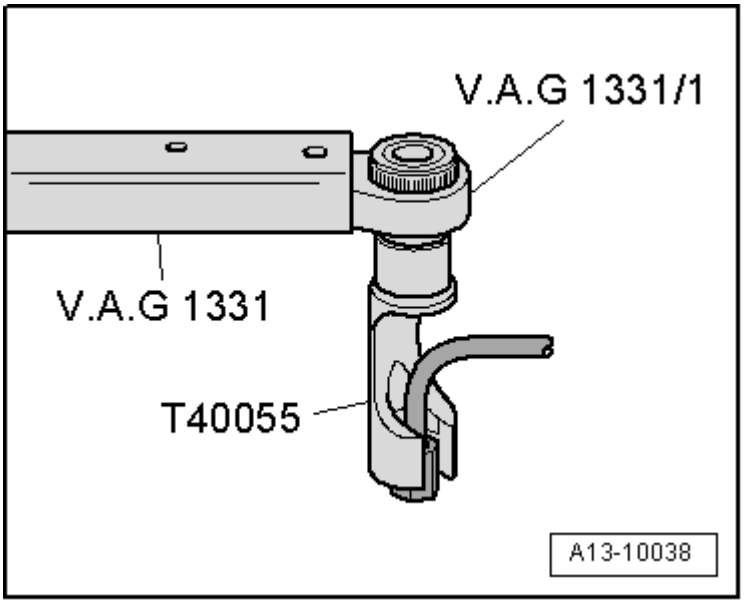


Fig. 4: Fastening High-Pressure Line At High Pressure Pump Using Torque Wrench V.A.G 1331 With Ratchet V.A.G 1331/1 And Socket 17mm T40055
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Tighten the union nut for the high pressure line by hand.

-- Make sure the high pressure line is seated free of stress.

-- Tighten the high pressure line to the injector using the torque wrench (5-50 Nm) V.A.G 1331 with the ratchet, reversible V.A.G 1331/1 and the socket T40055.

- **Tightening specification: 28 Nm.**

CYLINDER HEAD OVERVIEW

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

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

If the cylinder head is going to be replaced, then it is also necessary to replace the coolant.

Remanufacturing diesel cylinder heads is not permitted.

The illustration shows the cylinder head for cylinder bank 2 (left side).

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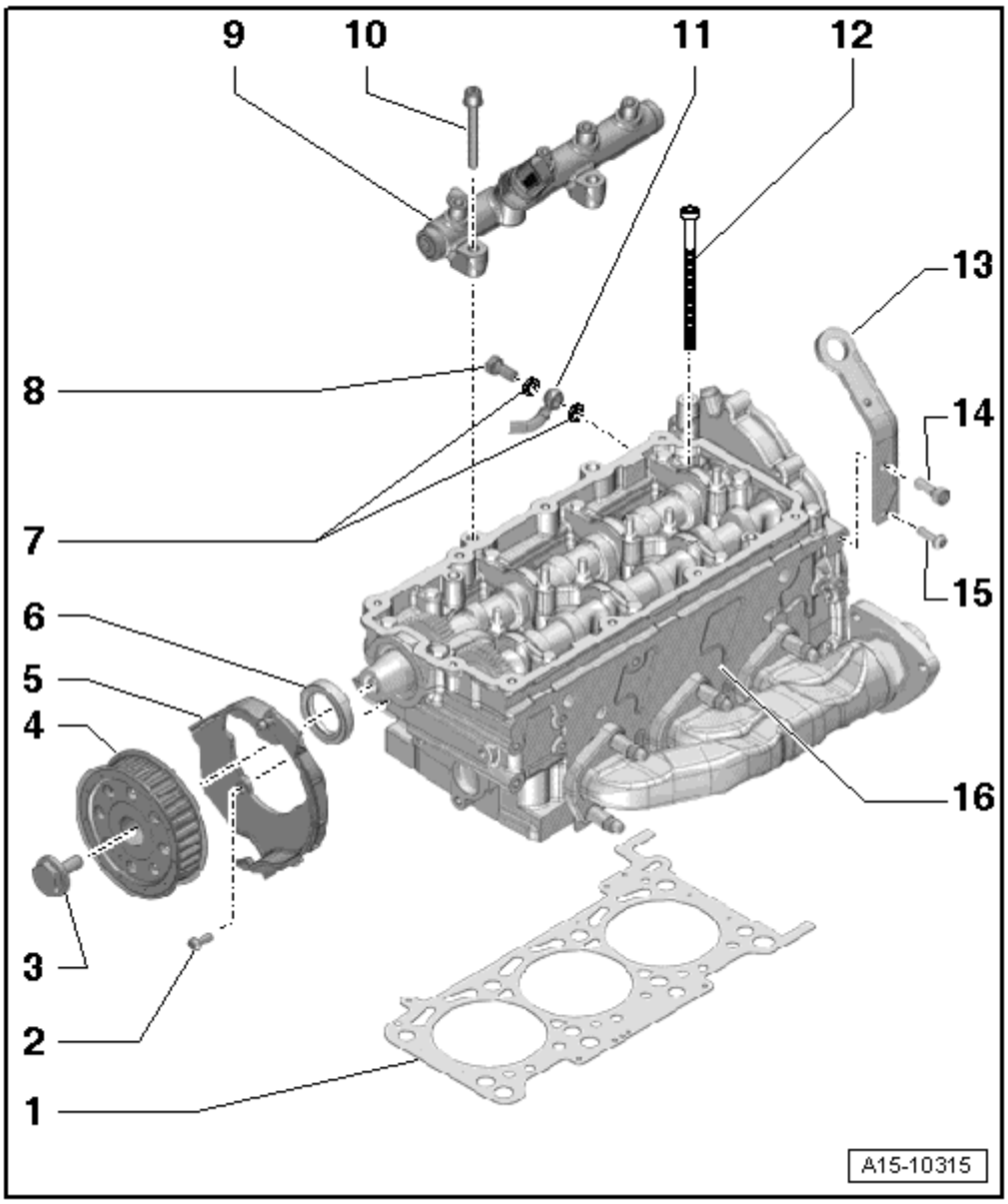


Fig. 5: Identifying Cylinder Head Overview
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Cylinder Head Gasket
   - **Removing and installing** , refer to **CYLINDER HEAD**.
   - Identification, refer to **Fig. 9**.
   - Installed position: The part number faces toward the cylinder head.
   - Replace the coolant after replacing.
2. Bolt
   - **9 Nm**
3. Bolt
   - **75 Nm**

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- Loosen and tighten using the retainer 3036 as a counter hold tool. Refer to **Fig. 6**.

4. Toothed Belt Drive Gear
   - Loosen and tighten the bolt using the retainer 3036 as a counter hold tool. Refer to **Fig. 6**.
   - Remove using the puller T10320. Refer to **Fig. 7**.
5. Rear Toothed Belt Guard
6. High Pressure Pump Toothed Belt Sprocket Seal
   - **Removing and installing** , refer to **CAMSHAFT SEAL**.
7. Seals
   - Always replace.
8. Banjo Bolt
   - **15.5 Nm**
9. Fuel Rail
   - Note the rules of cleanliness. Refer to **CLEAN WORKING CONDITIONS AND FUEL SYSTEM WORK INSTRUCTIONS** .
   - Do not change the angle of the high pressure lines.
   - Tighten the high pressure line to the fuel rail. Refer to **Fig. 3**.
10. Bolt
    - **23 Nm**
11. Coolant Ventilation Line
    - Illustration does not correspond to the version in the vehicle.
12. Bolt
    - Always replace.
    - Follow the sequence when loosening, refer to **Fig. 42**.
    - Note the tightening sequence, refer to **Fig. 54**.
13. Lifting Eye
14. Bolt, M8
    - **23 Nm**
15. Bolt, M6
    - **9 Nm**
16. Cylinder Head
    - Only set the removed cylinder head down on a foam pad. Otherwise the glow plugs can be damaged.
    - **Removing and installing** , refer to **CYLINDER HEAD**.
    - Checking for distortion. Refer to **Fig. 8**.
    - Do not rework diesel cylinder heads.
    - Replace the coolant after replacing.

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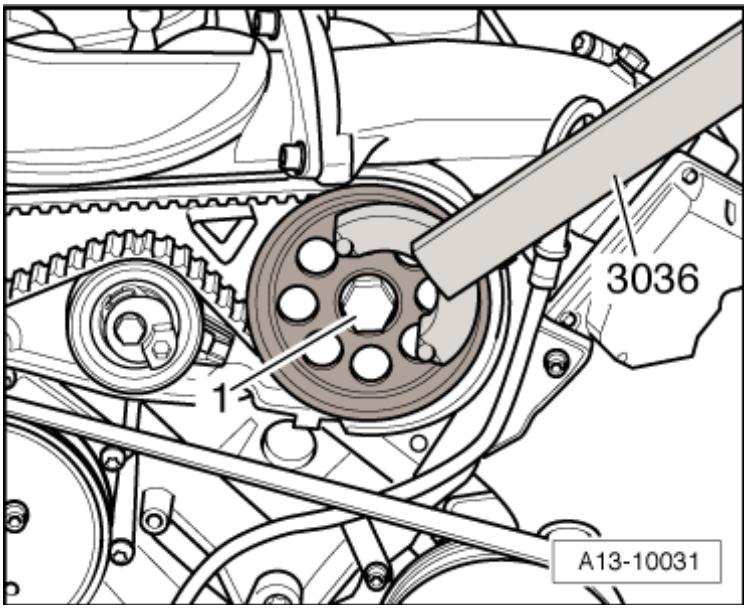


Fig. 6: Identifying Toothed Belt Drive Gear Bolt, Loosening and Tightening
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Loosen and tighten the bolt -1- using the retainer 3036 as a counter hold tool.

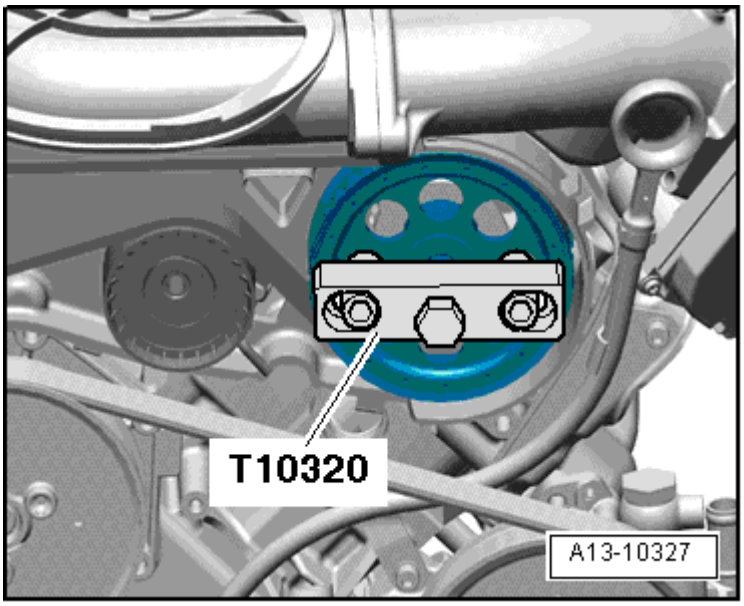


Fig. 7: Identifying Toothed Belt Drive Gear, Removal
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the toothed belt drive gear using the puller T10320.

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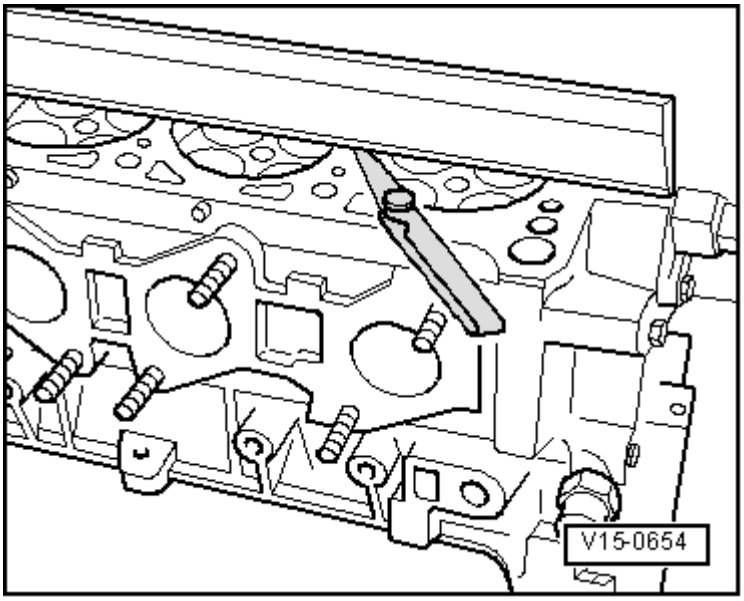


Fig. 8: Checking Cylinder Head For Distortion
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Check the cylinder head at multiple points for distortion, using a straight edge and feeler gauges.

- Max. permissible distortion: 0.1 mm.

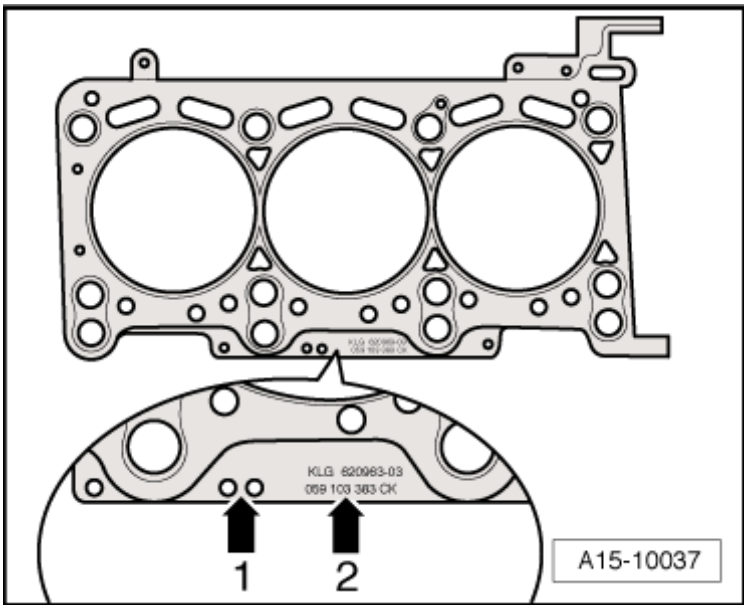


Fig. 9: Identifying Cylinder Head Gasket Identification
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Holes
2. Part number:

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NOTE: The cylinder head gaskets for the left and right cylinder head cannot be interchanged because they each have a different shape.

VACUUM PUMP OVERVIEW

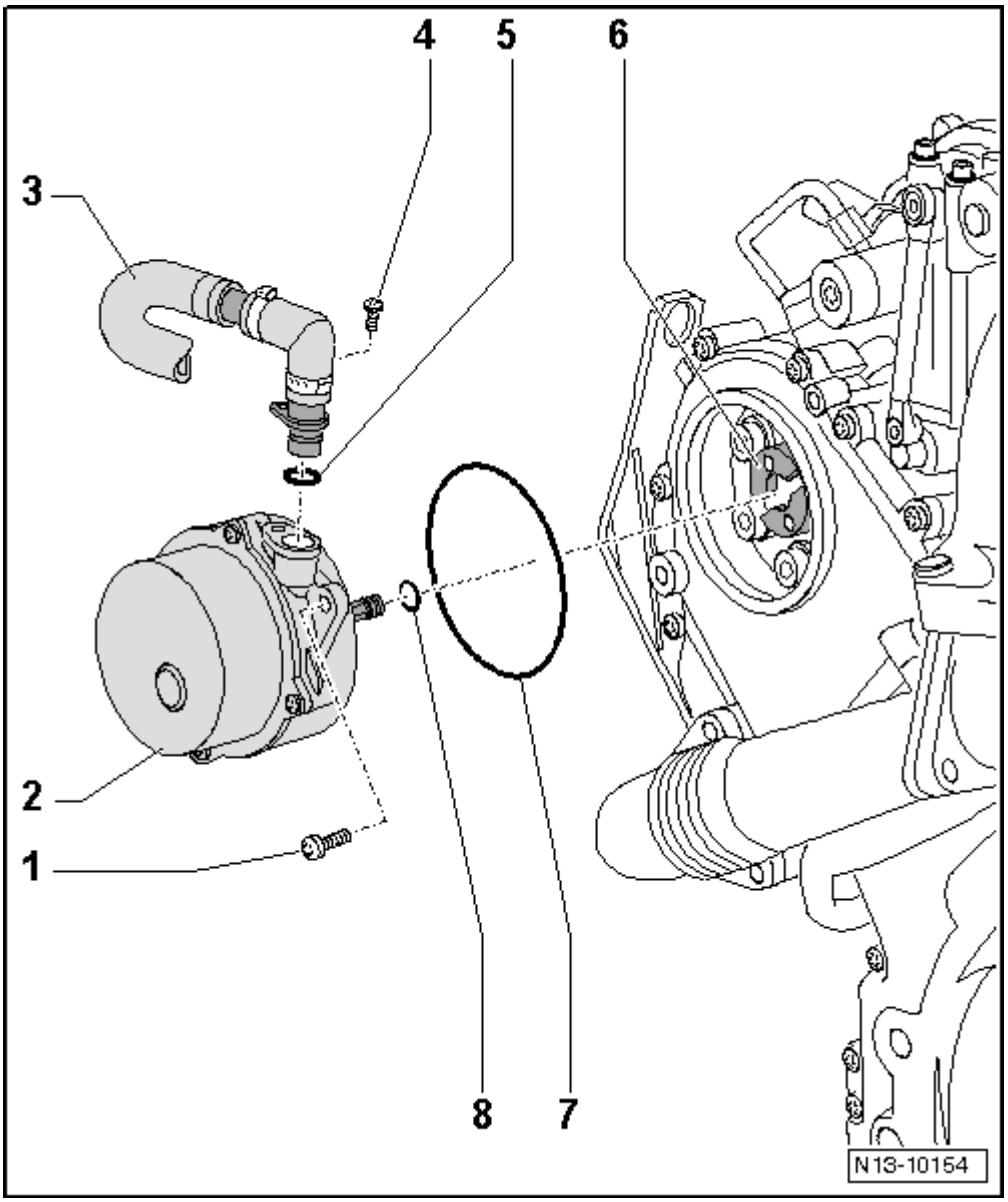


Fig. 10: Identifying Brake Booster Vacuum Pump Overview, Diesel Engine
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Bolt
   - **9 Nm**
2. Vacuum Pump
3. Vacuum Hose
4. Bolt

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- **5 Nm**

5. O-ring
    - Always replace.
6. Intake Camshaft
7. O-ring
    - Always replace.
8. O-ring
    - Always replace.

VALVETRAIN OVERVIEW

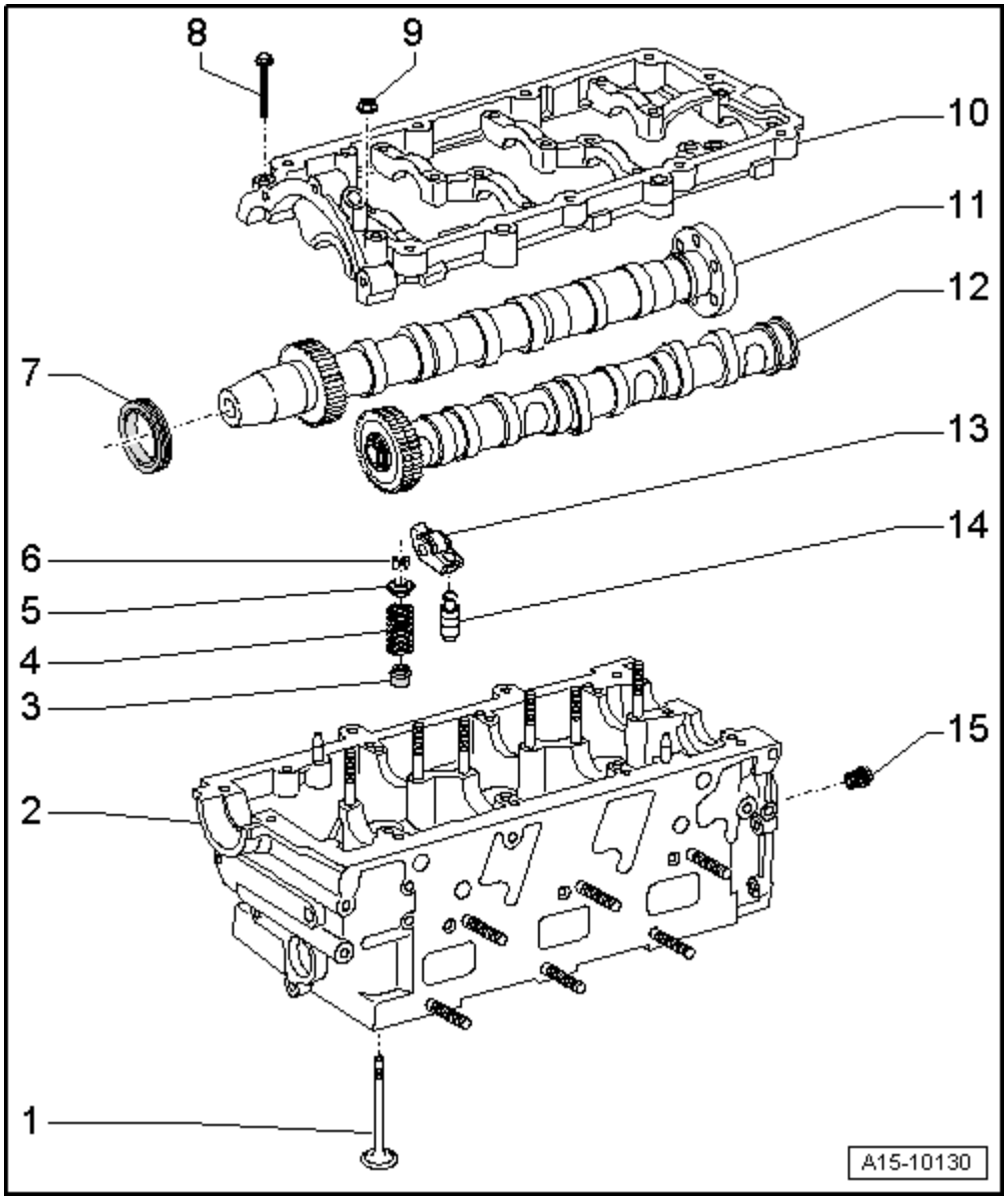


Fig. 11: Identifying Valvetrain Overview

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Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Valve
   - Replace if there are signs of wear on the stem and seating surface.
   - Do not grind, only hand lapping is permitted.
   - Mark the installed position for reinstallation later.
   - For the correct valve dimensions, refer to **VALVE DIMENSIONS**.
   - Checking valve guides. Refer to **VALVE GUIDE, CHECKING**.
2. Cylinder Head
   - **Removing and installing** , refer to **CYLINDER HEAD**.
3. Valve Stem Seal
   - **Removing and installing** , refer to **VALVE STEM SEALS**.
4. Valve Spring
5. Upper Spring Seat
6. Valve Retainers
7. Camshaft Seal
   - **Removing and installing** , refer to **CAMSHAFT SEAL**.
8. Bolt
   - **9 Nm**
   - Follow the tightening sequence, refer to **CAMSHAFTS**.
9. Nut
   - **9 Nm**
   - Follow the tightening sequence, refer to **CAMSHAFTS**.
10. Guide Frame
    - With integrated camshaft bearings.
    - **Removing and installing** , refer to **CAMSHAFTS**.
11. Intake Camshaft
    - **Removing and installing** , refer to **CAMSHAFTS**.
    - Checking axial play. Refer to **CAMSHAFT AXIAL CLEARANCE, CHECKING**.
    - Check radial clearance using Plastigage (roller rocker arms are removed).
    - Radial clearance, new: 0.035 to 0.085 mm.
    - Radial clearance wear limit: 0.1 mm.
    - Run out: maximum 0.01 mm.
12. Exhaust Camshaft
    - **Removing and installing** , refer to **CAMSHAFTS**.
    - Checking axial play. Refer to **CAMSHAFT AXIAL CLEARANCE, CHECKING**.
    - Check radial clearance using Plastigage (roller rocker arms are removed).
    - Radial clearance, new: 0.035 to 0.085 mm.

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- Radial clearance wear limit: 0.1 mm.
- Run out: maximum 0.01 mm.

13. Roller Rocker Arm
    - Mark the installed position.
    - Do not interchange.
    - Check the roller for ease of movement.
    - Lubricate the contact surfaces.
14. Hydraulic Lash Adjuster
    - Mark the installed position.
    - Checking, refer to **HYDRAULIC LASH ADJUSTER, CHECKING**.
    - Lubricate the running surfaces before installing.
15. Pressure Relief Valve
    - **25 Nm**
    - For lubricating points in the cylinder head.

LEFT CAMSHAFT TIMING CHAIN OVERVIEW

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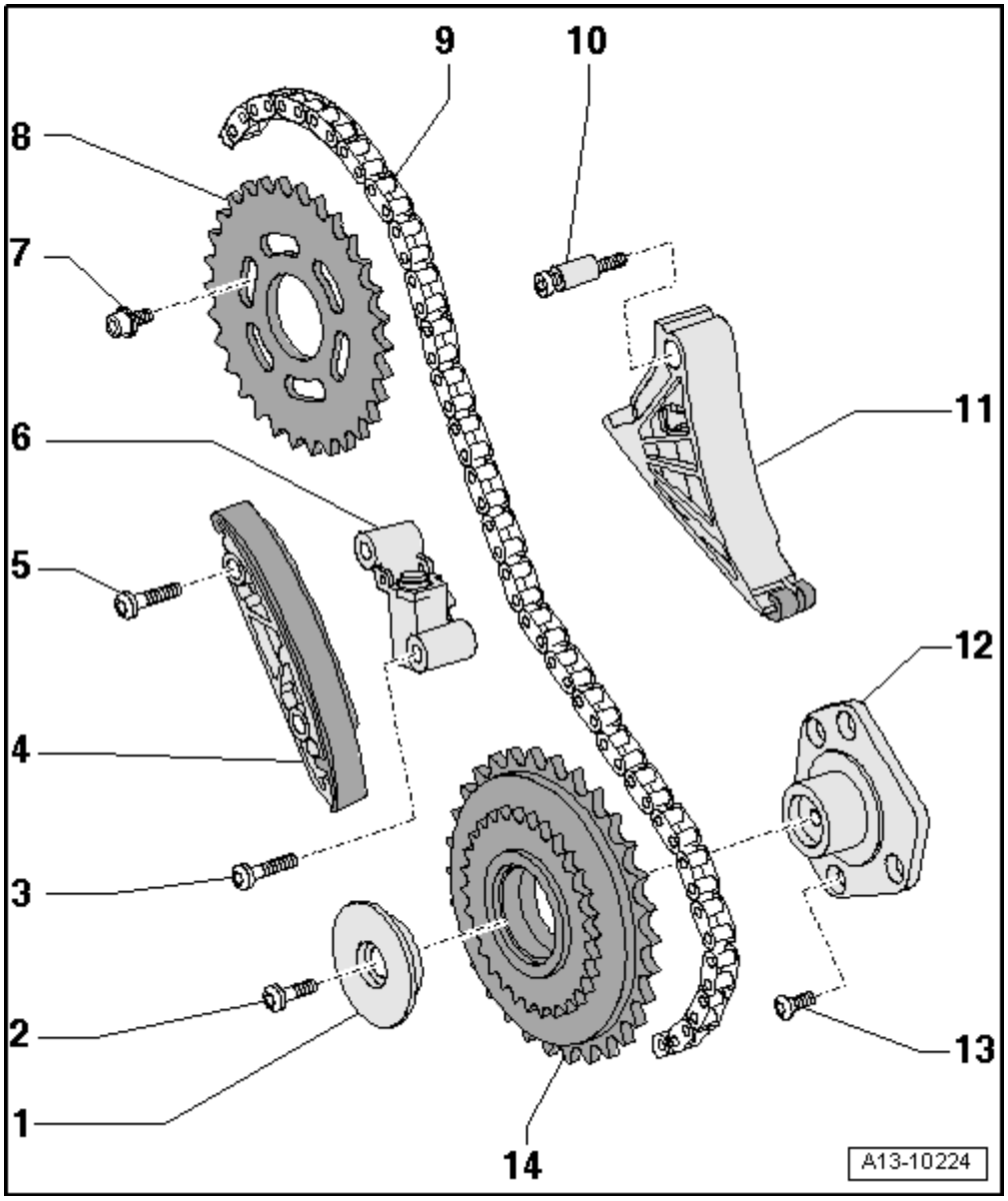


Fig. 12: Identifying Left Camshaft Timing Chain Overview
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Thrust Washer
   - For the drive sprocket.
2. Bolt
   - Tightening specification, see "Bolt" in **TIMING MECHANISM DRIVE CHAIN OVERVIEW** .
3. Bolt
   - **5 Nm + 90° (1/4) additional turn.**
   - Always replace.
4. Guide Rail
   - Pay attention to the installed position.

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5. Bolt
   - **5 Nm + 90° (1/4) additional turn.**
   - Always replace.
6. Chain Tensioner
   - For the left camshaft timing chain.
7. Bolt
   - **23 Nm**
8. Camshaft Sprocket
   - For the intake camshaft.
   - Installed position: The side with the lettering faces forward.
9. Left Camshaft Timing Chain
   - Removing from the camshafts, refer to **CAMSHAFT TIMING CHAINS, REMOVING FROM CAMSHAFTS**.
   - Before removing, mark the rotation direction with paint.
   - **Removing and installing** , refer to **CAMSHAFT TIMING CHAINS**.
10. Bolt
    - **5 Nm + 90° (1/4) additional turn.**
    - Replace
    - With a sleeve.
11. Tensioning Rail
12. Bracket
    - For the drive sprocket.
13. Bolt
    - Tightening specification, see "Bolt" in **TIMING MECHANISM DRIVE CHAIN OVERVIEW** .
14. Drive Sprocket
    - For the left camshaft timing chain.

RIGHT CAMSHAFT TIMING CHAIN OVERVIEW

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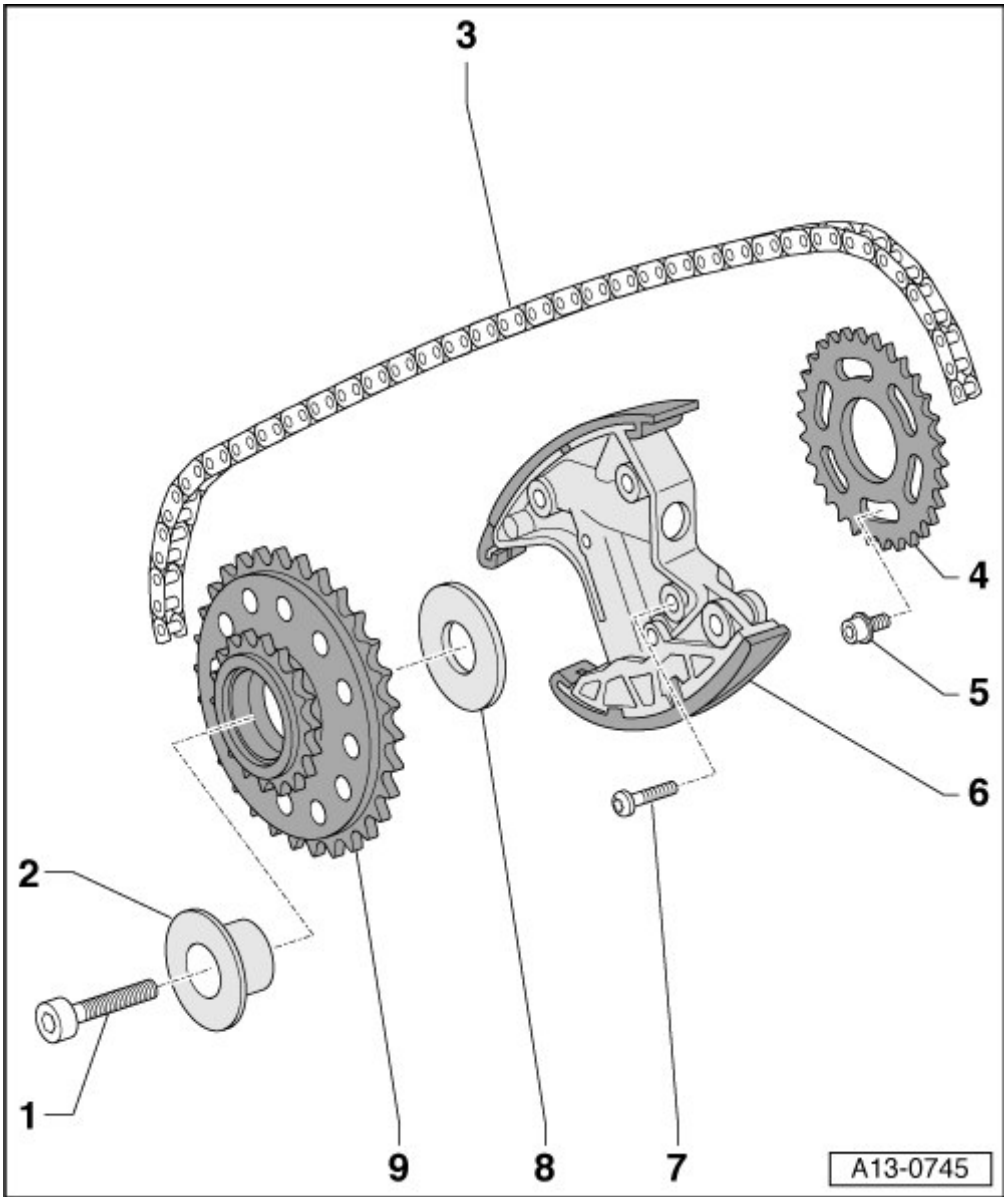


Fig. 13: Identifying Right Camshaft Timing Chain Overview
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Bolt
   - Tightening specification, see "Bolt" in **TIMING MECHANISM DRIVE CHAIN OVERVIEW** .
2. Pin
   - For the drive sprocket.
3. Right Camshaft Timing Chain
   - Removing from the camshafts, refer to **CAMSHAFT TIMING CHAINS, REMOVING FROM CAMSHAFTS**.
   - Before removing, mark the rotation direction with paint.
   - **Removing and installing** , refer to **CAMSHAFT TIMING CHAINS**.

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4. Camshaft Sprocket
    - For the intake camshaft.
    - Installed position: The side with the lettering faces forward.
5. Bolt
    - **23 Nm**
6. Chain Tensioner
    - For the right camshaft timing chain.
7. Bolt
    - **5 Nm + 90° (1/4) additional turn.**
    - Always replace.
    - Quantity: 3
8. Thrust Washer
    - For the drive sprocket.
9. Drive Sprocket
    - For the right camshaft timing chain.

SPECIFICATIONS

VALVE DIMENSIONS

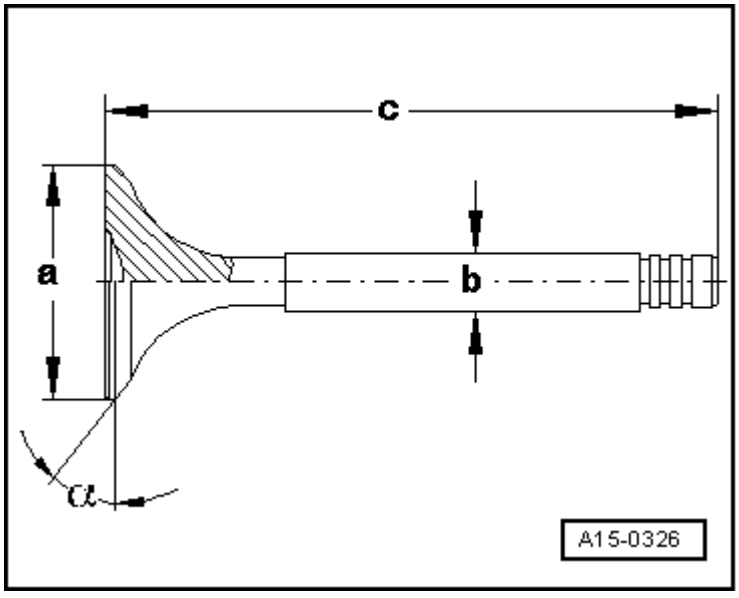


Fig. 14: Identifying Valve Dimensions
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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Dimension		Intake Valve	Exhaust Valve
Diameter a	mm	28.60 ••• 28.80	26.70 ••• 26.90
Diameter b	mm	5.968 ••• 5.982	5.958 ••• 5.972
c	mm	97.25 ••• 97.45	97.35 ••• 97.55
a	Angle°	45	45

WARNING:

- **Worn sodium filled exhaust valves must not be scrapped without first being properly treated.**
- **Using a metal saw, cut the valves into two pieces between the shaft center and valve head. While doing this, do not come into contact with water. At the very most, throw 10 of the cut valves into a bucket filled with water. Then, move away quickly, because a sudden chemical reaction will occur during which the sodium is burnt away.**
- **The treated valves may then be discarded through conventional disposal channels.**

FASTENER TIGHTENING SPECIFICATIONS

Component	Fastener Size	Nm
Chain Tensioner to Cylinder Block Bolt (1)	-	5 + 90°
Coolant Ventilation Line to Cylinder Head Banjo Bolt	-	15.5
Cylinder Head Cover Bolt (2)	-	9
Fuel Rail to Cylinder Head Bolt	-	23
Fuel Return Line to High Pressure Pump	-	28
Fuel Supply Line to High Pressure Pump	-	28
Guide Rail to Cylinder Block Bolt (1)	-	5 + 90°
High Pressure Fuel Line to Fuel Injector Union Nut	-	28
High Pressure Fuel Line to Fuel Rail Union Nut	-	28
Hose Clamp, 13 mm Wide	-	5.5
Intake Tube Bracket to Cylinder Head Bolt	-	9
Lifting Eye to Cylinder Head Bolt		
	M6	9
	M8	23
Pressure Relief Valve to Cylinder Head	-	25
Rear Toothed Belt Guard to Engine Bolt	-	9
Right Coolant Pipe to Cylinder Head Bolt	-	9
Sealing Cap to Cylinder Head Cover Bolt	-	5.5
Sprocket to Camshaft Bolt	-	23
Tensioning Plate to Cylinder Head Cover Nut	-	10
Tensioning Rail to Cylinder Block Bolt (1)	-	5 + 90°
Throttle Valve Control Module with Intake Tube to Bracket Bolt	-	9

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Throttle Valve Control Module with Intake Tube to Connecting Pipe for Exhaust Gas Recirculation Valve Bolt	-	9
Throttle Valve Control Module with Intake Tube to Intake Manifold Bolt	-	9
Toothed Belt Drive Gear to Camshaft Bolt	-	75
Vacuum Hose to Vacuum Pump Bolt	-	5
Vacuum Pump to Cylinder Head Bolt	-	9
Wiring Harness Bracket to Cylinder Head Cover Bolt	-	9
(1) Always replace (2) Tighten in a diagonal sequence and in stages		

Cylinder Head Bolt Tightening Sequence and Specifications

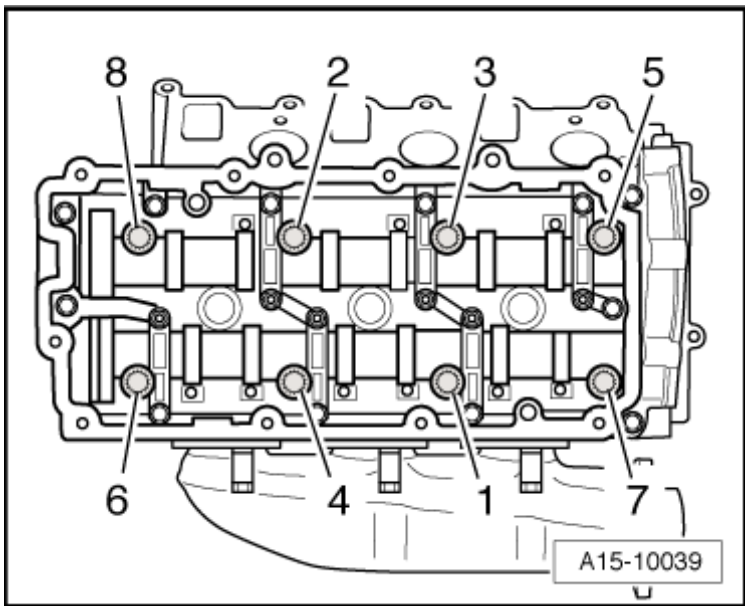


Fig. 15: Identifying Cylinder Head, Tightening Specifications and Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Tighten the cylinder head bolts in sequence -1 through 8- as follows:

-- Tighten the bolts to 35 Nm.

-- Tighten the bolts to 60 Nm.

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

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

Guide Frame Bolt Tightening Sequence and Specification

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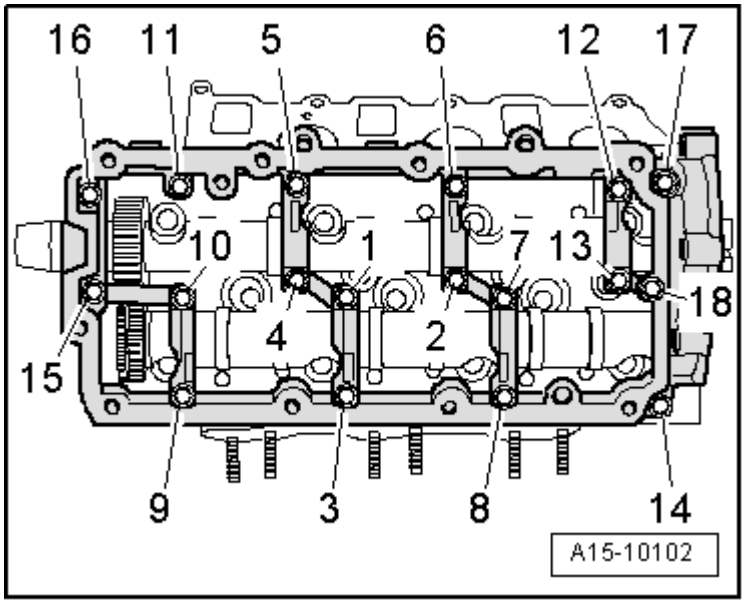


Fig. 16: Identifying Left Cylinder Head Guide Frame, Tightening Specifications and Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Tighten the guide frame bolts and nuts by hand evenly in the sequence -1 through 18- shown.

-- Tighten the guide frame bolts and nuts in the sequence -1 through 18- shown to 9 Nm.

DIAGNOSIS AND TESTING

COMPRESSION, CHECKING

Special tools and workshop equipment required

- Compression Tester V.A.G 1763

Procedure

- Engine oil temperature is approximately 80 °C (176 °F).
- Battery voltage is a minimum of 12.5 volts.

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

-- Disconnect the connectors from the glow plugs.

-- Disconnect the connector from the fuel pressure regulator valve -N276- -1- on the cylinder bank 1 (right side) fuel rail.

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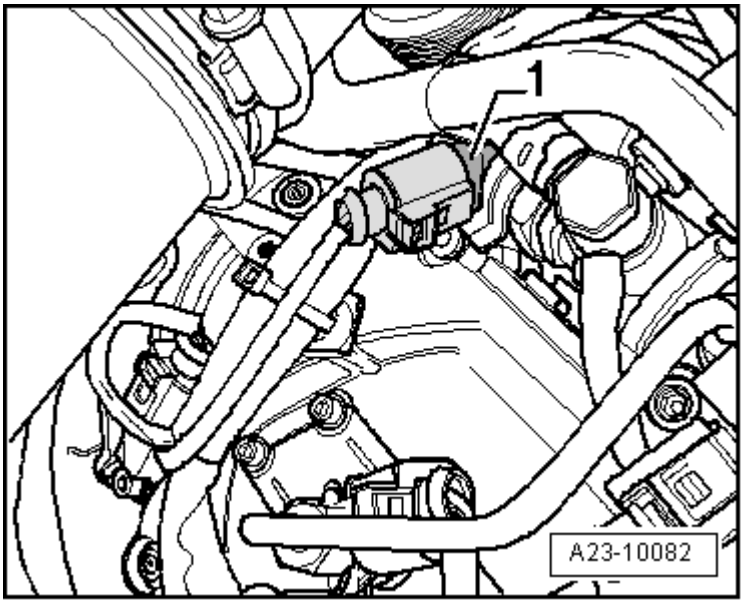


Fig. 17: Identifying Connector From Fuel Pressure Regulator Valve -1-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- In order to reduce the fuel pressure in the fuel rail, start the engine briefly.

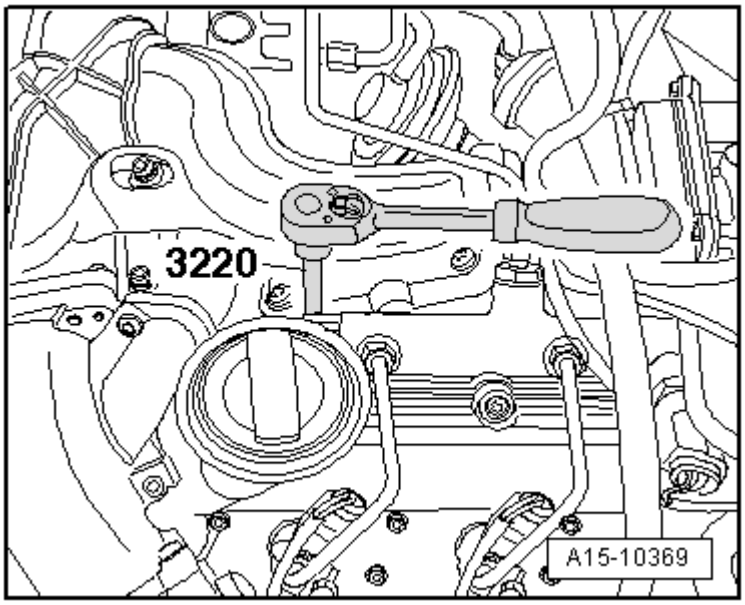


Fig. 18: Identifying Socket 3320 To Remove Glow Plugs
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the glow plugs. Refer to one of the following:

- **CERAMIC SHEATHED GLOW PLUGS** .
- **METAL GLOW PLUGS** .

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-- Install the adapter V.A.G 1763/8 instead of the glow plugs and connect the compression tester V.A.G 1763.

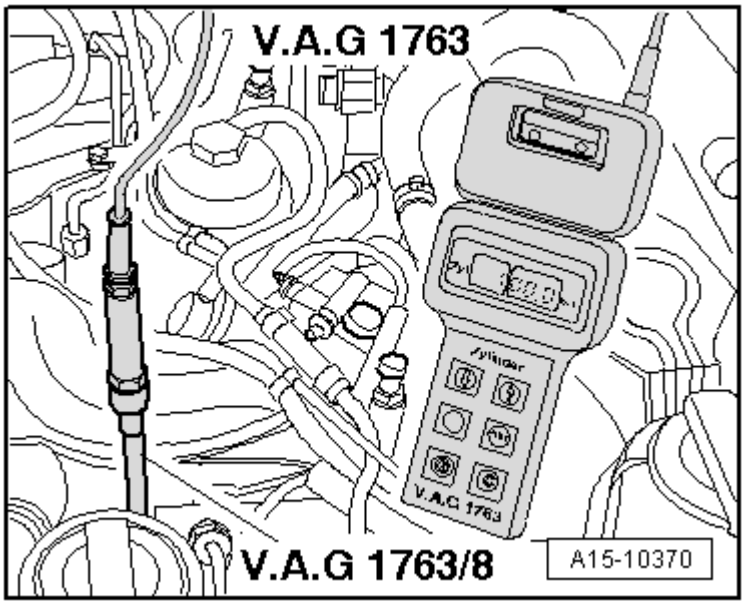


Fig. 19: Identifying Adapter V.A.G 1763/8 And Compression Tester V.A.G 1763
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

-- Have a second technician operate the starter until the tester does not show the pressure increasing any further.

Compression Pressure	Bar Pressure
New	28 ••• 33
Wear limit	21
Difference between cylinders	Max. 5

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

-- Install the glow plugs. Refer to one of the following:

- **CERAMIC SHEATHED GLOW PLUGS** .
- **METAL GLOW PLUGS** .

-- Check the Engine Control Module (ECM) Diagnostic Trouble Code (DTC) memory and erase it to clear any faults stored from disconnecting the connectors. Refer to the vehicle diagnostic tester.

CAMSHAFT AXIAL CLEARANCE, CHECKING

Special tools and workshop equipment required

- Dial Gauge Holder VW 387

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- Dial Gauge 0-10 mm VAS 6079

Test Sequence

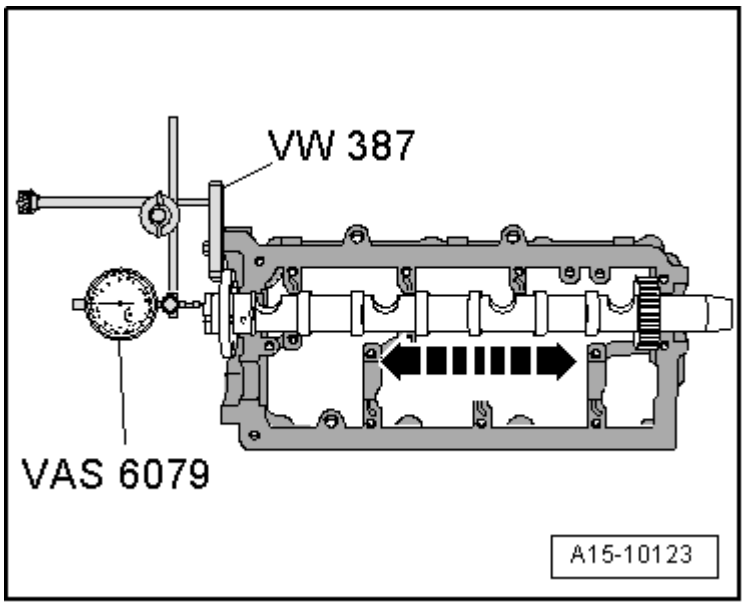


Fig. 20: Identifying Dial Gauge Holder VW387 And Dial Gauge (0-10 mm) VAS 6079, Intake Camshaft Check
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Take the measurement when the guide frame is removed.

Intake Camshaft

- Specified value: 0.03 to 0.08 mm.
- Wear limit 0.12 mm.

Exhaust Camshaft

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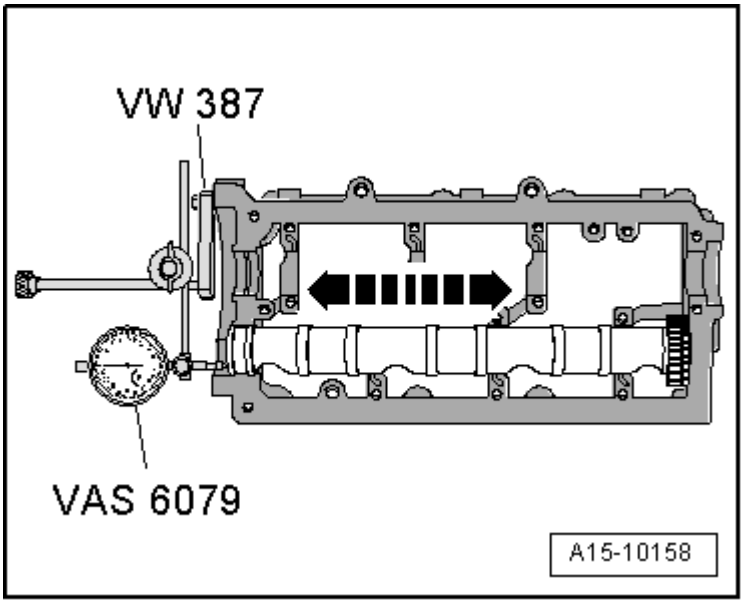


Fig. 21: Identifying Dial Gauge Holder VW387 And Dial Gauge (0-10 mm) VAS 6079, Exhaust Camshaft Check
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Specified value: 0.03 to 0.08 mm.
- Wear limit 0.12 mm.

HYDRAULIC LASH ADJUSTER, CHECKING

Special tools and workshop equipment required

- Feeler Gauge

NOTE: The hydraulic lash adjusters cannot be serviced.

Irregular valve noises are normal while starting the engine.

Procedure

-- Start the engine and let it run until the coolant temperature is at least 80 °C (176 °F).

-- Increase the engine speed for about 2 minutes to approximately 2500 RPM, perform a road test if necessary.

NOTE: If the irregular valve noises disappear but always appear when driving short differences, replace the oil check valve -arrow- on the rear face side in the affected cylinder head.

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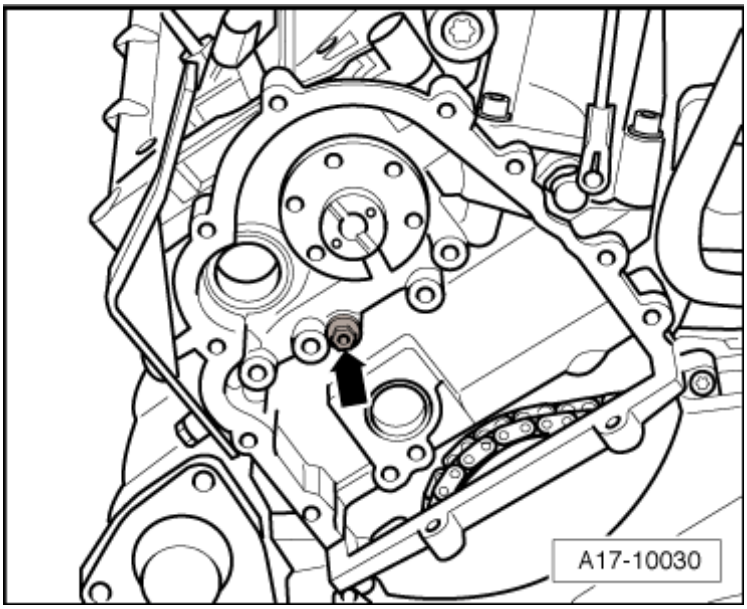


Fig. 22: Identifying Oil Check Valve
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

If the hydraulic lash adjusters are still noisy, determine which adjuster is defective as follows:

-- Remove the left or right cylinder head cover. Refer to **CYLINDER HEAD COVER**.

-- Rotate the crankshaft until the camshaft for the hydraulic adjuster to be checked is at the top. To do this:

- Remove the noise insulation and rotate the crankshaft clockwise at the vibration damper center bolt.

-- Determine the play between the camshaft and the roller rocker arm.

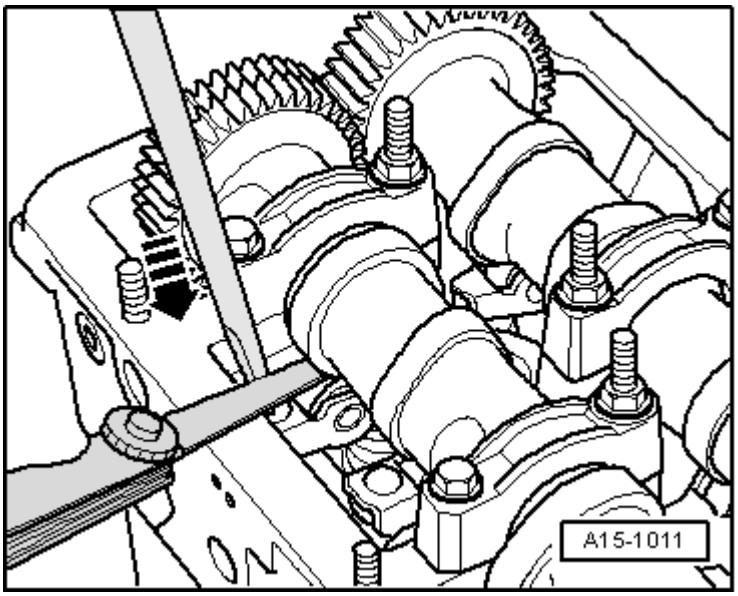


Fig. 23: Identifying Play Between Cams With Screwdriver -Arrow- And 0.20 mm Feeler Gauge

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Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Press the roller rocker arm down with a screwdriver -arrow-.

If a 0.20 mm feeler gauge can be inserted between the camshaft and roller rocker arm:

-- Replace the hydraulic lash adjuster.

VALVE GUIDE, CHECKING

Special tools and workshop equipment required

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

Test Sequence

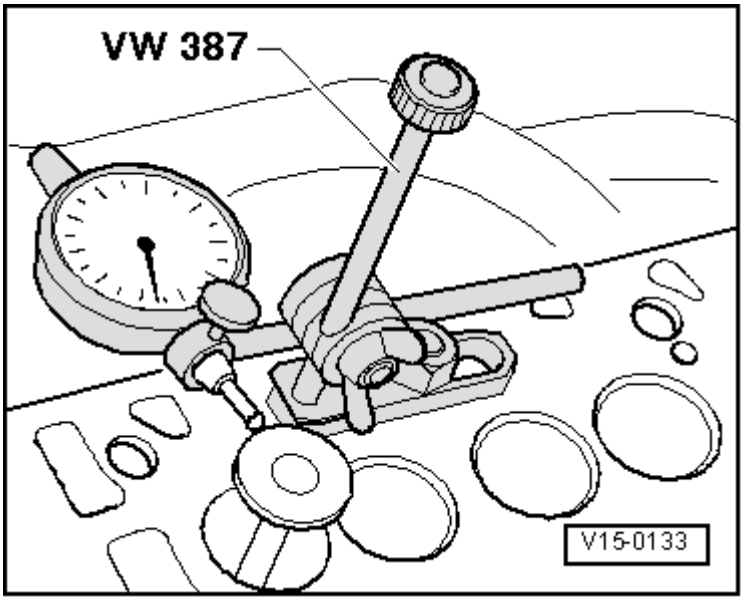


Fig. 24: Determining Valve Rock (Wear limit)
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Insert the valve into the valve guide.

- The valve stem tip must seal with the valve guide.

NOTE: Due to differences in valve stem diameter, make sure that only intake valves are used to check intake valve guides, and only exhaust valves are used to check exhaust valve guides.

-- Determine the tilt clearance.

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- Tilt clearance wear limit: Intake and exhaust valve: 1.0 mm.

NOTE: If the wear limit is exceeded, measure again using new valves. If the wear limit is still exceeded, replace the cylinder head. The valve guides cannot be replaced.

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

REMOVAL AND INSTALLATION

CYLINDER HEAD COVER

Special tools and workshop equipment required

- Torque Wrench (5-50 Nm) V.A.G 1331
- Ratchet, Reversible V.A.G 1331/1
- Tool Insert AF 19 V.A.G 1331/5
- Puller T10055
- Socket T40055

Removing

NOTE: The following removal and installation procedure is for the left cylinder head cover. The procedure for the right cover is identical except for a few steps.

-- Disconnect the vacuum hose to the vacuum reservoir -2-.

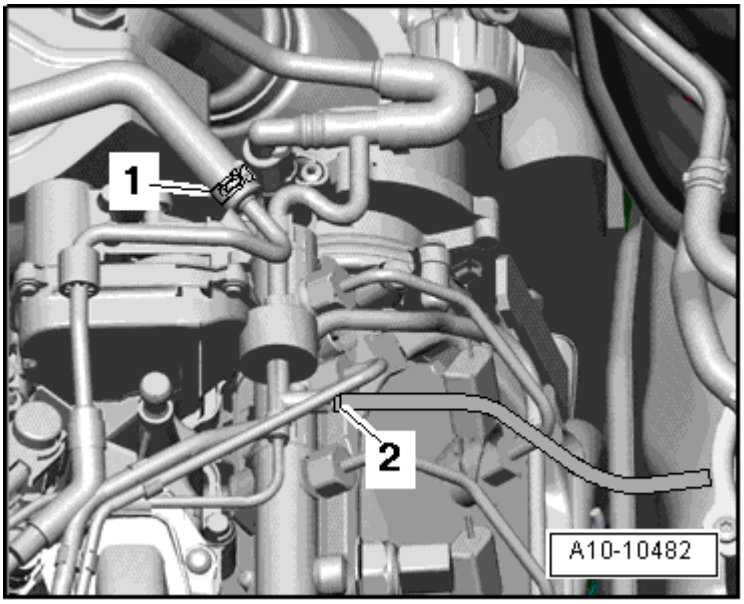


Fig. 25: Identifying Vacuum Hose -2-

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-- Remove the wiring connector -1-.

-- Remove the high pressure fuel lines -2- and the overflow oil line -3-.

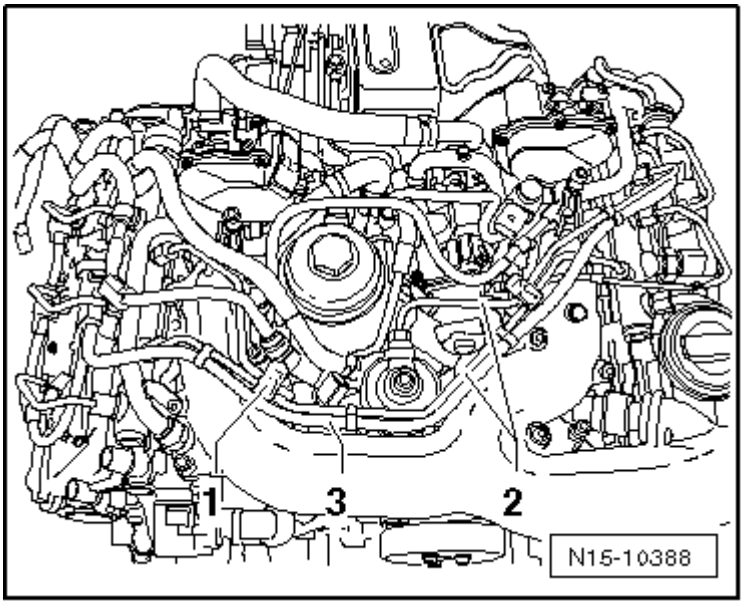


Fig. 26: Identifying Wiring Connector -1-, High Pressure Fuel Lines -2- And The Overflow Oil Line -3-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Only for Removing the Left Cylinder Head Cover

-- Remove the engine cover bracket -1-, the bolts -arrows- and the upper intake manifold.

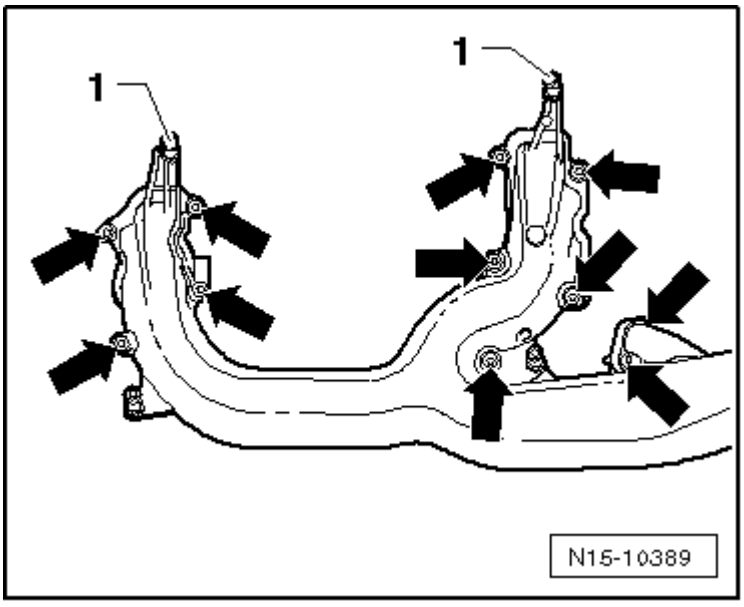


Fig. 27: Identifying Engine Cover Bracket -1-, Bolts -Arrows- And Upper Intake Manifold

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Continued for Both Sides

-- Lift the tab -1-, turn the oil filler tube counterclockwise -arrow- and remove the tube.

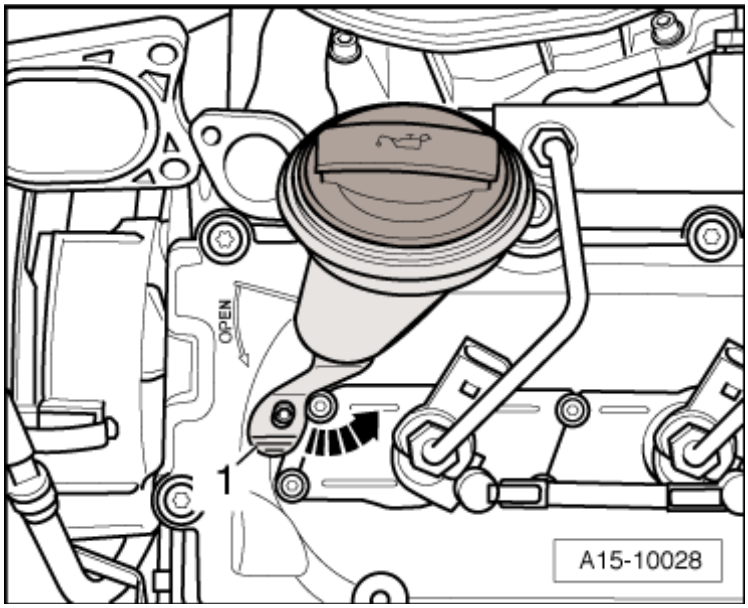


Fig. 28: Identifying Tab -1- And Position To Turn Oil Filler Tube (Counterclockwise -Arrow-)
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the wiring harness bracket bolt -5- and bracket from the cylinder head cover.

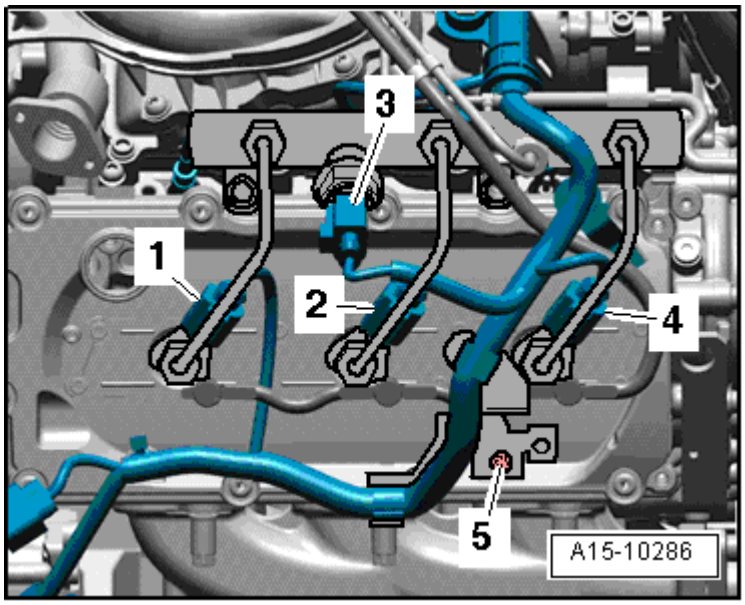


Fig. 29: Identifying Connectors -1 Through 4- To Fuel Injectors
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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-- Disconnect the connectors -1 through 4- from the fuel rail and injectors.

-- Free up the wiring harness.

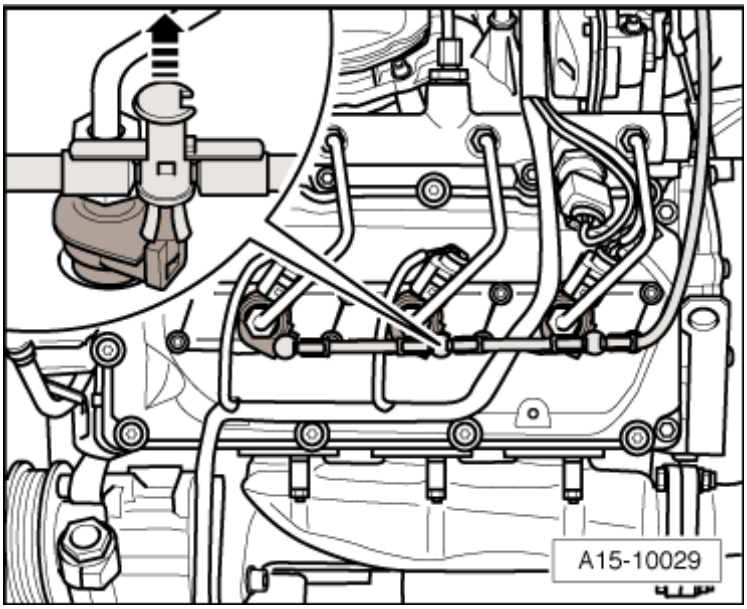


Fig. 30: Identifying Release Pins Upward -Arrow-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CAUTION: Always observe the rules for cleanliness when working on the injection system. Refer to CLEAN WORKING CONDITIONS AND FUEL SYSTEM WORK INSTRUCTIONS .

-- Pull the release pins upward -arrow- and remove the return line connections from the injectors.

-- Mark the assignment of the high pressure lines to the injectors.

-- Loosen the high pressure line union nuts -1 through 6- using the tool insert, AF 19 V.A.G 1331/5 or socket 14 mm 3150 and the socket T40055.

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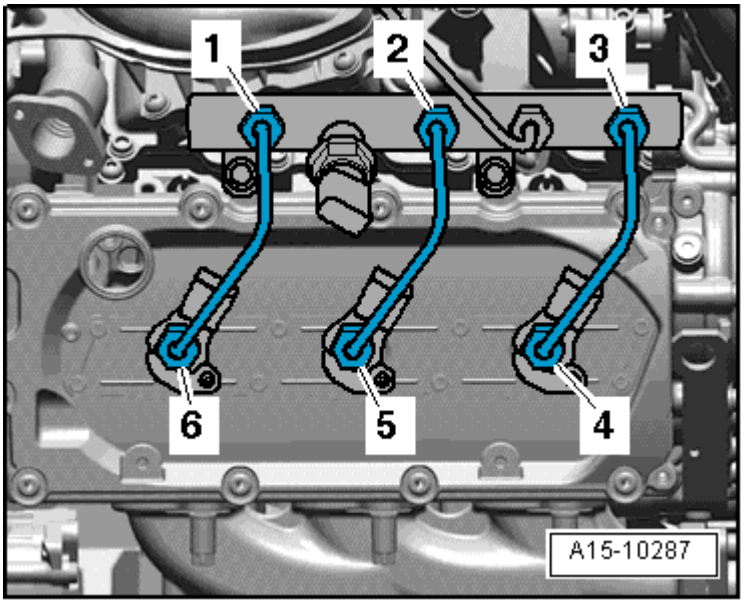


Fig. 31: Identifying High Pressure Line Union Nuts -1 Through 6-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the high pressure lines.

-- Remove the sealing cap bolts -arrows-.

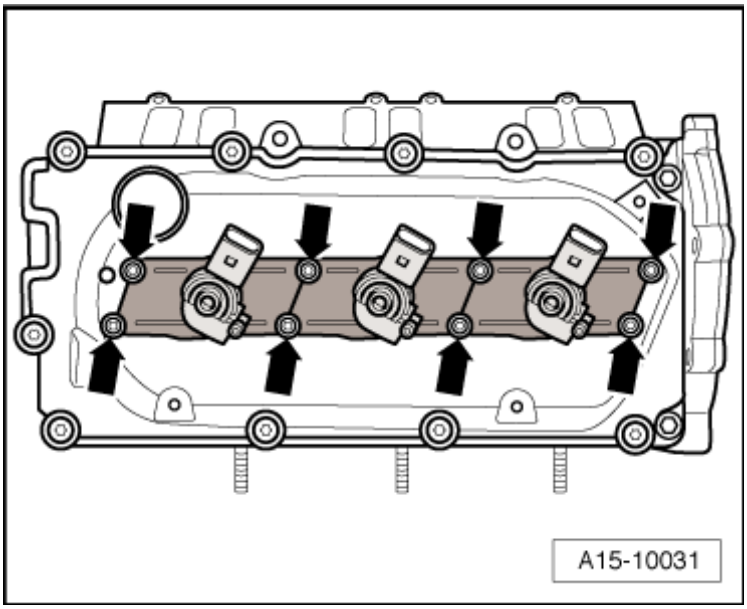


Fig. 32: Identifying Injector Cover Bolts -Arrows-
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-- Pull the caps upward and turn them 90° (1/4) turn.

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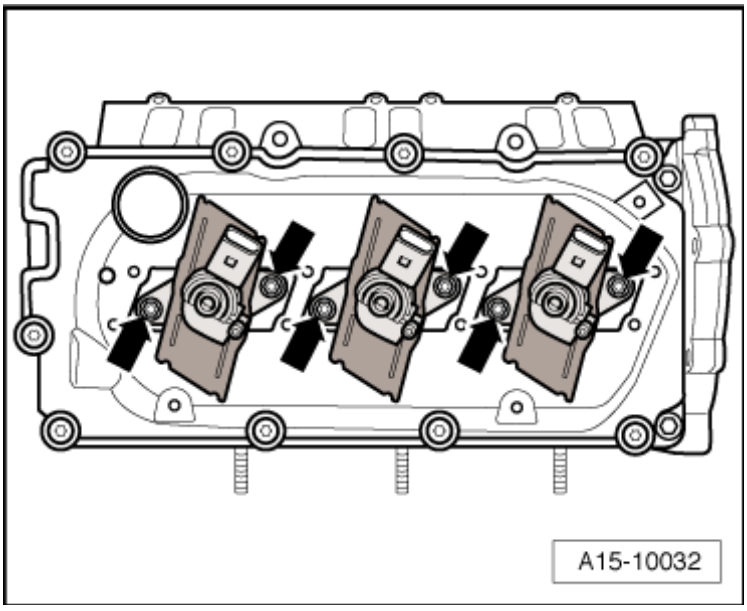


Fig. 33: Identifying Injector Tensioning Bracket Nuts -Arrows-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the tensioning plate nuts -arrows-.

-- Remove the injectors using the puller T10055 and the adapter T10055/1.

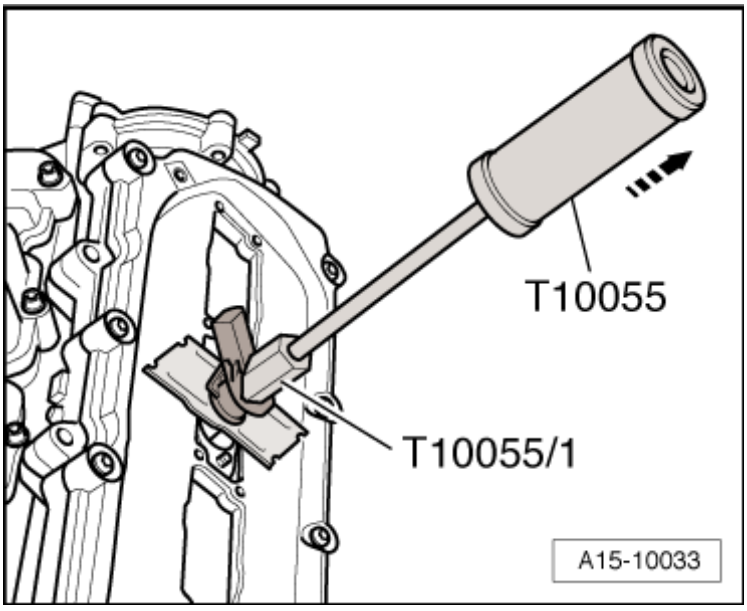


Fig. 34: Identifying Puller T10055 With Adapter T10055/1
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CAUTION:
- **Mark the allocation of the injectors to the cylinder.**
- **Used injectors may only be installed in the same cylinder.**

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-- Loosen the cylinder head cover bolts -arrows- diagonally, starting from the outside and working toward the inside.

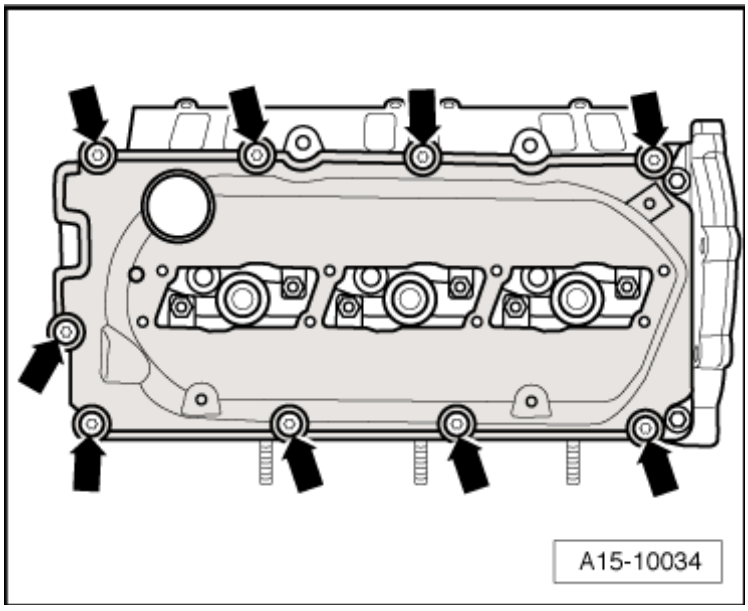


Fig. 35: Identifying Cylinder Head Cover, Tightening Specifications and Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the bolts and the cylinder head cover.

Installing

Install in reverse order of removal. Note the following:

NOTE: **Replace the cylinder head cover gasket if it is damaged.**

Replace gaskets, seals and O-rings.

Hose connections and charge air system hoses must be free of oil and grease before installing.

Secure all hose connections using hose clamps appropriate for the model type.

-- Tighten the cylinder head cover bolts, diagonally and in steps, starting from the inside and working toward the outside.

Injector Installation Information

- Make sure the injectors and their installed locations are clean before installing. Clean the injector shaft in the cylinder head with a clean cloth if necessary. Do not use any sharp tools and be careful not to damage it.
- Always use new seals. Lubricate all the seals with installation oil or assembly oil before installing.

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- The injectors must not be damaged. To remove the used copper sealing ring from the injector, clamp the sealing ring carefully in a vise until the clamping jaws on the vise prevent the ring from turning. Pull the injector out of the copper sealing ring by hand with a slight twisting and pulling motion.
- The injector line and tensioning plate must be replaced, when the injector is replaced.
- When installing, the injectors and injector lines may only be installed to the same cylinder as before.

-- Install the fuel injectors.

-- Tighten the high pressure line union nuts by hand.

-- Make sure the high pressure lines are seated free of stress.

-- Tighten the high pressure lines, refer to one of the following:

Fig. 2.

Fig. 4.

Fig. 3.

-- Inspect the fuel system for leaks. Refer to **FUEL SYSTEM, CHECKING FOR LEAKS** .

Tightening Specifications

Component		Nm
Cylinder head cover to cylinder head		9
Tensioning plate to cylinder head		10
Sealing cap to cylinder head		5.5
High pressure line		28
Wiring harness bracket to cylinder head		9
Intake tube bracket to cylinder head		9
Throttle valve control module -J338- with intake tube to	Intake manifold	9
	Bracket	9
	Connecting pipe for mechanical Exhaust Gas Recirculation (EGR) valve	9
Hose clamps 13 mm wide		5.5

CYLINDER HEAD

The following special tools are required for the left cylinder head only.

Special tools and workshop equipment required

- Retainer 3036

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- Puller T10320
- Puller T40064
- Adjustment Pin T40060

Removing

-- Drain the coolant. Refer to **COOLANT, DRAINING** .

Left Cylinder Head

-- Remove the high pressure pump toothed belt. Refer to **HIGH PRESSURE PUMP TOOTHED BELT** .

-- Remove the high pressure pump toothed belt sprocket using the puller T40064.

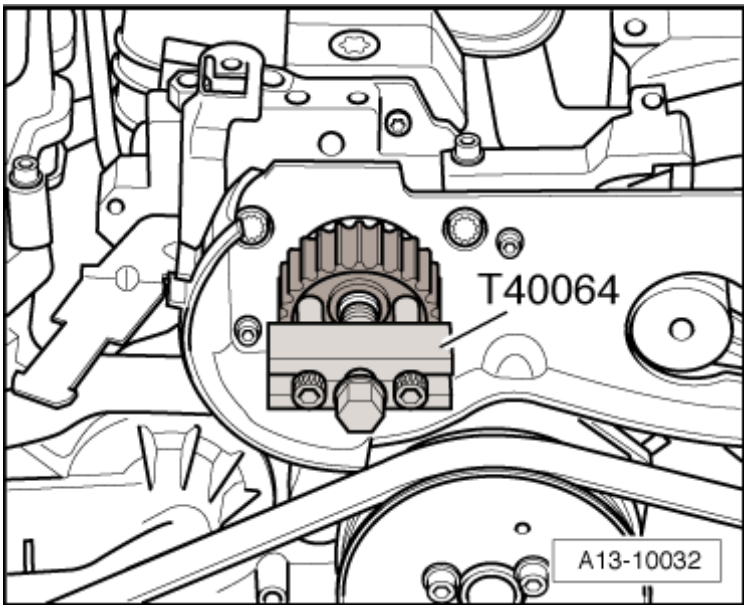


Fig. 36: Identifying High Pressure Pump Toothed Belt Sprocket, Removal
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-- Using the retainer 3036, loosen the center bolt -1- for the toothed belt drive gear approximately two turns.

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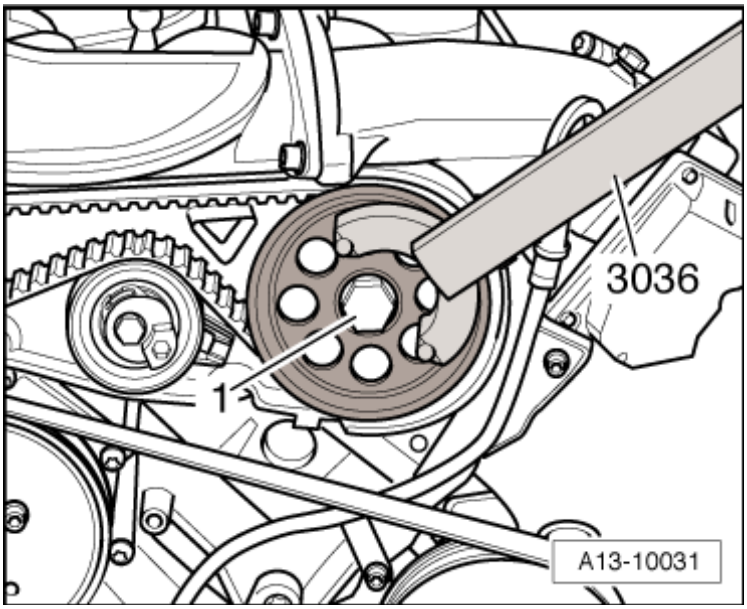


Fig. 37: Identifying Toothed Belt Drive Gear Bolt, Loosening and Tightening
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the toothed belt drive gear using the puller T10320.

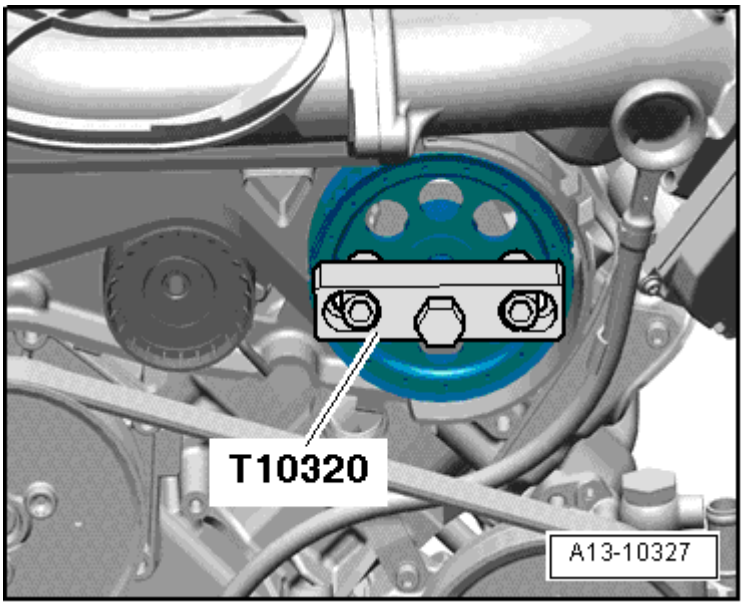


Fig. 38: Identifying Toothed Belt Drive Gear, Removal
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the toothed belt drive gear with the toothed belt.

-- Remove the bolts -arrows- and the rear toothed belt guard.

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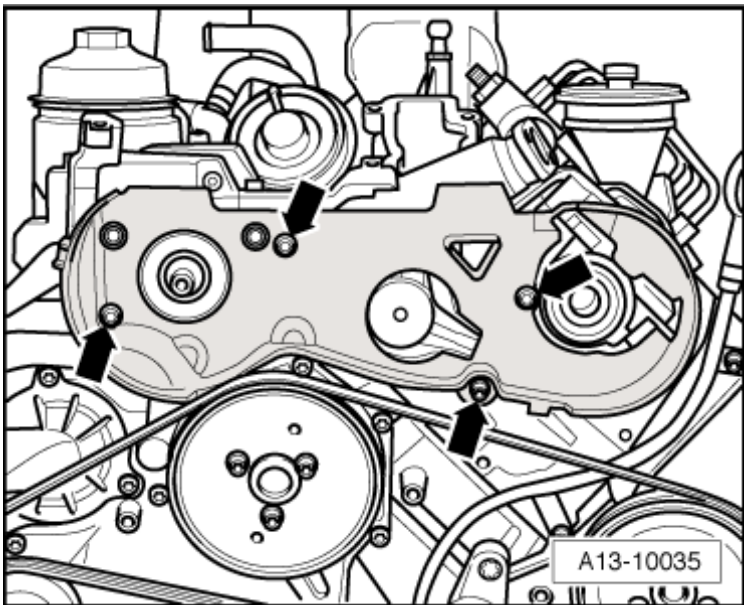


Fig. 39: Identifying Bolts -Arrows- And Rear Toothed Belt Guard
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the fuel supply line banjo bolt -2- and fuel return line banjo bolt -1- from the high pressure pump.

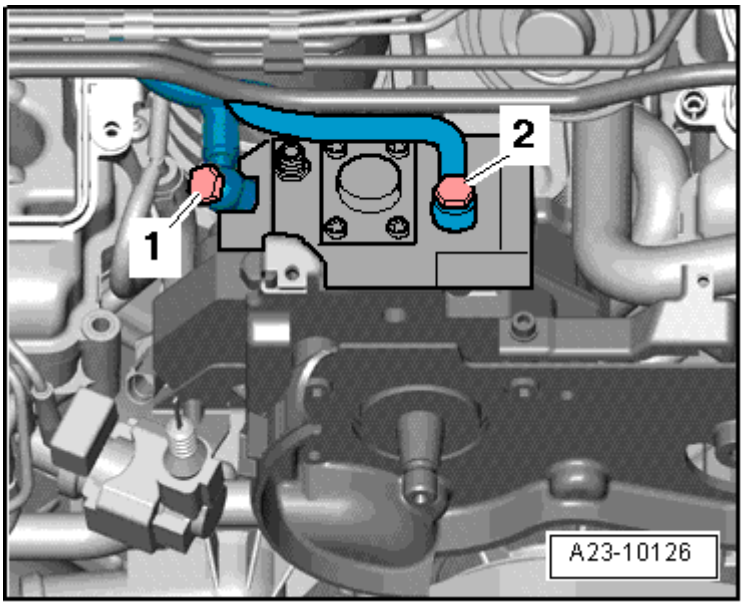


Fig. 40: Identifying Fuel Supply Line Banjo Bolt -2- And Fuel Return Line Banjo Bolt -1-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Continuation for Both Sides

-- Remove the upper intake manifold. Refer to **UPPER INTAKE MANIFOLD** .

-- Remove the left or right lower intake manifold. Refer to one of the following:

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LOWER LEFT INTAKE MANIFOLD .

LOWER RIGHT INTAKE MANIFOLD .

-- Remove the affected camshaft timing chain from the camshaft. Refer to **CAMSHAFTS**.

-- Remove the banjo bolt **CYLINDER HEAD OVERVIEW** and the coolant ventilation line.

-- Remove the intermediate pipes, refer to the following:

- **LEFT INTERMEDIATE PIPE** .
- **RIGHT INTERMEDIATE PIPE** .

-- Remove the left or right cylinder head cover. Refer to **CYLINDER HEAD COVER**.

Right Cylinder Head

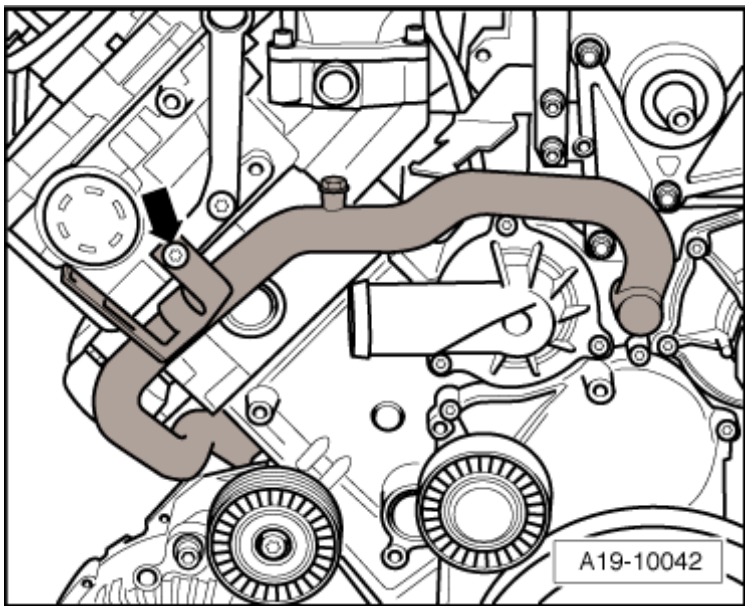


Fig. 41: Identifying Right Coolant Pipe Bolt -Arrow- From Cylinder Head
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the right coolant pipe bolt -arrow- from the cylinder head.

Continuation for Both Sides

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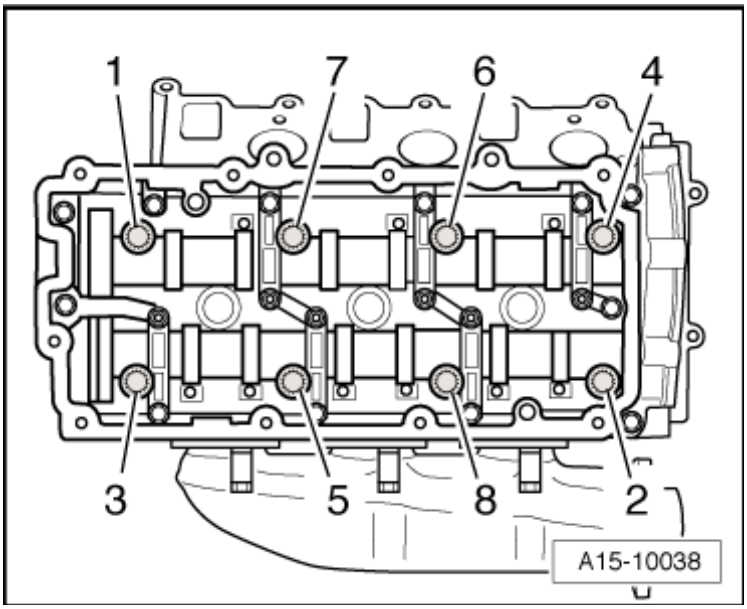


Fig. 42: Identifying Bolt Removal Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Loosen the cylinder head bolts in the following sequence.

-- Remove the bolts and carefully remove the cylinder head.

CAUTION: Do not lay the removed cylinder head on the sealing surface with the glow plugs installed, the glow plugs protrude slightly past the cylinder head.

Installing

NOTE: Remanufacturing diesel cylinder heads is not permitted.

Replace the cylinder head bolts.

During assembly, replace self-locking nuts and bolts.

Always replace bolts that have been tightened to a torque angle as well as any O-rings and gaskets.

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

Carefully remove all grinding and sanding residue.

There must be no oil or coolant in the cylinder head bolt holes in the cylinder block.

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Only unpack new the cylinder head gasket immediately prior to installation.

Handle the gasket carefully. Damages to the silicone layer and in the areas of the recesses may result in leaks.

Do not remove the plastic covers protecting the valves until immediately before installing the cylinder head.

When installing a replacement cylinder head with the camshafts installed, lubricate the contact surfaces between the roller rocker arms and the cam running surfaces.

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.

Secure all hose connections using hose clamps appropriate for the model type.

Hose connections and charge air system hoses must be free of oil and grease before installing.

Replace all of the coolant and engine oil when replacing the cylinder head or cylinder head gasket.

Use the sealant provided.

Install in reverse order of removal. Note the following:

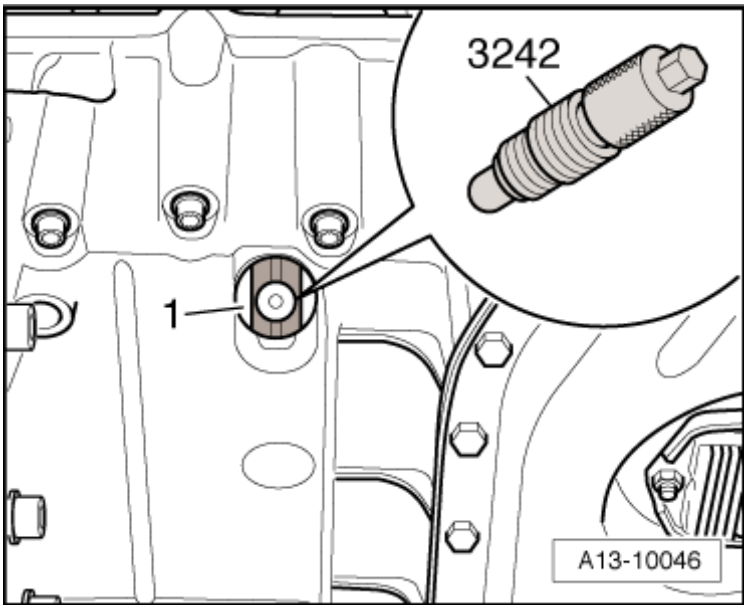


Fig. 43: Identifying Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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-- Move the crankshaft and the camshafts to the Top Dead Center (TDC) position before installing the cylinder head:

- The crankshaft holder 3242 must be installed in the TDC position for the crankshaft -1-.
- The camshafts on both cylinder heads must be secured using the adjustment pin T40060.

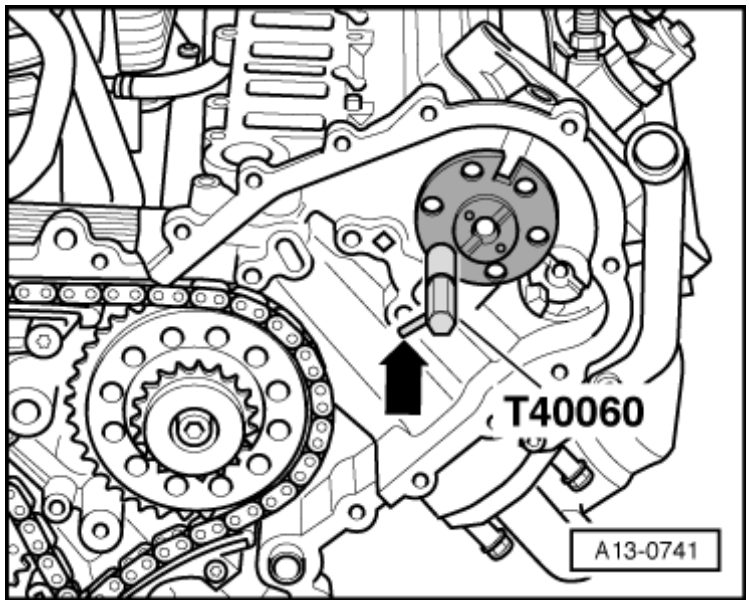


Fig. 44: Identifying Check Of Camshafts For Both Cylinder Heads In TDC Position And Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Note the cylinder head gasket identification:

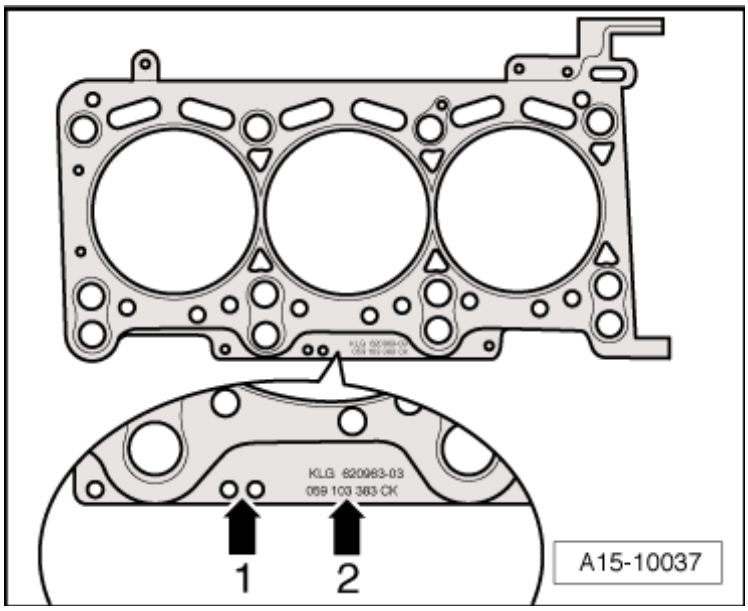


Fig. 45: Identifying Cylinder Head Gasket Identification

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Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Holes
2. Part number:

NOTE: If the cylinder head gasket or the cylinder head were replaced, select a new cylinder head gasket with the same number of holes as the old gasket.

If the cylinder head is replaced, measure the piston projection in TDC to determine the new cylinder head gasket. Refer to PISTON PROJECTION IN TDC, CHECKING .

The cylinder head gaskets for the left and right cylinder head cannot be interchanged because they each have a different shape.

-- Clean any oil or grease off the sealing surfaces.

NOTE: Note the expiration date of the sealant.

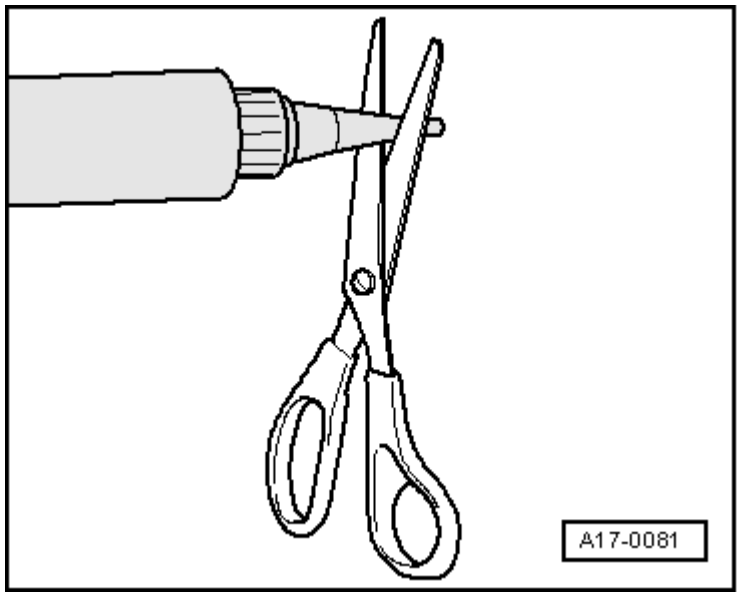


Fig. 46: Cutting Tube Nozzle At Front Marking (Nozzle Diameter Approx. 5 Mm)
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Cut the sealant tube nozzle at the front mark (nozzle diameter approximately 5 mm).

Left Cylinder Head

-- Apply beads of sealant -1 and 2- on the clean sealing surfaces on the cylinder block and the lower timing chain cover as illustrated.

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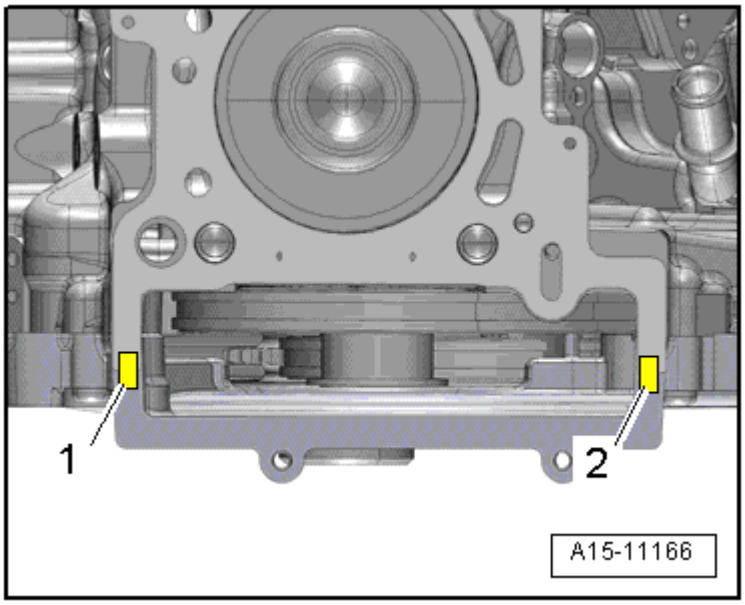


Fig. 47: Identifying Areas -1 And 2- To Apply Bead Of Sealant
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Apply the sealant in the amounts specified.

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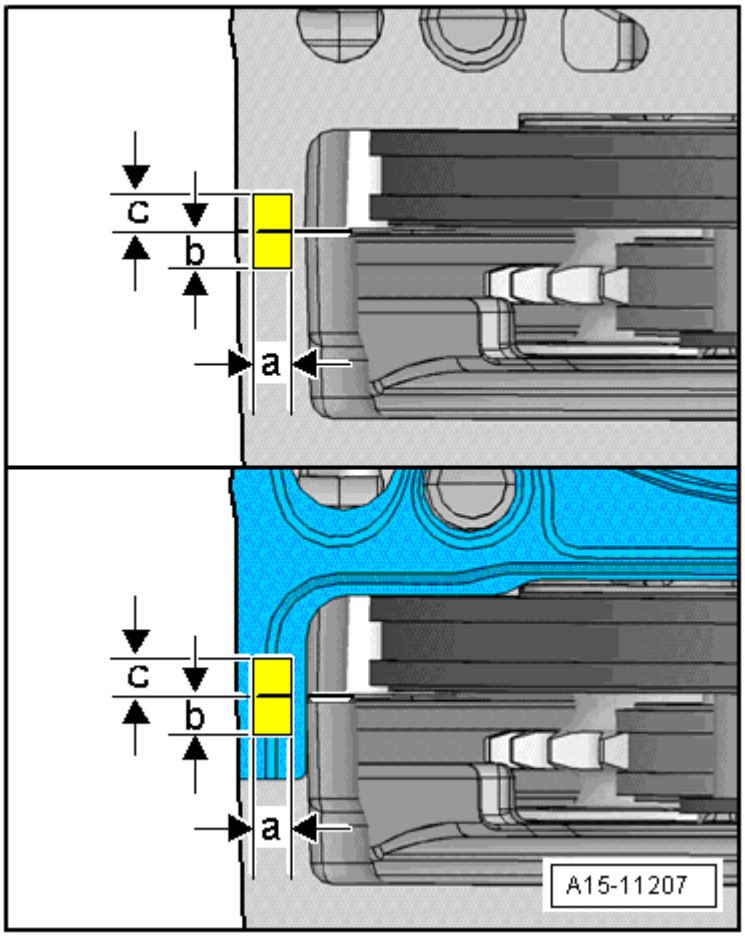


Fig. 48: Identifying Dimensions -a to c-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- a = 7 mm
- b = 7 mm
- c = 7 mm

-- Set the cylinder head gasket in place.

-- Apply sealant beads -1 and 2- to the clean sealing surfaces as illustrated.

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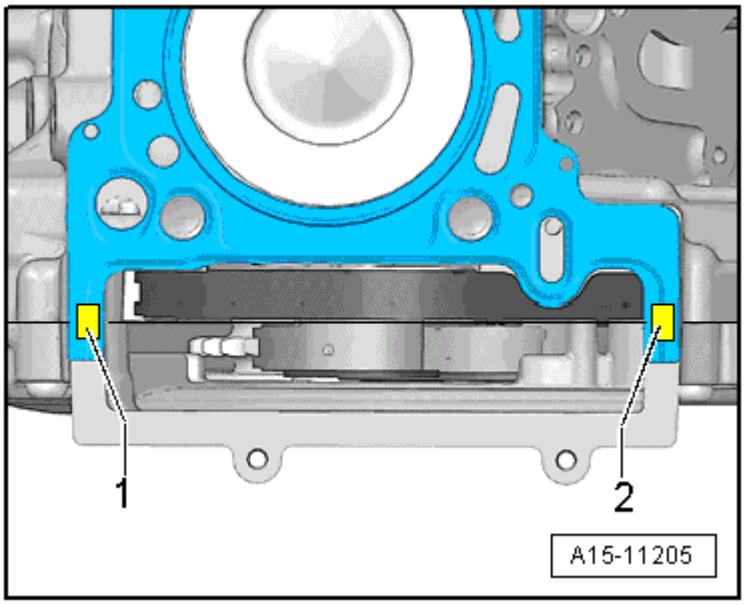


Fig. 49: Identifying Areas -1 And 2- To Apply Bead Of Sealant
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Right Cylinder Head

-- Apply beads of sealant -1 and 2- on the clean sealing surfaces of the cylinder block and the lower timing chain cover as illustrated.

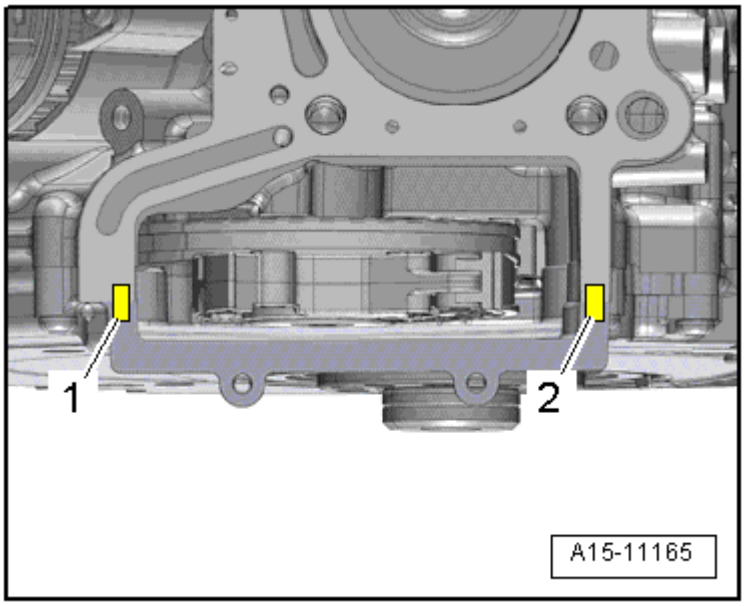


Fig. 50: Identifying Areas -1 And 2- To Apply Bead Of Sealant
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-- Apply the sealant in the amounts specified.

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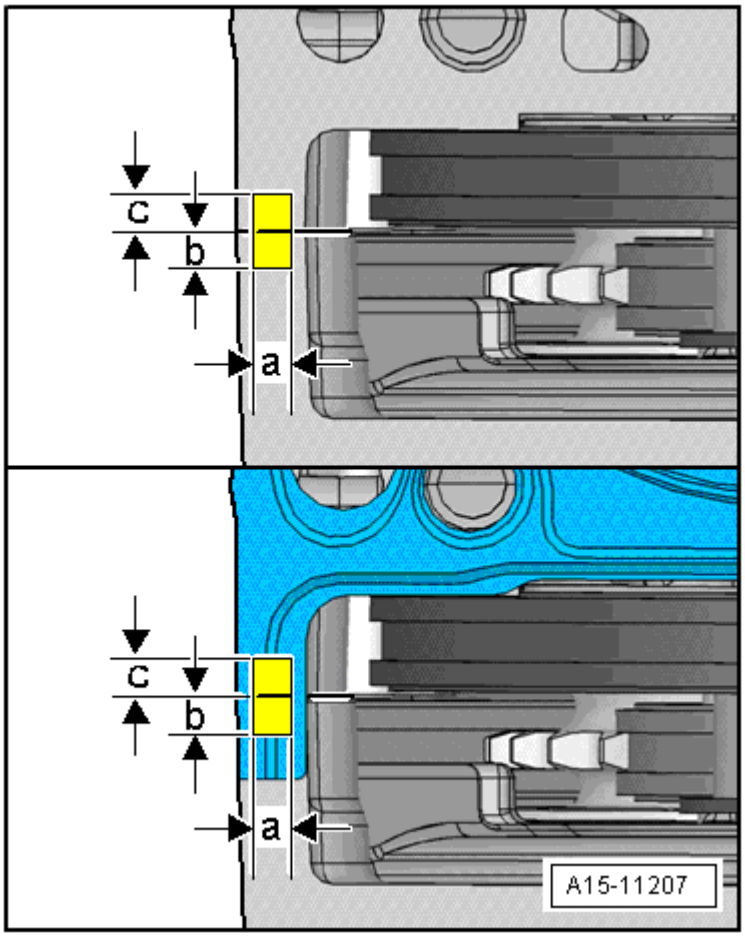


Fig. 51: Identifying Dimensions -a to c-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- a = 7 mm
- b = 7 mm
- c = 7 mm

-- Set the cylinder head gasket in place.

-- Apply sealant beads -1 and 2- to the clean sealing surfaces as illustrated.

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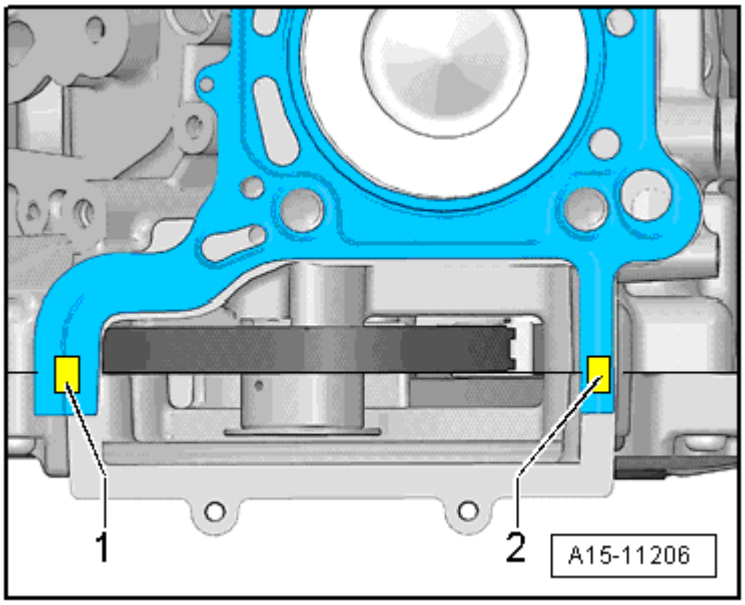


Fig. 52: Identifying Sealant Beads -1 And 2-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Continuation for Both Sides

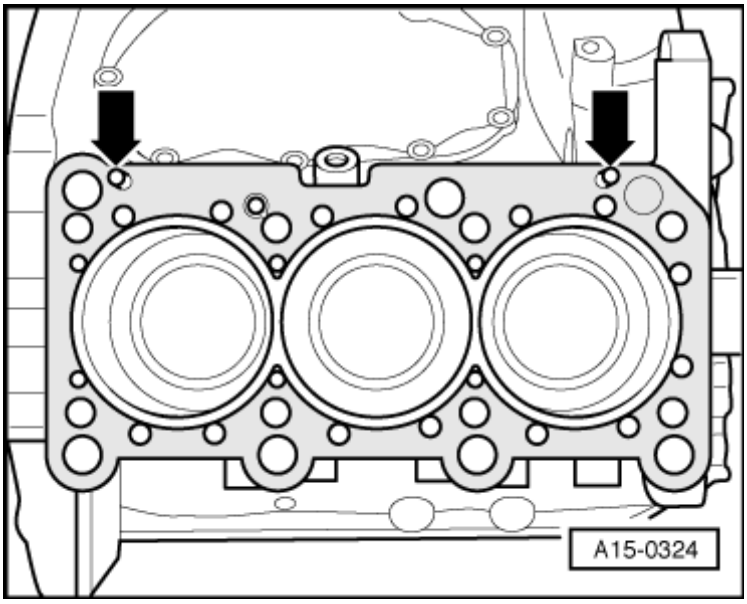


Fig. 53: Identifying Cylinder Head Gasket
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Pay close attention to the alignment bushings in the cylinder block -arrows-.
- Pay attention to installed position of the cylinder head gasket, the mark "upper" (top) or part number must face toward the cylinder head.

-- Install the cylinder head.

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-- Insert new cylinder head bolts and tighten them by hand.

-- Tighten the cylinder head bolts in the following sequence -1 through 8- as follows:

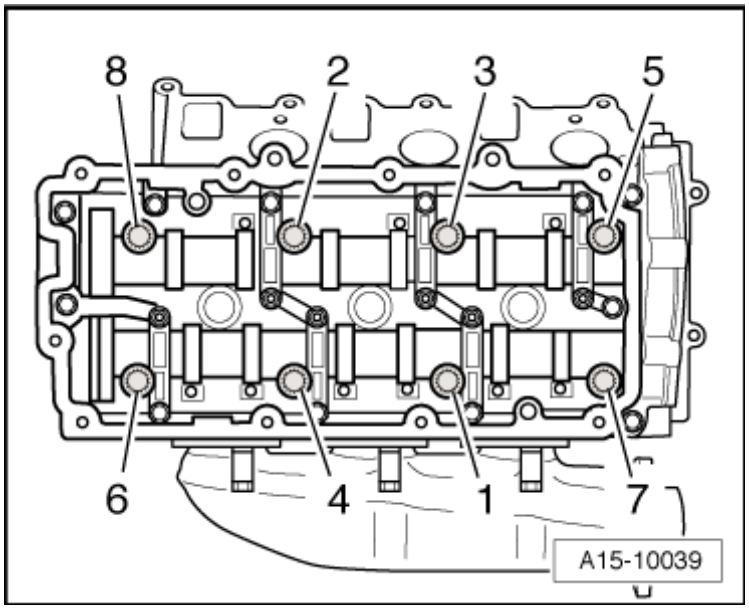


Fig. 54: Identifying Cylinder Head, Tightening Specifications and Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Using a torque wrench, tighten the bolts to 35 Nm.

-- Using a torque wrench, tighten the bolts to 60 Nm.

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

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

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

-- Install the left or right cylinder head cover. Refer to **CYLINDER HEAD COVER**.

-- Install the camshaft timing chains. Refer to **CAMSHAFTS**.

-- Install the intermediate pipe, refer to one of the following:

- **LEFT INTERMEDIATE PIPE** .
- **RIGHT INTERMEDIATE PIPE** .

-- Install the left or right intake manifold. Refer to one of the following:

LOWER LEFT INTAKE MANIFOLD .

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LOWER RIGHT INTAKE MANIFOLD .

-- Install the upper intake manifold. Refer to **UPPER INTAKE MANIFOLD** .

Left Cylinder Head

-- Install the high pressure pump toothed belt. Refer to **HIGH PRESSURE PUMP TOOTHED BELT** .

Continued for Both Sides

-- Change the engine oil.

-- Replace the coolant. Refer to **COOLANT, FILLING** .

-- Inspect the fuel system for leaks. Refer to **FUEL SYSTEM, CHECKING FOR LEAKS** .

Tightening Specifications

Component	Nm
Coolant line to cylinder head	15.5
Right coolant pipe to cylinder head	9
Toothed belt drive gear to camshaft	75
Rear toothed belt guard to engine	9
Fuel supply and return line to high pressure pump	28

CAMSHAFT SEAL

Special tools and workshop equipment required

- Seal Puller - General Usage 2085
- Retainer 3036
- M10 x 1.25 x 40 Bolt from Seal Installer 3241
- Assembly Tool T10053
- Puller T10320

Replacing

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

-- Loosen the clips -arrows-.

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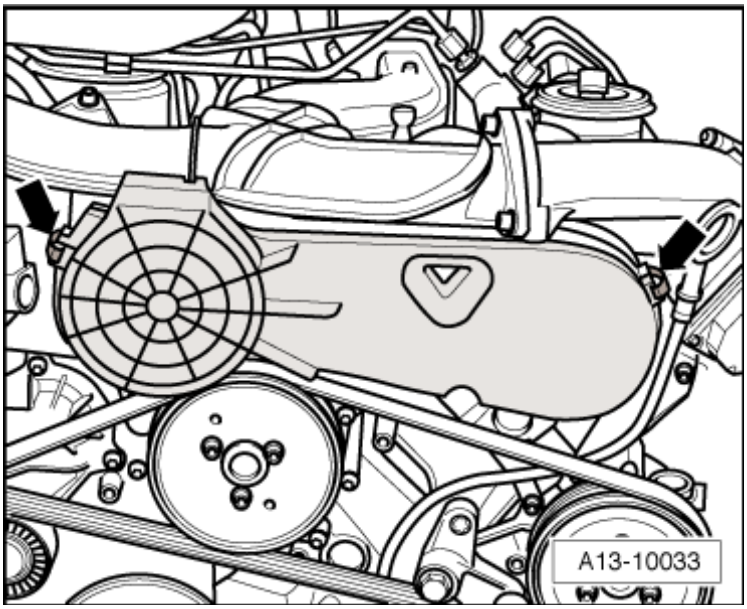


Fig. 55: Identifying Clamps -Arrows-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Tilt the toothed belt guard forward and disengage the pins on the bottom side of it.

-- Loosen the belt tension bolt -arrow- approximately two turns.

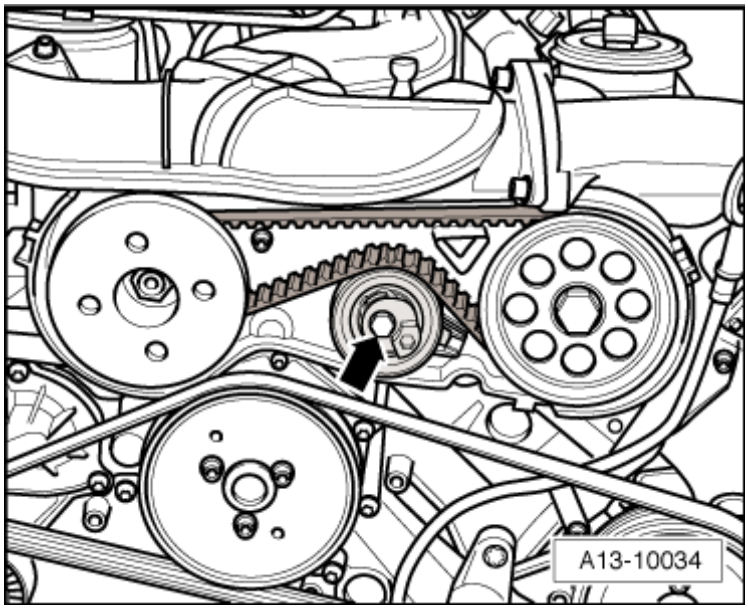


Fig. 56: Identifying Tensioner Bolt -Arrow-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Using the retainer 3036, loosen the center bolt -1- for the toothed belt drive gear approximately two turns.

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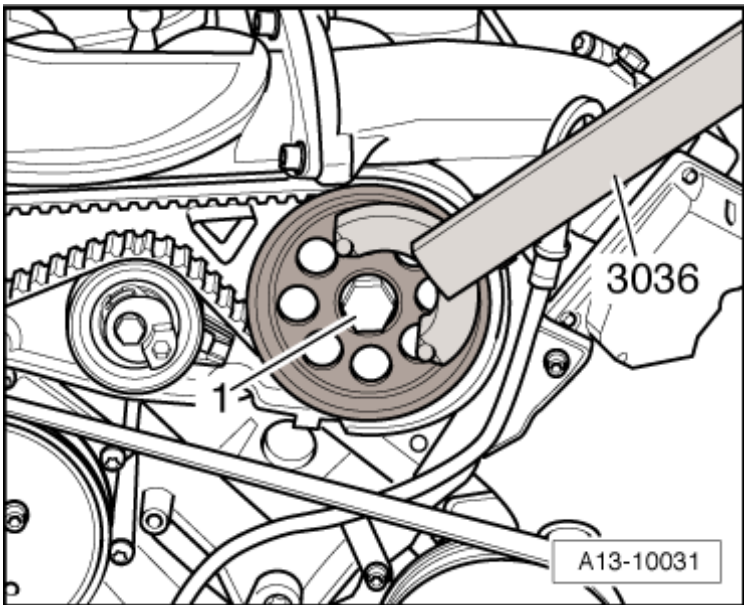


Fig. 57: Identifying Toothed Belt Drive Gear Bolt, Loosening and Tightening
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the toothed belt drive gear using the puller T10320.

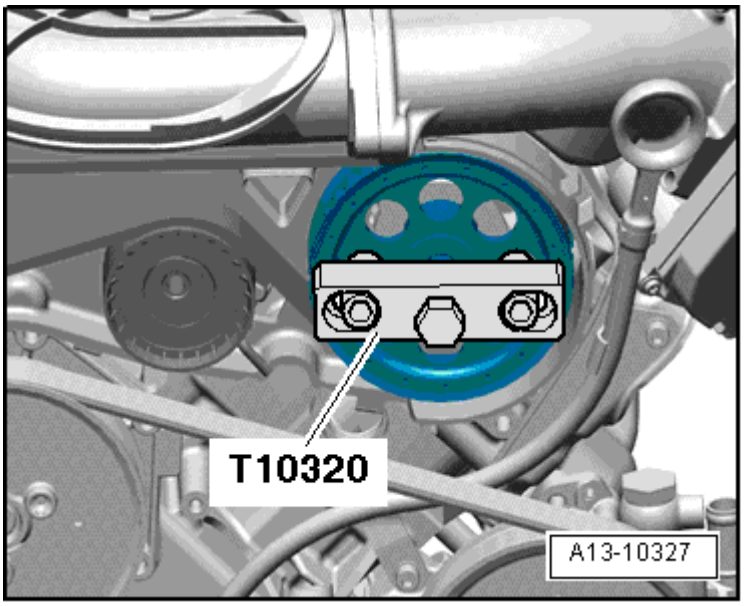


Fig. 58: Identifying Toothed Belt Drive Gear, Removal
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the toothed belt drive sprocket with the toothed belt.

-- Turn the inner part of the seal puller - general usage 2085 3 turns from the outer part and lock the knurled thumb screw.

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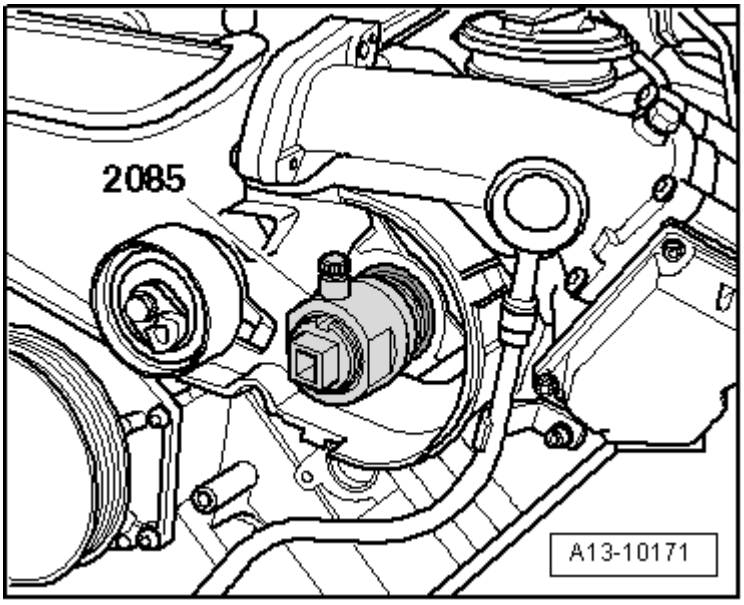


Fig. 59: Identifying Seal Puller 2085
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Lubricate the threaded head of the seal remover, place it against the seal, and with strong force, screw it into the seal as far as possible.

-- Loosen the knurled thumb screw and turn the inner part against the camshaft until the seal is removed.

-- Secure the seal removed in a vice at the flat spots and remove the seal with pliers.

-- Clean the running and sealing surfaces.

-- Install the new seal all the way using the thrust sleeve taken from assembly tool T10053. Use the M10 x 1.25 x 40 bolt -arrow- from the seal installer 3241.

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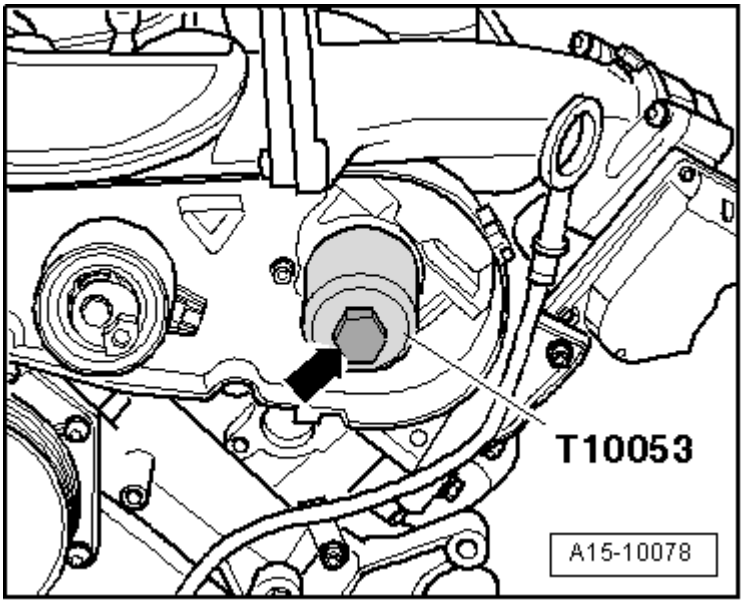


Fig. 60: Identifying Assembly Tool T10053 And M10 x 1.25 x 40 Bolt -Arrow- From Seal Installer 3241
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

-- Install the high pressure pump toothed belt. Refer to **HIGH PRESSURE PUMP TOOTHED BELT** .

CAMSHAFTS

Special tools and workshop equipment required

- Retainer 3036
- Puller T10320
- Camshaft Fitting Tool T40094
- Camshaft Fitting Tool T40095
- Camshaft Fitting Tool T40096
- Hand Drill with Plastic Brush Attachment
- Protective Eyewear
- Sealant

Removing

-- Remove the affected camshaft timing chain from the camshafts. Refer to **CAMSHAFT TIMING CHAINS, REMOVING FROM CAMSHAFTS**.

Left Cylinder Head

-- Remove the upper intake manifold. Refer to **UPPER INTAKE MANIFOLD** .

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-- Remove the high pressure pump toothed belt. Refer to **HIGH PRESSURE PUMP TOOTHED BELT** .

-- Using the retainer 3036, loosen the center bolt -1- for the toothed belt drive gear approximately two turns.

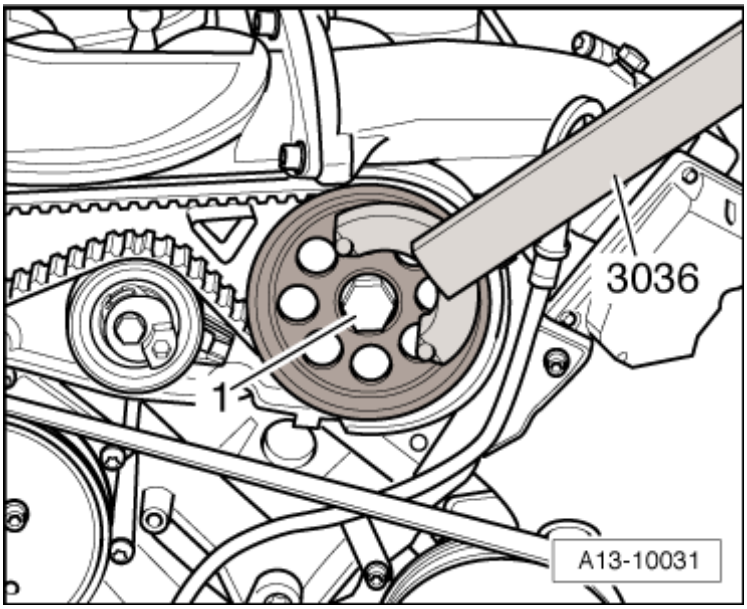


Fig. 61: Identifying Toothed Belt Drive Gear Bolt, Loosening and Tightening
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the toothed belt drive gear using the puller T10320.

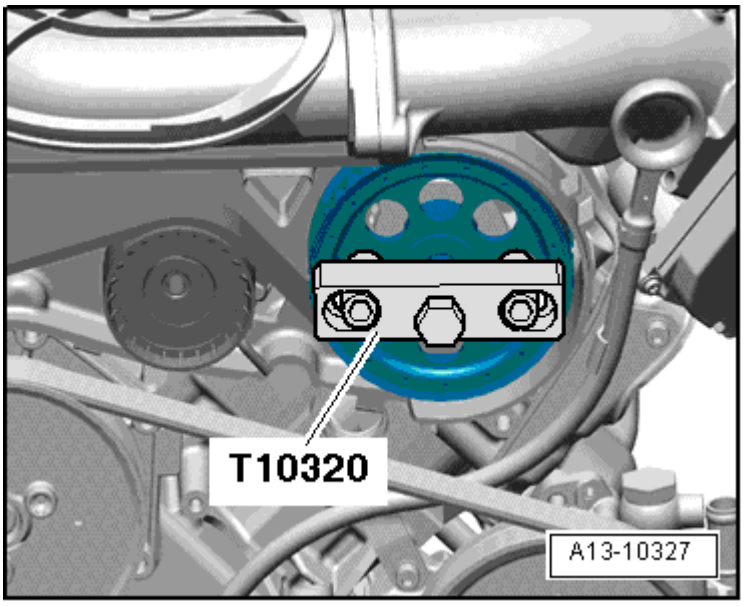


Fig. 62: Identifying Toothed Belt Drive Gear, Removal
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Continuation for Both Sides

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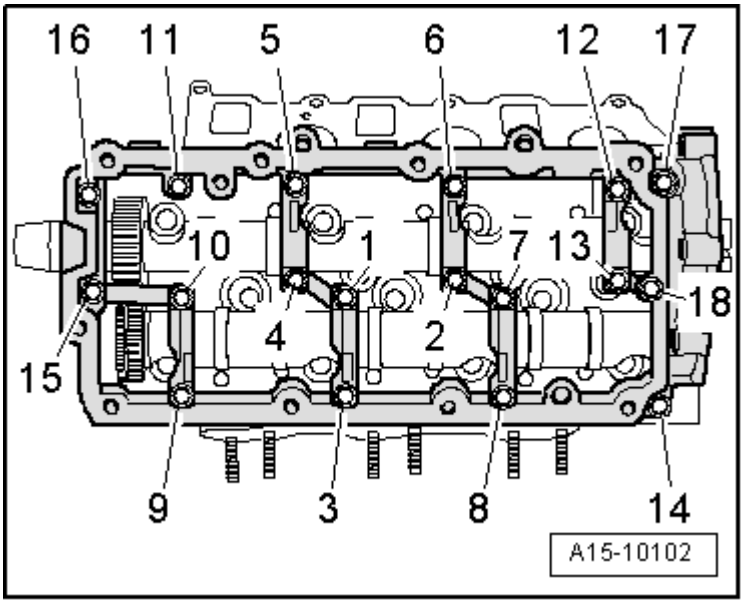


Fig. 63: Identifying Left Cylinder Head Guide Frame, Tightening Specifications and Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the left or right cylinder head cover. Refer to **CYLINDER HEAD COVER**.

-- Loosen the guide frame bolts and nuts in sequence -18 through 1-.

NOTE: Be careful of the roller rocker arms and the adjusters when removing the camshafts.

-- Carefully remove the guide frame and the camshafts.

Installing

CAUTION: Only install the camshafts using the camshaft insertion tool T40094 as described below. Otherwise the axial bearing in the guide frame will be destroyed and the cylinder head will have to be replaced.

WARNING: Wear safety glasses.

-- Remove the sealant residue from the cylinder head and guide frame using a rotating plastic brush.

CAUTION: Make sure that no sealant residue enters the cylinder head and bearings.

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

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-- Lubricate the journal surfaces of the camshafts.

Assemble the camshaft insertion tool T40094 as follows:

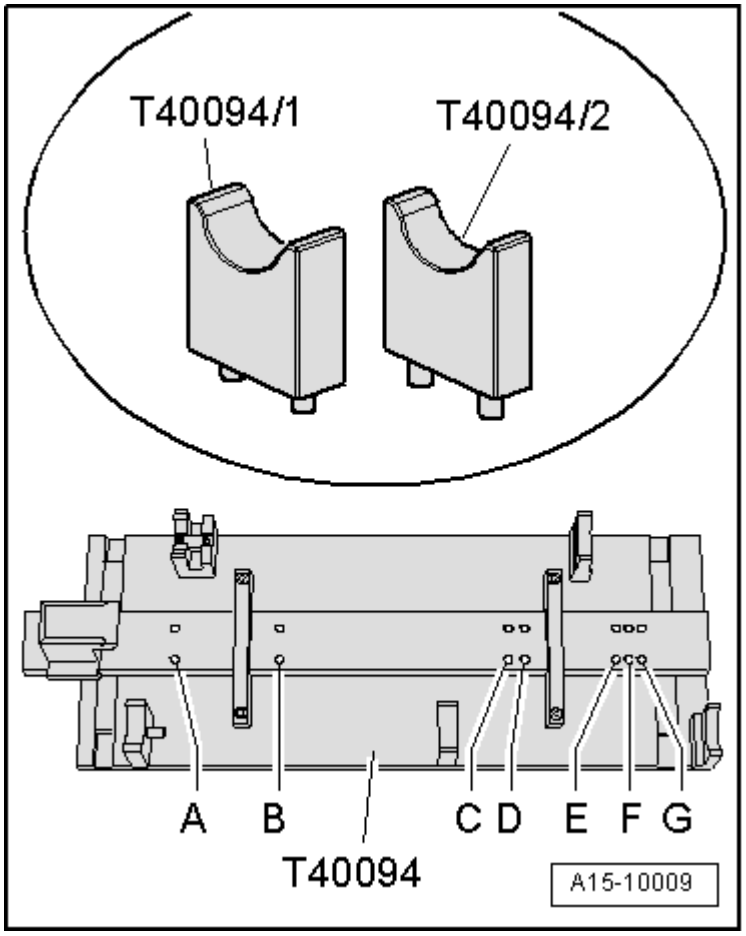


Fig. 64: Identifying Bracket T40094/1 And Bracket T40094/2
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Left Cylinder Head

-- Insert the bracket T40094/2 in location -A-.

-- Insert the bracket T40094/1 in location -D-.

Right Cylinder Head

-- Insert the bracket T40094/2 in location -B-.

-- Insert the bracket T40094/1 in location -C-.

Continuation for Both Sides

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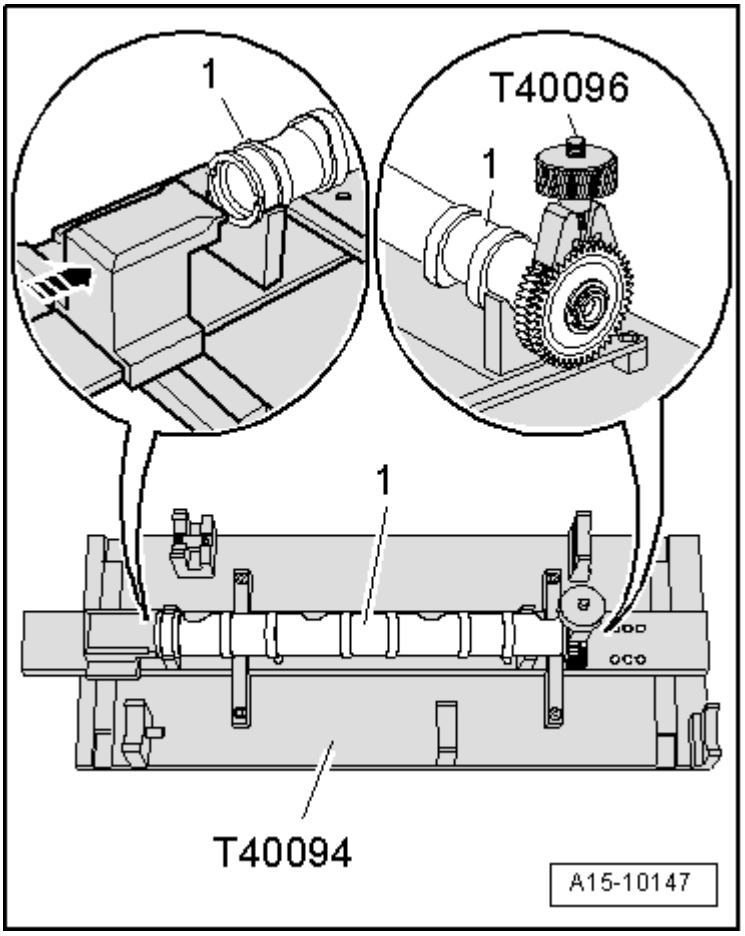


Fig. 65: Identifying Camshaft Insertion Tools T40094 And T40096
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

NOTE: The following procedure describes the left cylinder head.

The procedure is performed in the same order for the right cylinder head.

-- Insert the exhaust camshaft -1- in the brackets T40094/1 and T40094/2.

-- Rotate the camshaft so it can be secured in the Top Dead Center (TDC) position with the straight edge - arrow-.

-- Position the camshaft insertion tool T40096 on the camshaft splines so each of the arms on the tool engages in half of the sprocket.

-- Tighten the clamping tool with the knurled thumb screw until the tooth faces align.

-- Insert the intake camshaft -2- in the camshaft insertion tool T40094.

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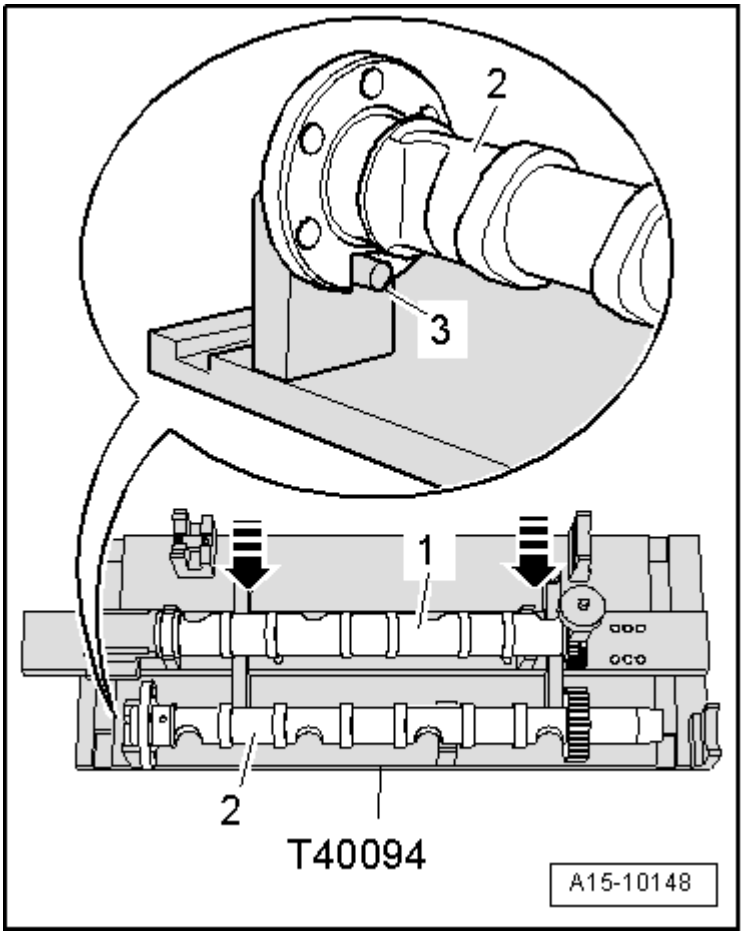


Fig. 66: Identifying Intake Camshaft -2- In Camshaft Insertion Tool T40094
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- The pin -3- must engage in the groove on the camshaft -2-.

-- Slide the exhaust camshaft -1- toward the intake camshaft until the splines mesh.

-- Make sure the camshaft is positioned correctly:

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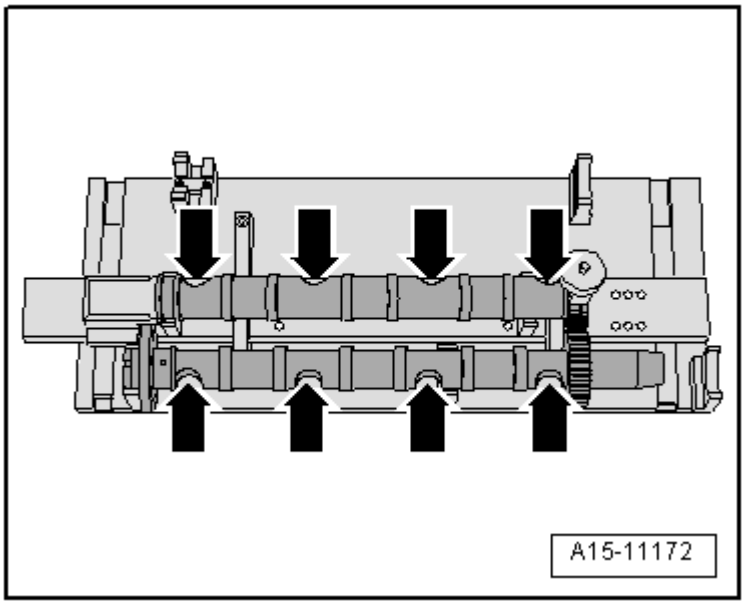


Fig. 67: Locating Camshaft Notches
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- The notches -arrows- on both camshafts must face upward.

-- Place the guide frame -1- on the camshafts.

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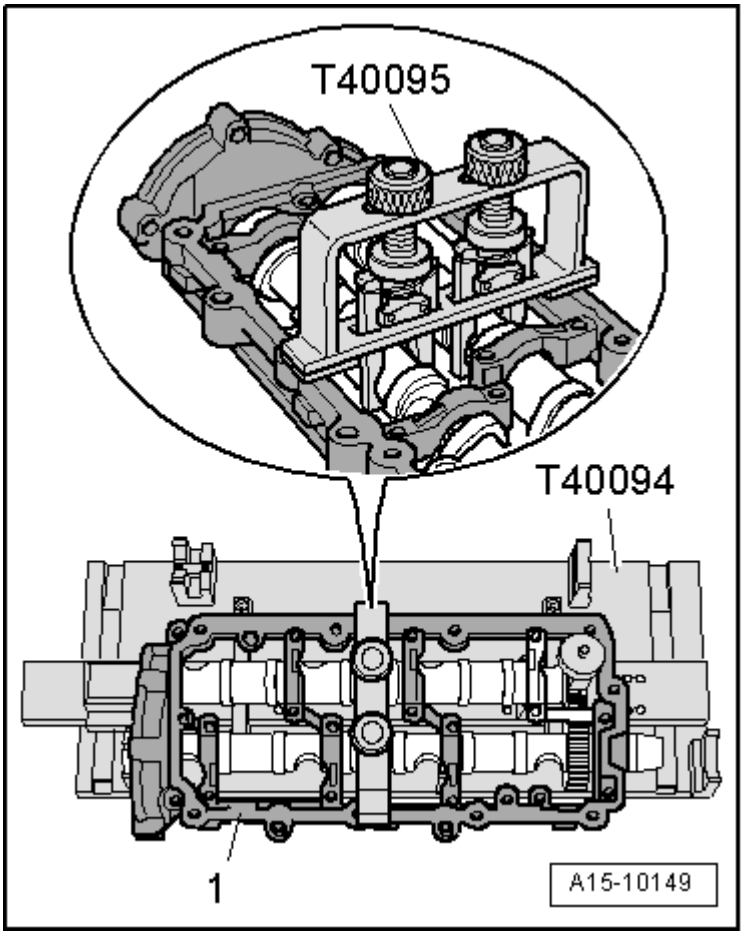


Fig. 68: Identifying Guide Frame -1- On Camshafts
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- All the camshaft bearings must lie on the camshafts.

-- Install the camshaft insertion tool T40095 onto the camshafts by aligning the clamps and tension using the knurled thumb screws.

-- Tension the camshafts by tightening the nuts -3-.

-- Make sure the alignment pins -arrows- are in the cylinder head. Insert any missing alignment pins.

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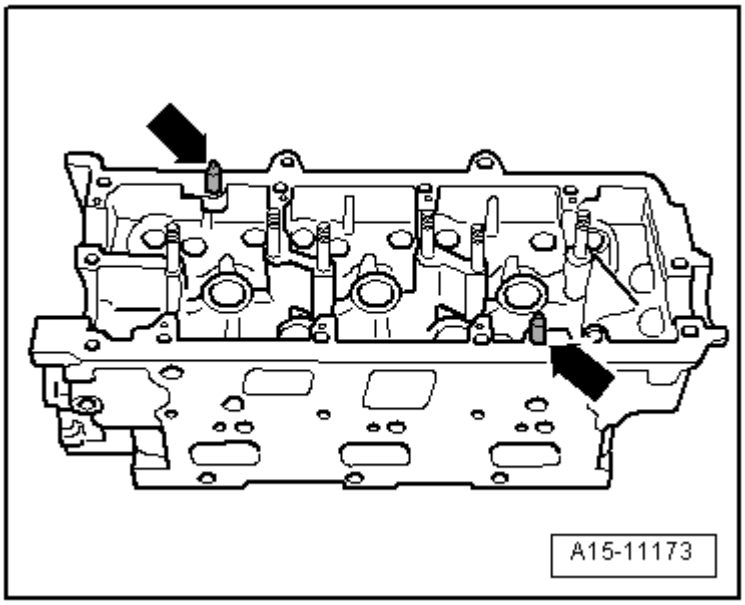


Fig. 69: Locating Cylinder Head Alignment Pins
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

NOTE: Note the expiration date of the sealant.

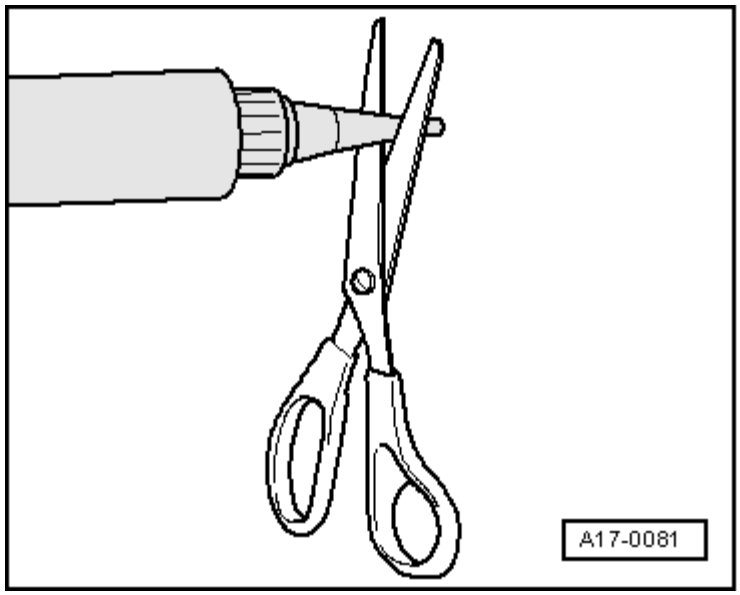


Fig. 70: Cutting Tube Nozzle At Front Marking (Nozzle Diameter Approx. 1.5 mm)
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Cut the sealant tube nozzle at the front mark (nozzle diameter approximately 1.5 mm).

NOTE: The illustration shows the guide frame without the camshafts.

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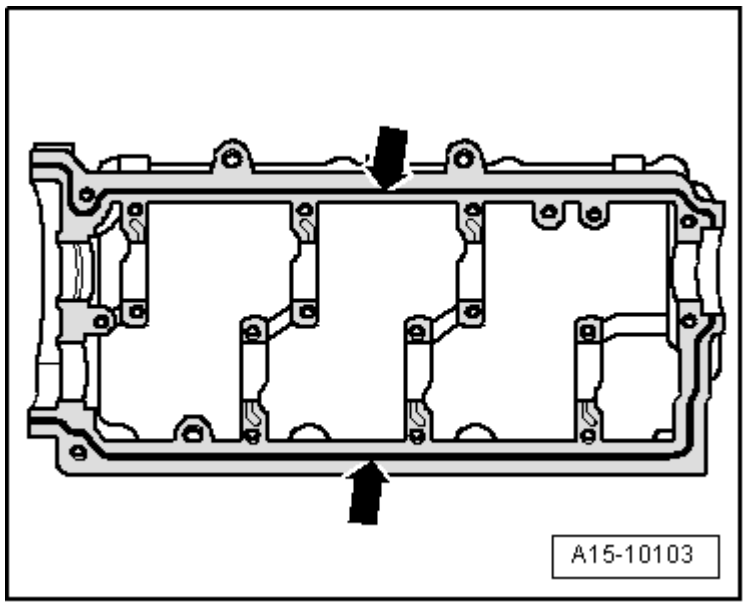


Fig. 71: Identifying Sealant Beads -Arrows- On Clean Sealing Surfaces Of Guide Frame
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Turn the guide frame around.

CAUTION: The lubrication system could be plugged with excess sealant.

- **Do not apply the sealant beads thicker than specified.**

-- Apply the sealant beads -arrows- on the clean sealing surfaces of the guide frame as shown in the illustration.

- The grooves -arrows- of the sealing surface must be completely filled with sealant.
- The sealant beads must be 1.5 to 2.0 mm above the sealing surface.

NOTE: The sealant beads must not be thicker than specified, otherwise the excess sealant can enter the camshaft bearing.

The guide frame must be installed within 5 minutes after application of the sealant.

CAUTION: The engine could be damaged.

- **Make sure all the roller rocker arms are seated correctly on the valve stem ends and the adjusters.**

-- Place the guide frame with both camshafts and the camshaft insertion tool T40095 on the cylinder head immediately.

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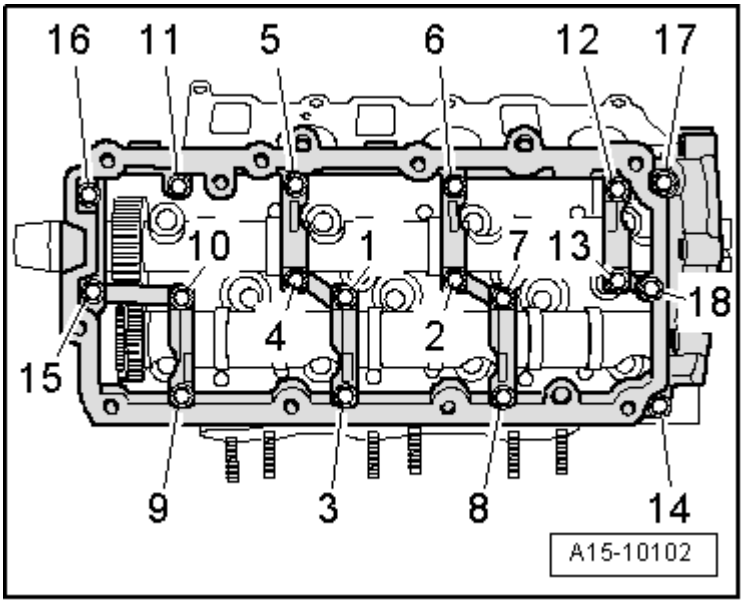


Fig. 72: Identifying Left Cylinder Head Guide Frame, Tightening Specifications and Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

NOTE: After installing the guide frame, the sealant must dry for approximately 30 minutes.

-- Hand tighten the guide frame bolts and nuts equally, in sequence -1 through 18-.

- The guide frame must be touching the entire contact surface of the cylinder head.

-- Tighten the guide frame bolts and nuts in sequence -18 through 1- until they are seated.

-- Remove the camshaft insertion tool T40095 and T40096.

Install in reverse order of removal. Note the following:

NOTE: Do not start the engine for approximately 30 minutes after installing the camshafts. The hydraulic lash adjusters must seat themselves (otherwise the valves will seat themselves on the pistons).

After working on the valvetrain, carefully rotate the engine by hand at least 2 full revolutions to ensure that valves do not strike the pistons when starting.

-- Install the left or right cylinder head cover. Refer to **CYLINDER HEAD COVER**.

Left Cylinder Head

-- Replace the camshaft seal. Refer to **CAMSHAFT SEAL**.

-- Install the high pressure pump toothed belt. Refer to **HIGH PRESSURE PUMP TOOTHED BELT** .

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-- Install the upper intake manifold. Refer to **UPPER INTAKE MANIFOLD** .

Right Cylinder Head

-- Replace the sealing cap on the cylinder head.

-- Drive the new sealing cap in with a suitable drift until it is flush.

Continuation for Both Sides

-- Install the camshaft timing chain. Refer to **CAMSHAFT TIMING CHAINS**.

Tightening Specifications

Component	Nm
Guide frame to cylinder head	9
Toothed belt drive gear to camshaft	75

VALVE STEM SEALS

Special tools and workshop equipment required

- Hinged Socket 3220
- Valve Seal Removal Tool 3364
- Valve Stem Seal Driver 3365
- Valve Cotters Asm/disasm Device VAS 5161
- Guide Plate for 3.0L TDI Engine VAS 5161/23

Removing

Vehicles with Ceramic Glow Plugs

CAUTION:
- **Ceramic glow plugs are very sensitive because of the materials they are made with. They require special handling when assembling and disassembling. Always follow the procedures described when removing and installing. Refer to CERAMIC SHEATHED GLOW PLUGS .**

Vehicles with Metal Glow Plugs

-- Remove the glow plugs using the hinged socket 3220.

Continuation for all Vehicles

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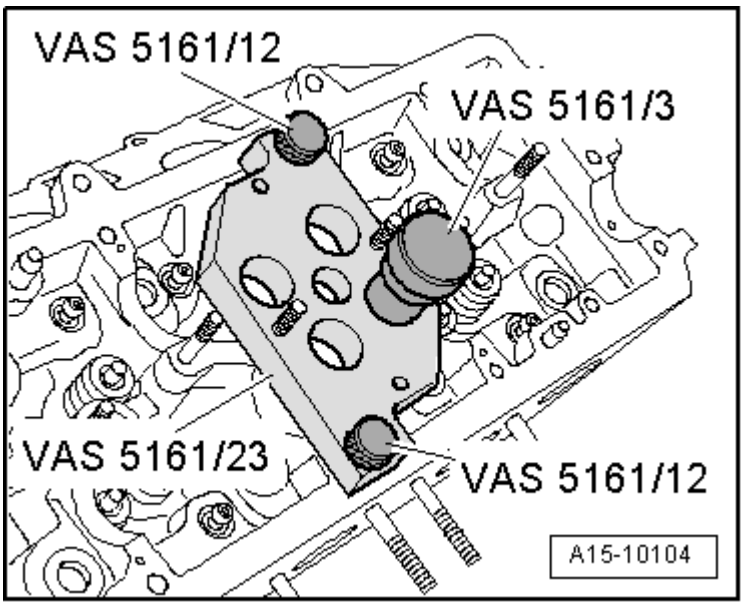


Fig. 73: Identifying Punch VAS 5161/3, Knurled Thumb Screws VAS 5161/12 And Guide Plate For 3.0 Liter TDI Engine VAS 5161/23
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

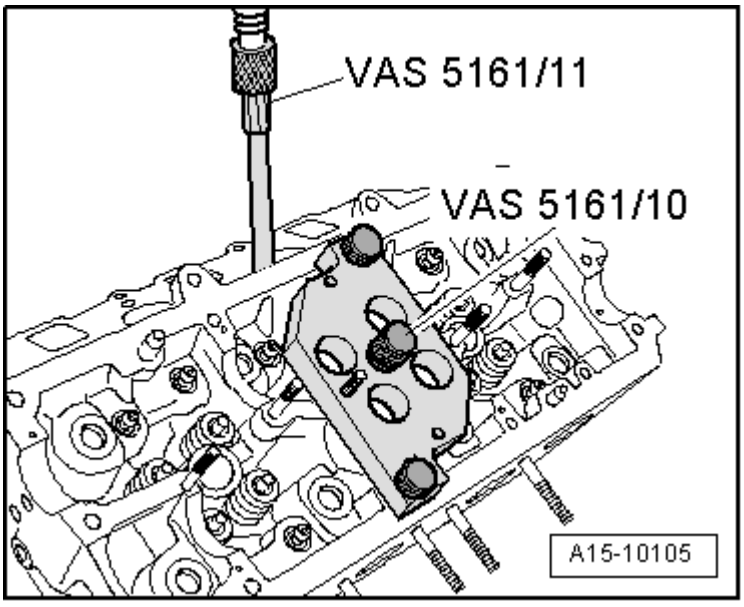
-- Remove the camshafts. Refer to **CAMSHAFTS**.

-- Position the guide plate for 3.0L TDI engine VAS 5161/23 on the cylinder head.

-- Secure the guide plate using the knurled thumb screws M6 VAS 5161/12.

-- Insert the punch VAS 5161/3 into the guide plate and loosen the stuck valve retainers using a plastic hammer.

-- Install the compression stud VAS 5161/10 in the guide plate.



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Fig. 74: Identifying Compression Stud VAS 5161/10 And Compressed Air Connection VAS 5161/11
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Install the adapter for compressed air connection VAS 5161/11 in the respective glow plug threads and tighten by hand.

-- Install the retainer VAS 5161/6 with the guide forks M6/M8 with threaded studs VAS 5161/5 into the guide plate.

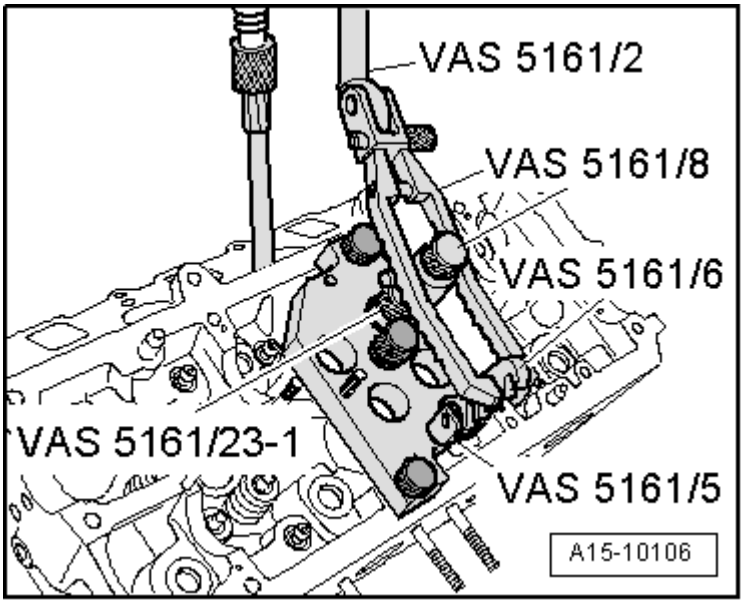


Fig. 75: Identifying Valve Insertion Device VAS 5161/8 Inserted In Guide Plate For 3.0 Liter TDI Engine VAS 5161/23
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Push the knurled spacer ring VAS 5161/23-1 onto the assembly cartridge VAS 5161/8.

-- Connect the adapter to compressed air with a commercially available connector and apply a constant pressure.

- Minimum pressure: 6 bar positive pressure.

-- Engage the pressure fork with lever for assembly cartridge VAS 5161/2 at the engaging device and press down the assembly cartridge.

-- At the same time, turn the knurled thumb screw on the assembly cartridge to the right, until the points engage in the valve retainers.

-- Lightly move the knurled thumb screw back and forth, causing the valve retainers to be pressed apart and be captured in the assembly cartridge.

-- Release the pressure fork.

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-- Remove the assembly cartridge with the spacer ring, the valve plate and the valve spring.

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

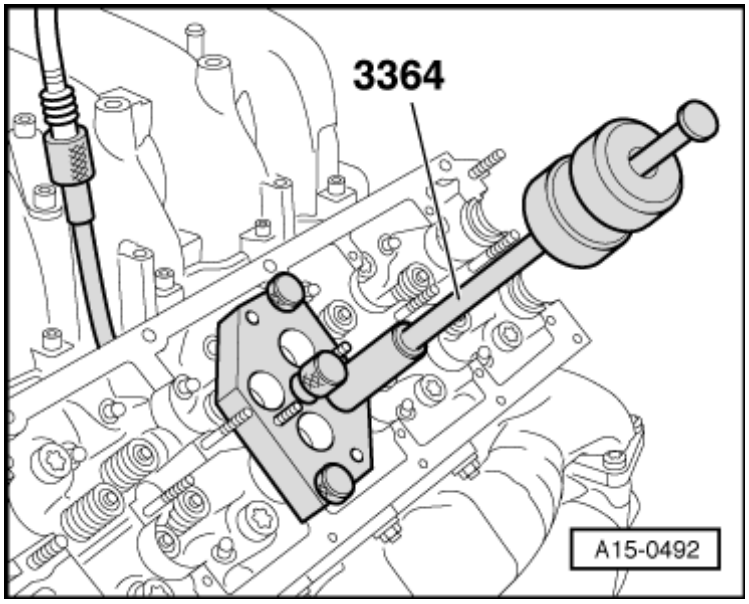


Fig. 76: Identifying Valve Seal Removal Tool 3364
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

If the valve seal removal tool 3364 cannot be used on some valve stem seals due to restricted clearance, proceed as follows:

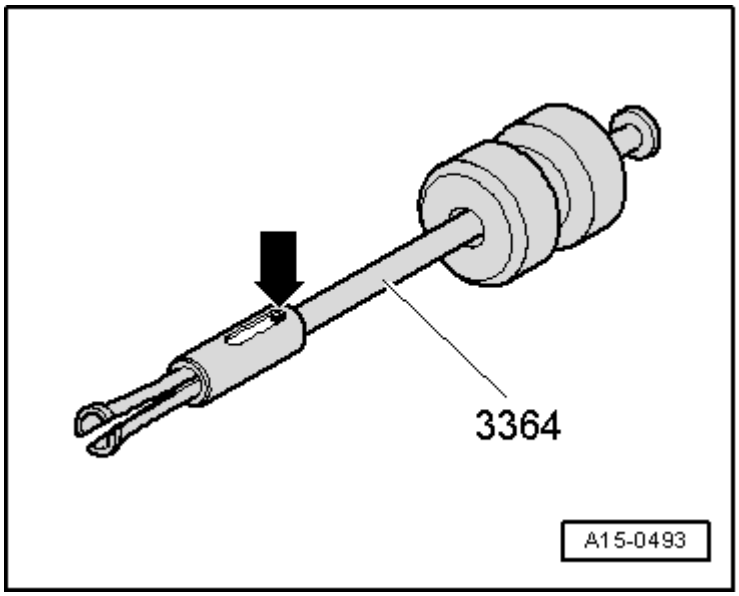


Fig. 77: Driving Out Spring Dowel Sleeve
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Drive the roll pin -arrow- on the valve seal removal tool 3364 out with a drift and remove the impact puller

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attachment.

-- Place the lower section of the valve seal removal tool 3364 on the valve stem seal.

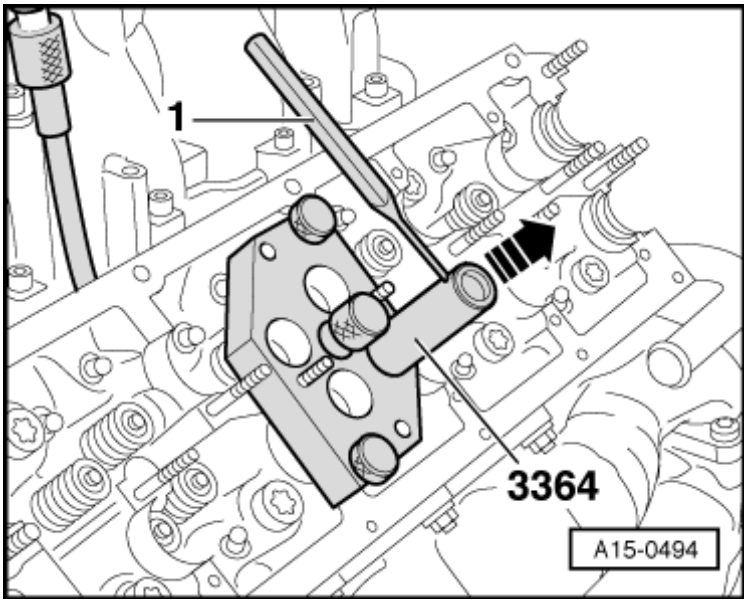


Fig. 78: Identifying Lower Section Of Valve Seal Removal Tool 3364 On Valve Stem Seal
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Insert a punch -1- into the hole in the valve stem seal puller as illustrated.

-- Using the punch -1- as a lever, pull the valve stem seal puller up -arrow- and remove the seal.

Installing

NOTE: A plastic sleeve -A- is supplied with the new valve stem seal.

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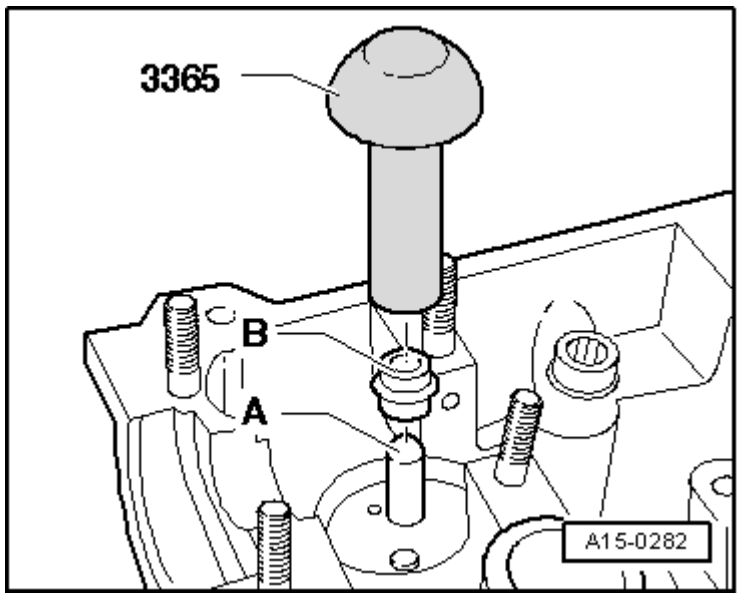


Fig. 79: Identifying Plastic Sleeve, New Valve Stem Oil Seals & Valve Stem Seal Driver 3365
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Place the plastic sleeve -A- on the valve stem to prevent damage to the new valve stem seal -B-.

-- Lightly lubricate the sealing lips of the valve stem seal with oil.

-- Push the valve stem seal onto the plastic sleeve.

-- Carefully press the valve stem seal onto the valve guide using the valve stem seal driver 3365.

-- Remove the plastic sleeve.

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

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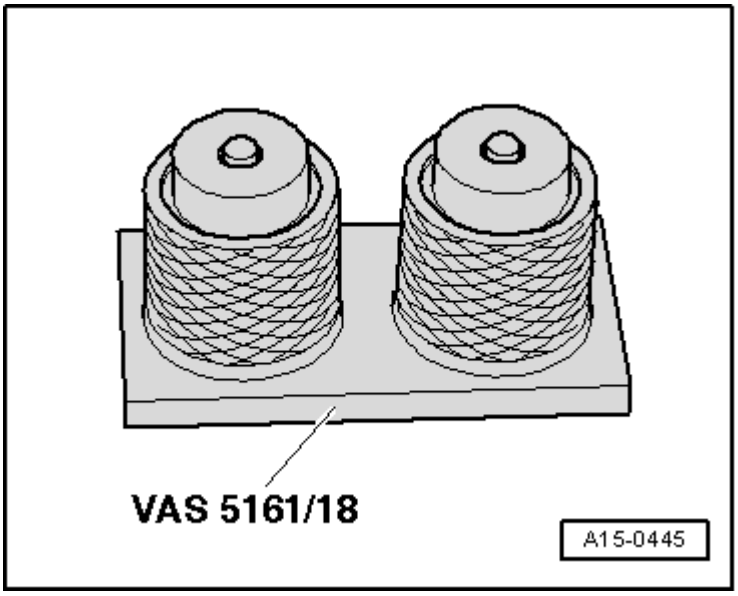


Fig. 80: Identifying Installation Cartridge VAS 5161/8
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

NOTE: The large diameter of the valve retainers point upward.

-- Press the assembly cartridge onto the valve insertion device from above and remove the valve retainers.

-- Insert the assembly cartridge VAS 5161/8 in the guide plate.

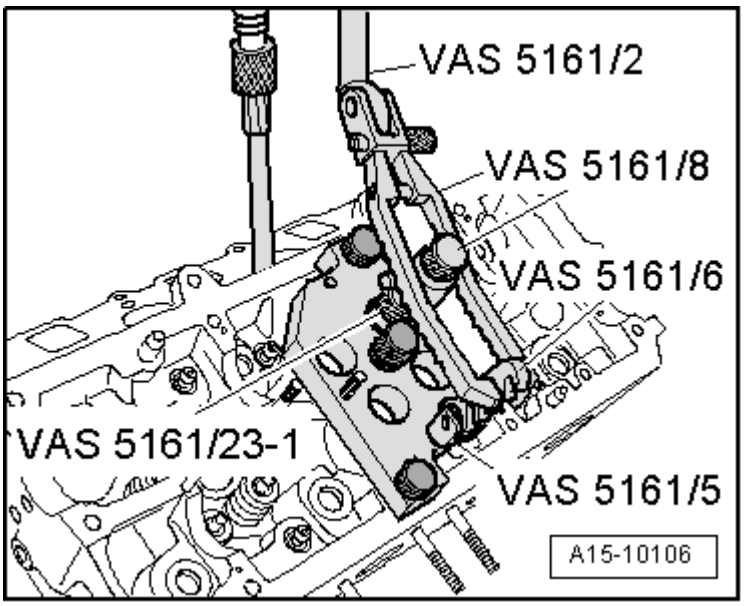


Fig. 81: Identifying Valve Insertion Device VAS 5161/8 Inserted In Guide Plate For 3.0 Liter TDI Engine VAS 5161/23
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Press the pressure fork down and pull the knurled thumb screw upward while turning it left and right to insert

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the valve retainers.

-- Release the pressure fork with the knurled thumb screw still pulled.

Further installation is in the reverse order of removal. Note the following:

-- Install the glow plugs. Refer to one of the following:

- **METAL GLOW PLUGS** .
- **METAL GLOW PLUGS, CHECKING** .

-- Install the camshafts. Refer to **CAMSHAFTS**.

NOTE: After installing the camshafts, do not crank the engine for at least 30 minutes. The hydraulic lash adjusters must seat themselves (otherwise the valves will seat themselves on the pistons).

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

CAMSHAFT TIMING CHAINS

Special tools and workshop equipment required

- Crankshaft Holder 3242
- Key T40049
- Adjustment Pin T40060 (Qty: 2)
- Adapter T40061
- Adapter T40062
- Two 3.3 mm Drill Bits

Removing

- Transmission is removed.

CAUTION: Risk of damaging valves and piston crowns.

- **Rotate the crankshaft and camshafts only with the chain drive completely installed.**

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

-- Remove the timing chain covers. Refer to **TIMING CHAIN COVERS** .

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-- Install the key T40049 at the rear of the crankshaft using two used drive plate bolts -arrows-.

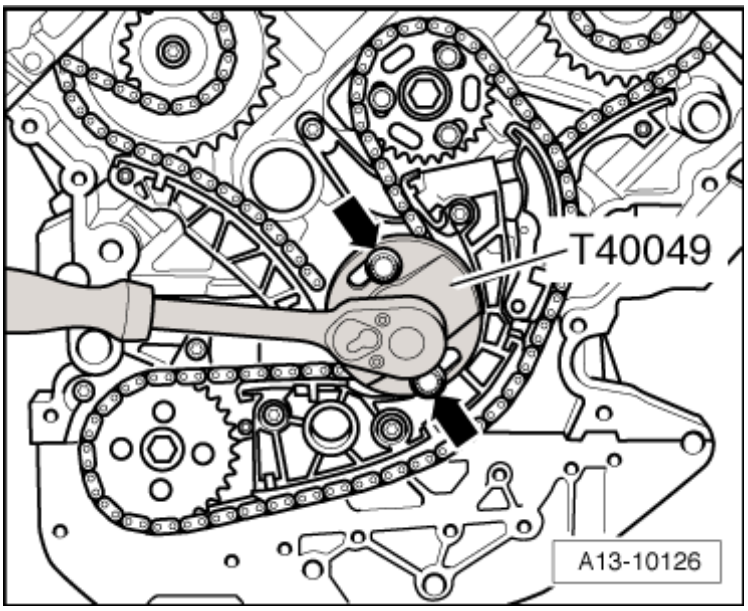


Fig. 82: Identifying Key T40049 At Rear On Crankshaft And 2 Old Bolts For Dual-Mass Flywheel
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

NOTE: The adjustment pin T40060 has a flat part -2- which makes it easier to insert if the camshaft and the cylinder head are slightly offset.

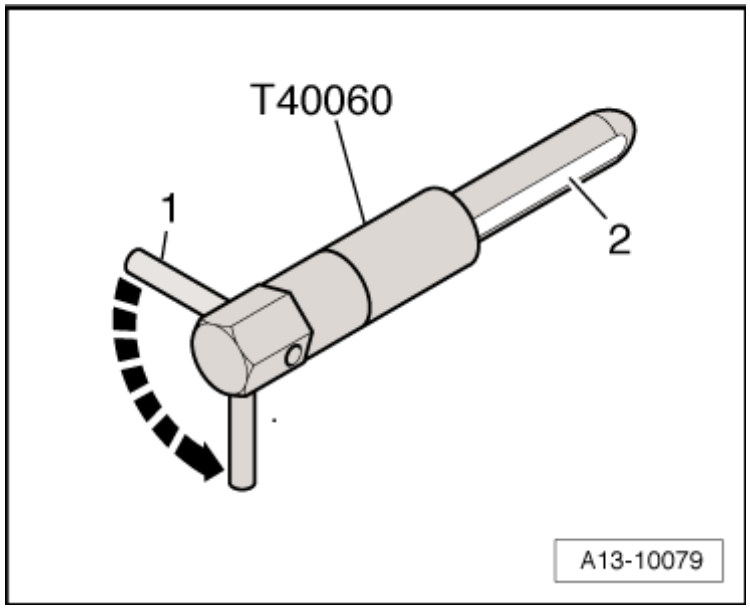


Fig. 83: Identifying Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Insert the pin so that the lever -1- is perpendicular to the camshaft axis.

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Move the pin -1- 90° -arrow- so that it is perpendicular to the camshaft axis and it is possible to attain the correct Top Dead Center (TDC) position.

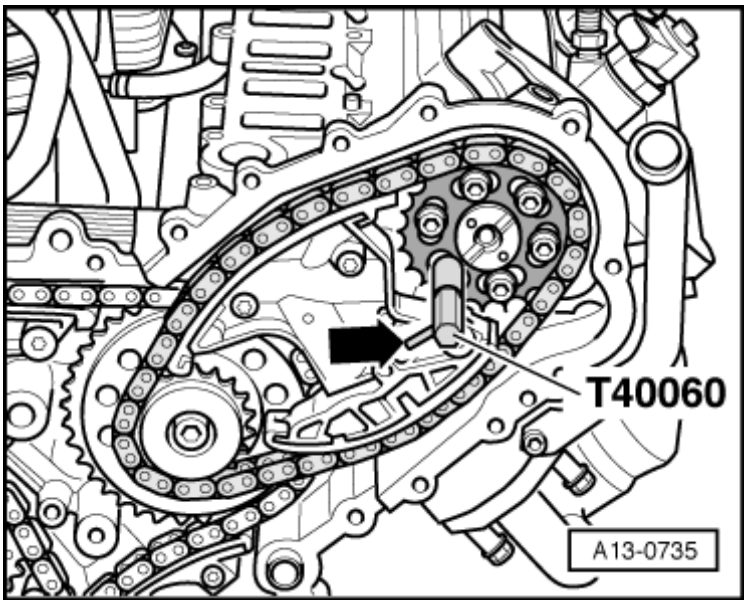


Fig. 84: Identifying TDC Position Of Camshafts
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CAUTION: Components could be destroyed by the camshaft timing chain jumping off.

- **Only rotate the crankshaft in engine rotation direction.**

-- Rotate the crankshaft to TDC:

- It must be possible to secure the camshafts using the adjustment pin T40060.
- The lever -arrow- on the adjustment pin T40060 must be perpendicular to the center axis of the camshaft on cylinder bank 1 (right side).
- The pin -arrow- on the adjustment pin T40060 must be perpendicular to the center axis of the camshaft on cylinder bank 2 (left side).

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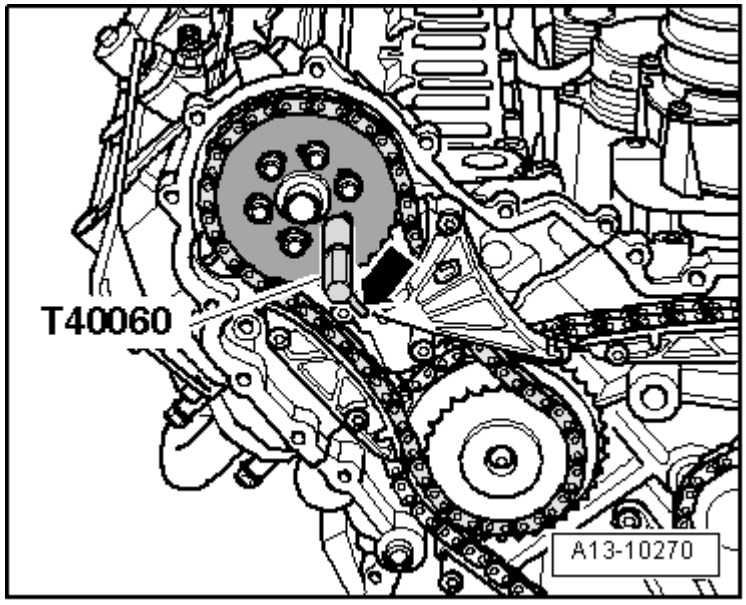


Fig. 85: Identifying Perpendicular Pin -Arrow- On Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the bolt -arrow- from the upper oil pan.

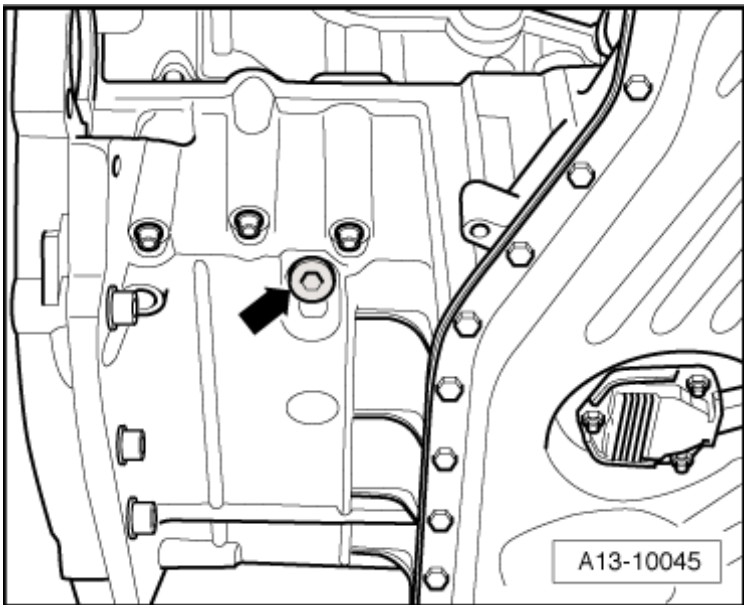


Fig. 86: Identifying Locking Bolt Of Upper Part Of Oil Pan
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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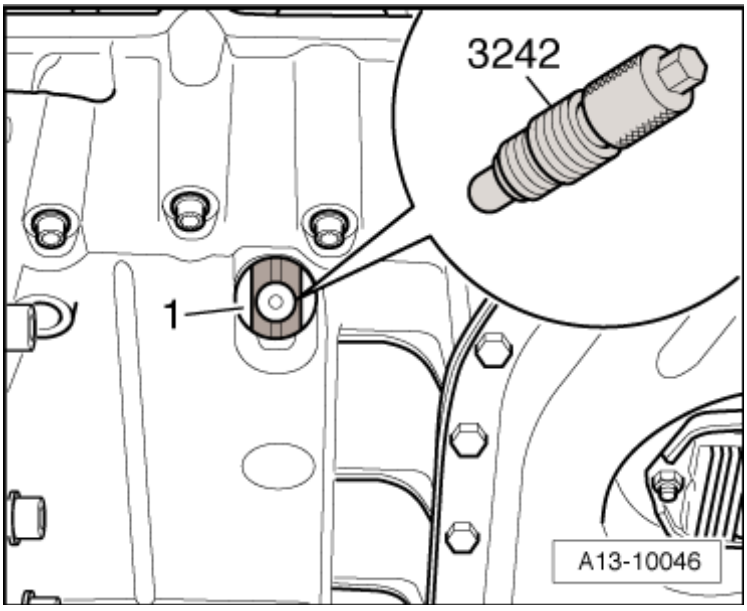


Fig. 87: Identifying Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

WARNING: Risk of injury when touching the "TDC" hole with finger.

- **Do not rotate the crankshaft -1-.**

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

-- To protect against cuts, wrap the point and the cutting edges of a 3.3 mm drill bit with insulating tape.

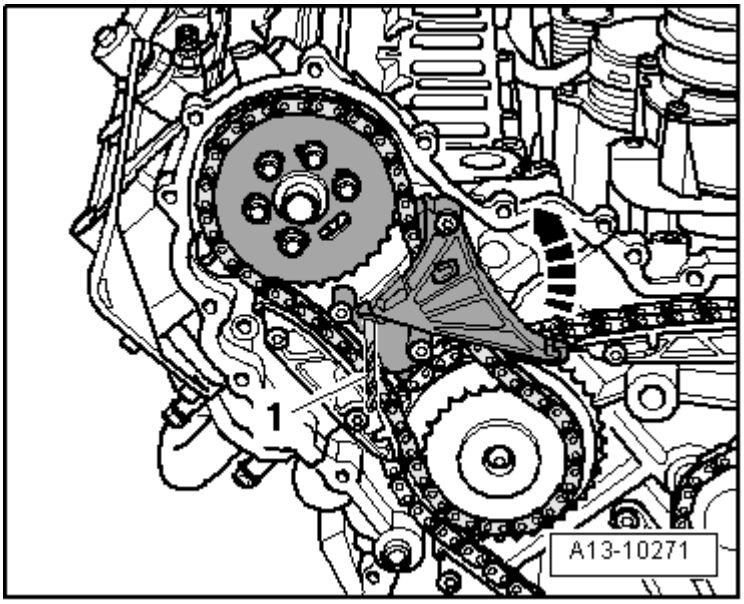


Fig. 88: Identifying Chain Tensioner Secured Using 3.3 Mm Diameter Drill Bit

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Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Push the tensioning rail for the chain tensioner for the left camshaft timing chain in the -direction of the arrow- and secure the chain tensioner using the 3.3 mm drill bit -1-.

CAUTION: If the running direction is reversed on a used camshaft timing chain, it could be destroyed.

- **Paint arrows to mark the timing chain running direction so it can be installed again.**

-- Remove the adjustment pin T40060 from both camshafts.

-- Remove the bolt -3- and remove the tensioning rail.

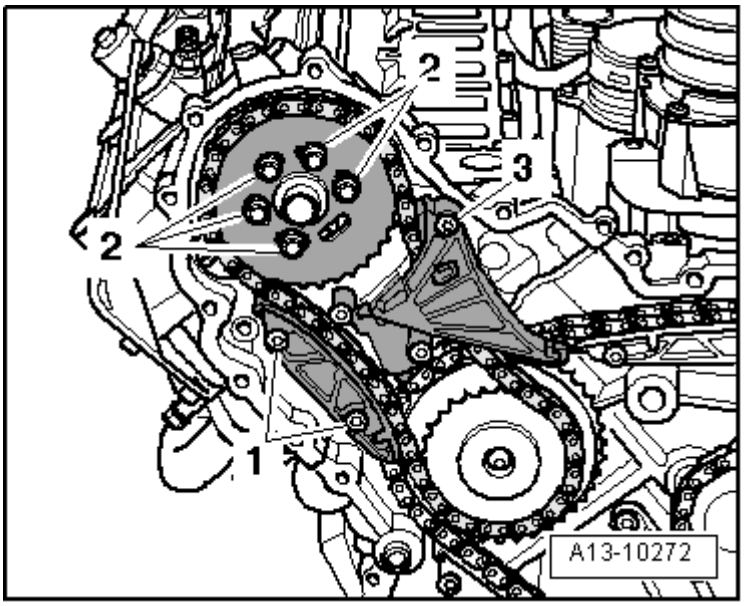


Fig. 89: Identifying Bolts -1- For Guide Rail And Bolts -2- For Camshaft Chain Sprocket
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the bolts -1- for the guide rail and the bolts -2- for the camshaft sprocket.

-- Remove the camshaft sprocket, guide rail and left camshaft timing chain.

-- To protect against cuts, wrap the point and the cutting edges of a 3.3 mm drill bit with insulating tape.

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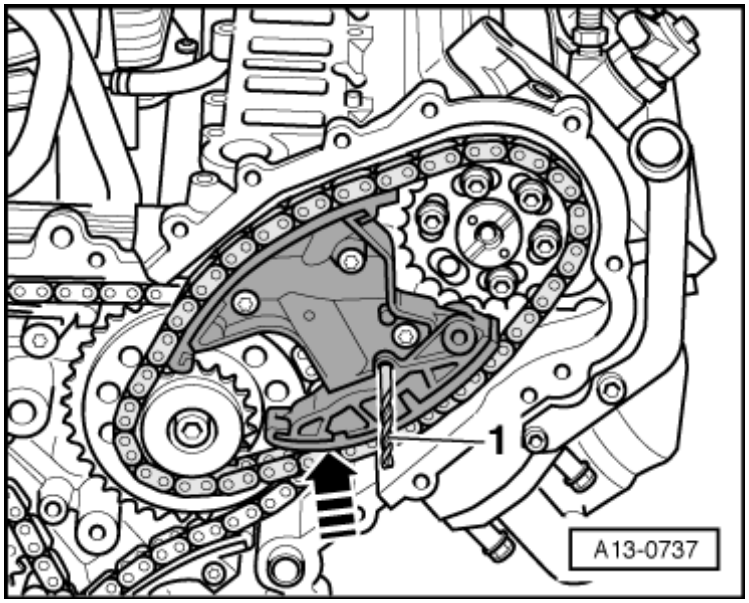


Fig. 90: Identifying 3.3 mm Diameter Drill Bit -1- To Install Chain Tensioner Guide Rail On Right Camshaft Timing Chain
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Push the chain tensioner guide rail for the right camshaft timing chain in the -direction of the arrow- and secure the chain tensioner with the 3.3 mm drill bit -1-.

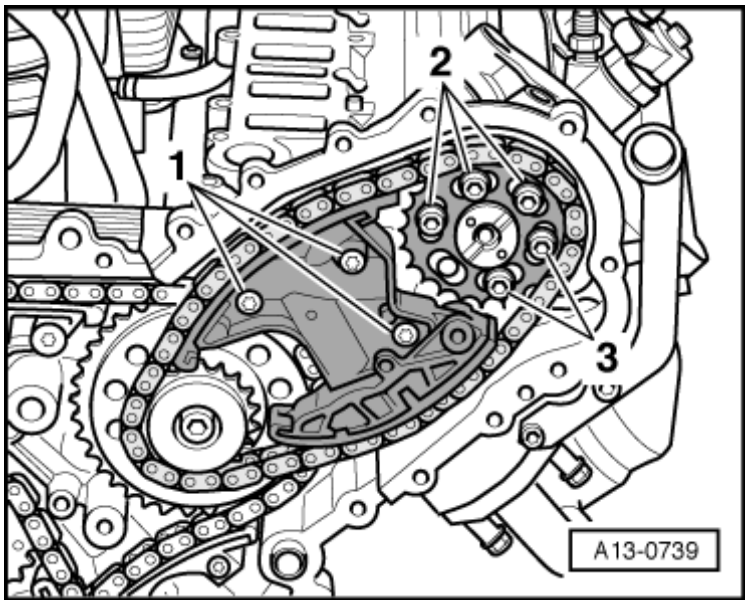


Fig. 91: Identifying Chain Tensioner Guide Rail Installed On Right Camshaft Timing Chain
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CAUTION: If the running direction is reversed on a used camshaft timing chain, it could be destroyed.

- **Paint arrows to mark the timing chain running direction so it can be**

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installed again.

-- Remove the chain tensioner bolts -1- and the camshaft sprocket bolts -2 and 3-.

-- Remove the camshaft sprocket, chain tensioner and right camshaft timing chain.

Installing

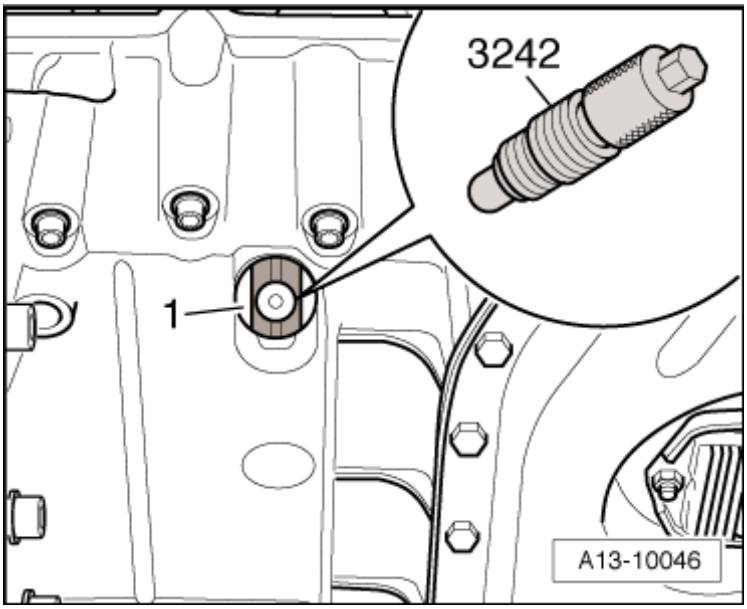


Fig. 92: Identifying Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- For the correct tightening specifications, refer to **LEFT CAMSHAFT TIMING CHAIN OVERVIEW**.
- Secure the crankshaft -1- in TDC position using the crankshaft holder 3242.
- Install the drive chain for timing mechanism. Refer to **BALANCE SHAFT AND OIL PUMP CHAIN** .

NOTE: Replace the I seal for the TDC plug.

Replace bolts which have been tightened to an additional torque angle.

CAUTION: Risk of damaging valves and piston crowns.

- **If the camshafts are rotated, the crankshaft may not rest with any piston at TDC.**

-- Check whether the camshafts for both cylinder are in the TDC position.

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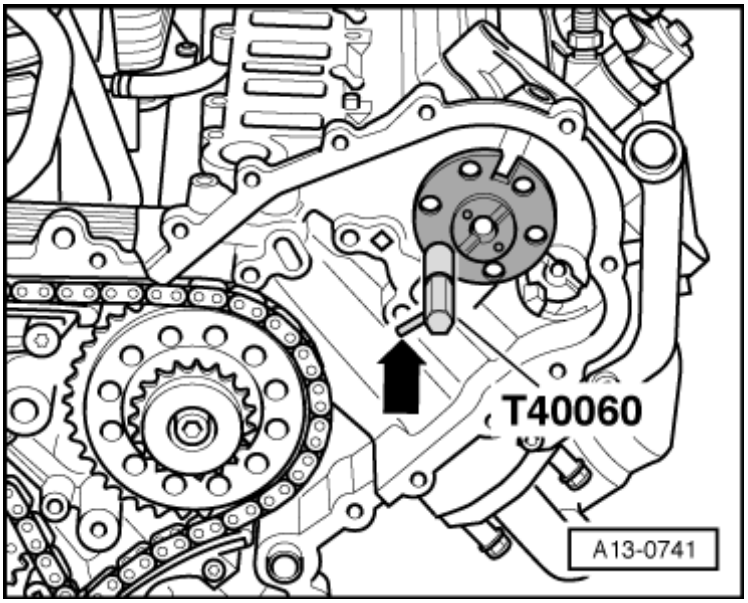


Fig. 93: Identifying Check Of Camshafts For Both Cylinder Heads In TDC Position And Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- It must be possible to secure the camshafts with the adjustment pin T40060.
- The lever -arrow- on the adjustment pin T40060 must be perpendicular to the center axis of the camshaft on cylinder bank 1 (right side).

- The lever -arrow- on the adjustment pin T40060 must be perpendicular to the center axis of the camshaft on cylinder bank 2 (left side).

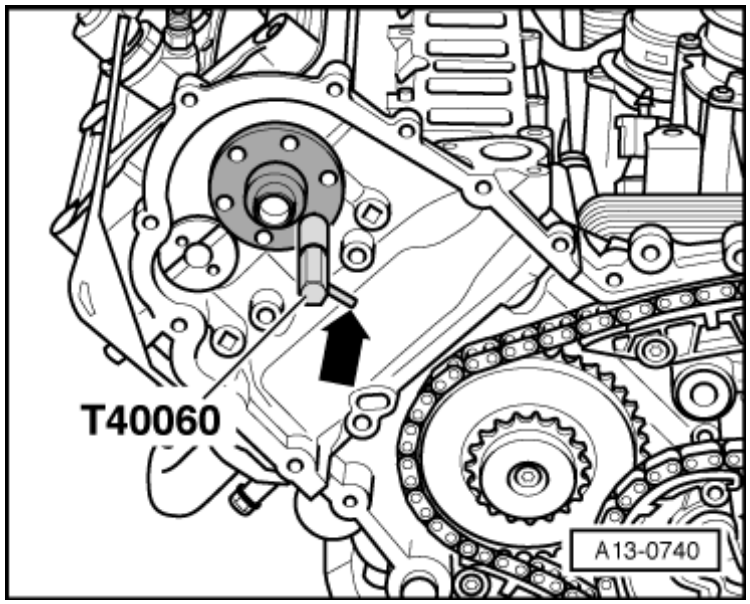


Fig. 94: Identifying Perpendicular Pin -Arrow- On Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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-- Remove the adjustment pin T40060 from both camshafts.

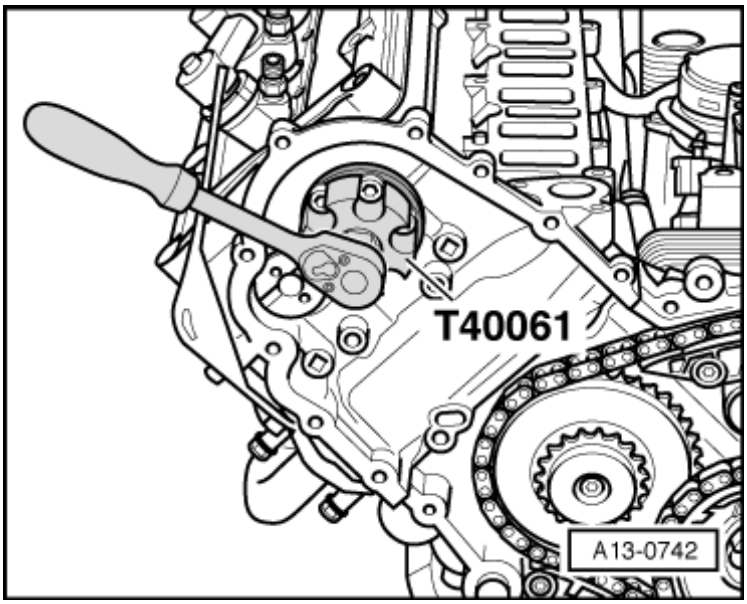


Fig. 95: Identifying Adapter T40061 And Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CAUTION: Risk of damaging valves and piston crowns.

- **If the camshafts are rotated, the crankshaft may not rest with any piston at TDC.**

NOTE: If the camshafts are not secured, it is possible to correct them slightly using the adapter T40061 by installing the camshaft sprocket bolts to the camshaft.

-- Install the left camshaft timing chain with the camshaft sprocket, the guide rail and the tensioning rail.

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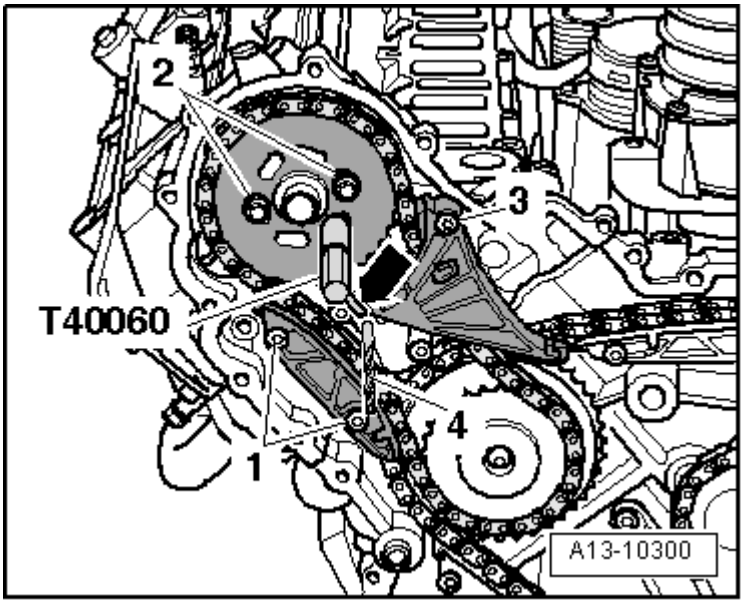


Fig. 96: Identifying Left Camshaft Timing Chain, Camshaft Chain Sprocket, Guide Rail And Tensioning Rail
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- The slots in the camshaft sprocket must be at the middle position in relation to the threaded holes in the camshaft.

-- Tighten the bolts -1 and 3- for the guide rail and the tensioning rail.

-- Install two camshaft sprocket bolts -2- loosely.

- It must still be possible to rotate the camshaft sprocket on the camshaft and it must not tilt.

-- Secure the left camshaft using the adjustment pin T40060.

- The lever -arrow- on the adjustment pin T40060 must be perpendicular to the center axis of the camshaft.

-- Pull the drill bit -4- out of the hole, thereby releasing the chain tensioner.

-- Install the right camshaft timing chain with the sprocket and chain tensioner.

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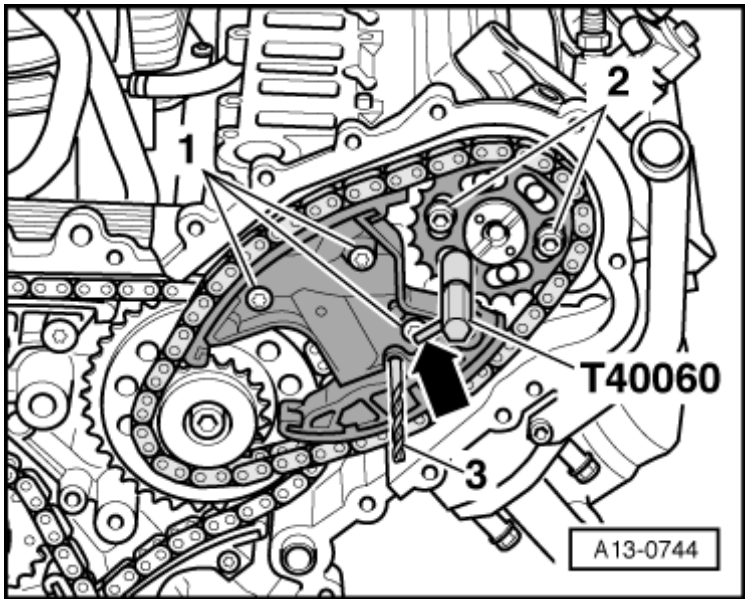


Fig. 97: Identifying Drill Bit -4- And Alignment Hole
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- The slots in the camshaft sprocket must be at the middle position in relation to the threaded holes in the camshaft.

-- Tighten the chain tensioner bolts -1-.

-- Install two camshaft chain sprocket bolts -2- loosely.

- It must still be possible to rotate the camshaft chain sprocket on the camshaft and it must not tilt.

-- Secure the right camshaft using the adjustment pin T40060.

- The lever -arrow- on the adjustment pin T40060 must be perpendicular to the center axis of the camshaft.

-- Pull the drill bit -3- out of the hole, thereby releasing the right chain tensioner.

-- Pre-tighten the right camshaft sprocket using the adapter T40062 and torque wrench to 20 Nm in the -direction of the arrow- and hold.

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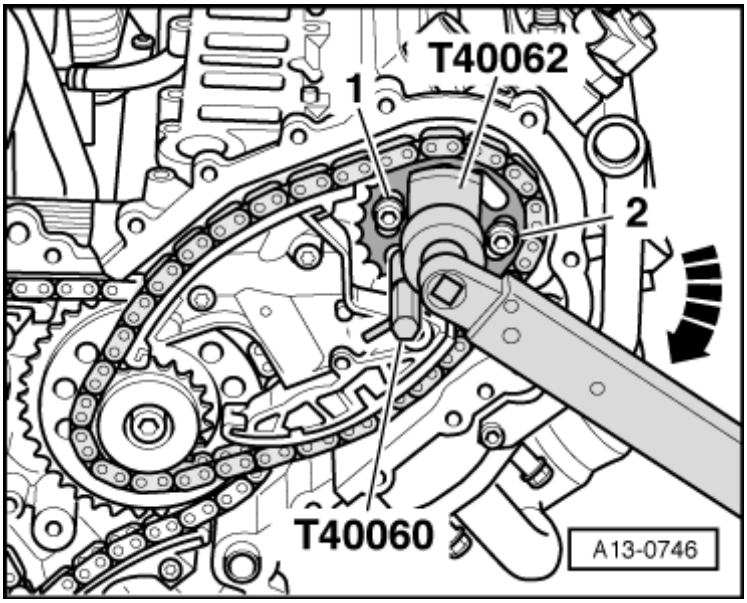


Fig. 98: Identifying Bolts -1 And 2-, Torque Wrench, Adapter T40062 And Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Tighten the bolts -1 and 2-.

-- Remove the adapter T40062 and adjustment pin T40060.

-- Tighten the remaining bolts for the right camshaft sprocket.

-- Pre-tighten the left camshaft sprocket using the adapter T40062 and torque wrench to 15 Nm in the -direction of the arrow- and hold.

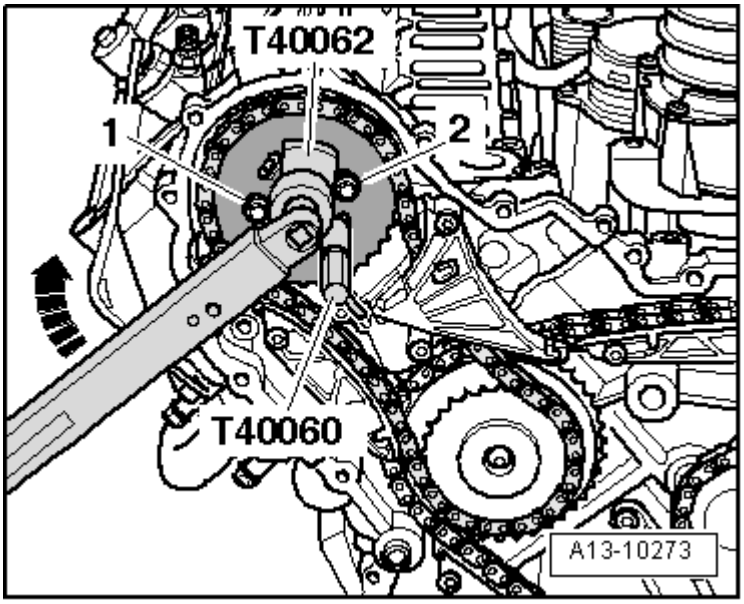


Fig. 99: Identifying Adapter T40062 On Left Camshaft Chain Sprocket
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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-- Tighten the bolts -1 and 2-.

-- Remove the adapter T40062 and adjustment pin T40060.

-- Tighten the remaining bolts for the left camshaft sprocket.

-- Remove the crankshaft holder 3242.

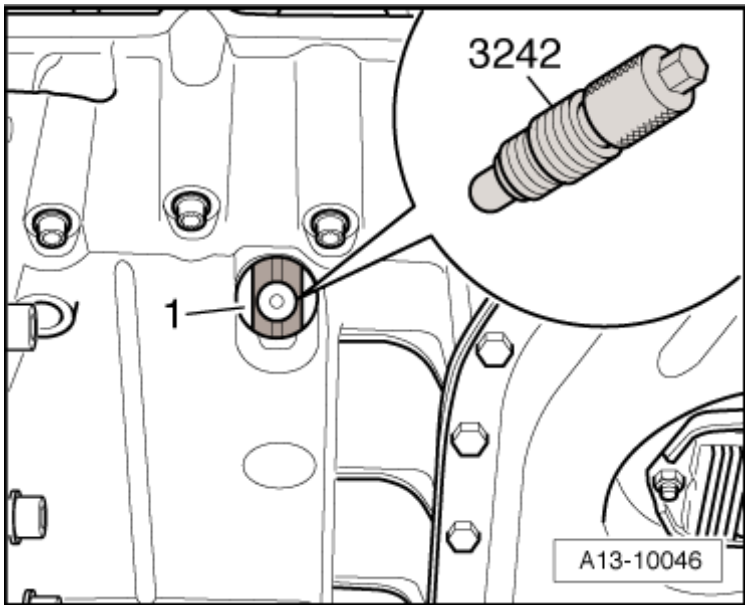


Fig. 100: Identifying Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

VALVE TIMING, CHECKING

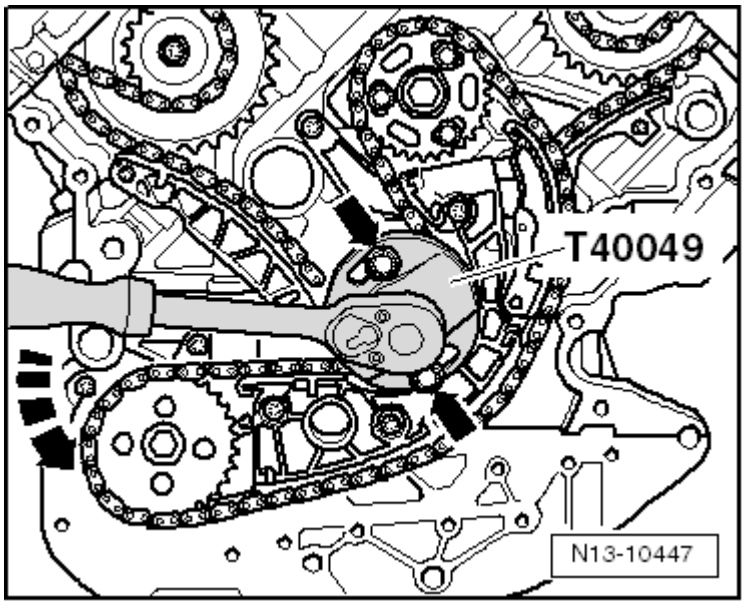


Fig. 101: Identifying Valve Timing, Checking

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Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CAUTION: Components could be destroyed by the camshaft timing chain jumping off.

- **Turn the crankshaft only in engine rotation direction -arrow-.**

-- Turn the crankshaft 2 turns using the key T40049 until it is just in front of TDC.

-- Lock the crankshaft -1- from turning using the crankshaft holder 3242, tighten it to 20 Nm.

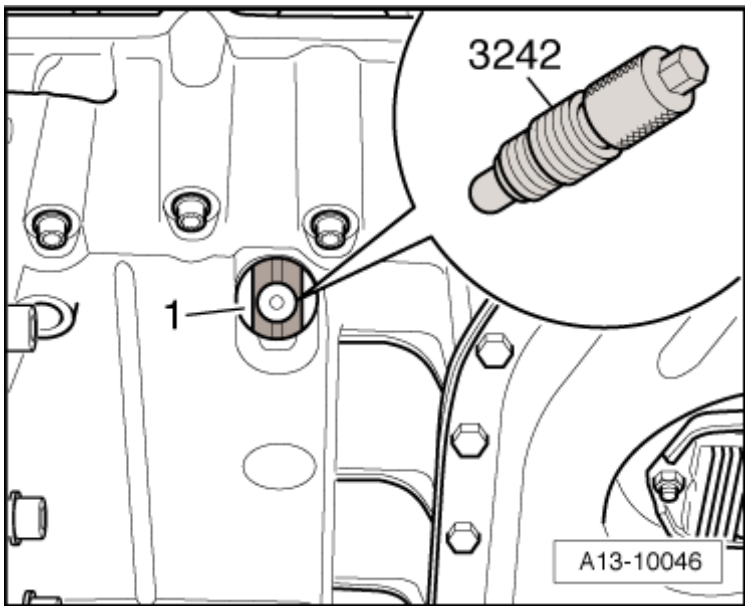


Fig. 102: Identifying Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CAUTION: An inaccurate TDC setting will cause an inaccurate setting.

- **If the crankshaft was only rotated slightly past TDC, first rotate it back approximately 10° and then rotate it in engine rotation direction again to TDC.**

-- Check whether the camshafts for both cylinder heads are in TDC position.

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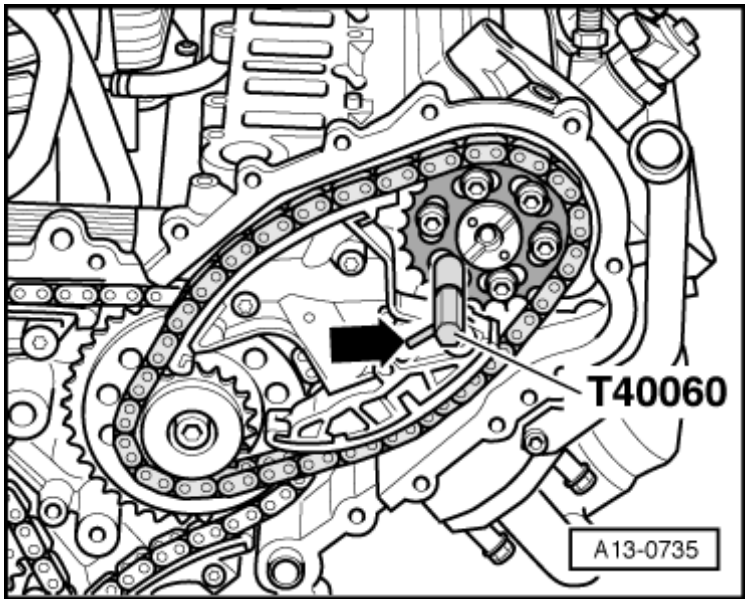


Fig. 103: Identifying TDC Position Of Camshafts
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- It must be possible to secure the camshafts using the adjustment pin T40060.
- The lever -arrow- on the adjustment pin T40060 must be perpendicular to the center axis of the camshaft on cylinder bank 1 (right side).
- The lever -arrow- on the adjustment pin T40060 must be perpendicular to the center axis of the camshaft on cylinder bank 2 (left side).

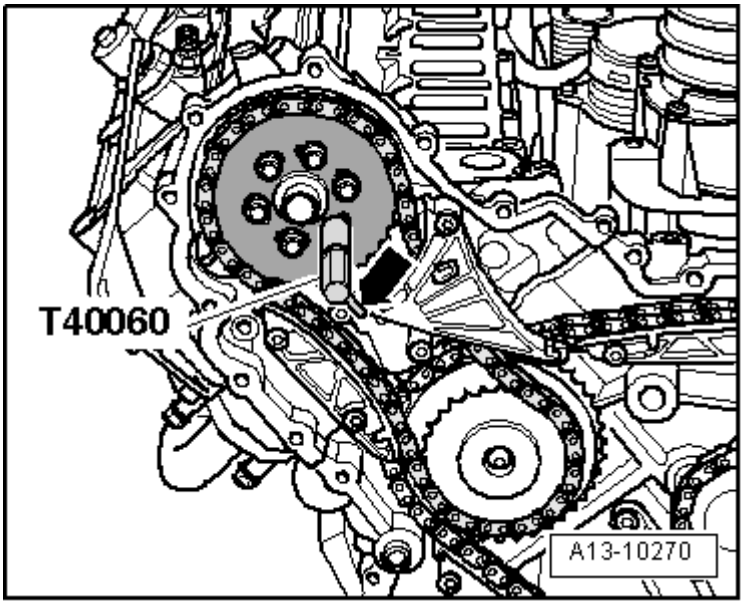


Fig. 104: Identifying Perpendicular Pin -Arrow- On Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Correcting the Valve Timing

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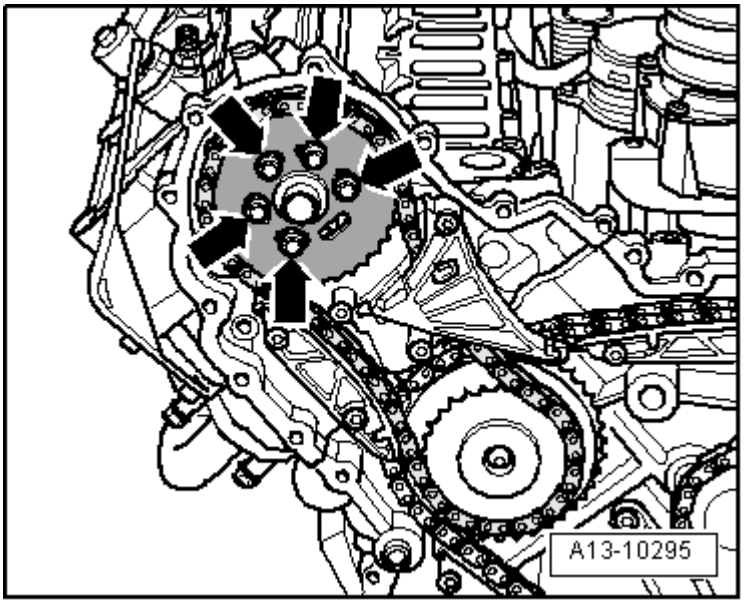


Fig. 105: Identifying Bolts -Arrows-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- If one of the camshafts does not lock, loosen all the bolts -arrows- for that particular camshaft sprocket about 1 turn.

-- Install the adapter T40061 over the bolt heads.

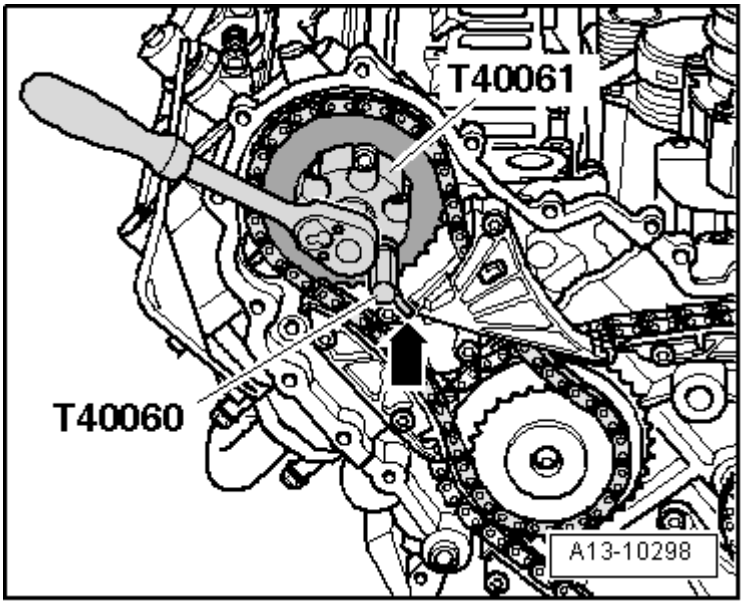


Fig. 106: Identifying Adapter T40061 And Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Turn the camshaft using the adapter T40061 just a little back and forth until it is possible to insert the adjustment pin T40060.

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- The lever -arrow- on the adjustment pin T40060 must be perpendicular to the center axis of the camshaft.

-- Tighten the bolts for the camshaft sprocket with the adapter T40061 and the adjustment pin T40060 still attached, to approximately 5 Nm.

-- Remove the adjustment pin T40060 and adapter T40061.

-- Tighten the camshaft chain sprocket bolts to their final torque.

-- Repeat the procedure on the other cylinder bank, if necessary.

-- Remove the crankshaft holder 3242.

-- Check the valve timing once again. Refer to **CAMSHAFT TIMING CHAINS, REMOVING FROM CAMSHAFTS**.

Further installation is in the reverse order of removal. Note the following:

-- Install the plug -arrow- in the upper he oil pan. Refer to **UPPER OIL PAN OVERVIEW** .

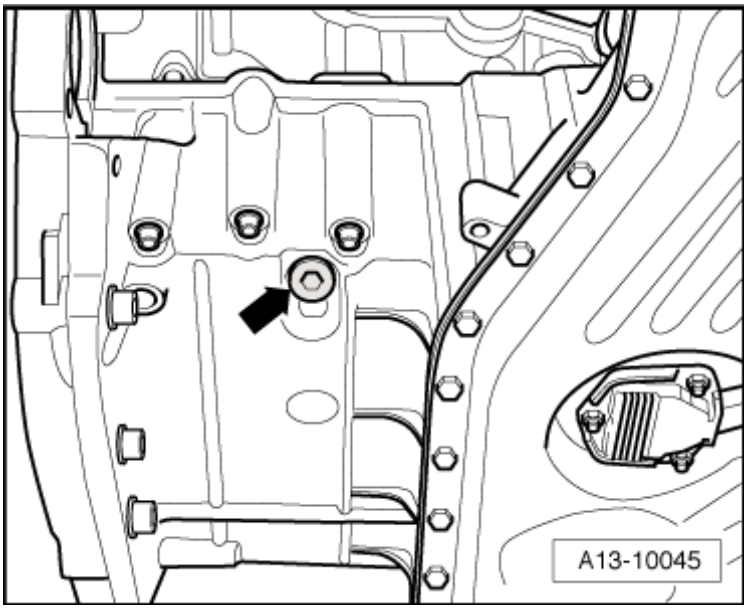


Fig. 107: Identifying Locking Bolt Of Upper Part Of Oil Pan
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Install the timing chain covers. Refer to **TIMING CHAIN COVERS** .

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

-- Fill the oil and then check the level.

CAMSHAFT TIMING CHAINS, REMOVING FROM CAMSHAFTS

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Special tools and workshop equipment required

- Crankshaft Holder 3242
- Socket T40058
- Adjustment Pin T40060 (Qty: 2)
- Adapter T40061
- Adapter T40062
- Two 3.3 mm Drill Bits

Removing

- Engine and transmission are installed.

NOTE: If work will only be done on the cylinder head, it is only necessary to adjust the valve timing on the cylinder bank that was repaired.

-- Drain the coolant. Refer to **COOLANT, DRAINING** .

-- Remove the front exhaust pipe with catalytic converter. Refer to **EXHAUST SYSTEM** .

-- Remove the vacuum pump. Refer to **VACUUM PUMP OVERVIEW**.

-- Remove rear right coolant pipe. Refer to **REAR COOLANT PIPE** .

-- Remove the left rear coolant pipe. Refer to **LEFT REAR COOLANT PIPE** .

NOTE: The following illustrations shows the steps for the drive chains from behind with the engine removed.

-- Remove the bolts -1 through 4- and the left timing chain cover.

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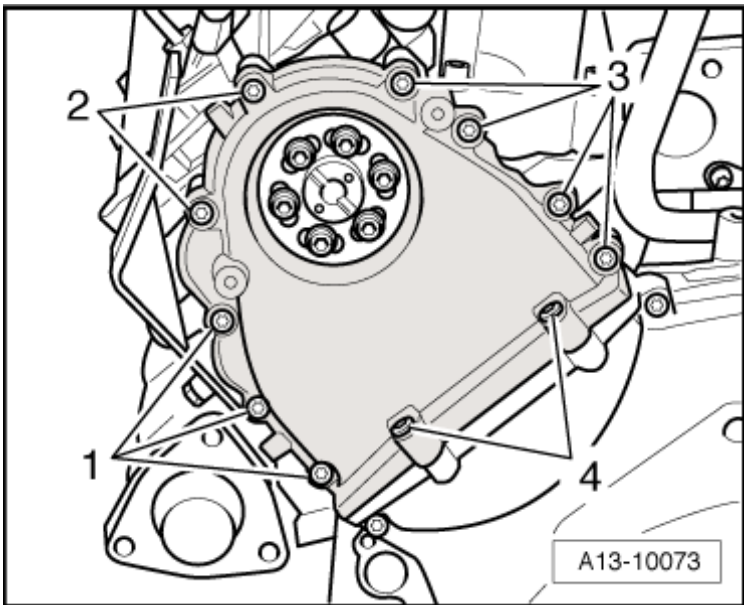


Fig. 108: Identifying Bolt Tightening Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the bolts -1 through 4- and the right timing chain cover.

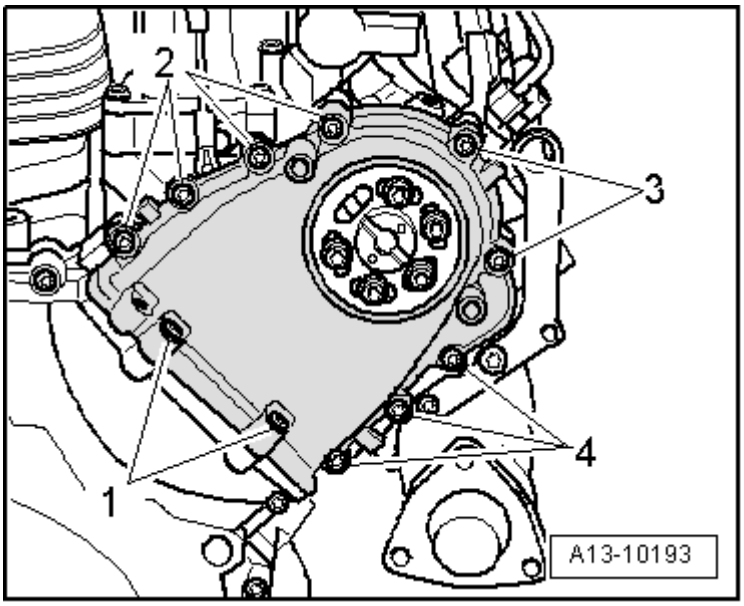


Fig. 109: Identifying Bolts -1 Through 4-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Assemble the socket T40058 as follows:

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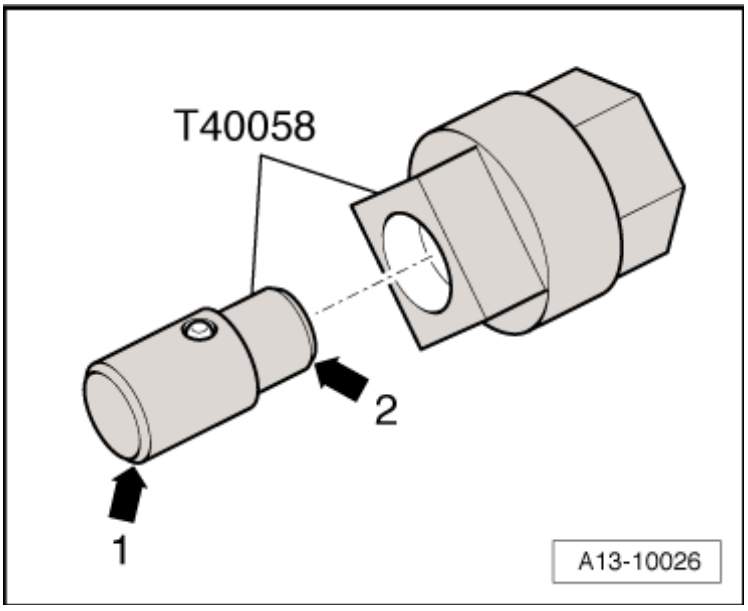


Fig. 110: Inserting Guide Pin Of Adapter T40058
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- The large diameter -arrow 1- faces the engine.
- The small diameter -arrow 2- points to the socket

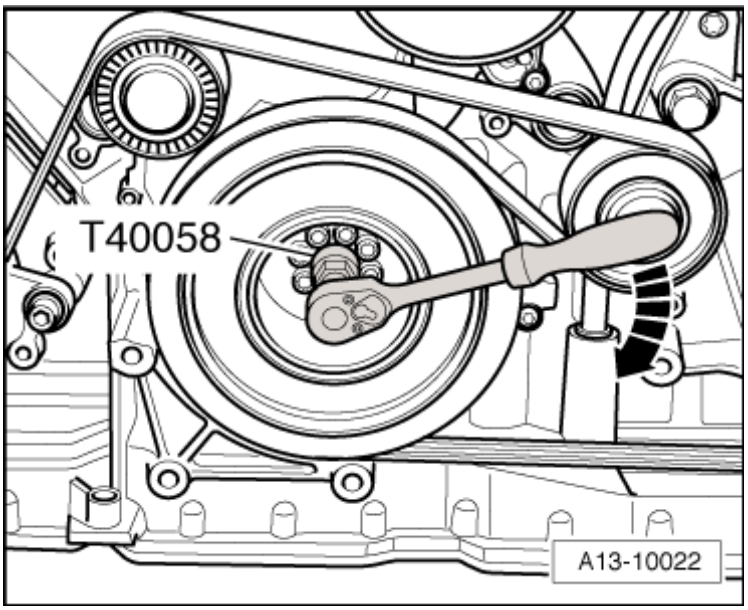


Fig. 111: Loosening Torque Converter Bolts Using Adapter T40058
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CAUTION: Components could be destroyed by the camshaft timing chain jumping off.

- **Turn the crankshaft only in engine rotation direction -arrow-.**

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-- Use the socket T40058 to rotate the crankshaft to Top Dead Center (TDC).

NOTE: The adjustment pin T40060 has a flat part -2- which makes it easier to insert if the camshaft and the cylinder head are slightly offset.

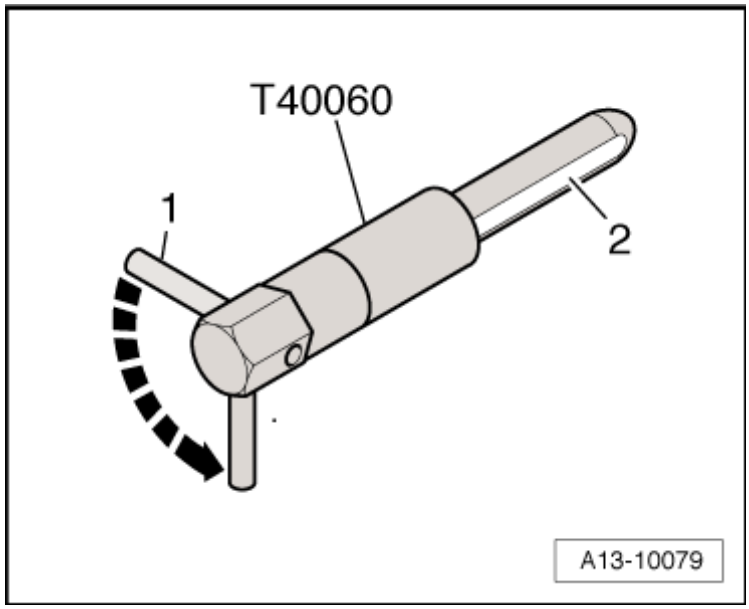


Fig. 112: Identifying Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Insert the pin so that the lever -1- is perpendicular to the camshaft axis.

Move the lever -1- 90° -arrow- so that it is perpendicular to the camshaft axis and it is possible to attain the correct TDC position.

-- Check whether the camshafts of both cylinder heads are in TDC position.

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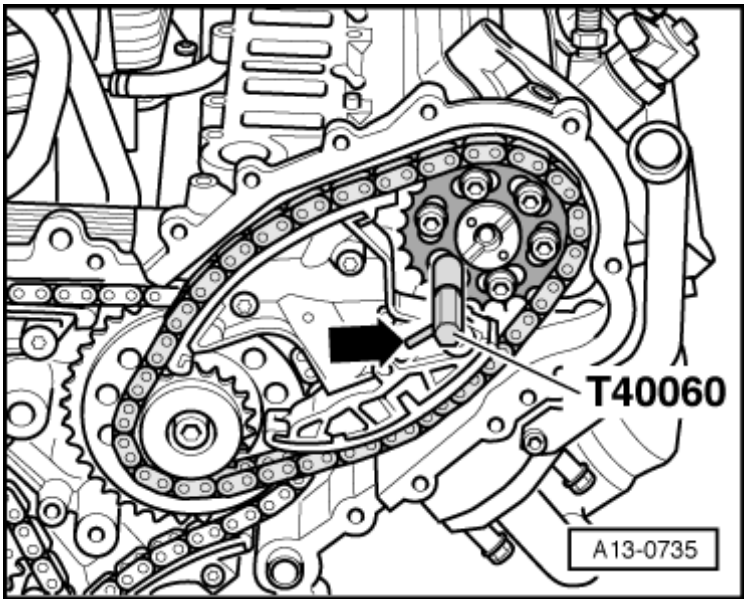


Fig. 113: Identifying TDC Position Of Camshafts
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- It must be possible to secure the camshafts using the adjustment pin T40060.
- The lever -arrow- on the adjustment pin T40060 must be perpendicular to the center axis of the camshaft on cylinder bank 1 (right side).

- The lever -arrow- on the adjustment pin T40060 must be perpendicular to the center axis of the camshaft on cylinder bank 2 (left side).

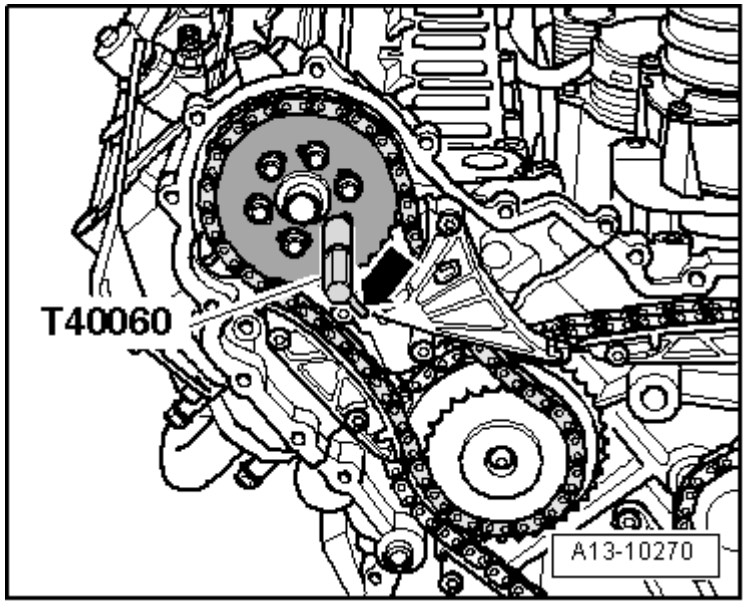


Fig. 114: Identifying Perpendicular Pin -Arrow- On Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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NOTE: To collect leaking engine oil, place a clean cloth under the upper oil pan.

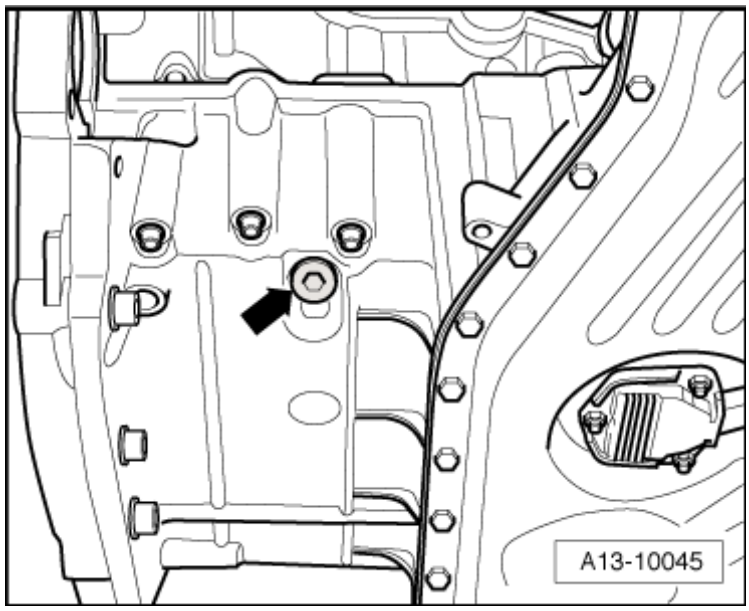


Fig. 115: Identifying Locking Bolt Of Upper Part Of Oil Pan
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the plug -arrow- from the upper oil pan.

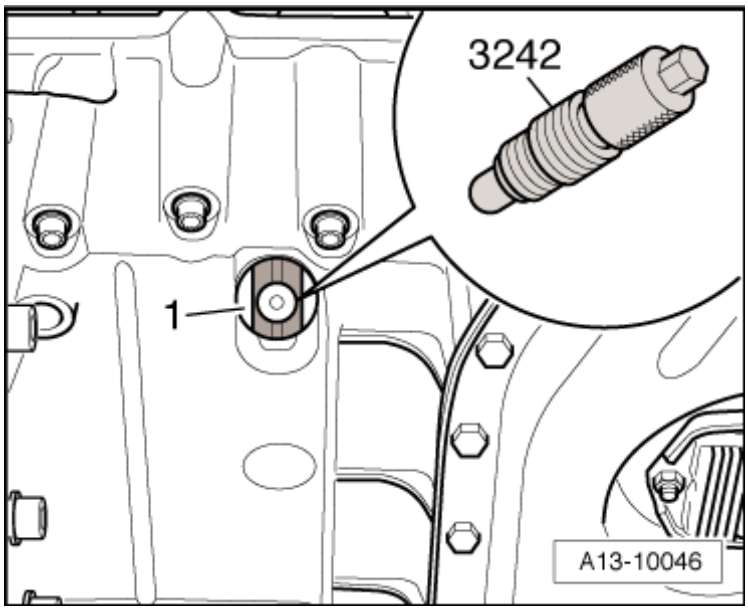


Fig. 116: Identifying Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

WARNING: Risk of injury when touching the TDC hole with finger.

- **Do not rotate the crankshaft -1-.**

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

-- To protect against cuts, wrap the point and the cutting edges of a 3.3 mm drill bit with insulating tape.

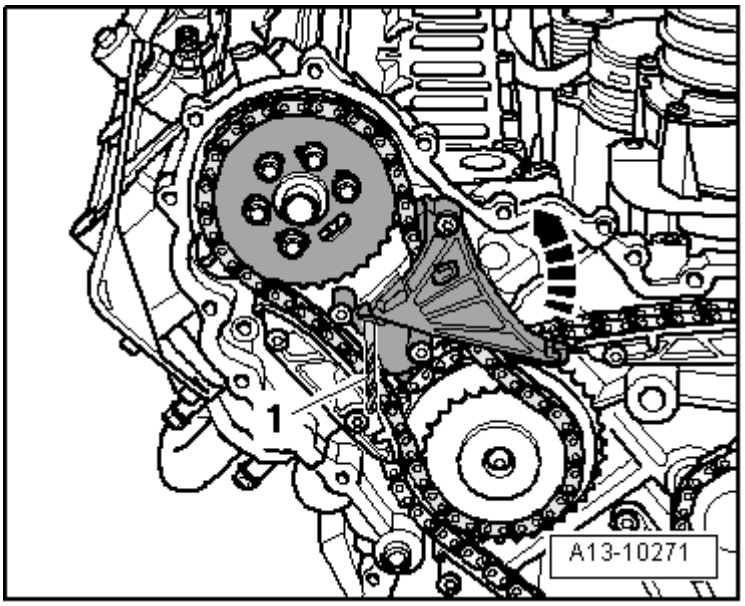


Fig. 117: Identifying Chain Tensioner Secured Using 3.3 Mm Diameter Drill Bit
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Push the tensioning rail of the chain tensioner for the left camshaft timing chain in the -direction of the arrow- and secure the chain tensioner with the 3.3 mm drill bit -1-.

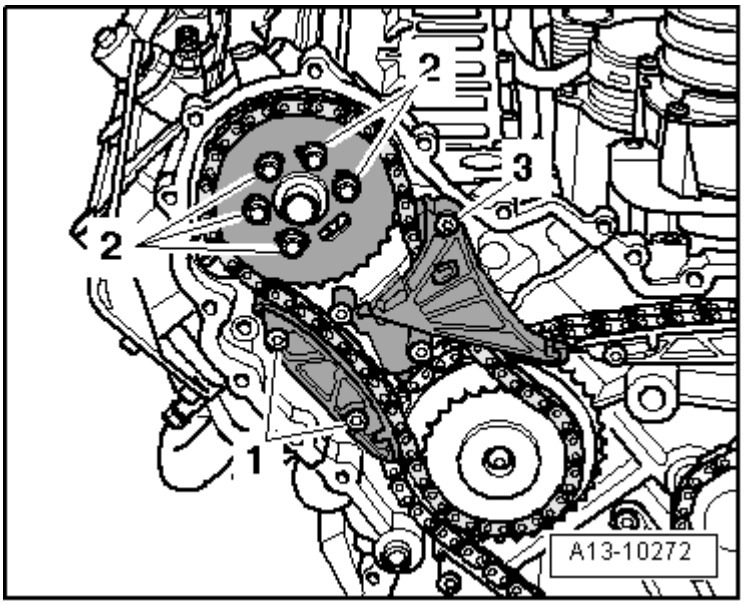


Fig. 118: Identifying Bolts -1- For Guide Rail And Bolts -2- For Camshaft Chain Sprocket
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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CAUTION: The engine could be destroyed.

- **To prevent small parts from accidentally entering the engine through the opening in the timing chain compartment, cover the opening with a clean cloth.**

-- Remove the bolt -3- and remove the tensioning rail.

-- Remove the bolts -1- for the guide rail and the bolts -2- for the camshaft sprocket.

-- Remove the camshaft sprocket and guide rail.

-- To protect against cuts, wrap the point and the cutting edges of a 3.3 mm drill bit with insulating tape.

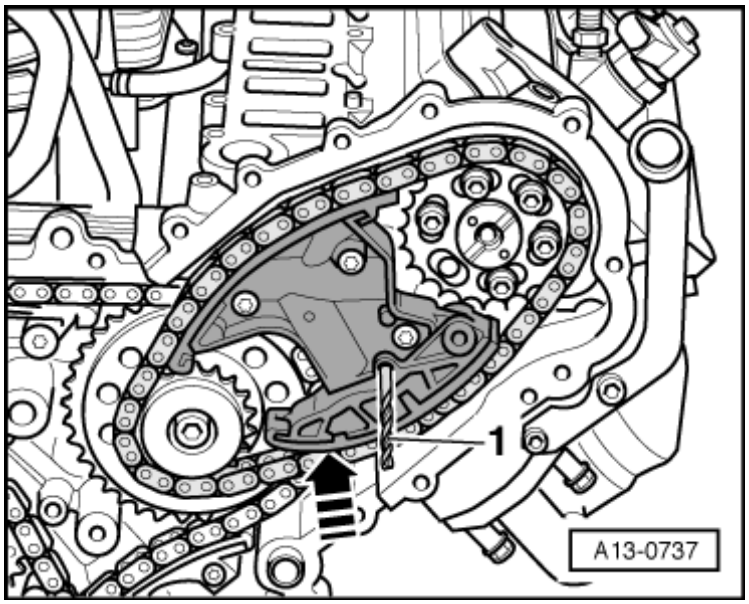


Fig. 119: Identifying 3.3 mm Diameter Drill Bit -1- To Install Chain Tensioner Guide Rail On Right Camshaft Timing Chain
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Push the chain tensioner guide rail for the right camshaft timing chain in the -direction of the arrow- and secure the chain tensioner with the 3.3 mm drill bit -1-.

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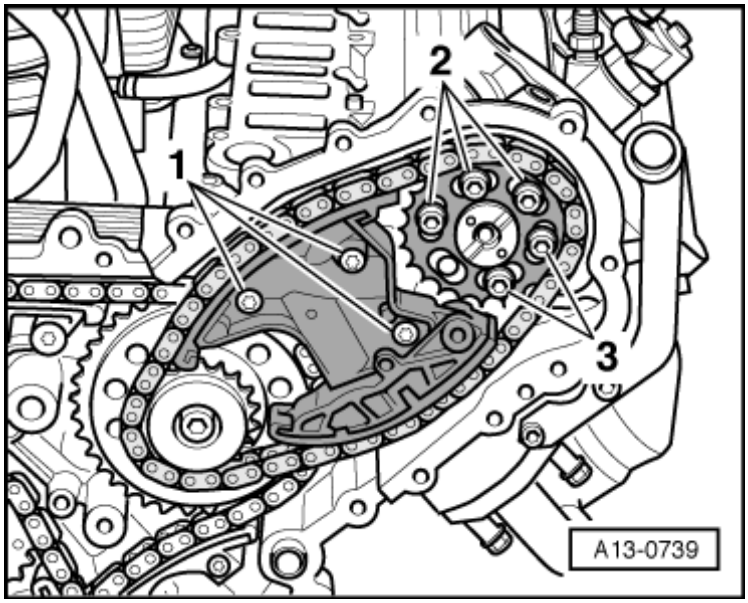


Fig. 120: Identifying Chain Tensioner Guide Rail Installed On Right Camshaft Timing Chain
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CAUTION: The engine could be destroyed.

- **To prevent small parts from accidentally entering the engine through the opening in the timing chain compartment, cover the opening with a clean cloth.**

-- Remove the chain tensioner bolts -1- and the camshaft sprocket bolts -2 and 3-.

-- Remove the camshaft sprocket and chain tensioner.

Installing

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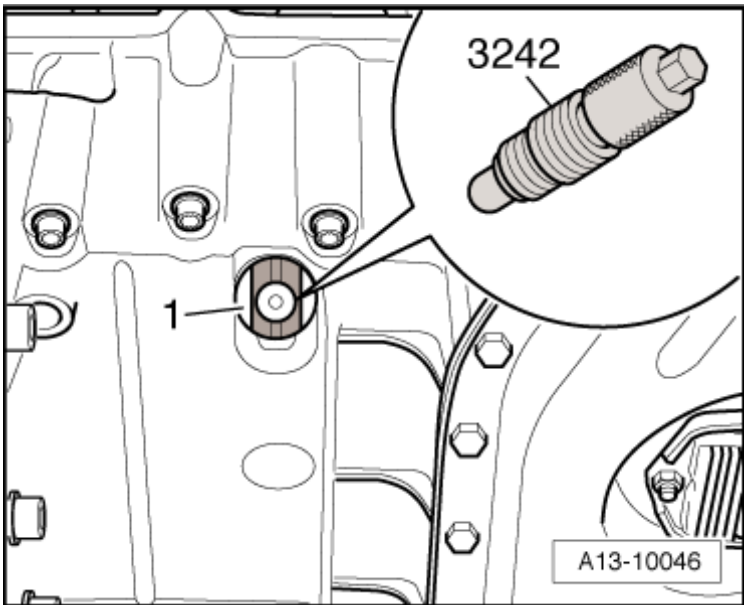


Fig. 121: Identifying Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- For the correct tightening specifications, refer to **LEFT CAMSHAFT TIMING CHAIN OVERVIEW**.
- Secure the crankshaft -1- in TDC position using the crankshaft holder 3242.

NOTE: Replace bolts which have been tightened to an additional torque angle.

Replace the TDC plug seal.

CAUTION: Risk of damaging valves and piston crowns.

- **If the camshafts are rotated, the crankshaft may not rest with any piston at TDC.**

-- Check whether the camshafts for both cylinder heads are in TDC position.

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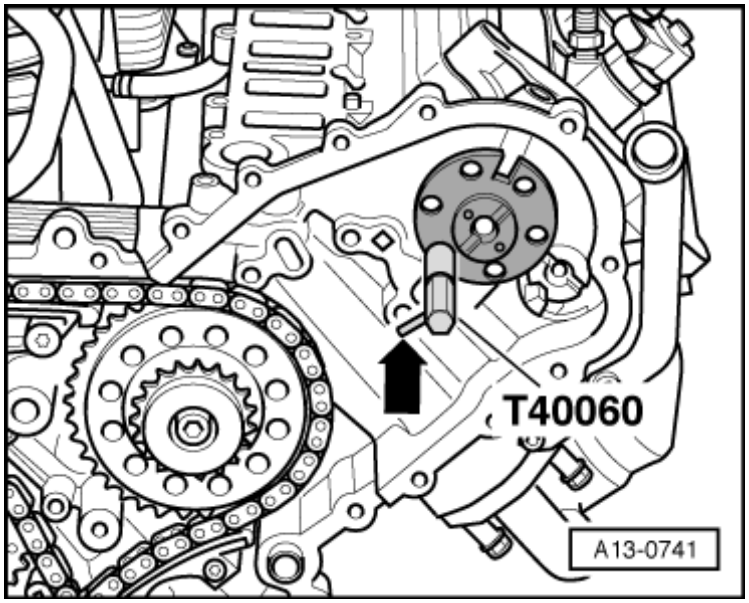


Fig. 122: Identifying Check Of Camshafts For Both Cylinder Heads In TDC Position And Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- It must be possible to secure the camshafts using the adjustment pin T40060.
- The lever -arrow- on the adjustment pin T40060 must be perpendicular to the center axis of the camshaft on cylinder bank 1 (right side).

- The lever -arrow- on the adjustment pin T40060 must be perpendicular to the center axis of the camshaft on cylinder bank 2 (left side).

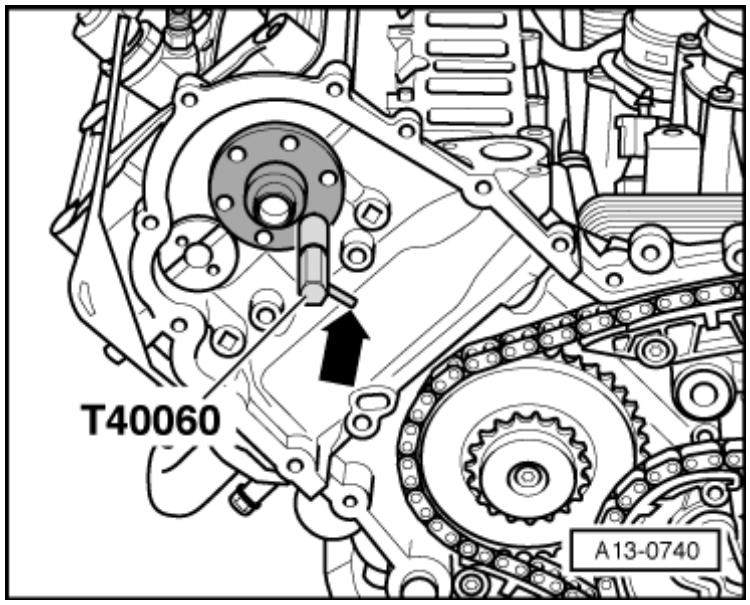


Fig. 123: Identifying Perpendicular Pin -Arrow- On Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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-- Remove the adjustment pin T40060 from both camshafts.

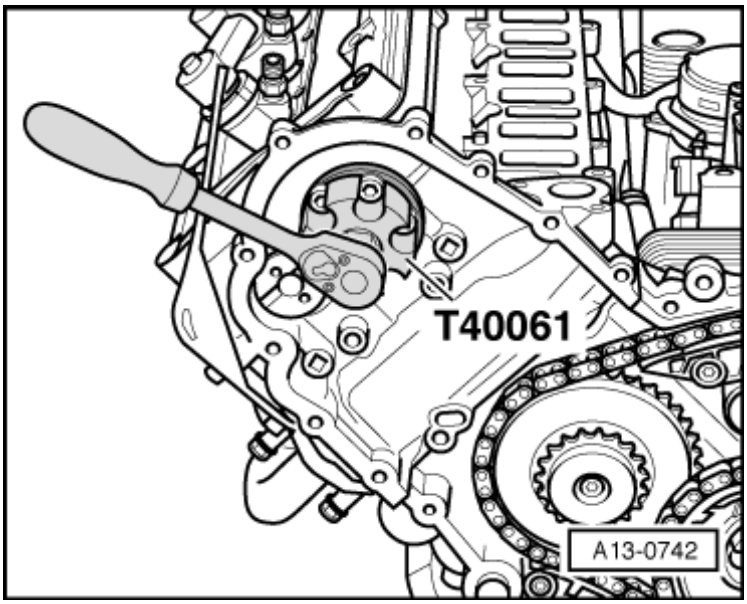


Fig. 124: Identifying Adapter T40061 And Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CAUTION: Risk of damaging valves and piston crowns.

- **If the camshafts are rotated, the crankshaft may not rest with any piston at TDC.**

NOTE: If the camshafts are not secured, it is possible to correct them slightly using the adapter T40061 by installing the camshaft sprocket bolts to the camshaft.

-- Install the left camshaft timing chain with the camshaft sprocket, the guide rail and the tensioning rail.

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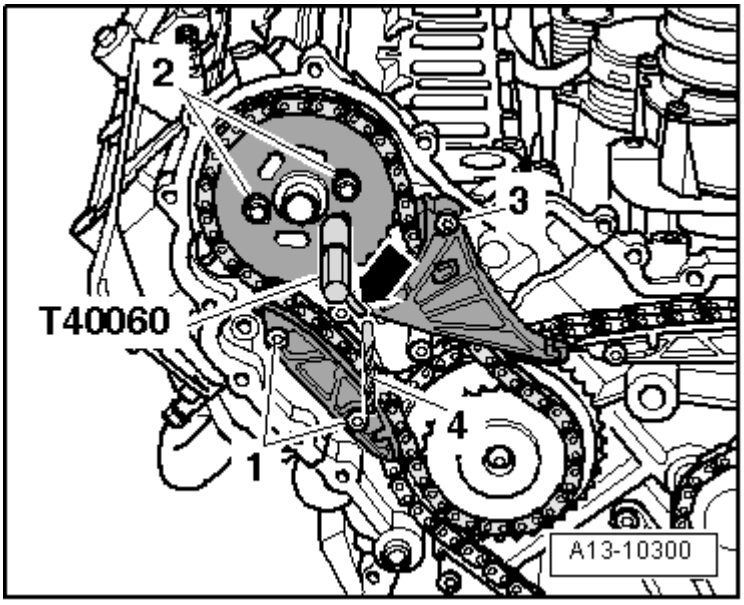


Fig. 125: Identifying Left Camshaft Timing Chain, Camshaft Chain Sprocket, Guide Rail And Tensioning Rail
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- The slots in the camshaft sprocket must be at the middle position in relation to the threaded holes in the camshaft.

-- Tighten the bolts -1 and 3- for the guide rail and the tensioning rail.

-- Install two camshaft sprocket bolts -2- loosely.

- It must still be possible to rotate the camshaft sprocket on the camshaft and it must not tilt.

-- Secure the left camshaft using the adjustment pin T40060.

- The lever -arrow- on the adjustment pin T40060 must be perpendicular to the center axis of the camshaft.

-- Pull the drill -4- out of the hole, thereby releasing the chain tensioner.

-- Install the right camshaft timing chain with the sprocket and chain tensioner.

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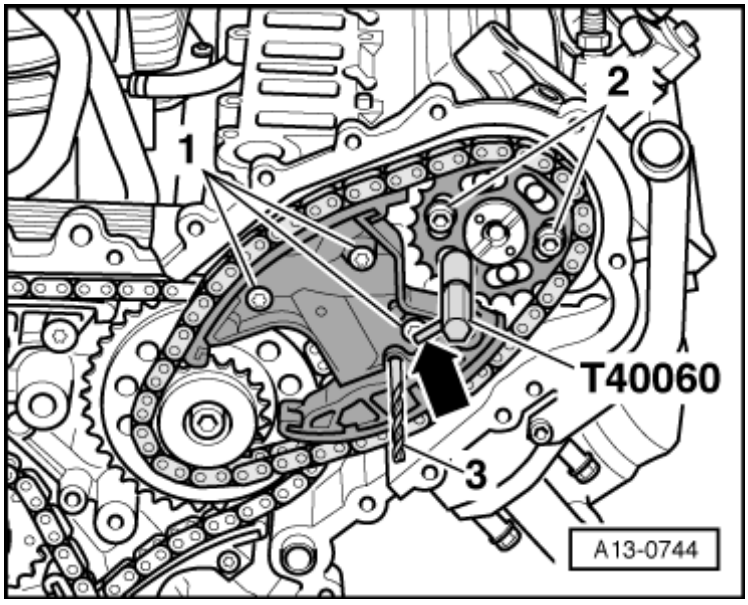


Fig. 126: Identifying Drill Bit -4- And Alignment Hole
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- The slots in the camshaft sprocket must be at the middle position in relation to the threaded holes in the camshaft.

-- Tighten the chain tensioner bolts -1-.

-- Install two camshaft sprocket bolts -2- loosely.

- It must still be possible to rotate the camshaft chain sprocket on the camshaft and it must not tilt.

-- Secure the right camshaft using the adjustment pin T40060.

- The lever -arrow- on the adjustment pin T40060 must be perpendicular to the center axis of the camshaft.

-- Pull the drill -3- out of the hole, thereby releasing the right chain tensioner.

-- Pre-tighten the right camshaft sprocket using the adapter T40062 and torque wrench to 20 Nm in the -direction of the arrow- and hold.

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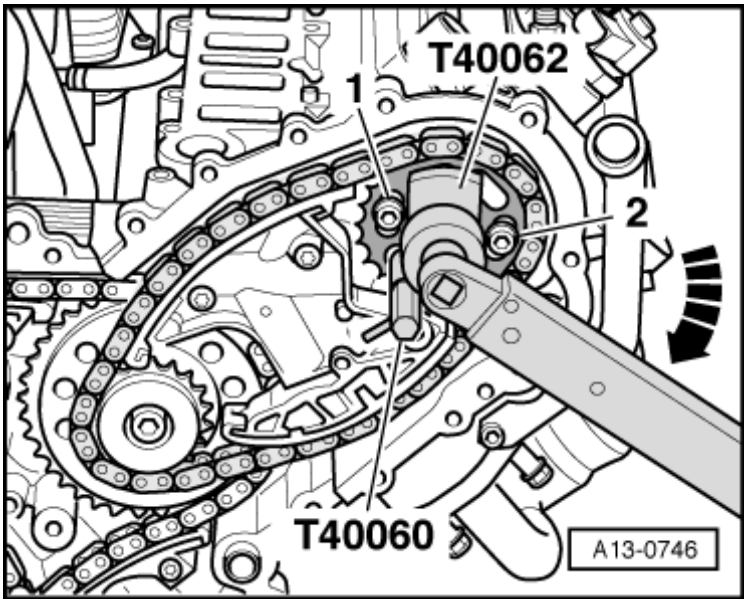


Fig. 127: Identifying Bolts -1 And 2-, Torque Wrench, Adapter T40062 And Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Tighten the bolts -1 and 2-.

-- Remove the adapter T40062 and the adjustment pin T40060.

-- Tighten the remaining bolts for the right camshaft sprocket.

-- Pre-tighten the left camshaft sprocket using the adapter T40062 and torque wrench to 15 Nm in the -direction of the arrow- and hold.

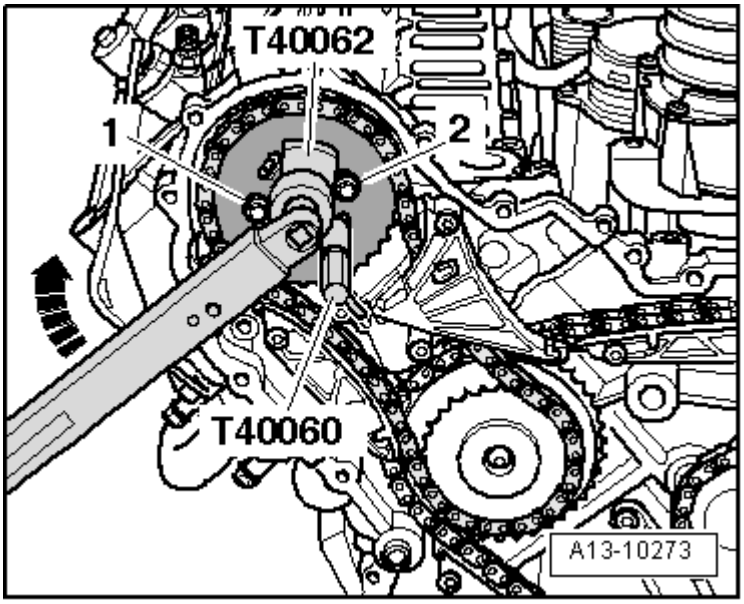


Fig. 128: Identifying Adapter T40062 On Left Camshaft Chain Sprocket
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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-- Tighten the bolts -1 and 2-.

-- Remove the adapter T40062 and the adjustment pin T40060.

-- Tighten the remaining bolts for the left camshaft sprocket.

-- Remove the crankshaft holder 3242.

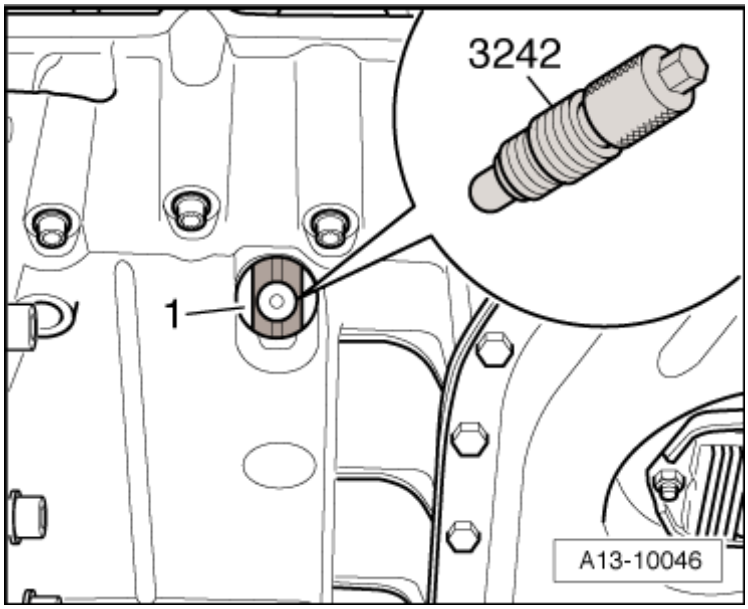


Fig. 129: Identifying Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

VALVE TIMING, CHECKING

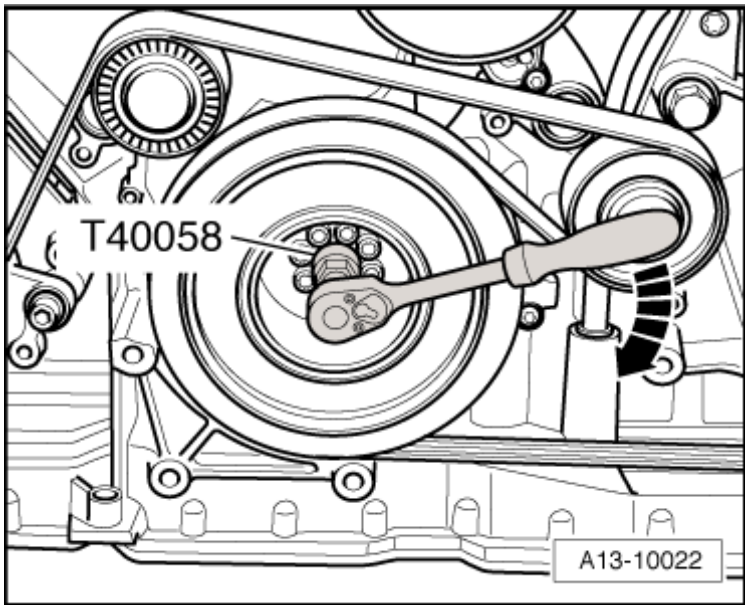


Fig. 130: Loosening Torque Converter Bolts Using Adapter T40058

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Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CAUTION: Components could be destroyed by the camshaft timing chain jumping off.

- **Turn the crankshaft only in engine rotation direction -arrow-.**

-- Turn the crankshaft two turn until the crankshaft is just in front of TDC.

-- Lock the crankshaft -1- from turning using the crankshaft holder 3242 to 20 Nm.

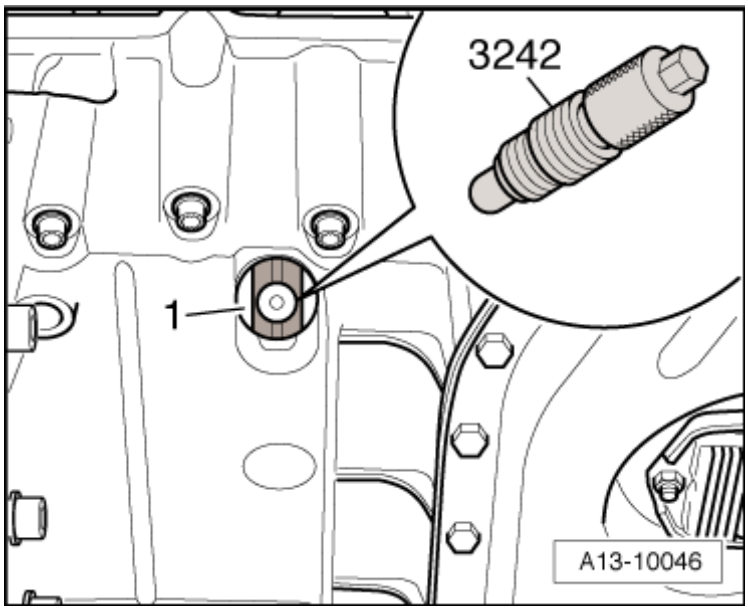


Fig. 131: Identifying Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CAUTION: An inaccurate TDC setting will cause an inaccurate setting.

- **If the crankshaft was only rotated slightly past TDC, first rotate it back approximately 10° and then rotate it in engine rotation direction again to TDC.**

-- Check whether the camshafts for both cylinder heads are in TDC position.

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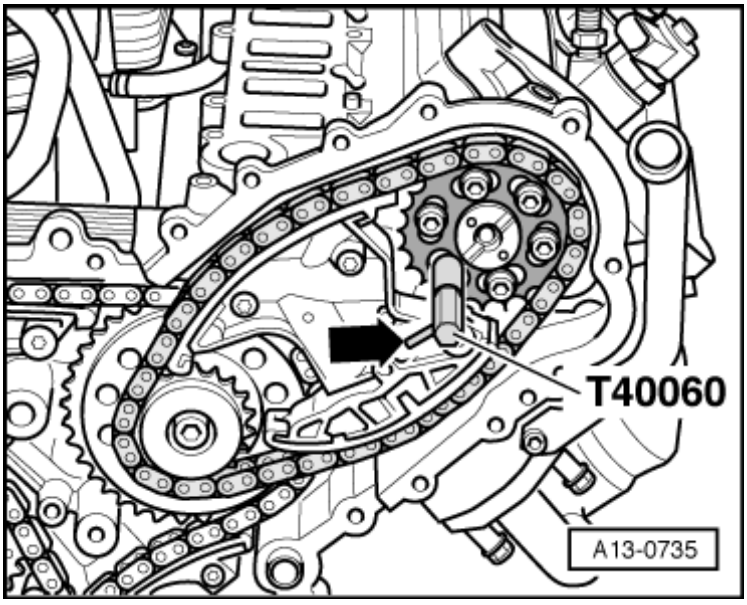


Fig. 132: Identifying TDC Position Of Camshafts
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- It must be possible to secure the camshafts using the adjustment pin T40060.
- The lever -arrow- on the adjustment pin T40060 must be perpendicular to the center axis of the camshaft on cylinder bank 1 (right side).
- The lever -arrow- on the adjustment pin T40060 must be perpendicular to the center axis of the camshaft on cylinder bank 2 (left side).

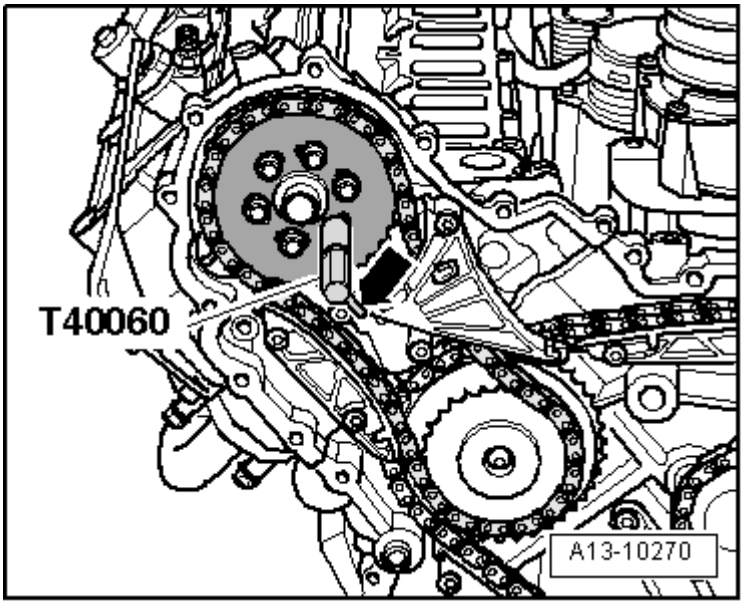


Fig. 133: Identifying Perpendicular Pin -Arrow- On Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Correcting the Valve Timing

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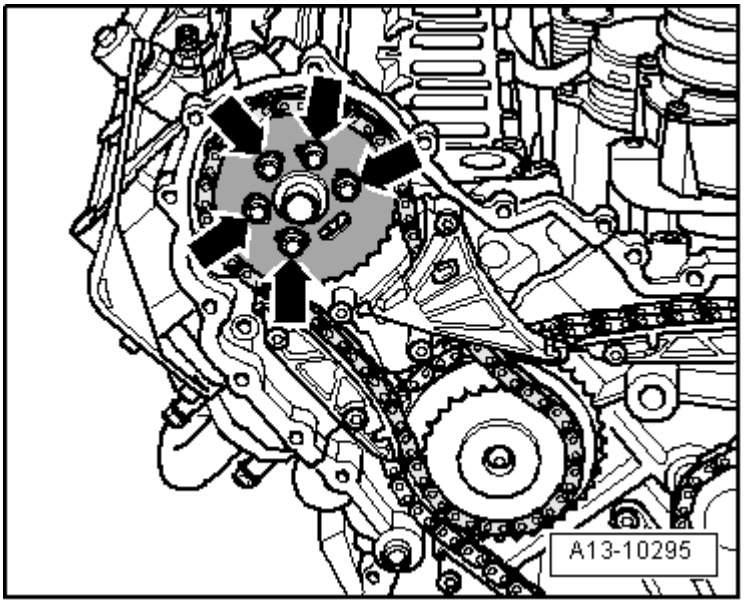


Fig. 134: Identifying Bolts -Arrows-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- If one of the camshafts does not lock, loosen all the bolts -arrows- for that particular camshaft sprocket about 1 turn.

-- Install the adapter T40061 over the bolt heads.

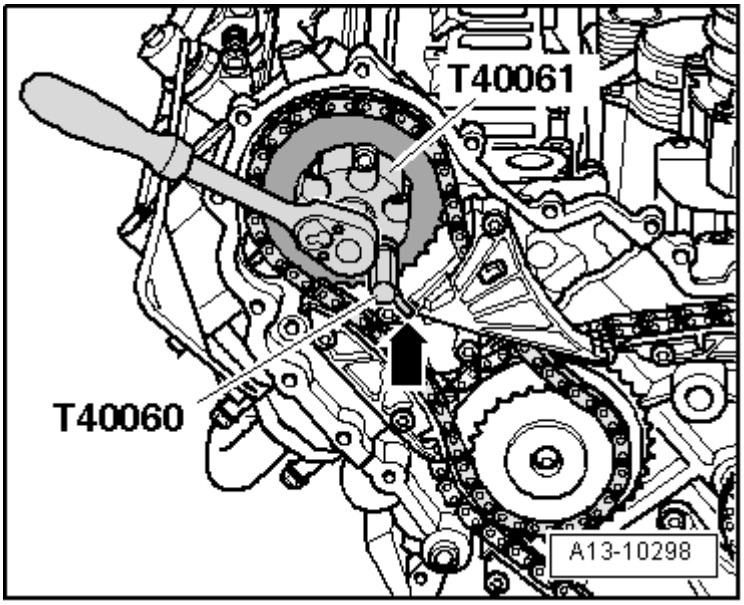


Fig. 135: Identifying Adapter T40061 And Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Turn the camshaft by the adapter T40061 just a little back and forth until it is possible to insert the adjustment pin T40060.

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- The lever -arrow- on the adjustment pin T40060 must be perpendicular to the center axis of the camshaft.

-- Tighten the bolts for the camshaft sprocket with the adapter T40061 and the adjustment pin T40060 still attached to approximately 5 Nm.

-- Remove the adjustment pin T40060 and adapter T40061.

-- Tighten the camshaft sprocket bolts to their final torque.

-- Repeat the procedure on the other cylinder bank, if necessary.

-- Remove the crankshaft holder 3242.

-- Check the valve timing once again. Refer to **CAMSHAFT TIMING CHAINS, REMOVING FROM CAMSHAFTS**.

Further installation is in the reverse order of removal. Note the following:

-- Install the plug -arrow- to the upper oil pan. Refer to **UPPER OIL PAN OVERVIEW** .

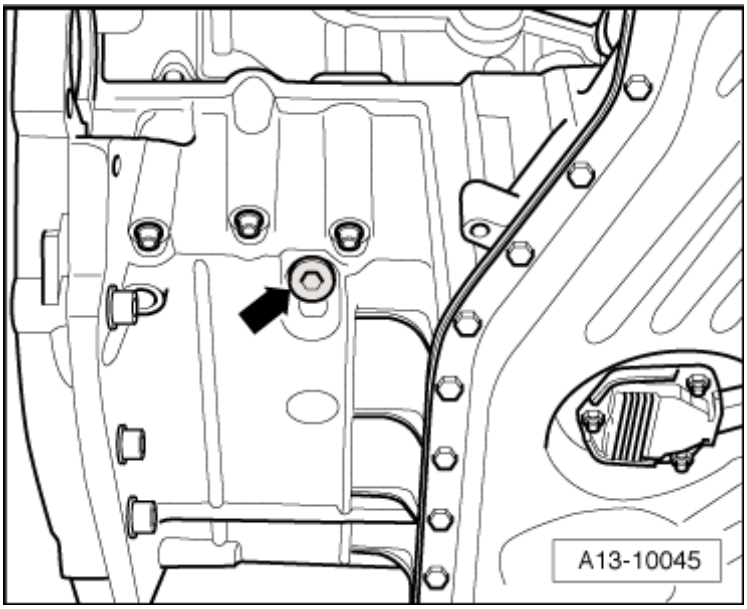


Fig. 136: Identifying Locking Bolt Of Upper Part Of Oil Pan
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Install the timing chain covers. Refer to **TIMING CHAIN COVERS** .

SPECIAL TOOLS

Special tools and workshop equipment required

- Puller T40064

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- Seal Puller - General Usage 2085
- M10 x 1.25 x 40 Bolt from Seal Installer 3241
- Assembly Tool T10053
- Socket T40058
- Compression Tester V.A.G 1763

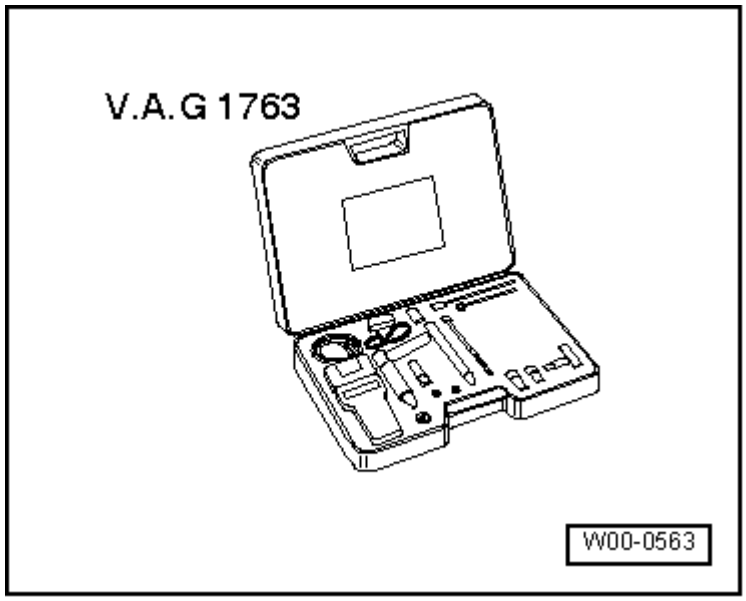


Fig. 137: Identifying Compression Tester V.A.G 1763
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Dial Gauge Holder VW 387

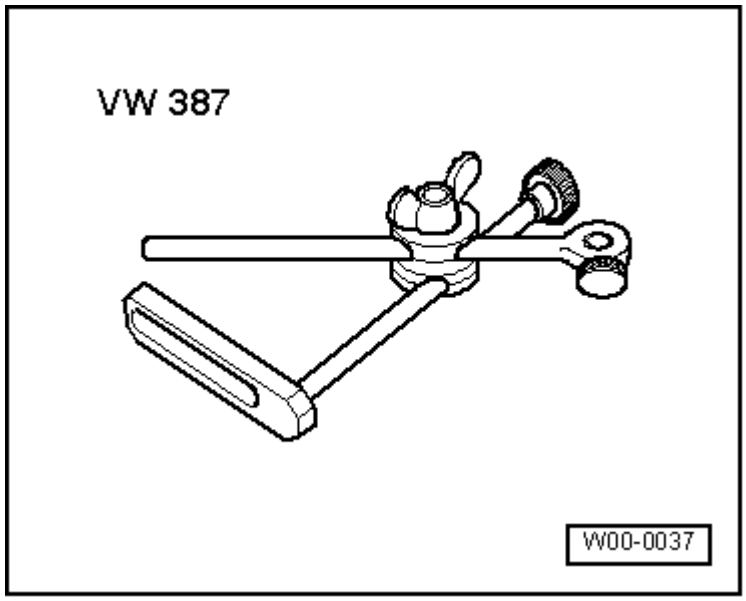


Fig. 138: Identifying Dial Gauge Holder VW 387
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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- Dial Gauge 0-10 mm VAS 6079

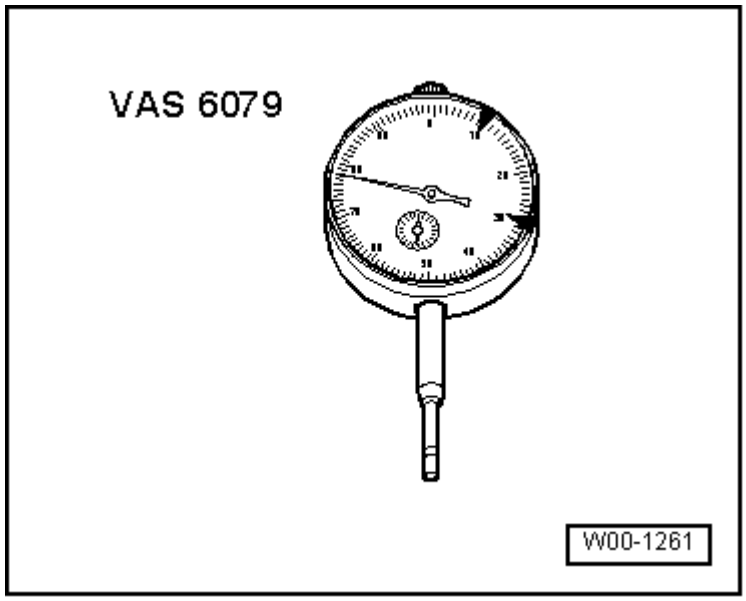


Fig. 139: Identifying Dial Gauge VAS 6079
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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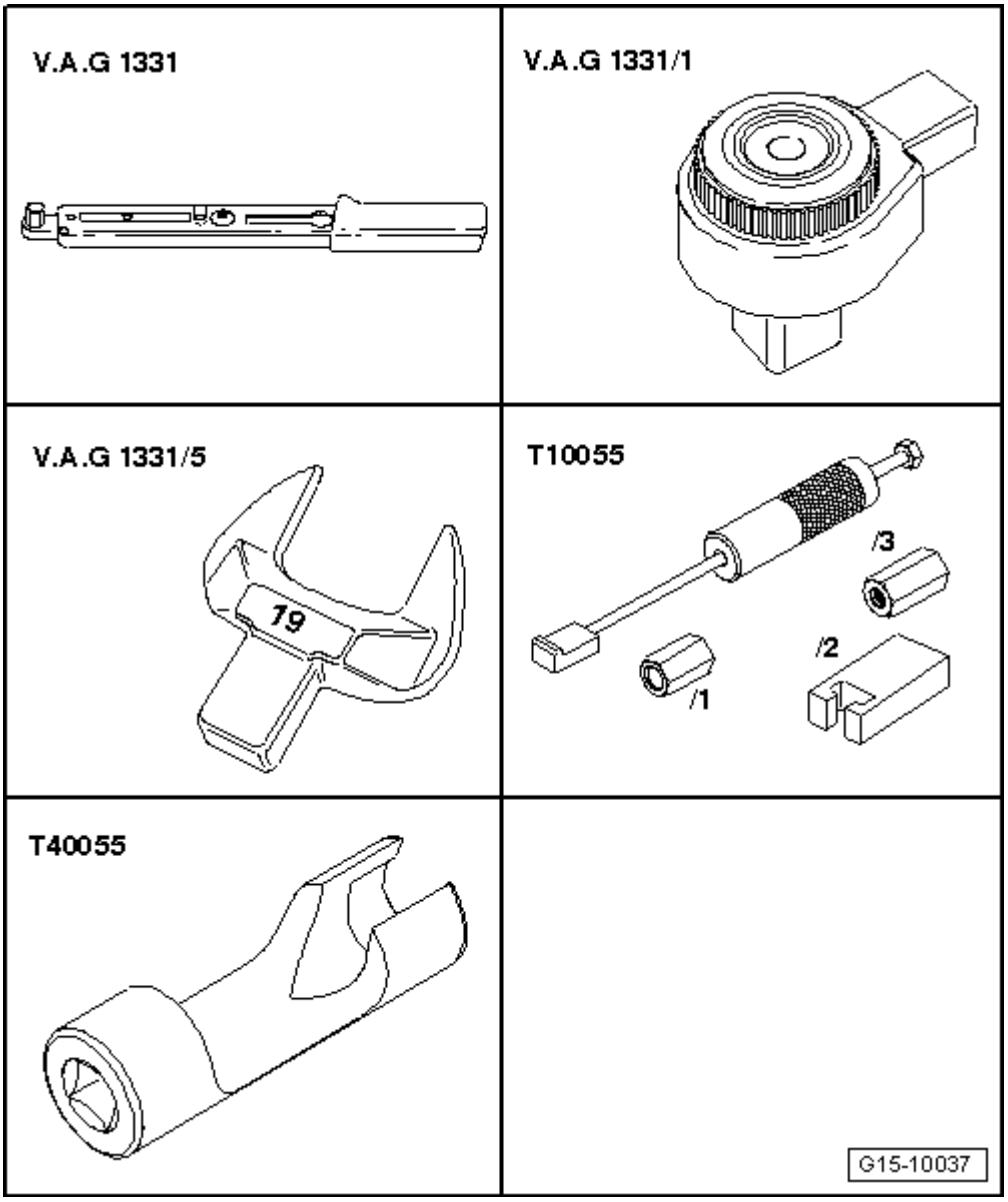


Fig. 140: Identifying Special Tools -- Torque Wrench, Ratchet And Puller
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Special tools and workshop equipment required

- Torque Wrench (5-50 Nm) V.A.G 1331
- Ratchet, Reversible V.A.G 1331/1
- Tool Insert AF 19 V.A.G 1331/5
- Puller T10055
- Socket T40055

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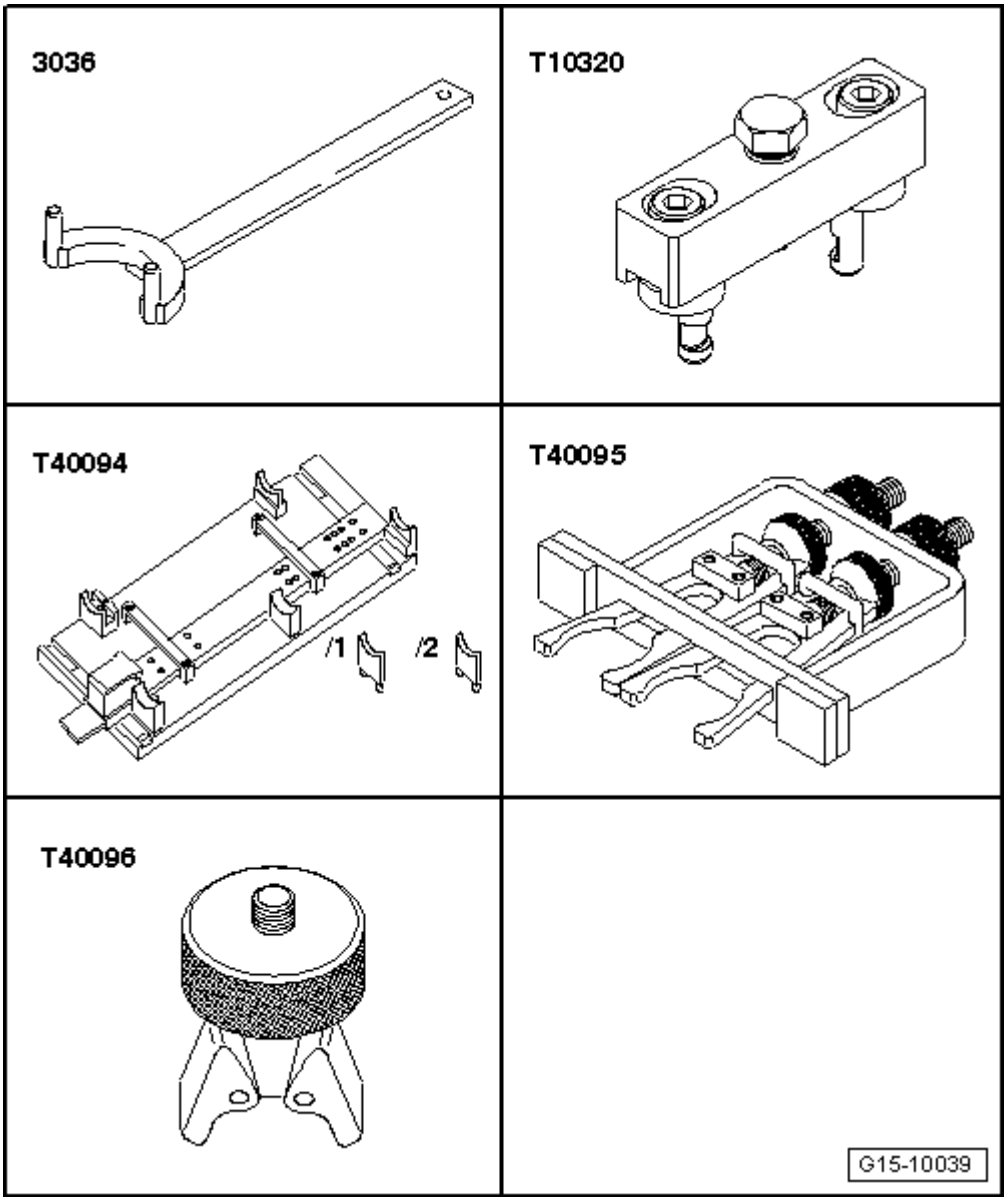


Fig. 141: Identifying Special Tools -- Camshafts
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Special tools and workshop equipment required

- Retainer 3036
- Puller T10320
- Camshaft Fitting Tool T40094
- Camshaft Fitting Tool T40095
- Camshaft Fitting Tool T40096

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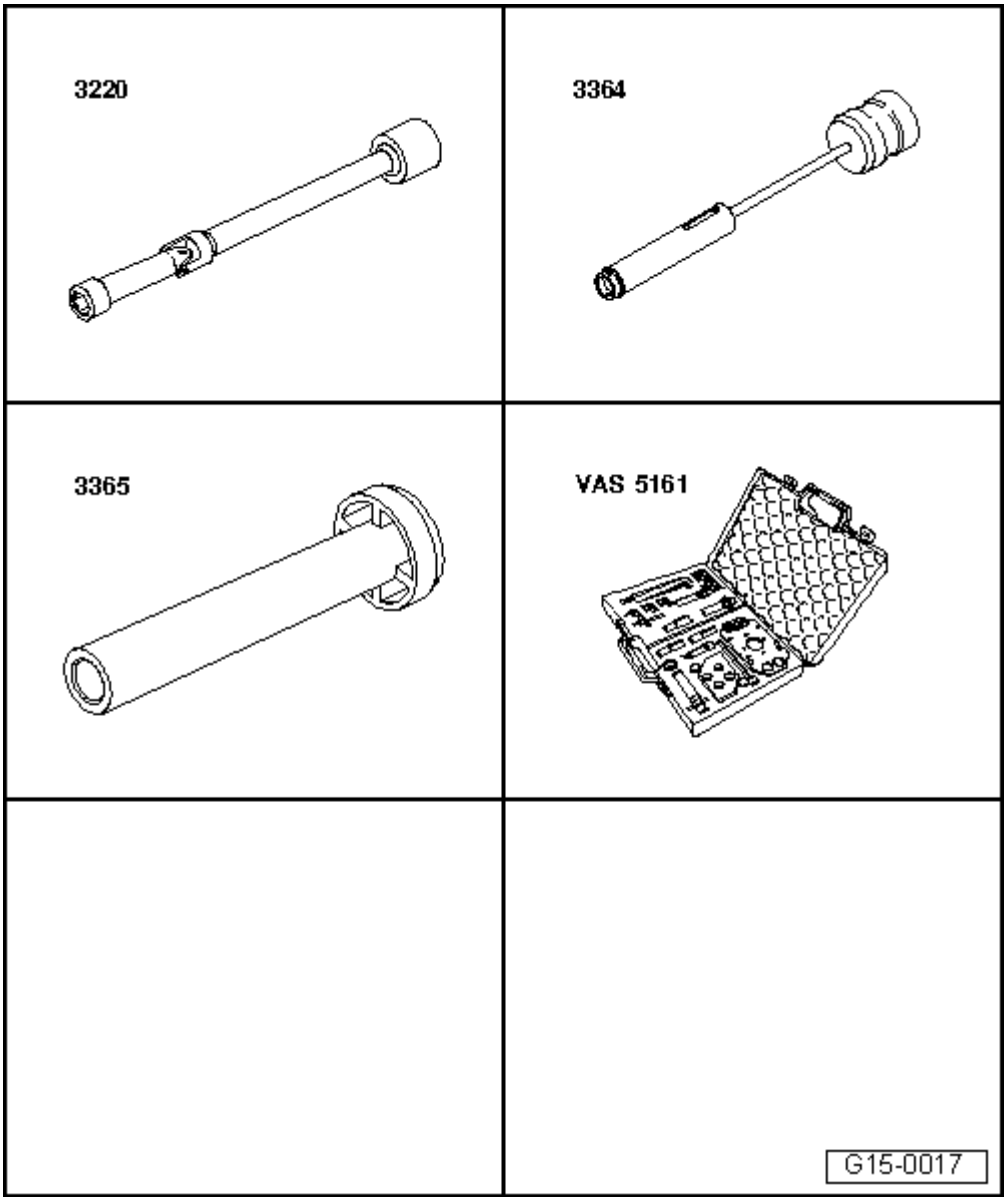


Fig. 142: Identifying 3220, 3364, 3365 And VAS 5161
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Special tools and workshop equipment required

- Hinged Socket 3220
- Valve Seal Removal Tool 3364
- Valve Stem Seal Driver 3365
- Valve Cotters Asm/Disasm Device VAS 5161
- Guide Plate for 3.0L TDI Engine VAS 5161/23

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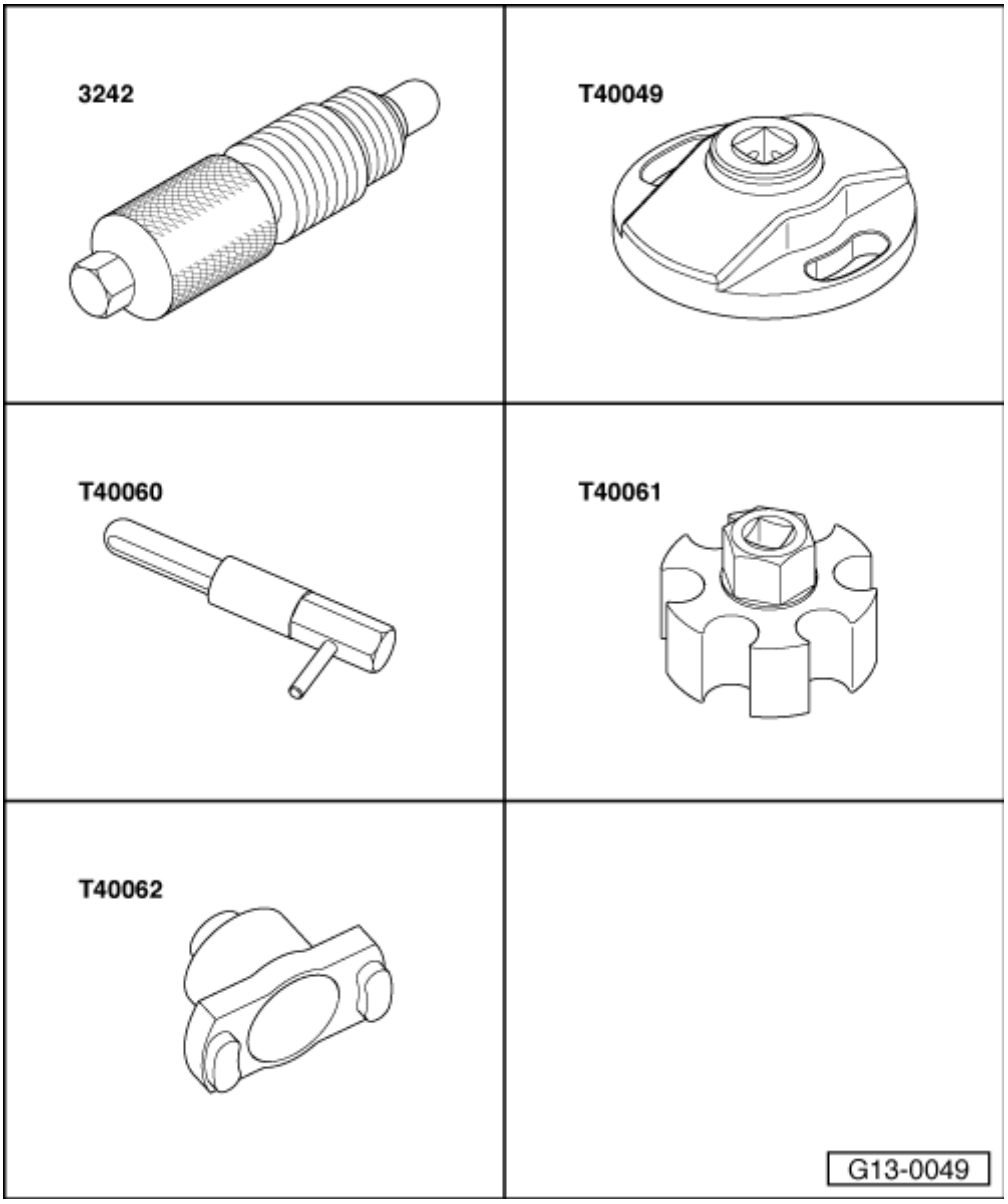


Fig. 143: Identifying Special Tools -- Crankshaft Holder And Accessories
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Special tools and workshop equipment required

- Crankshaft Holder 3242
- Key T40049
- Adjustment Pin T40060
- Adapter T40061
- Adapter T40062

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