ENGINE

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

13 CRANKSHAFT, CYLINDER BLOCK

GENERAL INFORMATION

ENGINE

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 passages thoroughly and replace the oil cooler to prevent further damage.

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

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

PISTON AND CONNECTING ROD

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

CRANKSHAFT

NOTE: Secure the engine on the engine and transmission holder VAS 6095 with 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.

DESCRIPTION AND OPERATION

RIBBED BELT DRIVE OVERVIEW

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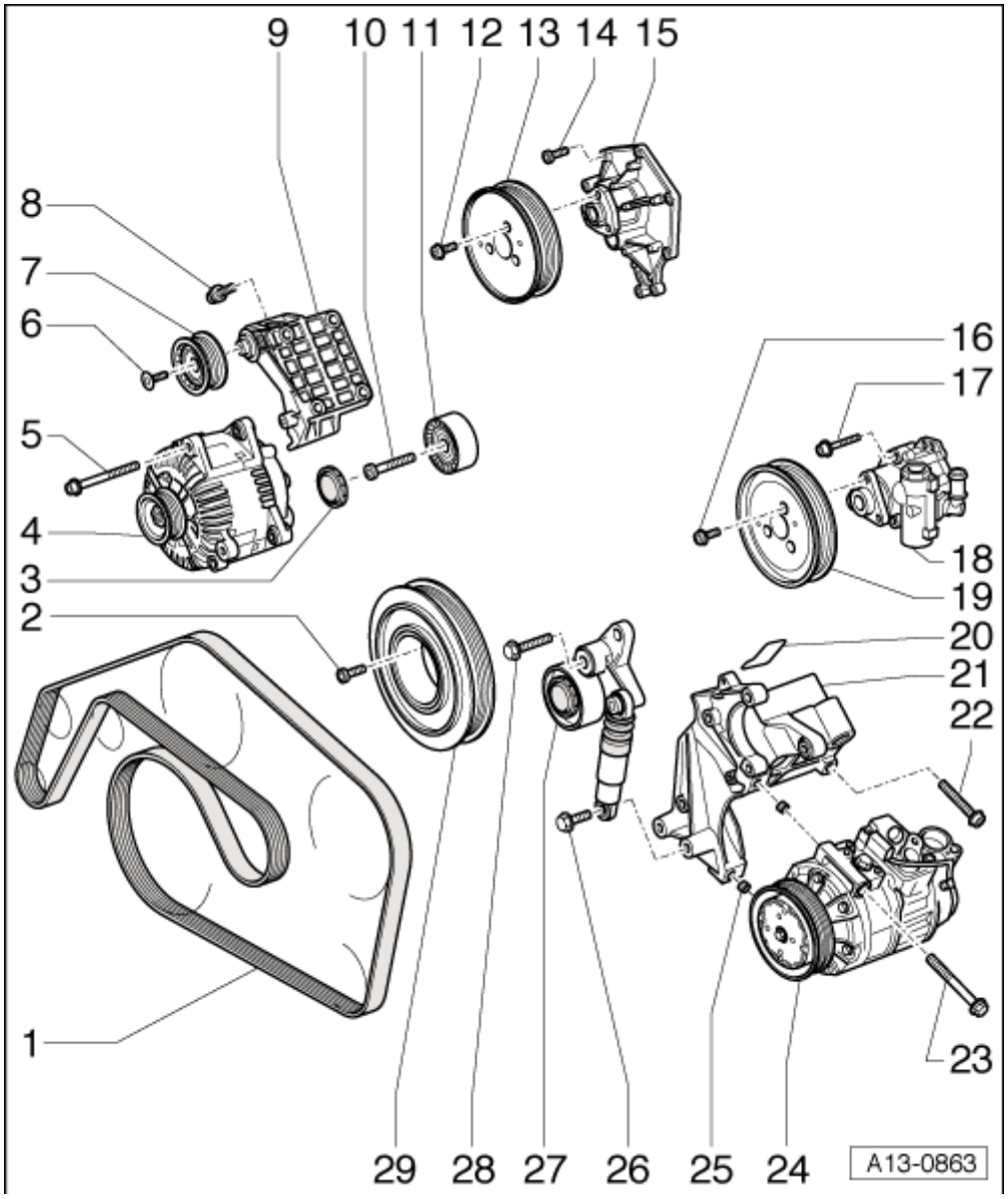


Fig. 1: Ribbed Belt Drive Overview
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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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- Install with a shim, refer to **RIBBED BELT DRIVE OVERVIEW**.

3. Idler Pulley Cover
4. Generator
   - Removing and installing, refer to **Removal and Installation** .
   - To facilitate installing the generator, slightly push back the threaded bushings for the generator bolts.
5. Bolt
   - 22 Nm
6. Bolt
   - 25 Nm
7. Idler Pulley
   - Note the installed position.
8. Bolt
   - 40 Nm
9. Generator and Idler Pulley Bracket
   - Follow the tightening sequence, refer to **Fig. 3**.
10. Bolt
    - 22 Nm
11. Idler Pulley
    - Note the installed position.
12. Bolt
    - 22 Nm
13. Coolant Pump Pulley
    - Installed location: writing "front" indicates direction of travel.
    - Counter hold using the spanner wrench 3212 to remove.
14. Bolt
    - 9 Nm
15. Coolant Pump
    - Removing and installing, refer to **COOLANT PUMP** .
16. Bolt
    - 22 Nm
17. Bolt
    - 22 Nm
18. Power Steering Pump
    - Removing and installing, refer to **Removal and Installation** .
    - Installed position: writing "front" indicates direction of travel.
19. Power Steering Pump Pulley
    - Counter hold using the spanner wrench 3212 to remove.

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20. Gasket
    - Always replace.
21. Accessory Bracket
22. Bolt
    - 40 Nm
23. Bolt
    - 25 Nm
    - Check for washers
24. A/C Compressor
    - Removing and installing, refer to **Removal and Installation** .
    - Observe the alignment bushing -item 25- when installing.
25. Alignment Bushing
    - Ensure they are seated correctly in the bracket.
26. Bolt
    - 25 Nm
27. Belt Tensioner
    - Pivot using a T60 TORX® socket.
28. Bolt
    - M10 bolt: 50 Nm +90° (1/4) additional turn.
    - M11 bolt: 60 Nm +90° (1/4) additional turn.
    - Always replace.

CAUTION: Differing threads in the cylinder block.

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

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

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

Vibration Damper Threaded Connection

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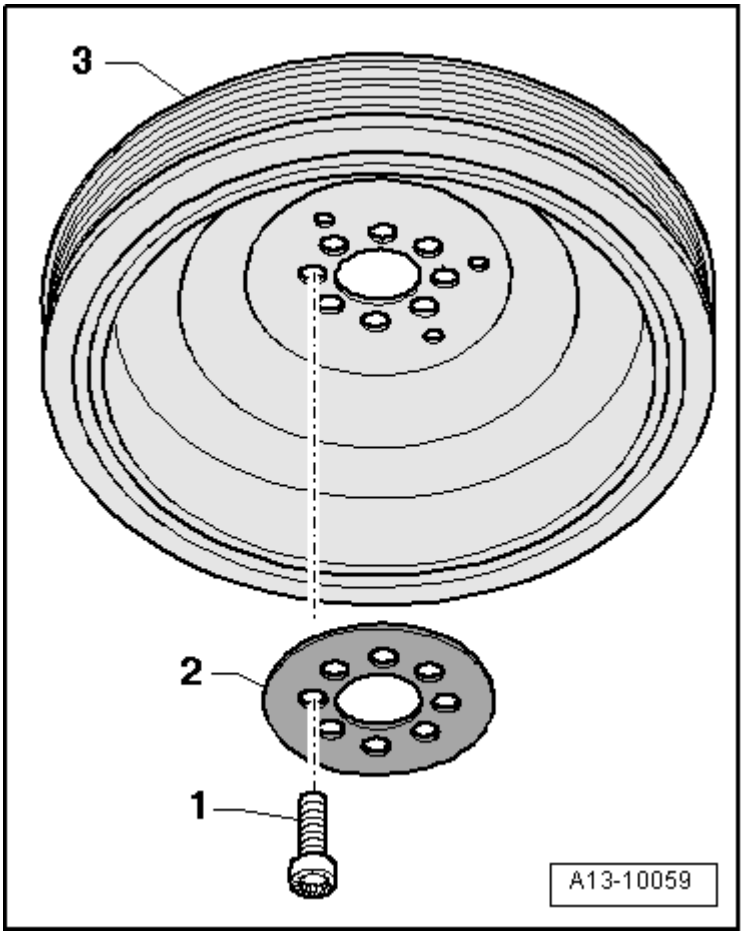


Fig. 2: Vibration Damper Connection
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

2 - Shim, replace

3 - Vibration damper

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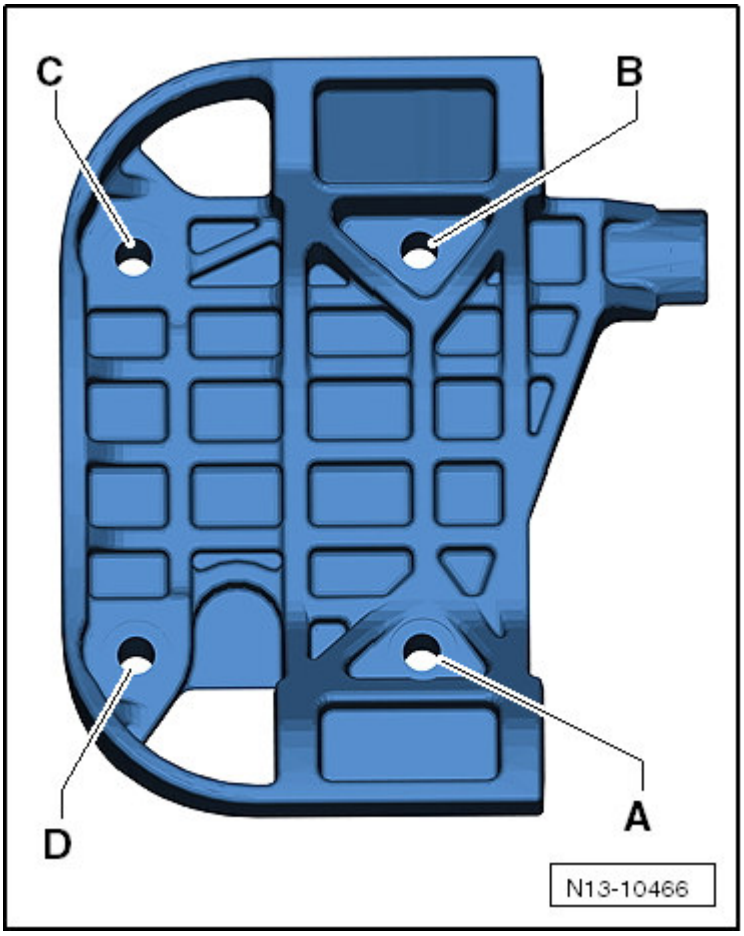


Fig. 3: Generator Bracket Tightening Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Install the generator bracket using the following steps:

1.: Install bolt -A- and tighten by hand.

2.: Install bolt -B- and tighten.

3.: Tighten bolt -A-.

4.: Install bolt -D- and tighten.

5.: Install bolt -C- and tighten.

DRIVE PLATE OVERVIEW

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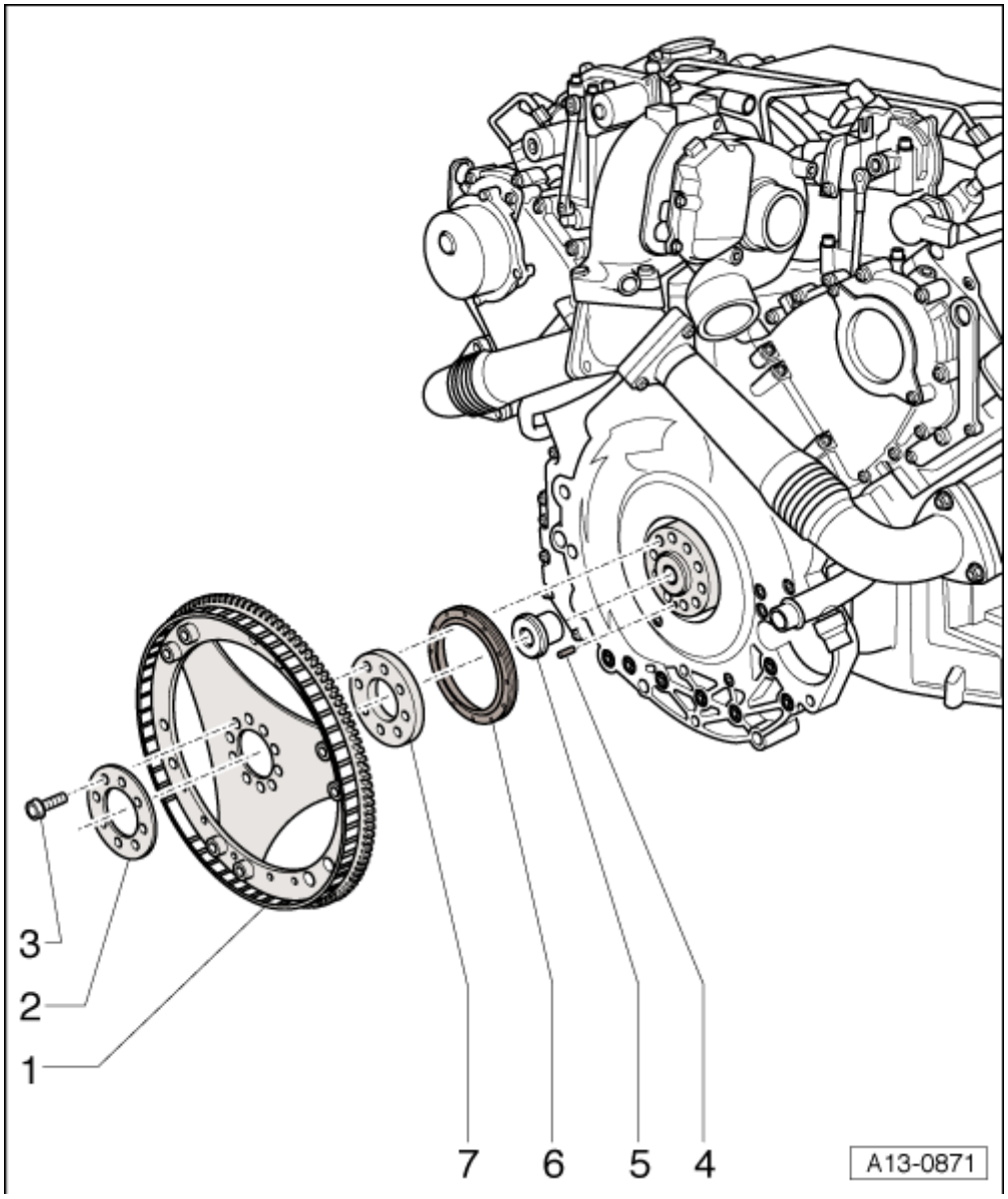


Fig. 4: Drive Plate Overview
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Drive Plate
   - Removing and installing, refer to **DRIVE PLATE**.
2. Washer
   - Thickness: 3.4 mm
3. Bolt
   - 30 Nm + 90° (1/4) additional turn.
   - Always replace.
4. Alignment Bushing
5. Torque Converter Centering Bushing

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6. Crankshaft Seal, Timing Chain Side
   - Removing and installing, refer to **CRANKSHAFT SEAL, TIMING CHAIN SIDE**.
7. Shim
   - Thickness: 1.5 mm

TIMING CHAIN COVERS OVERVIEW

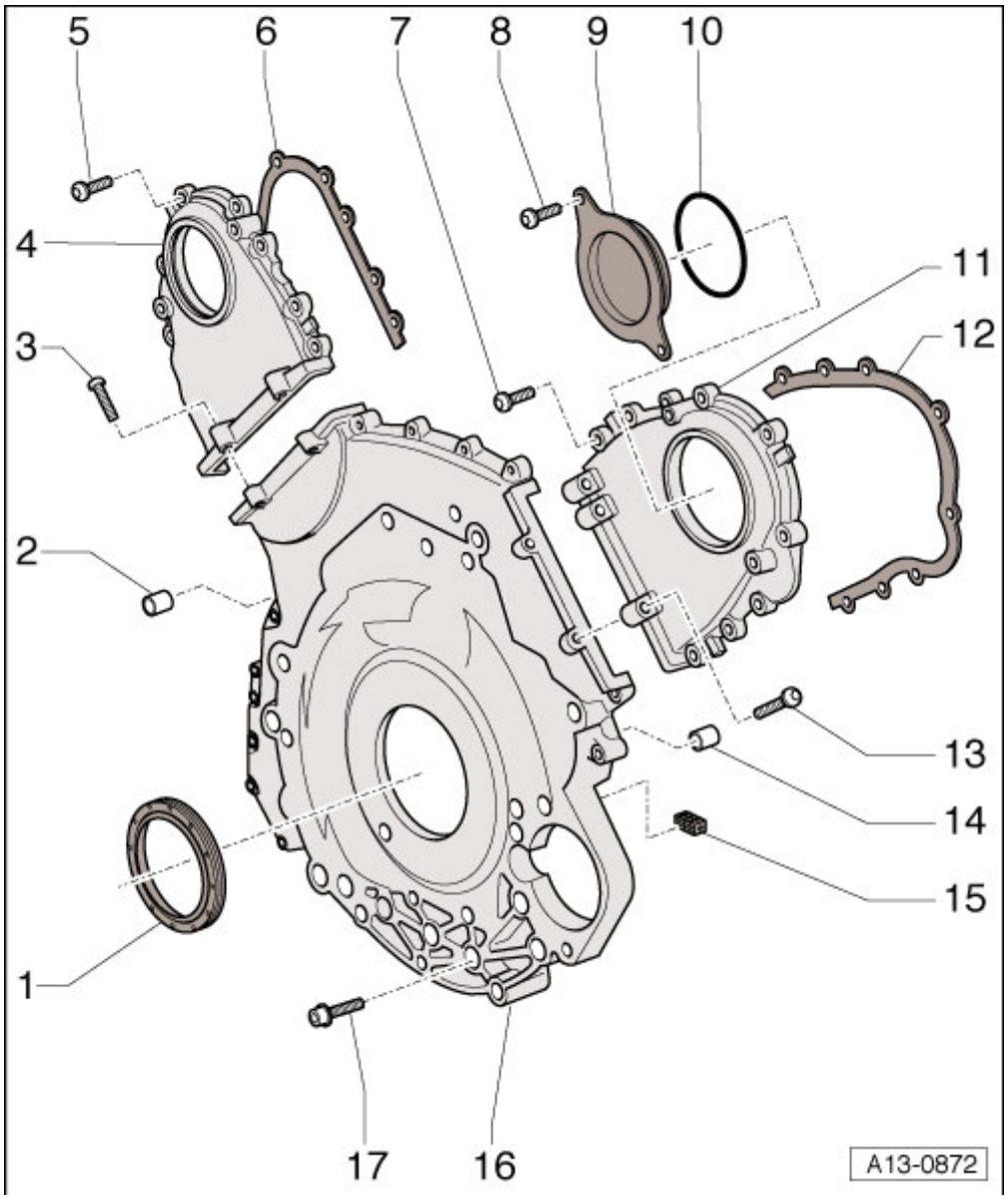


Fig. 5: Timing Chain Covers Overview
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Crankshaft Seal, Timing Chain Side
   - Removing and installing, refer to **CRANKSHAFT SEAL, TIMING CHAIN SIDE**.
2. Alignment Bushing

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- Quantity: 2

3. Bolt
   - 9 Nm
   - Note the tightening sequence, refer to **TIMING CHAIN COVERS**.
4. Left Timing Chain Cover
   - Removing and installing, refer to **TIMING CHAIN COVERS**.
5. Bolt
   - 9 Nm
   - Note the tightening sequence, refer to **TIMING CHAIN COVERS**.
6. Gasket
   - Always replace.
7. Bolt
   - 9 Nm
   - Note the tightening sequence, refer to **TIMING CHAIN COVERS**.
8. Bolt
   - 9 Nm
9. Cap
10. O-ring
    - Always replace.
11. Right 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 **TIMING CHAIN COVERS**.
14. Alignment Bushing
    - Quantity: 2
15. Sealing Piece
    - Quantity: 2
16. Lower Timing Chain Cover
    - removing and installing, refer to **TIMING CHAIN COVERS**.
17. Bolt
    - M6 = 9 Nm
    - M8 = 22 Nm
    - Note the tightening sequence, refer to **TIMING CHAIN COVERS**.

BALANCE SHAFT OVERVIEW

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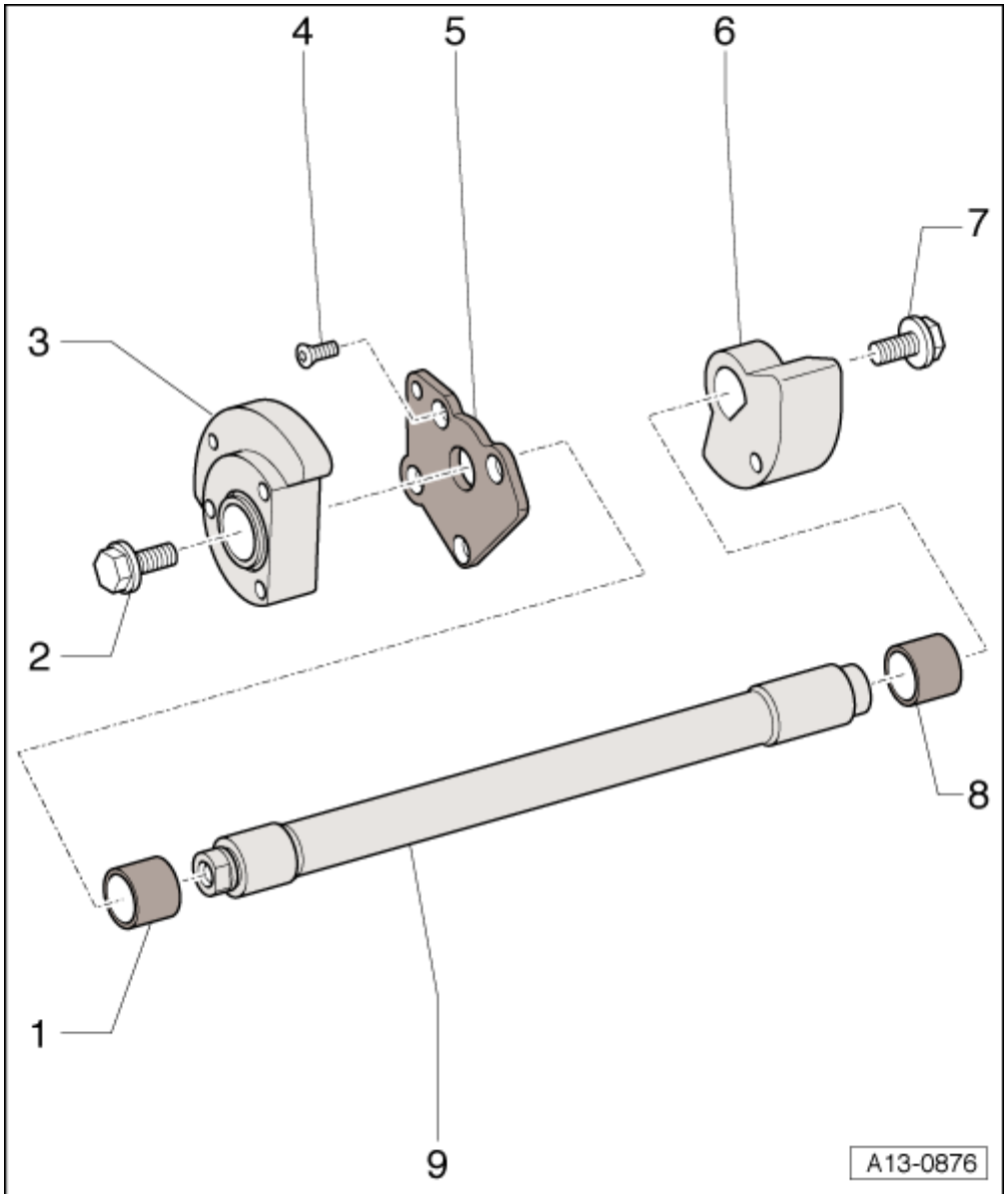


Fig. 6: Balance Shaft Overview
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Friction 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, use the diesel injection pump locking pin 3359 as a counter hold tool.
8. Friction Bearing
9. Balance Shaft
    - Removing and installing, refer to **BALANCE SHAFT**.

TIMING MECHANISM DRIVE CHAIN OVERVIEW

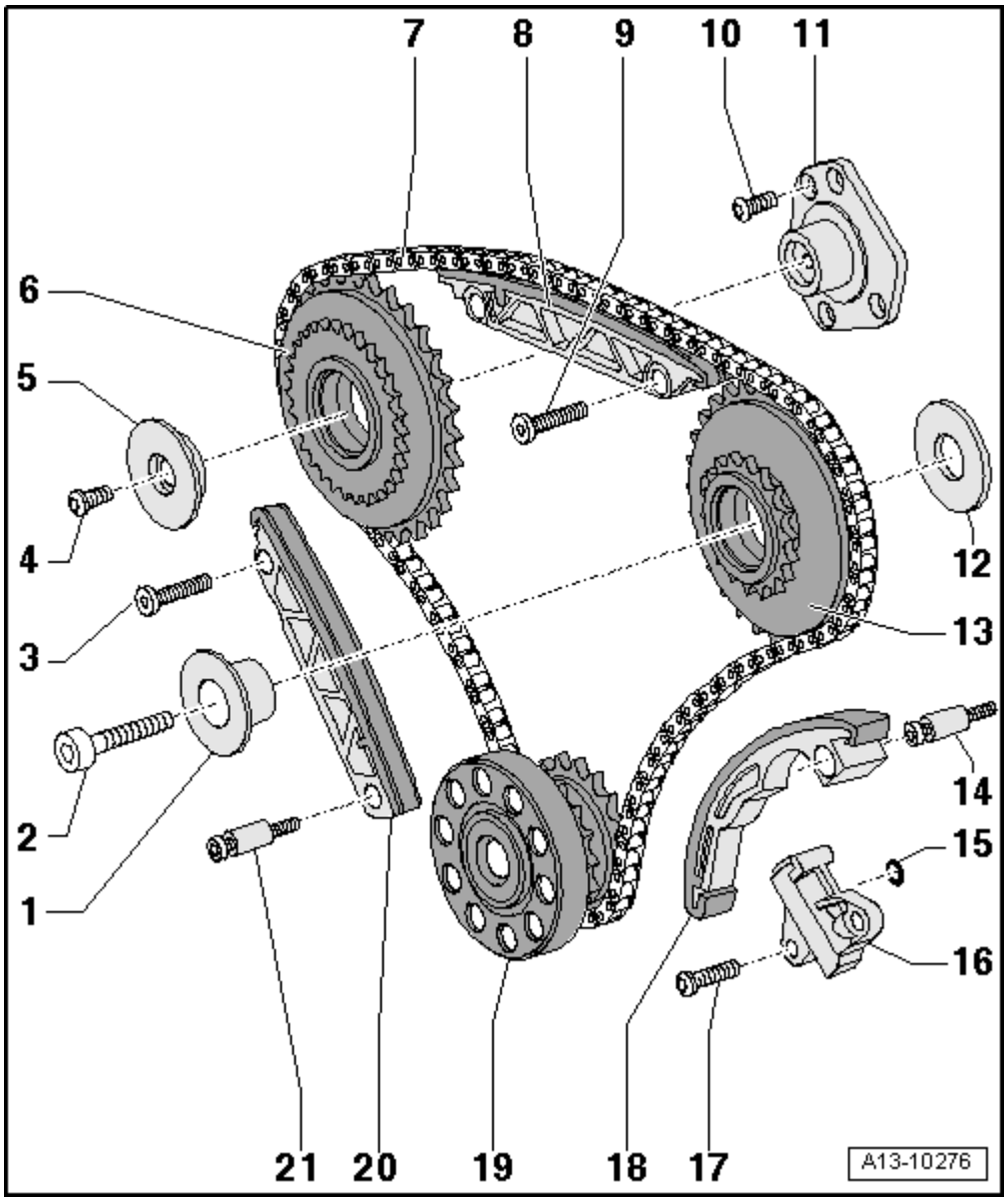


Fig. 7: Timing Mechanism Drive Chain Overview

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Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Drive Sprocket Pivot 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. Drive Sprocket Thrust Washer
6. Left Timing Chain Drive Sprocket
7. Timing Chain
   - Before removing, mark the direction of rotation using paint.
   - Removing and installing, refer to **TIMING MECHANISM DRIVE CHAIN**.
8. Guide Rail
   - Note 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. Drive Sprocket Mounting Bracket
12. Thrust Washer
13. Right Timing Chain Drive Sprocket
14. Mounting Pin
    - 12 Nm
15. O-ring
    - Always replace.
16. Chain Tensioner
17. Bolt
    - 12 Nm
18. Tensioning Rail
19. Crankshaft
    - With sprockets.
20. Guide Rail

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21. Mounting Pin
    - 12 Nm

BALANCE SHAFT AND OIL PUMP CHAIN OVERVIEW

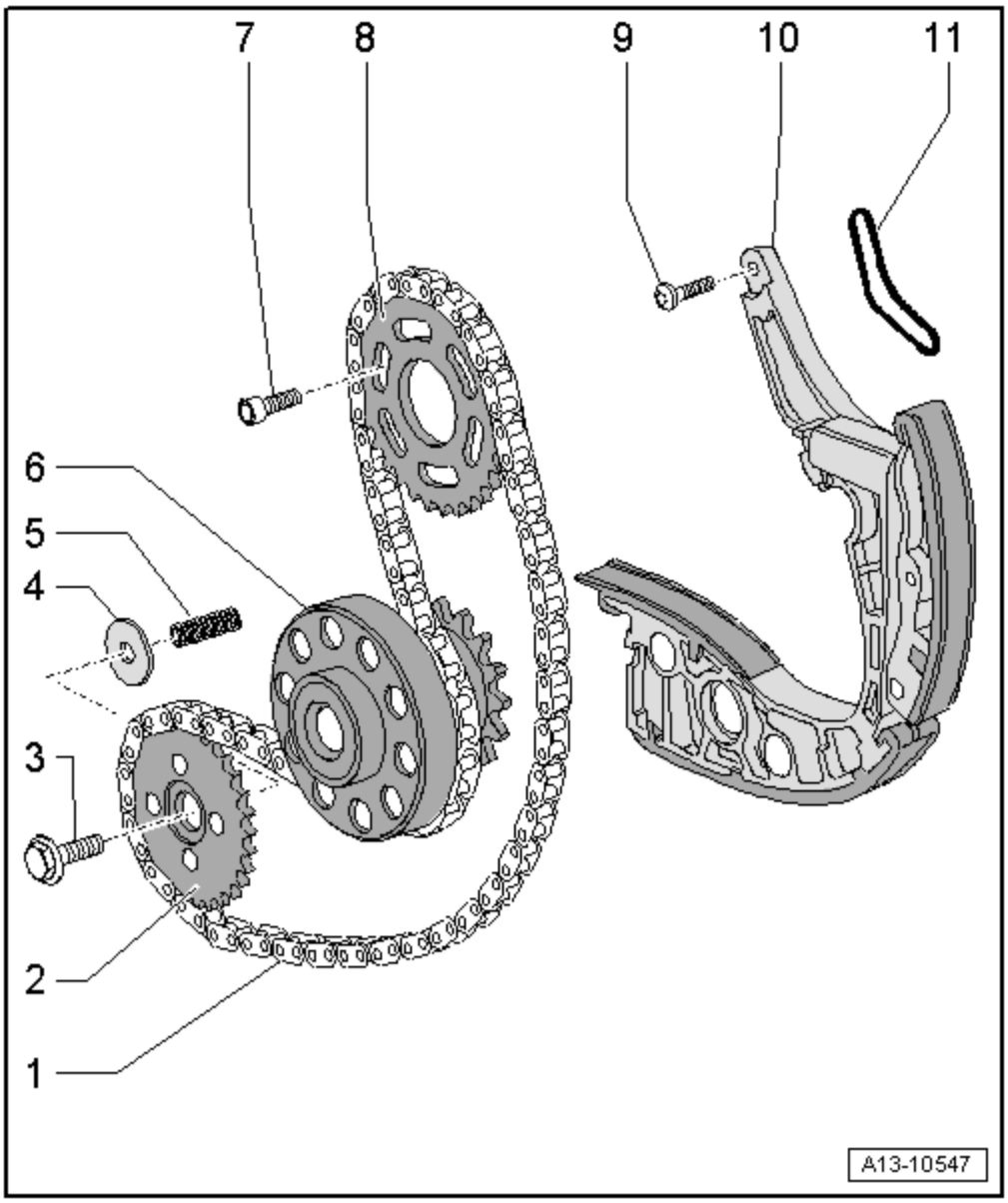


Fig. 8: Balance Shaft And Oil Pump Chain Overview
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Drive Chain
    - Removing and installing, refer to **BALANCE SHAFT AND OIL PUMP CHAIN**.
2. Oil Pump Sprocket
    - Installed position: the side with the lettering on it faces the engine.

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3. Bolt
    - 62 Nm
    - If it is not possible to tighten the bolt to 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 side with the lettering on it faces the transmission.
9. Bolt
    - 9 Nm
10. Chain Tensioner
    - With guide rail.
11. Gasket
    - Always replace.

PISTONS AND CONNECTING ROD OVERVIEW

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

NOTE: Oil spray jet for piston cooling, refer to PISTONS AND CONNECTING ROD OVERVIEW.

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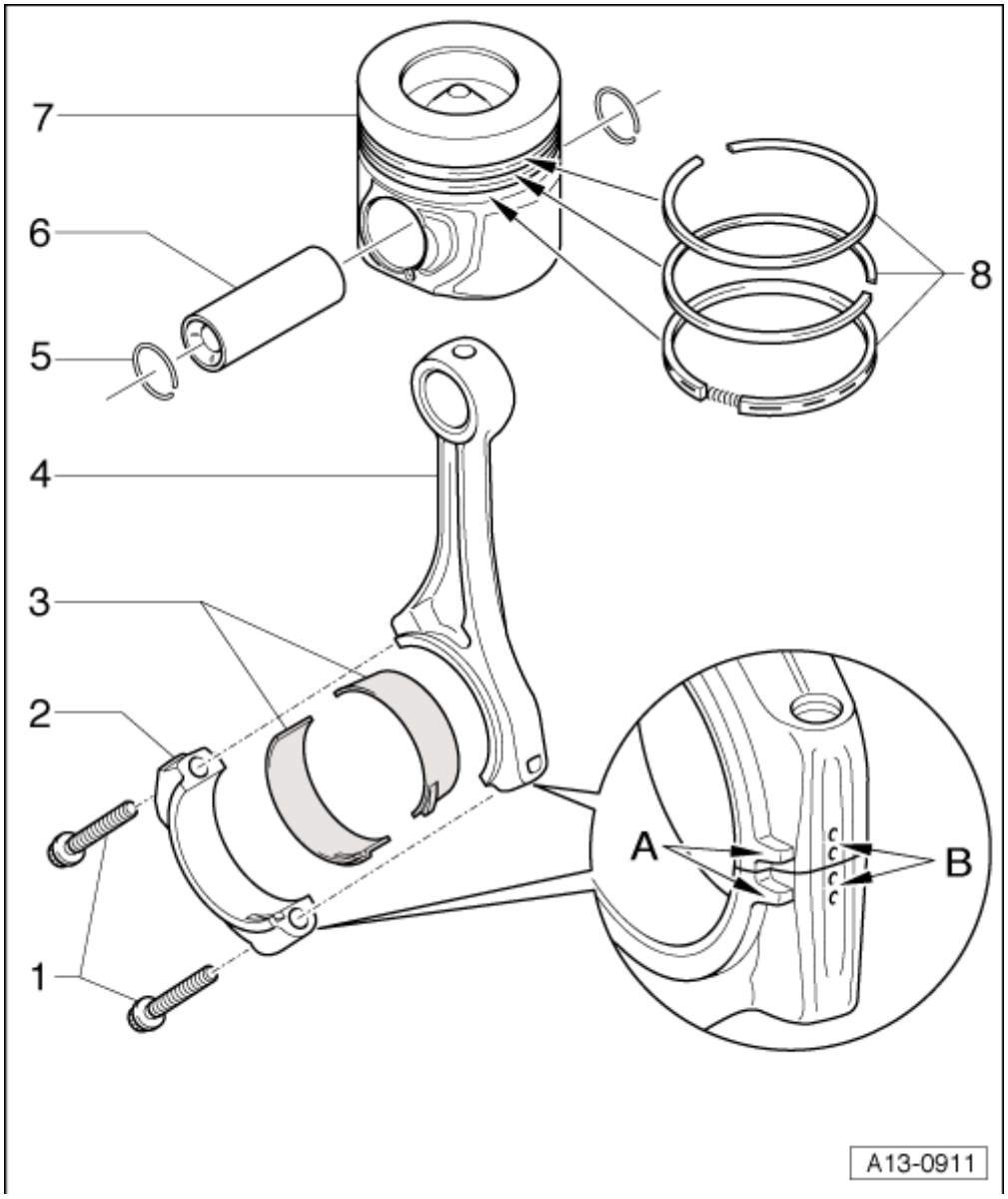


Fig. 9: Pistons And Connecting Rod Overview
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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.
   - Radial clearance, measuring. Refer to **CONNECTING ROD RADIAL CLEARANCE, CHECKING**.
2. Connecting Rod Bearing Cap
   - Do not interchange.

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- Affiliation to the cylinder mark -B-, refer to **PISTONS AND CONNECTING ROD OVERVIEW**.
- Installed position: casting marks -A-.

3. Bearing Shells
   - Note the installed position.
   - Do not interchange used bearing shells (mark them).
   - Bearing shells that are worn down to the nickel layer must be replaced.
   - Radial clearance, measuring. Refer to **CONNECTING ROD RADIAL CLEARANCE, CHECKING**.
   - When measuring radial clearance, tighten bolts -item 1- to 30 Nm but do not tighten further.
4. Connecting Rod
   - Only replace as set with the cap.
   - Affiliation to the cylinder mark -B-, refer to **PISTONS AND CONNECTING ROD OVERVIEW**.
   - Installed position: casting marks -A-.
   - Axial play for each new connecting rod and cap pair: 0.20 to 0.44 mm
5. Circlip
6. Piston Pin
   - If tight, heat the piston to 60 °C (140 °F).
   - Remove and install using a pilot drift VW 222 A.
7. Piston
   - With the combustion chamber.
   - Mark the installed position and cylinder allocation, refer to **PISTONS AND CONNECTING ROD OVERVIEW**.
   - Checking, refer to **PISTONS AND CONNECTING ROD OVERVIEW**.
   - Install with a piston ring compressor.
   - Replace if there are cracks on the piston shaft.
   - Piston and cylinder dimensions. Refer to **PISTON AND CYLINDER DIMENSIONS**.
   - Piston projection in Top Dead Center (TDC), checking. Refer to **PISTON PROJECTION IN TOP DEAD CENTER, CHECKING**.
   - Cylinder bore, checking. Refer to **PISTONS AND CONNECTING ROD OVERVIEW**.
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 ring gap, refer to **PISTONS AND CONNECTING ROD OVERVIEW**.
   - Checking piston ring groove clearance, refer to **PISTONS AND CONNECTING ROD OVERVIEW**.

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Oil Spray Jet for Piston Cooling

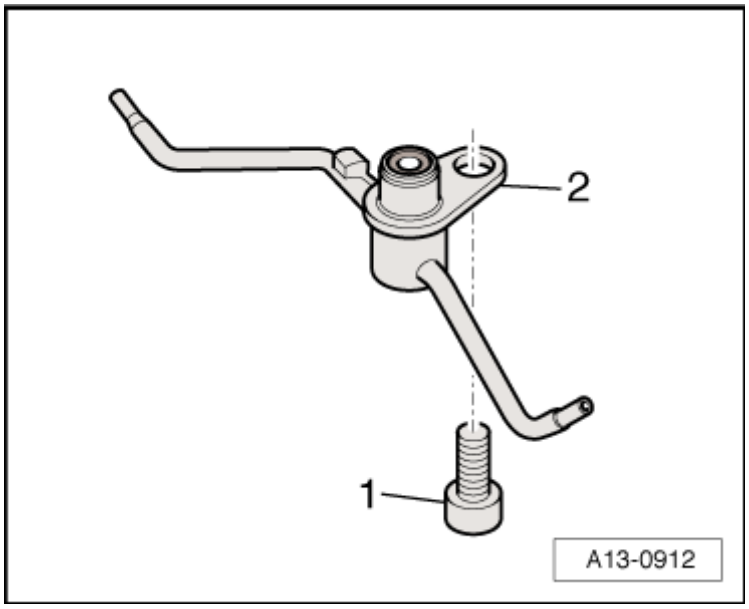


Fig. 10: Oil Spray Jet for Piston Cooling
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

- Opening pressure: 1.3 bar.

Piston Ring Gap, Checking

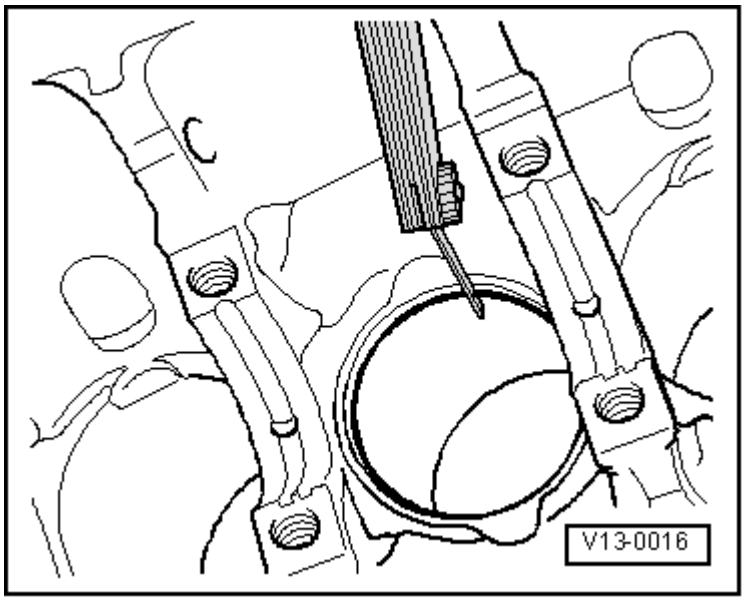


Fig. 11: Checking Piston Ring Gap
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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-- 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.

Piston Ring dimensions in mm	New	Wear limit
1. Compression ring	0.25 to 0.38	0.80
2. Compression ring	0.70 to 0.90	1.30
Oil scraping ring	Max. 0.40	0.70

Piston Ring Groove Clearance, Checking

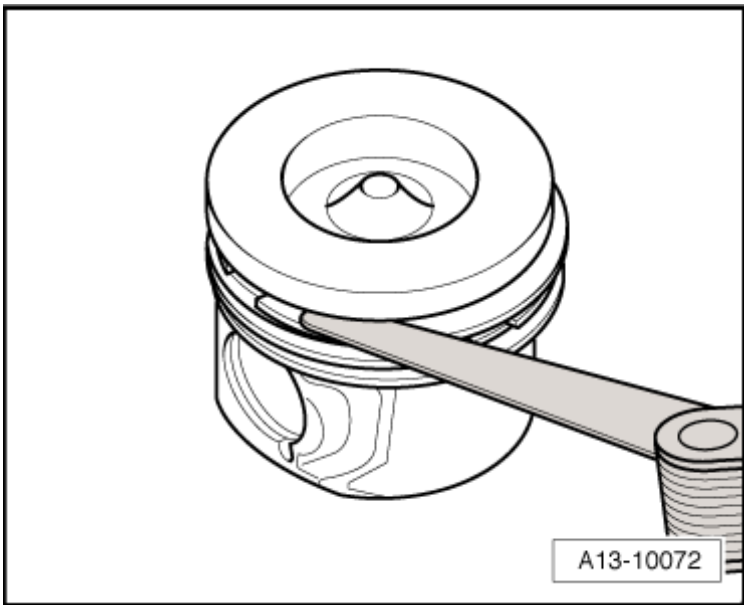


Fig. 12: Piston Ring Groove Clearance, Checking
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Clean the ring groove of piston before checking.

Piston Ring dimensions in mm	New	Wear limit
1. Compression ring	0.120 to 0.160	0.175
2. Compression	0.020 to 0.090	0.115

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ring		
Oil scraping ring	0.020 to 0.090	0.115

Piston, Checking

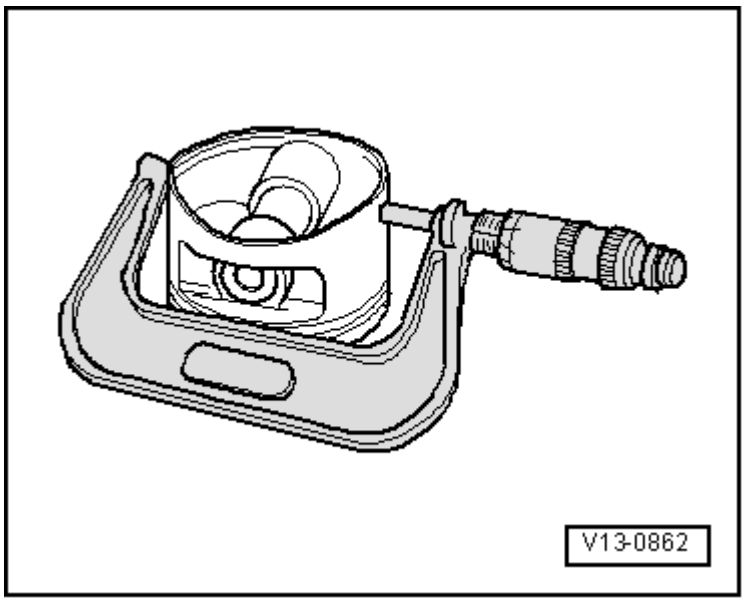


Fig. 13: Checking Piston
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- 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**.

Cylinder Bore, Checking

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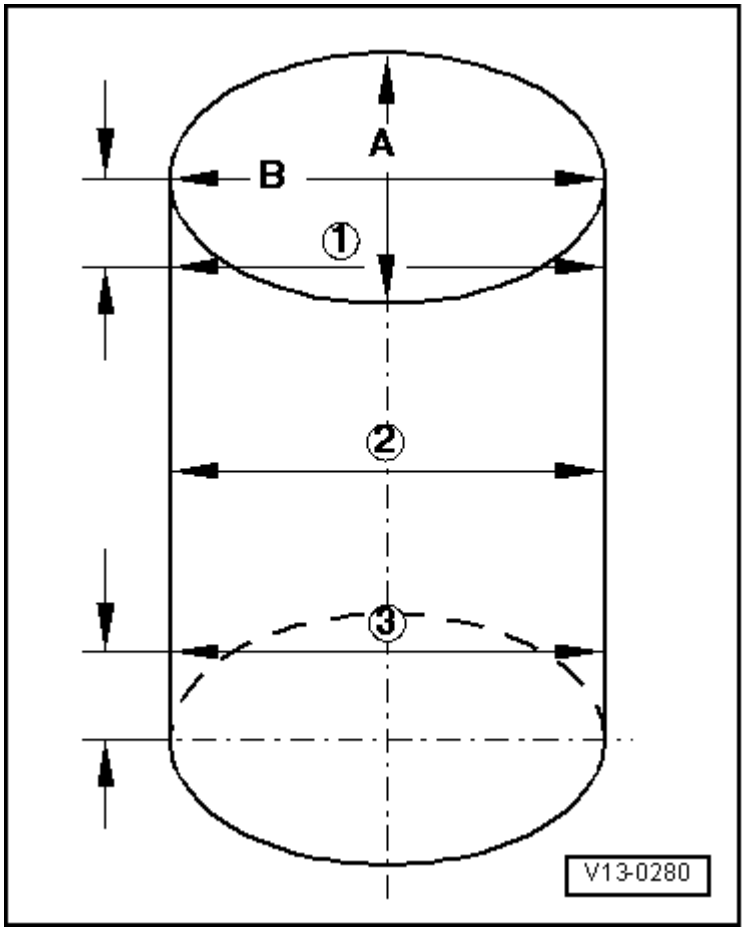


Fig. 14: Checking Cylinder Bores
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- 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**.

Piston Installed Position

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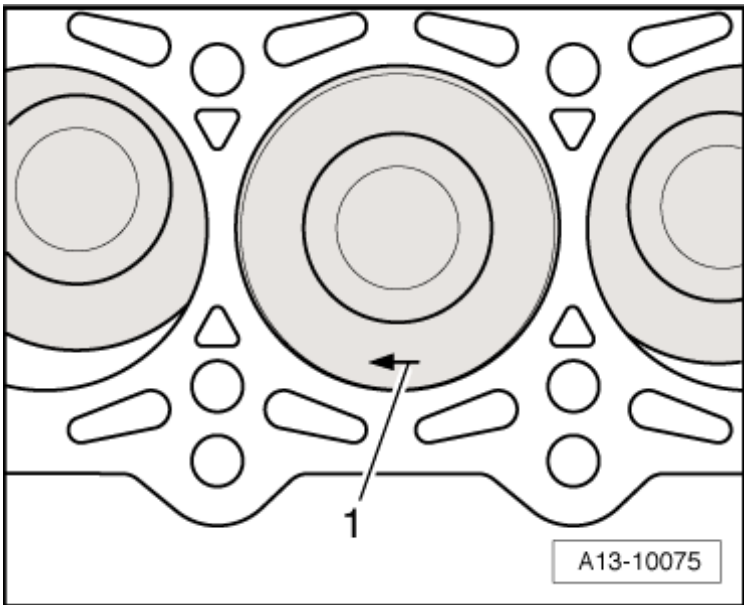


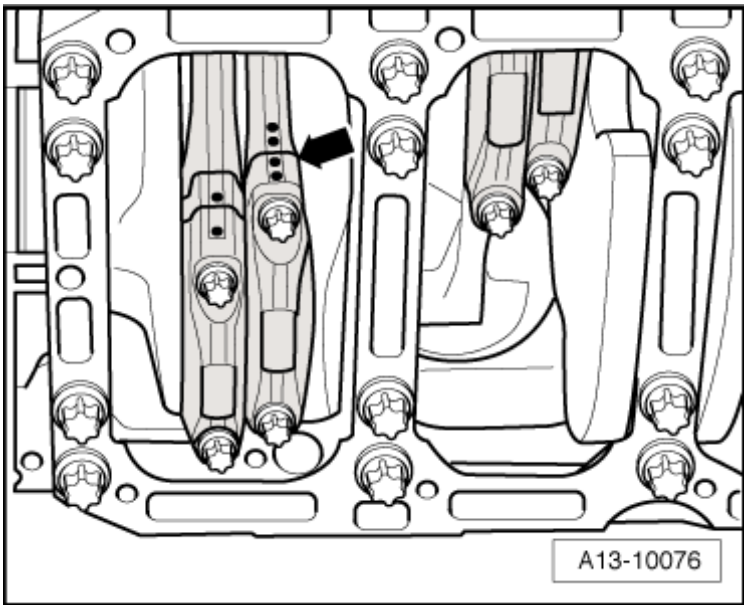
Fig. 15: Piston, Installed Position
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Installed position: arrow -1- on the piston head points toward the belt pulley side.

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

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

Connecting Rod Marking



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Fig. 16: Connecting Rod, Marking
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 connecting rod bearings.

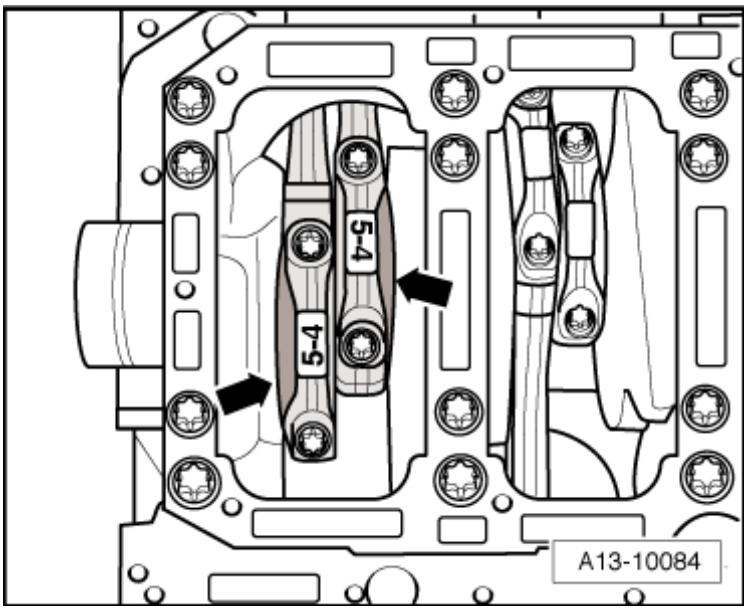


Fig. 17: Connecting Rod, Installed Position
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

NOTE: The illustration shows the front connecting rod pair.

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 passages thoroughly and replace the oil cooler to prevent further damage.

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

NOTE:

- **Secure the engine on the engine and transmission holder VAS 6095- using the universal mounting VAS 6095/1- and the brackets VAS 6095/1-4- when performing assembly work.**

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- **Oil all bearing and contact surfaces before assembly work.**

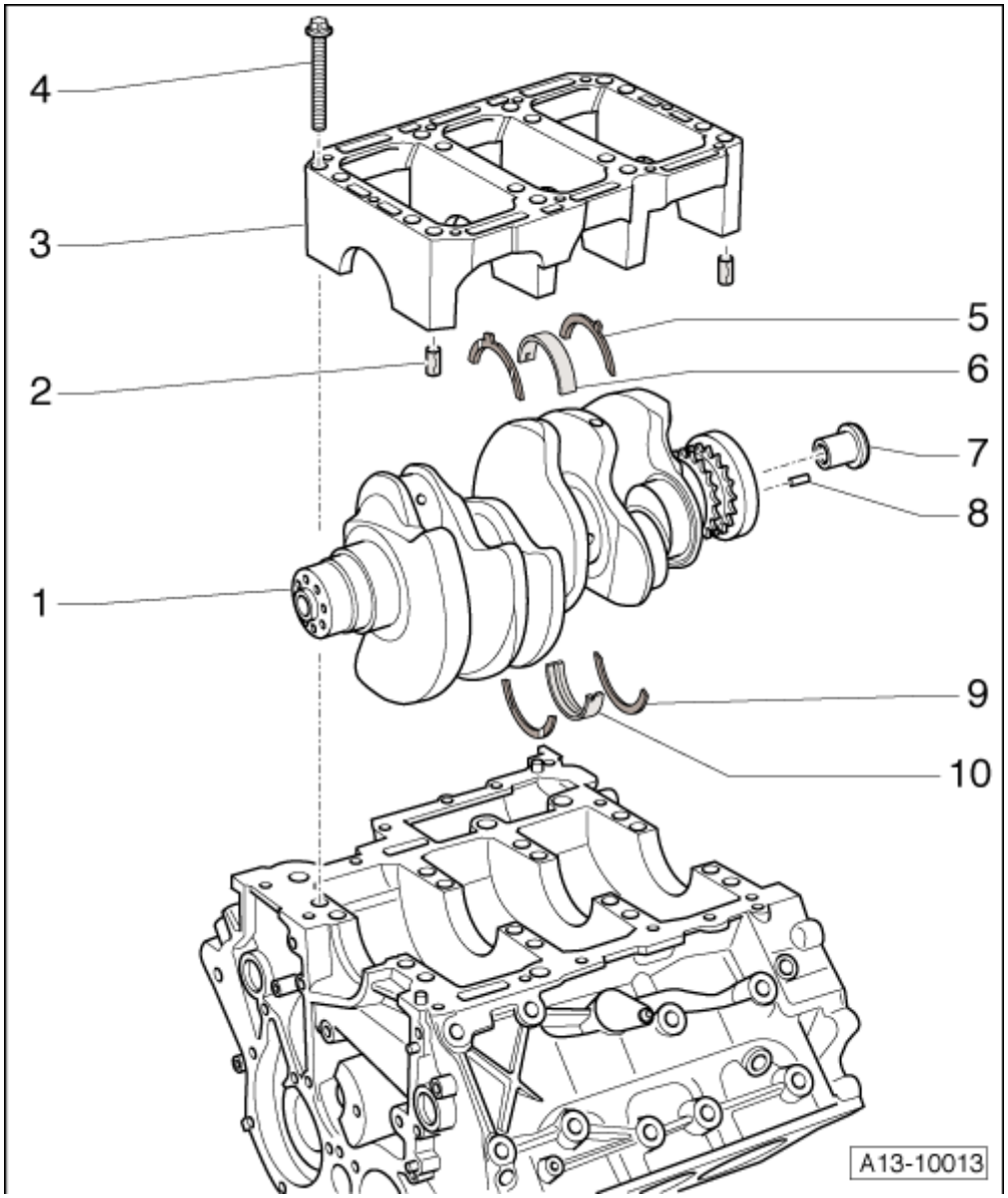


Fig. 18: Crankshaft Overview
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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- Install into the cylinder block.

3. Guide Frame
   - Installing, refer to **CRANKSHAFT OVERVIEW**.
4. Bolt
   - Always replace.
   - Tightening sequence, refer to **CRANKSHAFT OVERVIEW**.
5. Thrust Washer
   - Only on the 3rd crankshaft bearing.
   - Lubricating grooves face outward.
   - Observe the locating point.
   - Measuring crankshaft axial clearance, refer to **CRANKSHAFT AXIAL CLEARANCE, CHECKING**.
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 **CRANKSHAFT OVERVIEW**.
7. Torque Converter Centering Bushing
   - Refer to **CRANKSHAFT OVERVIEW**.
8. Fitting Pin
   - Make sure the crankshaft fits correctly.
9. Thrust Washer
   - Only on the 3rd crankshaft bearing.
   - Lubricating grooves face outward.
   - Observe the locating point.
   - Measuring crankshaft axial clearance, refer to **CRANKSHAFT AXIAL CLEARANCE, CHECKING**.
10. Bearing Shell
    - For the cylinder block with oil groove.
    - Do not interchange used bearing shells (mark them).
    - Install new bearing shells for the cylinder block with the proper colored mark. Refer to **CRANKSHAFT OVERVIEW**.

Guide Frame, Installing

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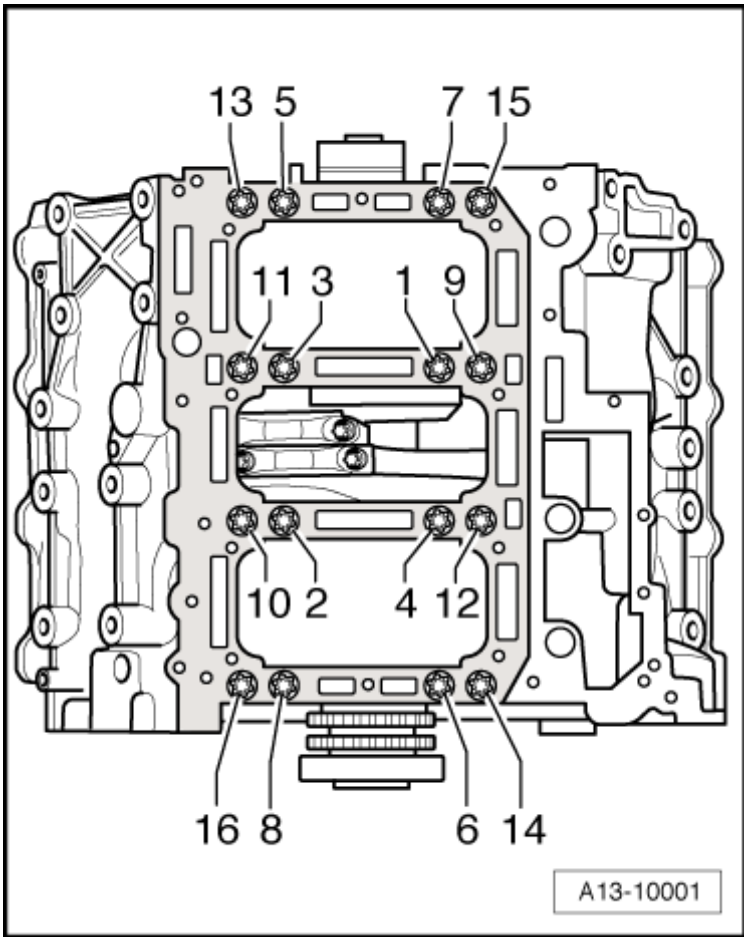


Fig. 19: Guide Frame, Installing
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Replace the bolts -1 through 16-.

-- Install 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.

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

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

Allocation of Crankshaft Bearing Shells for the Cylinder Block

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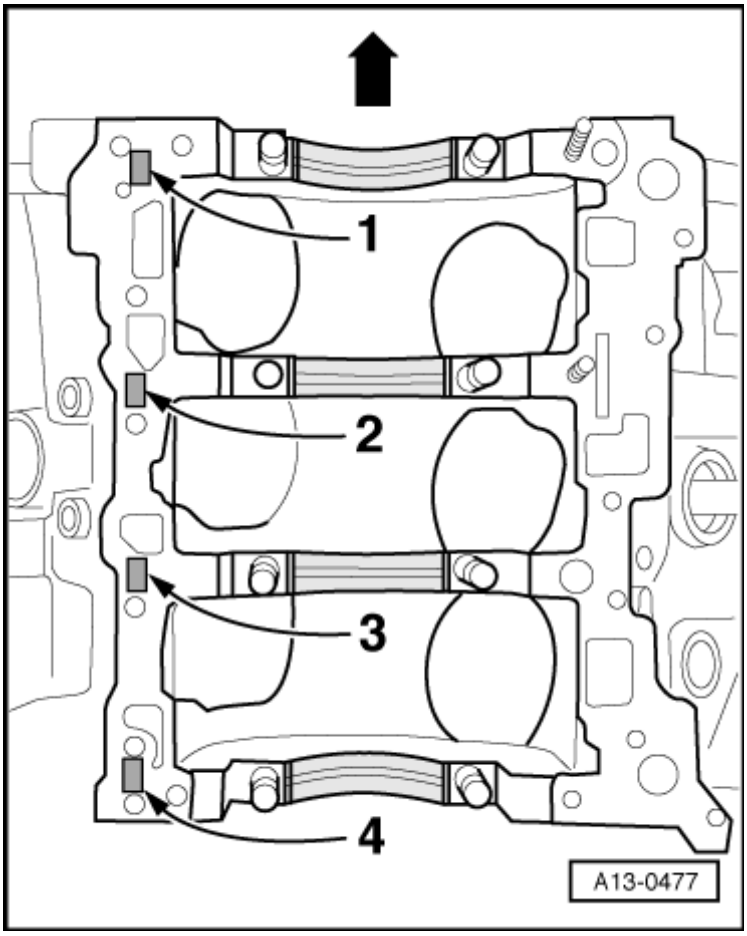


Fig. 20: Application Of Crankshaft Bearing Shells For Cylinder Block
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

- -Arrow- points to belt pulley side.

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

Letter on Cylinder Block	Color of Bearing
R =	Red
G =	Yellow
B =	Blue

Allocation of Crankshaft Bearing Shells for the Guide Frame

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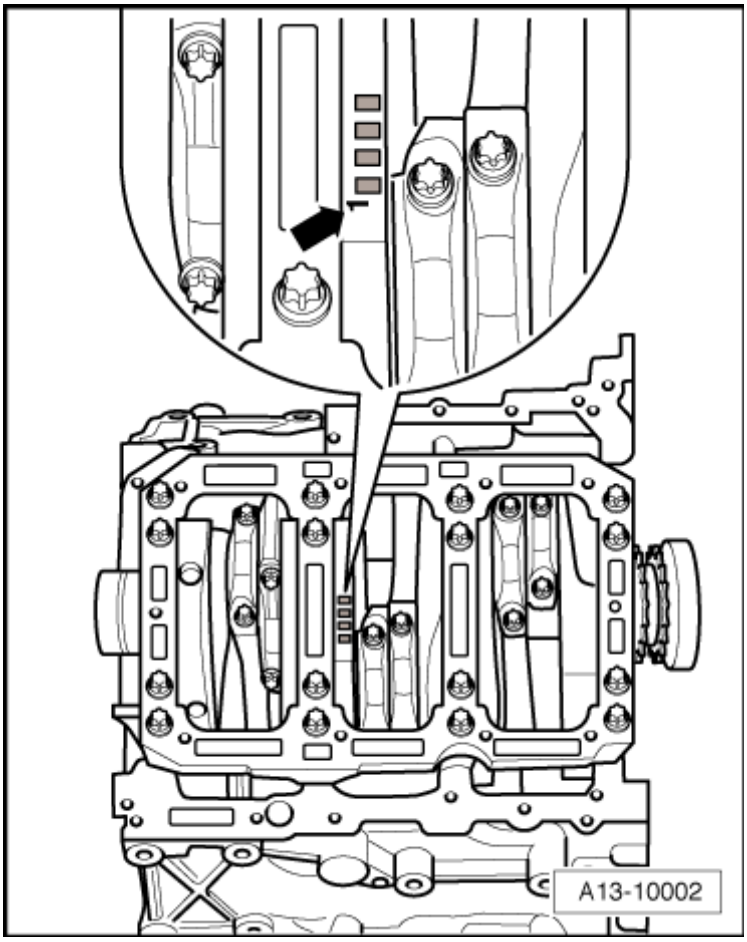


Fig. 21: Allocation of Crankshaft Bearing Shells for the Guide Frame
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

Letter on Crankshaft	Color of Bearing
R =	Red
G =	Yellow
B =	Blue

Torque Converter Bushing

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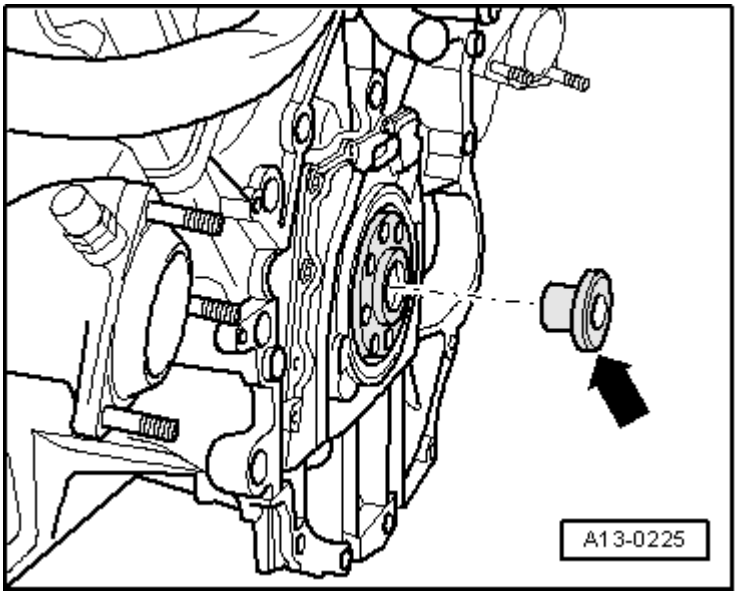


Fig. 22: Torque Converter Centering Bushing
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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.

SPECIFICATIONS

CRANKSHAFT DIMENSIONS

Reconditioning Dimension in mm	Crankshaft 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 to 82.951 (1)	83.006 to 83.014
Repair stage	82.979 to 82.991 (1)	83.046 to 83.054
(1) Measurement does not include the graphite coating (thickness = 0.02 mm). The graphite coating wears off.		

FASTENER TIGHTENING SPECIFICATIONS

Component	Fastener Size	Nm

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Air Conditioning Compressor Bolt	-	25
Air Conditioning Compressor and Power Steering Pump Bracket Bolt	-	40
Balance Shaft Bearing End Bracket to Cylinder Block Bolt	-	9
Balance Shaft and Oil Pump Chain Tensioner Bolt	-	9
Balance Shaft Sprocket Bolt	-	23
Balance Weight to Balance Shaft Bolt	-	60
Connecting Rod Bolt (1)	-	30 + 90°
Coolant Pump Bolt	-	9
Coolant Pump Pulley Bolt	-	22
Drive Sprocket Mounting Bracket Bolt (1)	-	5 + 90°
Drive Sprocket Pivot Pin Bolt	-	45
Drive Sprocket Thrust Washer Bolt (1)	-	5 + 90°
Drive Plate Bolt (1)	-	30 + 90°
Generator to Generator and Idler Pulley Bracket Bolt	-	22
Generator and Idler Pulley Bracket Bolt	-	40
Guide Rail Bolt (1)	-	5 + 90°
Guide Rail Mounting Pin (2)	-	12
Idler Pulley to Generator and Idler Pulley Bracket Bolt	-	25
Idler Pulley to Sealing Flange Bolt	-	22
Oil Pump Drive Sprocket Bolt	-	62
Oil Spray Jet (for piston cooling) Bolt	-	9
Power Steering Pump Bolt	-	22
Power Steering Pump Pulley Bolt	-	22
Ribbed Belt Tensioner		
-- Lower Bolt	-	25
-- Upper Bolt	-	40
Tensioning Rail Mounting Pin	-	12
Timing Mechanism Drive Chain Tension Bolt	-	12
Upper Timing Chain Cover Cap Bolt	-	9
Vibration Damper Bolt (1)	-	20 + 90°
(1) Always replace (2) Insert using locking compound,		

Guide Frame Bolt Tightening Sequence and Specification

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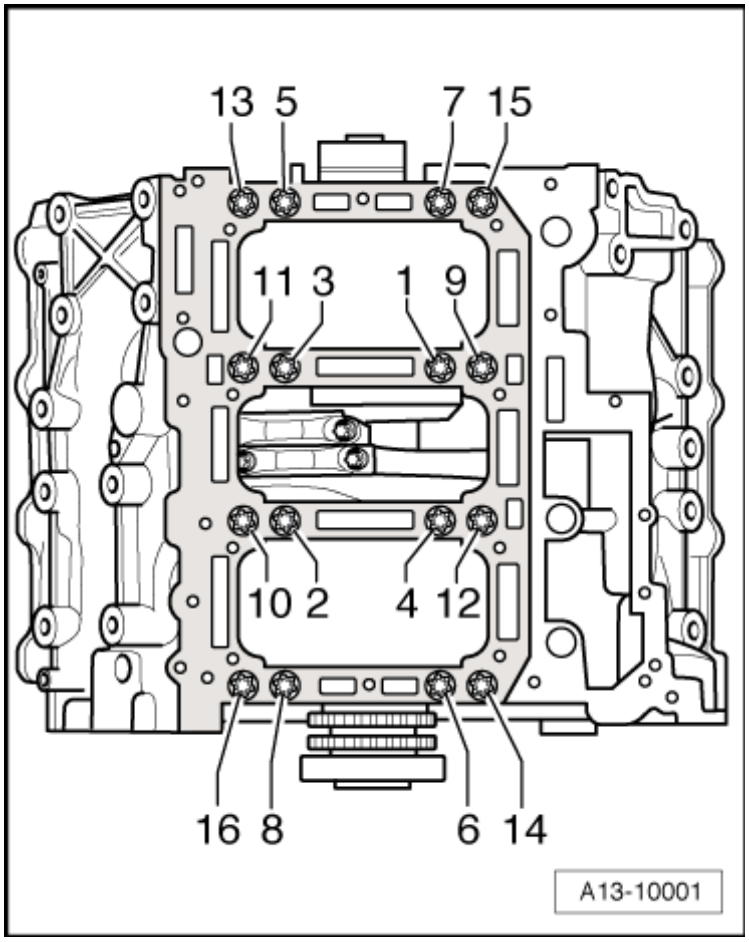


Fig. 23: Guide Frame, Installing
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- 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.

Sealing Flange Bolt Tightening Sequence and Specification

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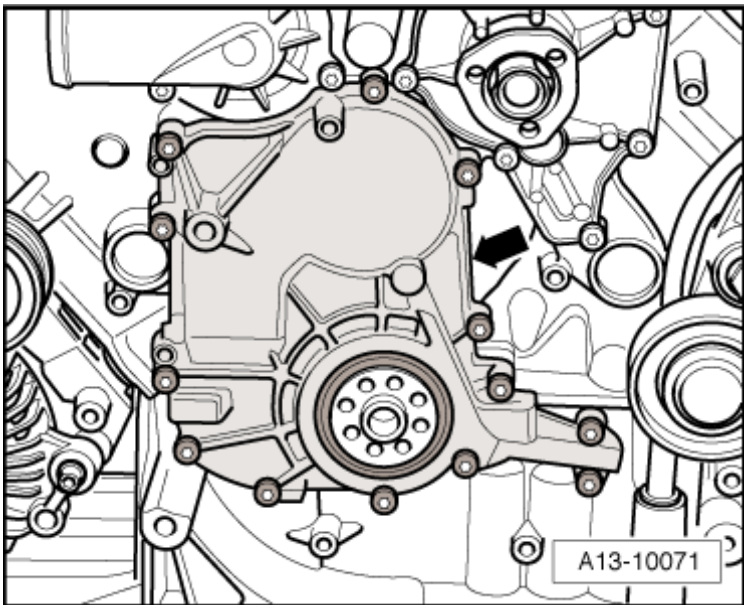


Fig. 24: Identifying Sealing Flange -Arrow- Bolts -- Tighten Diagonally
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Tighten the sealing flange -arrow- bolts in a diagonal sequence and in stages to 9 Nm.

Lower Timing Chain Cover Bolt Tightening Sequence and Specification

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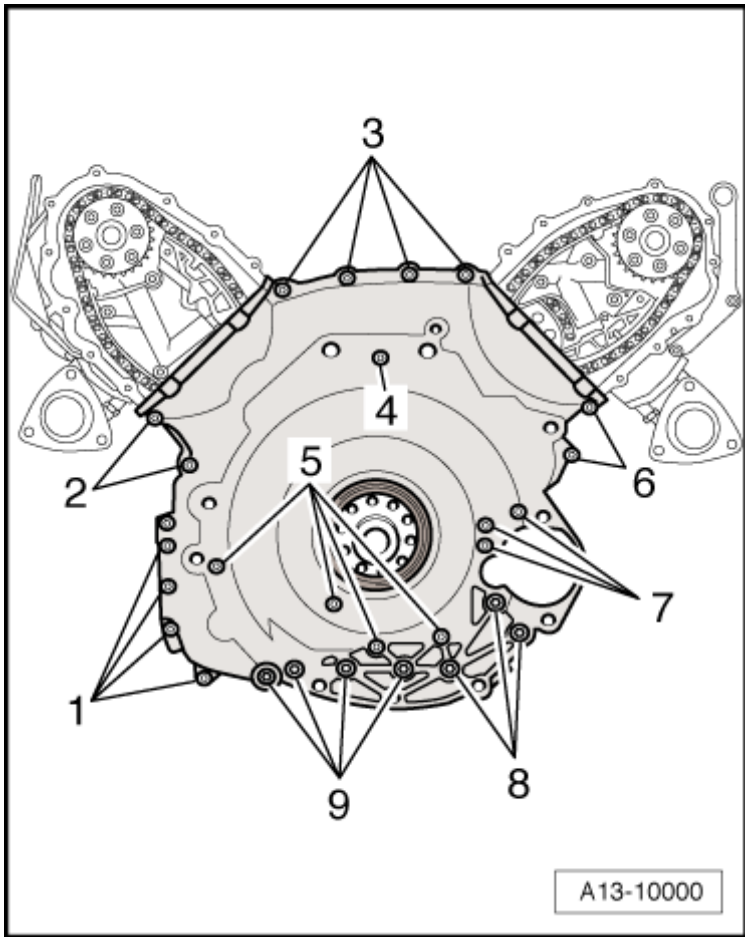


Fig. 25: Lower Timing Chain Cover Bolt Tightening Sequence and Specification
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Tighten the bolts -1 through 9- from the inside toward the outside diagonally to 5 Nm.

-- Tighten the bolts -1 through 7- from the inside toward the outside diagonally to 9 Nm.

-- Tight the bolts -8 and 9- to 22 Nm.

Upper Left Timing Chain Cover Bolt Tightening Sequence and Specification

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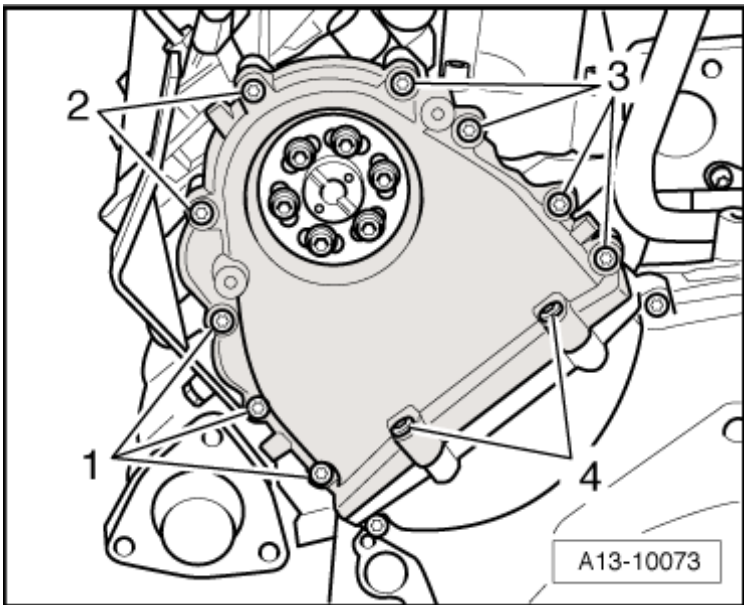


Fig. 26: Bolt Tightening Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Tighten the bolts -1 through 3- in a diagonal sequence to 5 Nm.

-- Tighten the bolts -4- in a diagonal sequence to 9 Nm.

-- Tighten the bolts -1 through 3- to 9 Nm.

Upper Right Timing Chain Cover Bolt Tightening Sequence and Specification

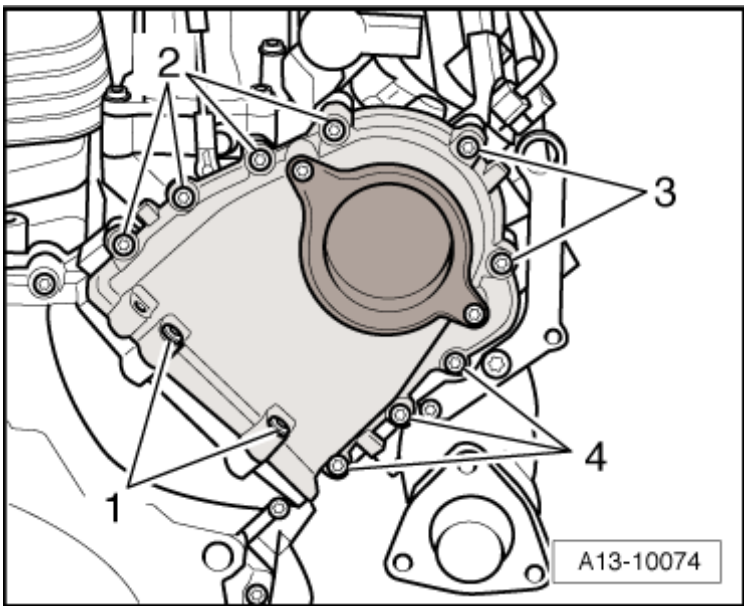


Fig. 27: Bolt Tightening Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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-- Tighten the bolts -2 through 4- in a diagonal sequence to 5 Nm.

-- Tighten the bolts -1- in a diagonal sequence to 9 Nm.

-- Tighten the bolts -2 through 4- to 9 Nm.

DIAGNOSIS AND TESTING

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

Procedure

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

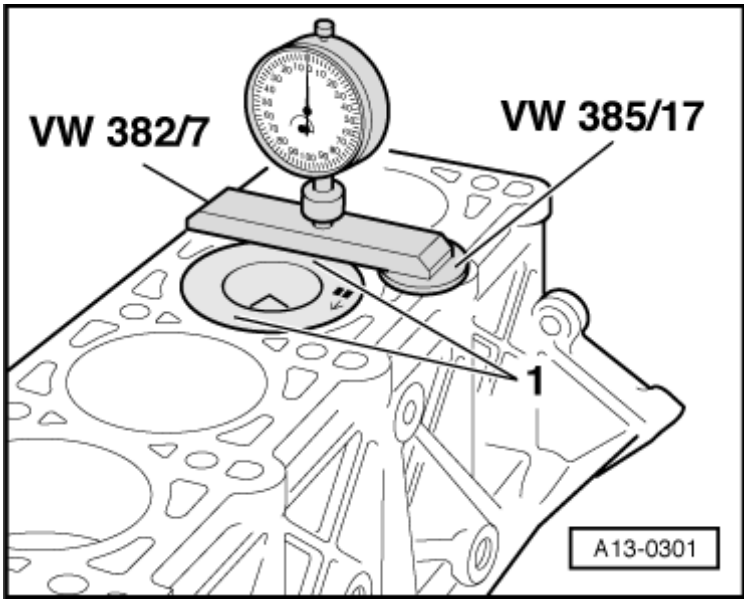


Fig. 28: Identifying VW 382/7 And Measuring Bar VW 385/17
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

Piston Projection Above the Cylinder Block Upper Edge	Identification Holes
0.39 to 0.49 mm	1
0.49 to 0.54 mm	2

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0.54 to 0.65 mm	3

Cylinder Head Gasket Identification

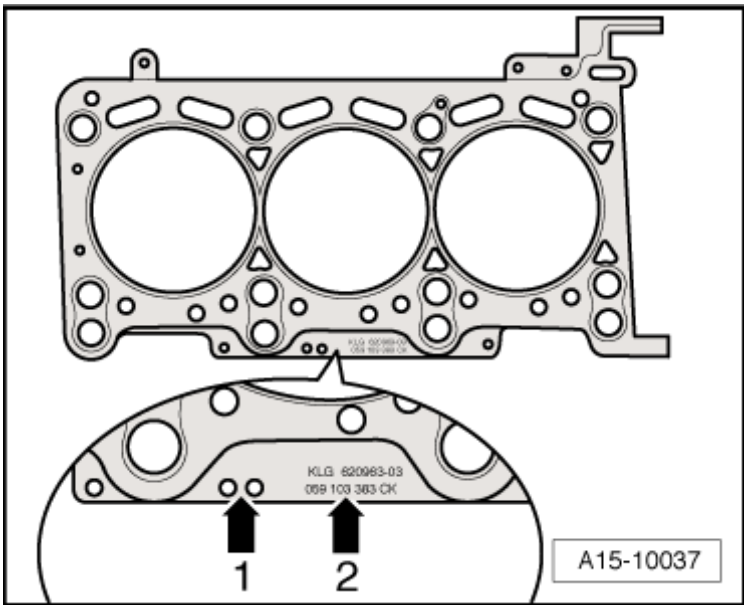


Fig. 29: Cylinder Head Gasket Identification
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-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, CHECKING

Special tools and workshop equipment required

- Plastigage®

Procedure

-- 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.

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

-- Remove the bearing cap again.

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-- 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.

AXIAL CLEARANCE, CHECKING

Special tools and workshop equipment required

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

Procedure

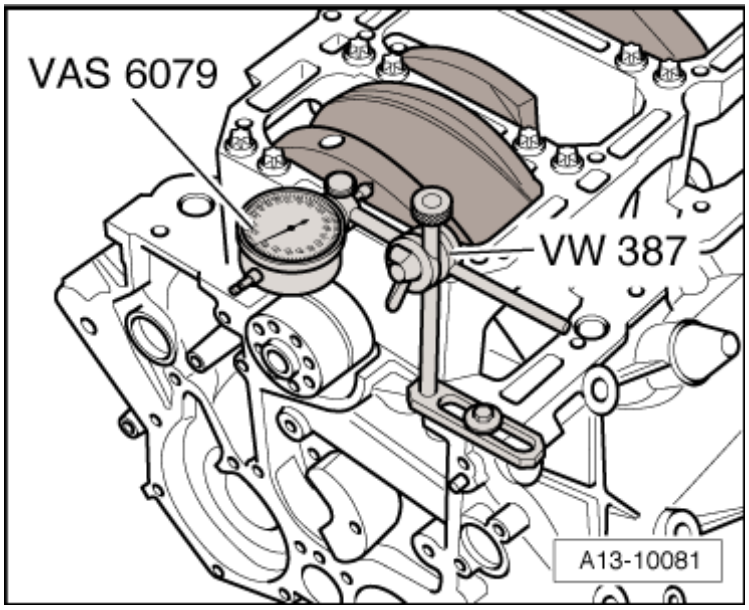


Fig. 30: Attaching Dial Indicator VAS 6079 Together With Dial Gauge Holder VW 387 To Cylinder Block And Setting Indicator Against Crankshaft Counterweight
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Attach the dial gauge to the cylinder block using 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: 0.280 mm

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RADIAL CLEARANCE, CHECKING

Special tools and workshop equipment required

- Plastigage®

Procedure

NOTE: Do not interchange used bearing shells.

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 shells.

- 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

REMOVAL AND INSTALLATION

RIBBED BELT

Removing

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

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

Remove the left charge air pipe. Refer to **CHARGE AIR COOLER HOSES/PIPES**

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

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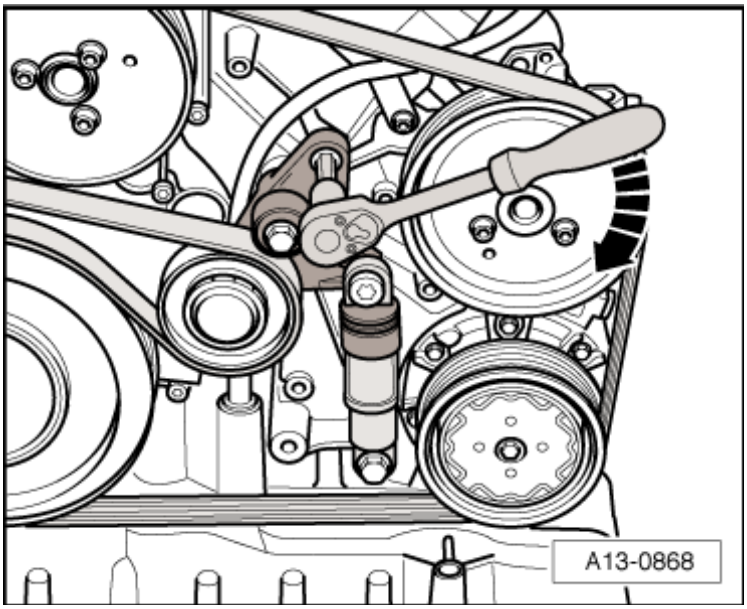


Fig. 31: Rotating Belt Tensioner In -Direction Of Arrow-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the ribbed belt from the tensioner.

Installing

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

Check the idler pulleys for ease of movement

If reinstalling the old belt, note the previously marked direction of belt rotation and be sure that it is seated correctly on the pulleys.

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

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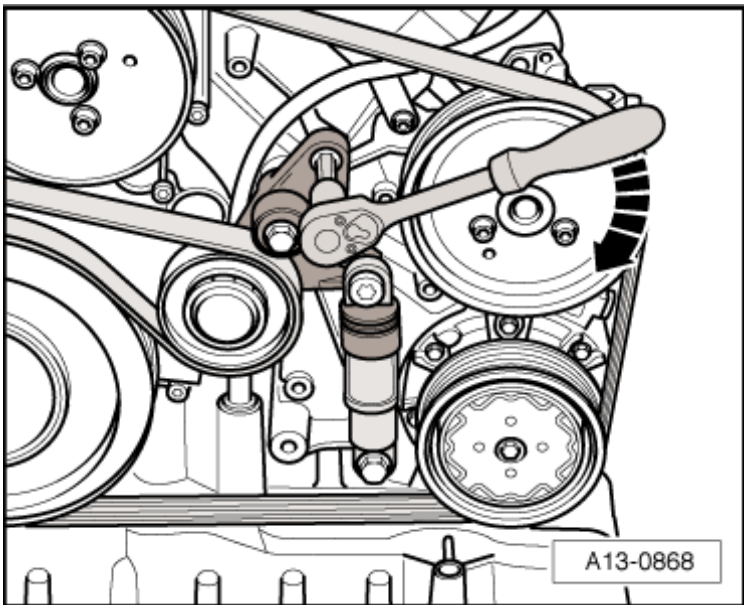


Fig. 32: Rotating Belt Tensioner In -Direction Of Arrow-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Route the ribbed belt as shown.

Vehicles Without an Additional Idler Pulley

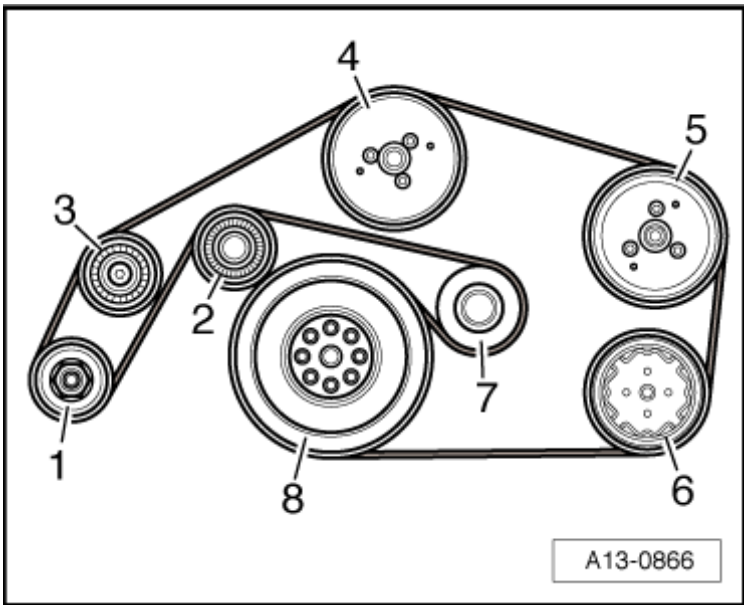


Fig. 33: Identifying Ribbed Belt Components
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. Generator
2. Idler roller
3. Idler roller

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4. Coolant pump pulley
5. Power steering pump pulley
6. A/C compressor pulley
7. Ribbed belt tensioner
8. Vibration damper

with an Additional Idler Roller

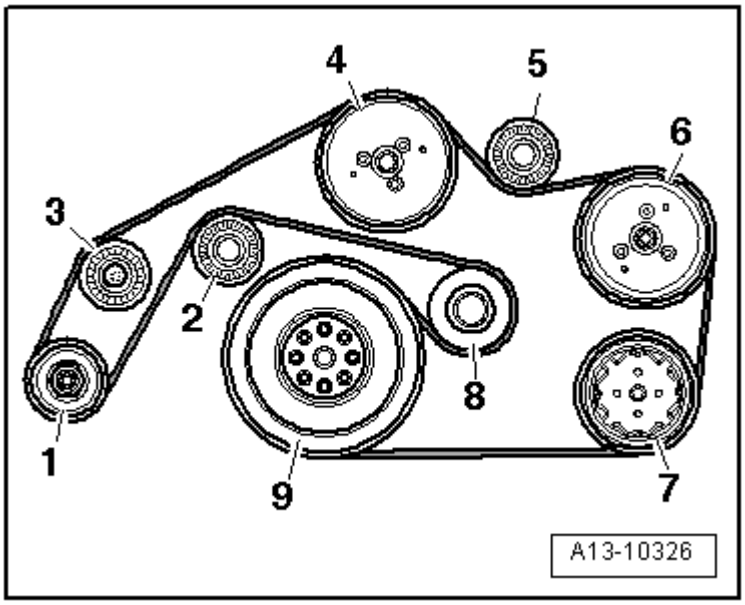


Fig. 34: Identifying Ribbed Belt Components With An Additional Idler Pulley
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

Continuation for All

-- Install the left charge air pipe. Refer to **CHARGE AIR COOLER HOSES/PIPES** .

After completing the repairs always:

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-- Start the engine and check the belt running direction.

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.

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

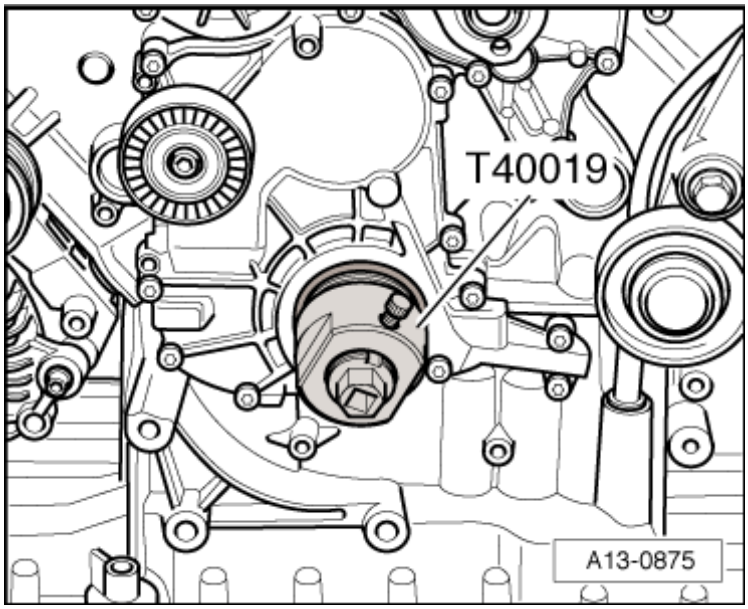


Fig. 35: Installing Inner Part Of Oil Seal Extractor T40019
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Lubricate the threaded head of the seal remover, place against the seal, and with strong force screw 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 seal remover in a vice on the flat spots. Remove the seal using pliers

-- Clean the running and sealing surface.

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Installing

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

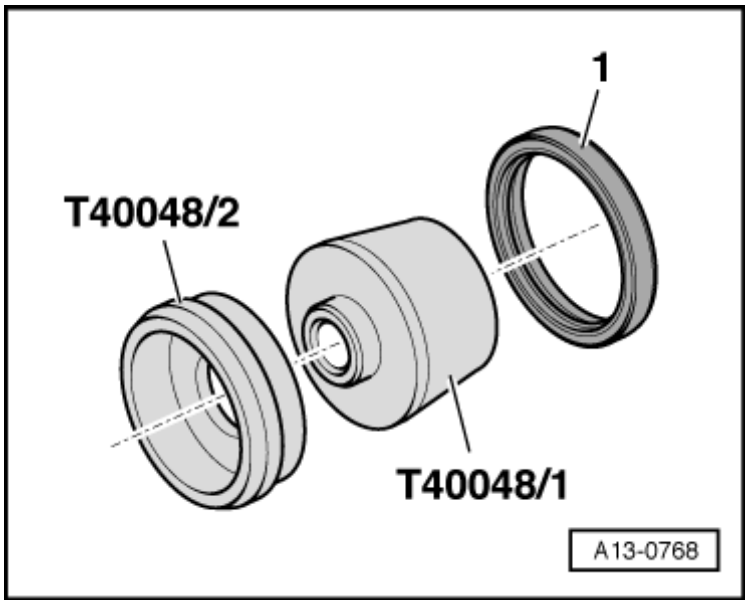


Fig. 36: Inserting Assembly Device T40048/1 Onto Pull Sleeve T40048/2 And Slide Seal Onto Pull Sleeve
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the assembly device T40048/1.

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

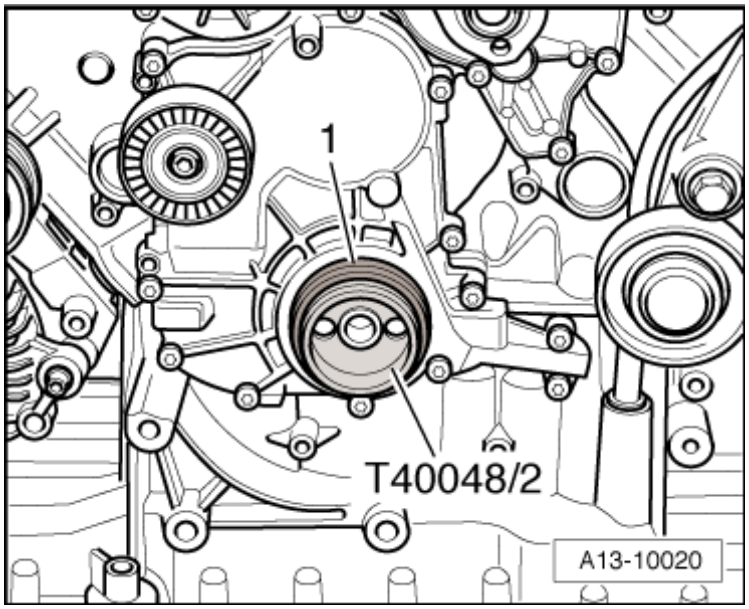


Fig. 37: Placing Pull Sleeve T40048/2 On Crankshaft And Slide Seal -1- Into Sealing Surface On Engine
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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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 2 M8 x 55 mm bolts -arrows-.

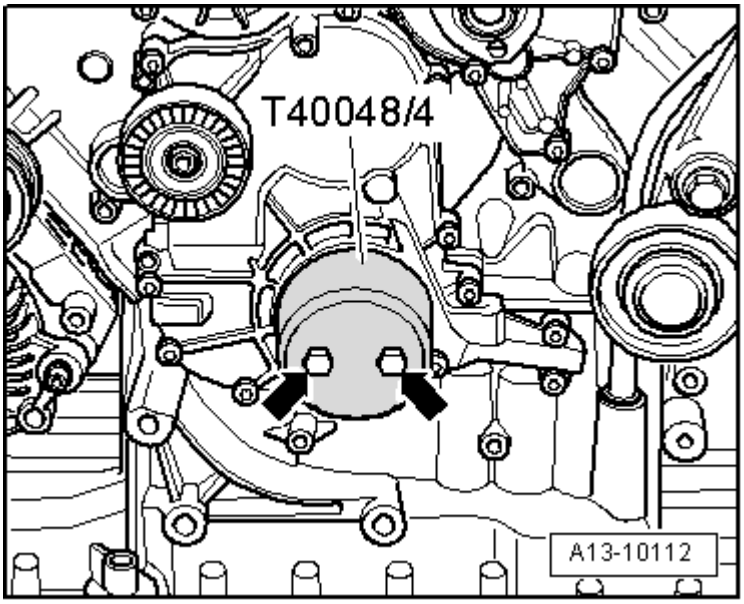


Fig. 38: Positioning Assembly Adapter T40048/4 On Crankshaft With 2 - M8 x 55 mm Bolts -Arrows-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Install the bolts by hand.

-- Tighten each bolt 1/2 rotation by alternating sides to press in the seal until it is seated.

-- Install the vibration damper.

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

SEALING FLANGE, BELT PULLEY SIDE

Special tools and workshop equipment required

- Spanner Wrench 3212
- Hand Drill with Plastic Brush Attachment
- Protective Eyewear
- Silicone Sealant D 176 404 A2

Removing

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

-- Remove the vibration damper.

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

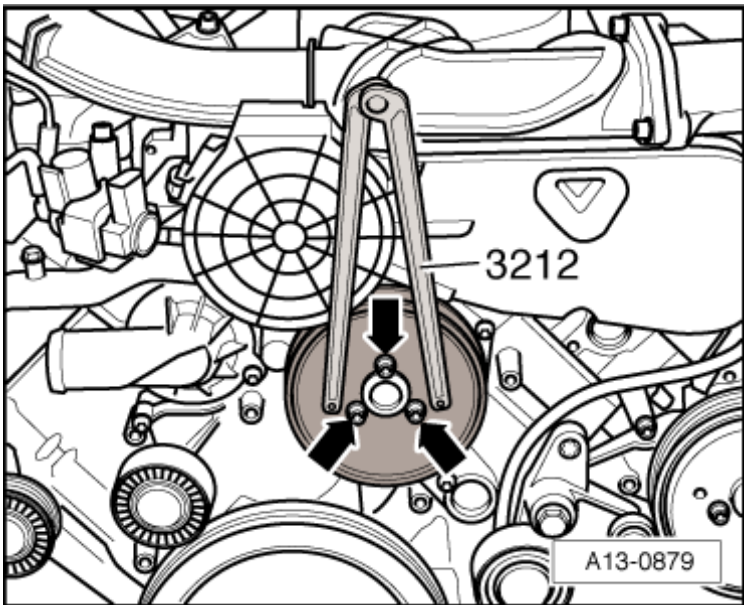


Fig. 39: Identifying Spanner Wrench 3212 And Bolts -Arrows-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Pry the cap off the idler pulley.

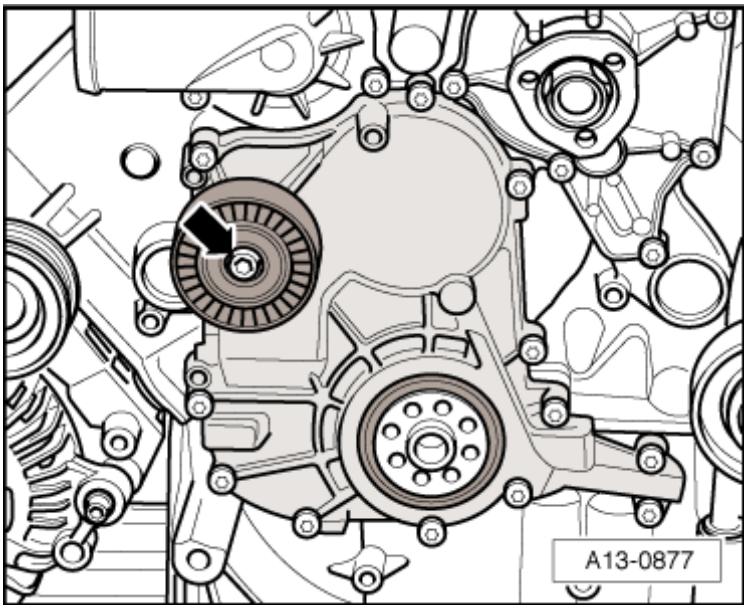


Fig. 40: Identifying Bolt -Arrow- And Idler Pulley
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

-- Remove the noise insulation retainers -arrows- on the front sealing flange.

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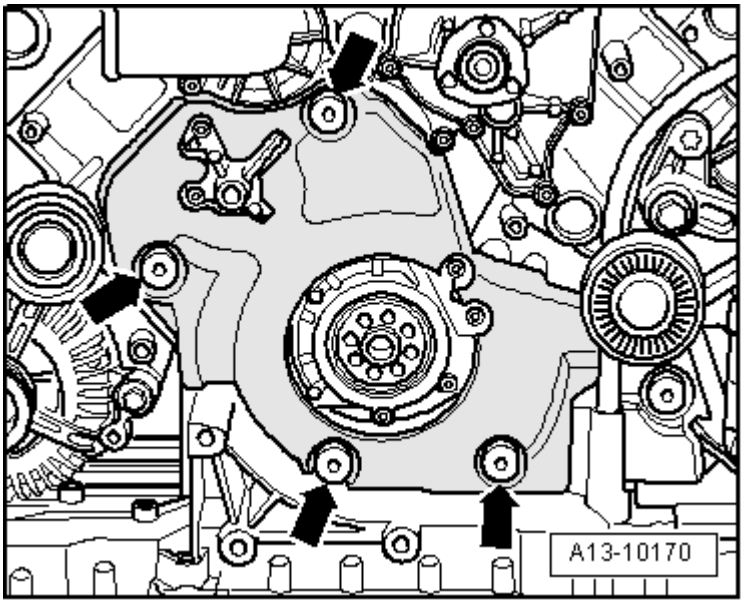


Fig. 41: Noise Insulation Retainers
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Loosen the nut on the coolant pipe.

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

-- Remove the sealing flange bolts.

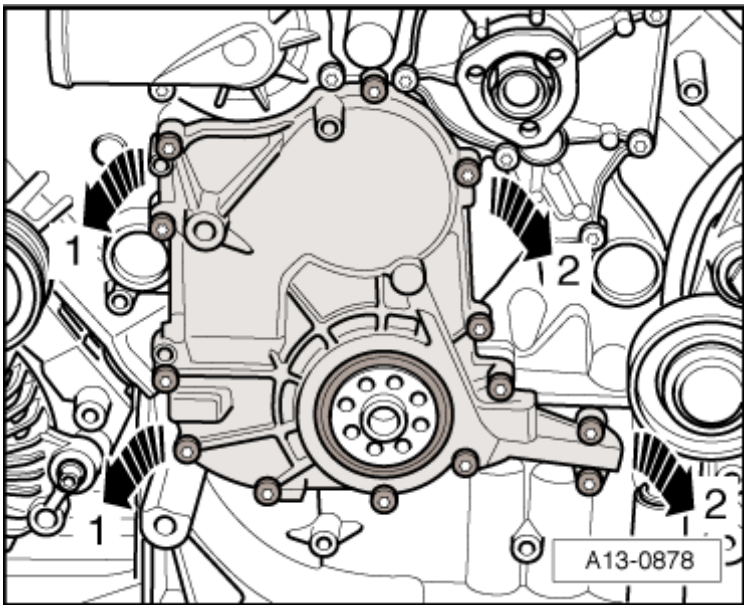


Fig. 42: Removing Front Sealing Flange First, At Right -Arrow 1-, Then At Left -Arrow 2-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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

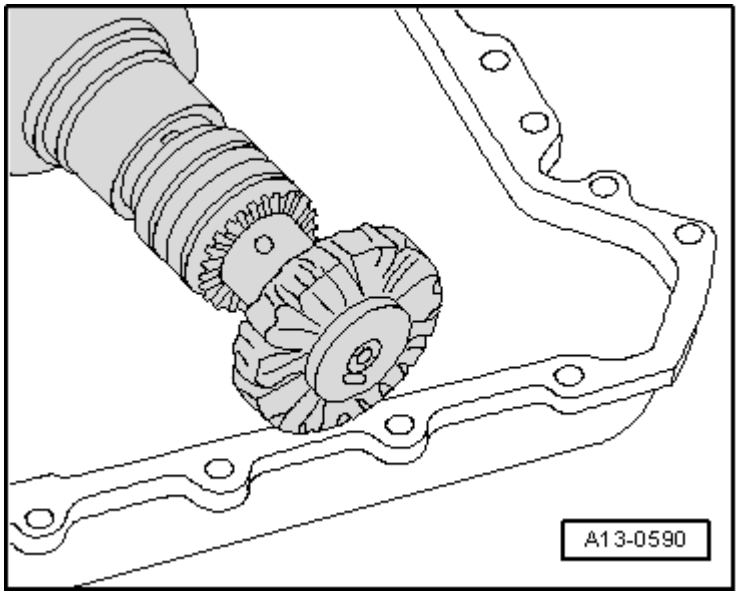


Fig. 43: Identifying Rotating Plastic Brush To Remove Sealant Residue From Sealing Flange, Cylinder Block And Upper Part Of Oil Pan
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Clean 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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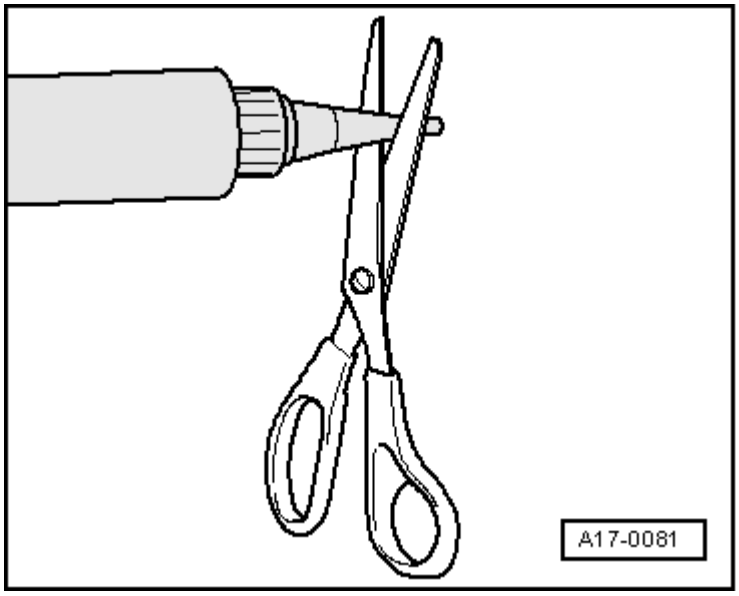
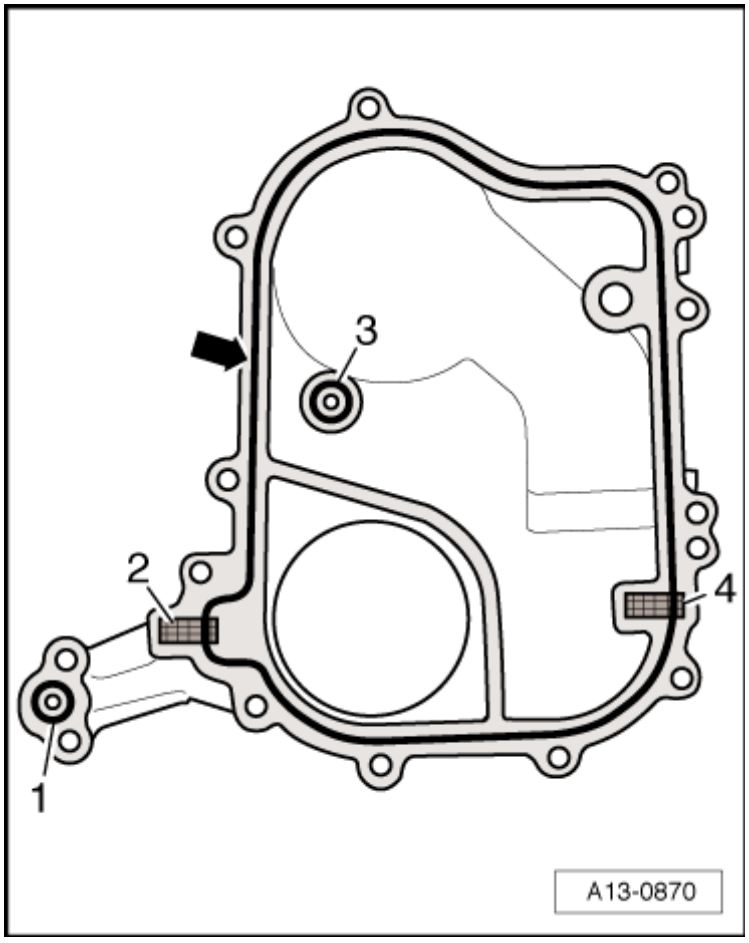


Fig. 44: Cut Tube Nozzle At Front Marking (Nozzle Diameter Approx. 3 Mm)
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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



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Fig. 45: 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: Sealant bead must not be thicker than specified, otherwise the 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 in stages. Tightening specification: 9 Nm.

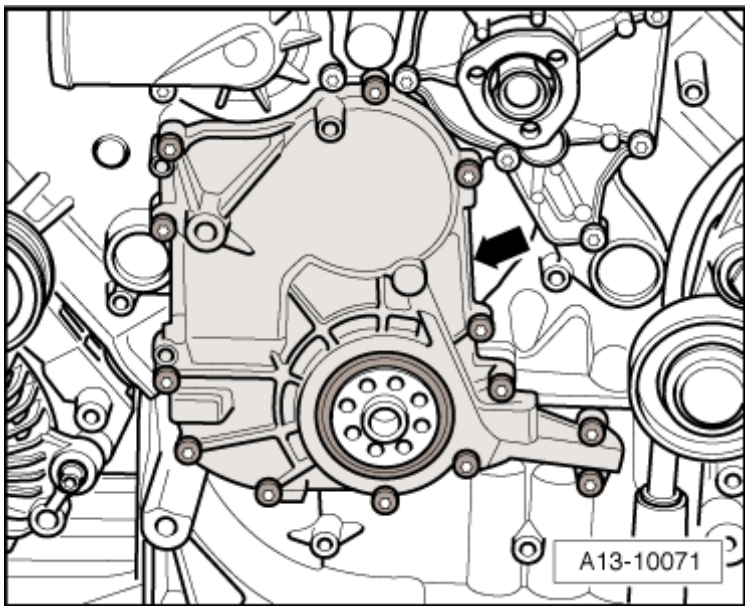


Fig. 46: Identifying Sealing Flange -Arrow- Bolts -- Tighten Diagonally
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

Further installation is performed in the reverse order of removal.

DRIVE PLATE

Special tools and workshop equipment required

- Counter Holder Tool 10-201

Removing

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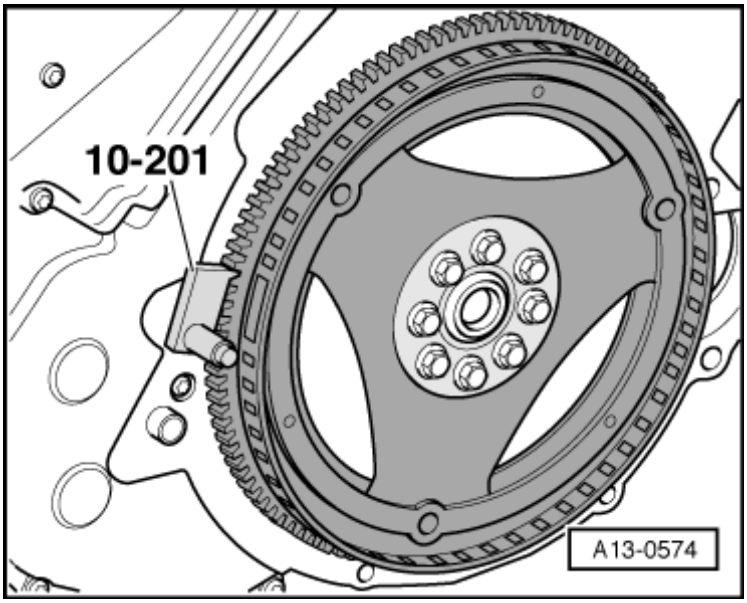


Fig. 47: Inserting Counter Hold Tool 10-201 To Loosen Bolts
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Engine or transmission removed.

-- Mark the drive plate to the engine.

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

-- Remove the drive plate.

-- Remove the shim behind it.

Installing

Installation is performed in the reverse order of removal, 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 holder tool 10-201 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

Removing

- Engine or transmission removed.

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

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

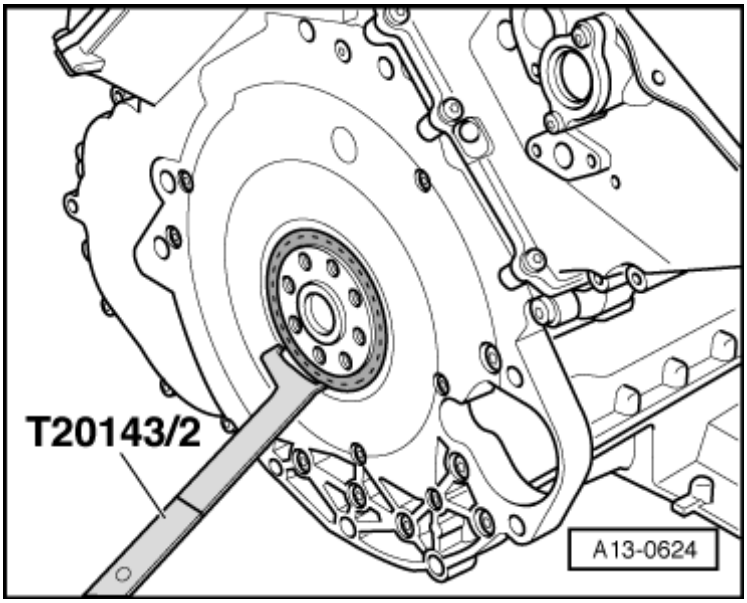


Fig. 48: Prying Out Sealing Ring Using Extractor Lever T20143/2
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Installing

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

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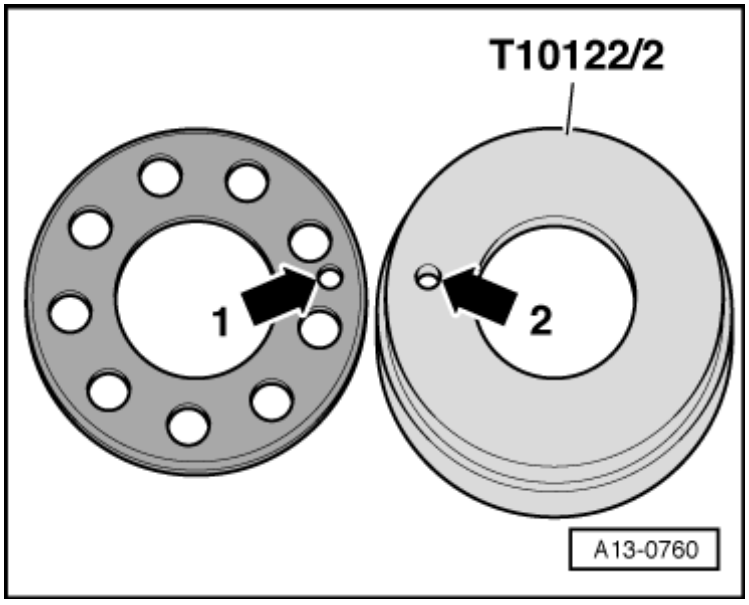


Fig. 49: Drill An 8 Mm Hole -Arrow 2- In Guide Sleeve T10122/2 For Alignment Sleeve
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

-- Clean the running and sealing surfaces.

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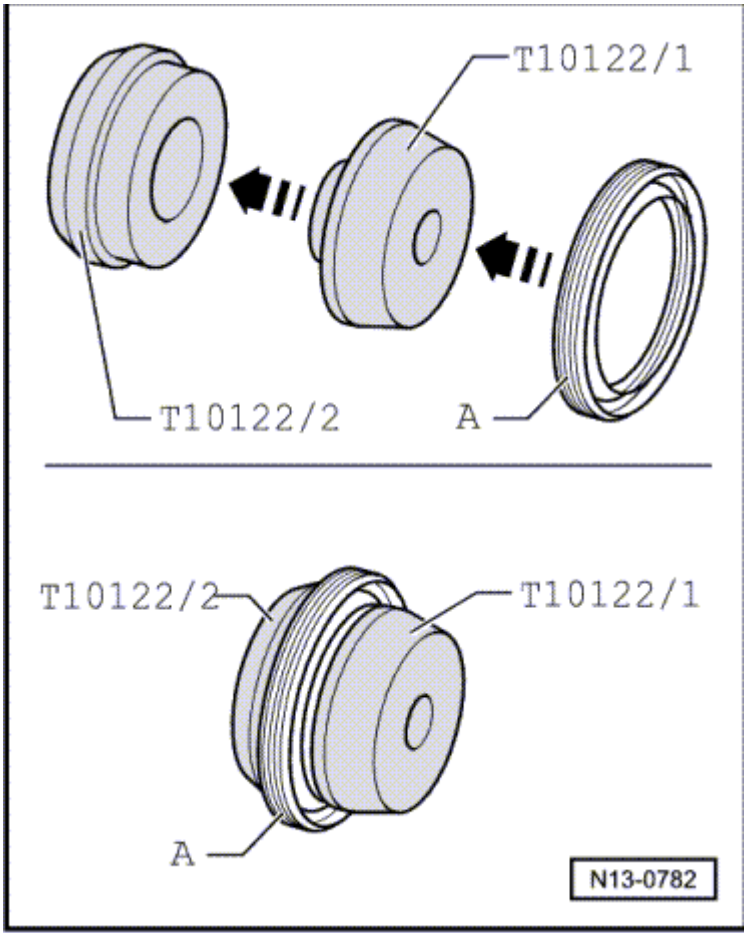


Fig. 50: Identifying Seal, Sleeve T10122/1 And Assembly Tool T10122/2
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

-- Remove the assembly device T10122/1.

-- Install the guide sleeve T10122/2 with the seal to the crankshaft.

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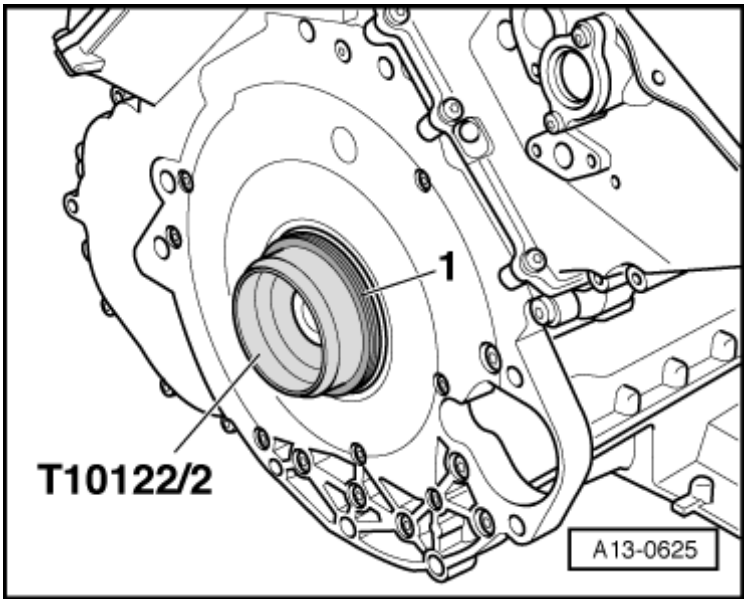


Fig. 51: Installing Pull Sleeve T10122/2 With Sealing Ring Onto Crankshaft
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

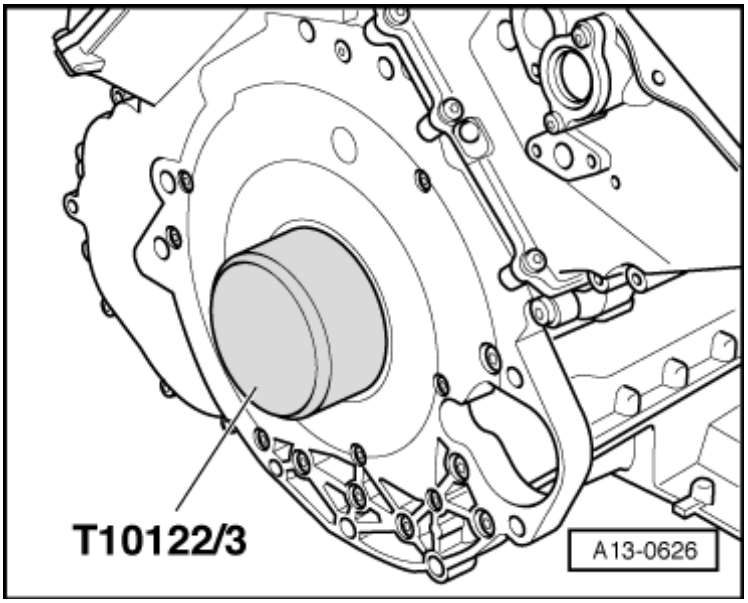


Fig. 52: Pressing In Seal Evenly All Around Until It Reaches Stop Using T10122/3
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

TIMING CHAIN COVERS

Special tools and workshop equipment required

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- Counter Holder Tool 10-201
- Used Oil Collecting and Extracting Device V.A.G 1782
- Hand Drill with Plastic Brush Attachment
- Protective Eyewear
- Silicone Sealant D 176 404 A2

Removing

NOTE: All cable ties opened or cut off during engine removal must be reinstalled at the same locations during installation.

-- Drain the engine oil.

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

-- Separate the engine and transmission. Refer to **ENGINE, REMOVING FROM SCISSOR LIFT TABLE** .

-- Secure the engine to the assembly stand. Refer to **ENGINE, SECURING TO ASSEMBLY STAND** .

-- 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-.

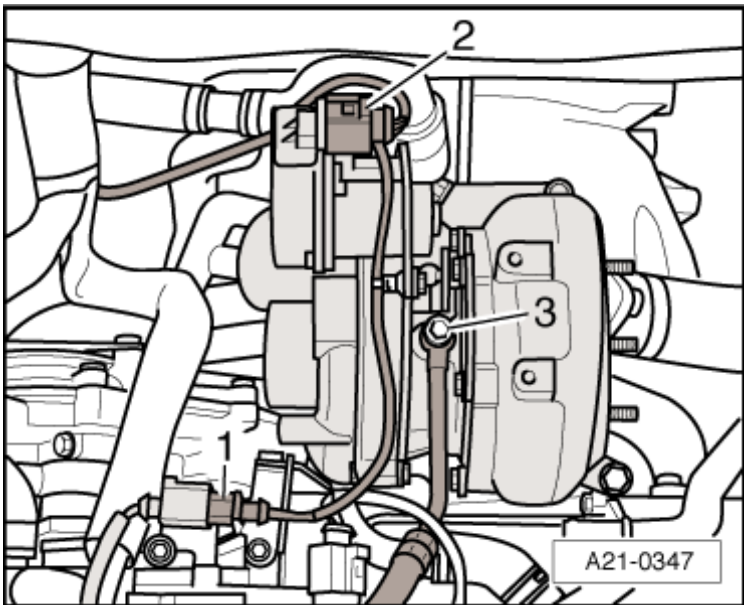


Fig. 53: Disconnecting Connectors -1 And 2-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

-- Disconnect the connector -4-.

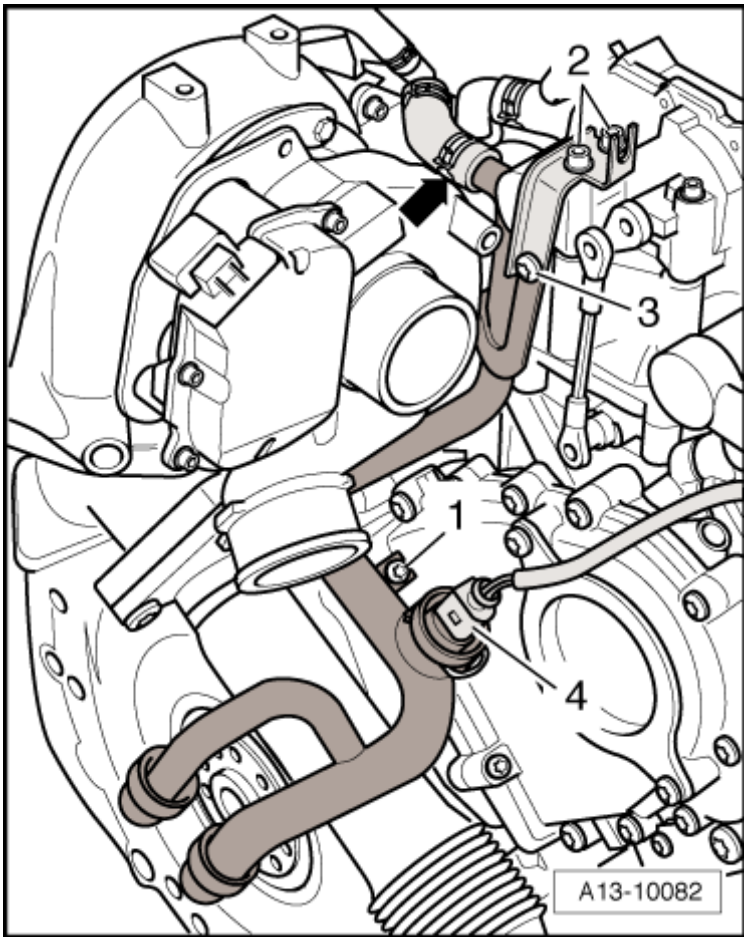


Fig. 54: Removing Bolts -2 And 3- And Remove Bracket
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

-- Remove the bolts -1-.

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

-- Remove the turbocharger oil return line -item 26- **TURBOCHARGER OVERVIEW** .

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

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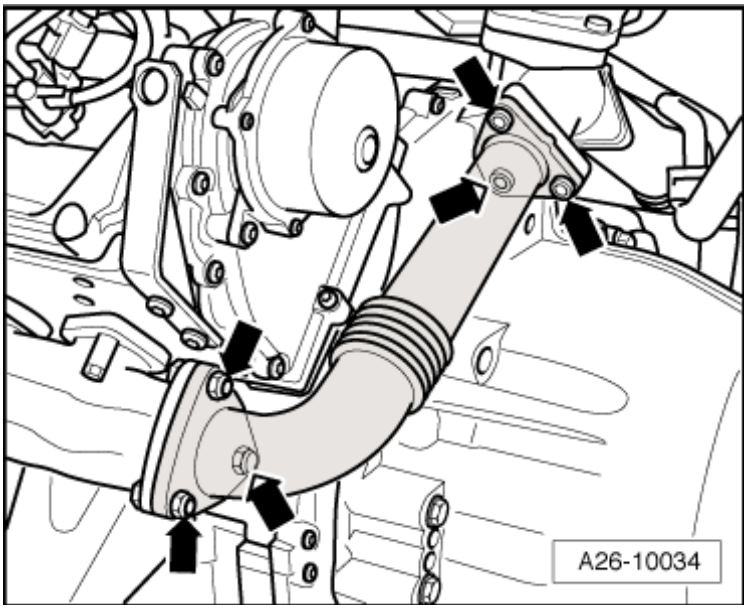


Fig. 55: Removing Intermediate Pipe Nuts -Arrows- And Pipe
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

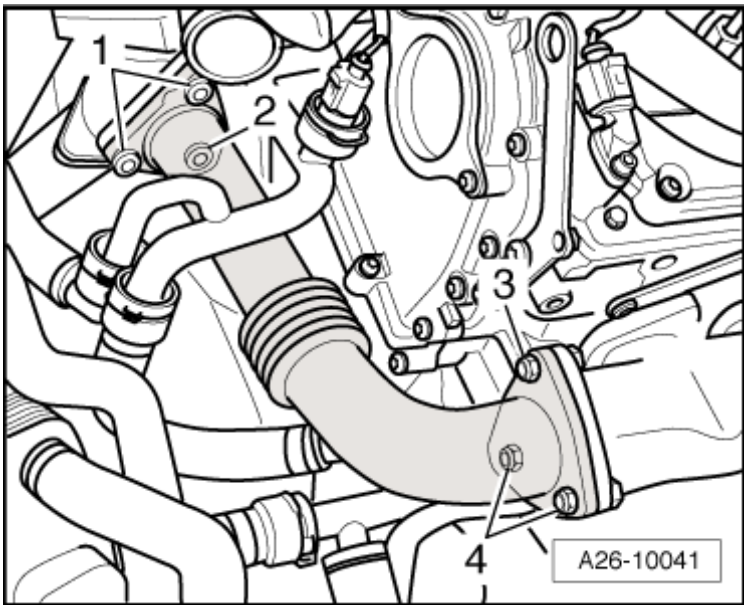


Fig. 56: Identifying Bolts And Nuts -1 Through 4-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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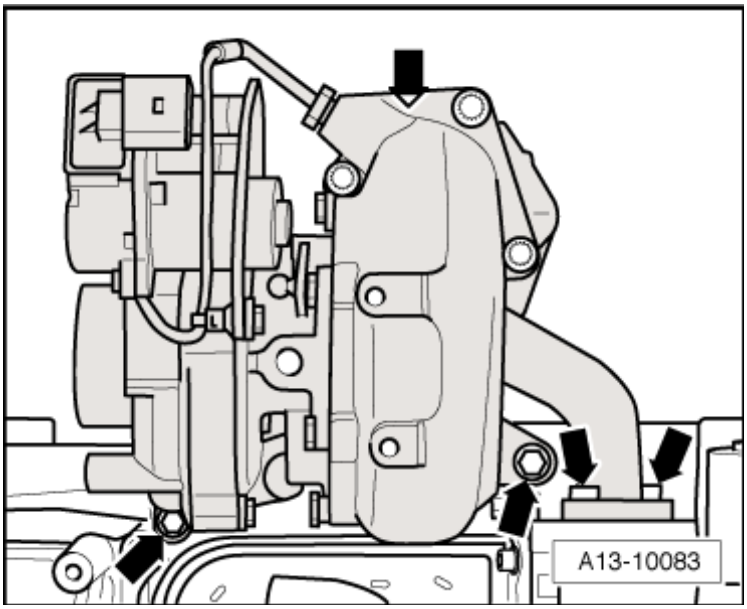


Fig. 57: Removing Bolts -Arrows- And Turbocharger.
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

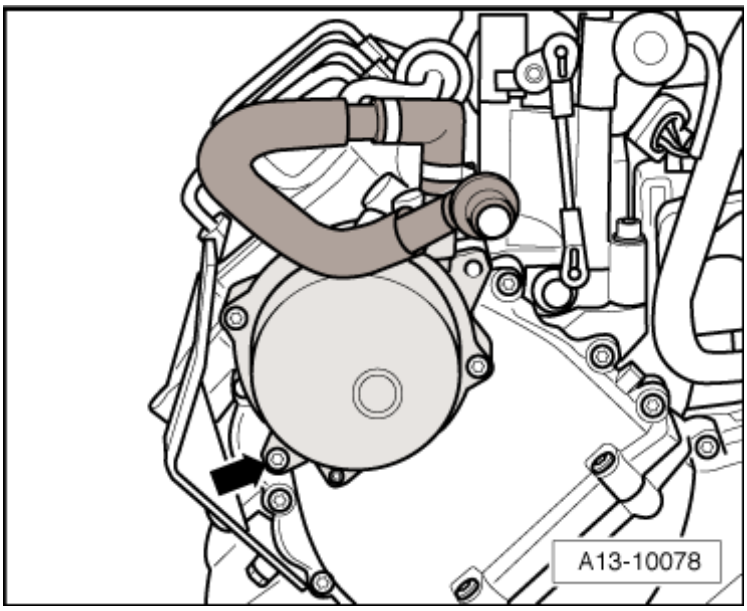


Fig. 58: Removing Bolt -Arrow- And Vacuum Pump
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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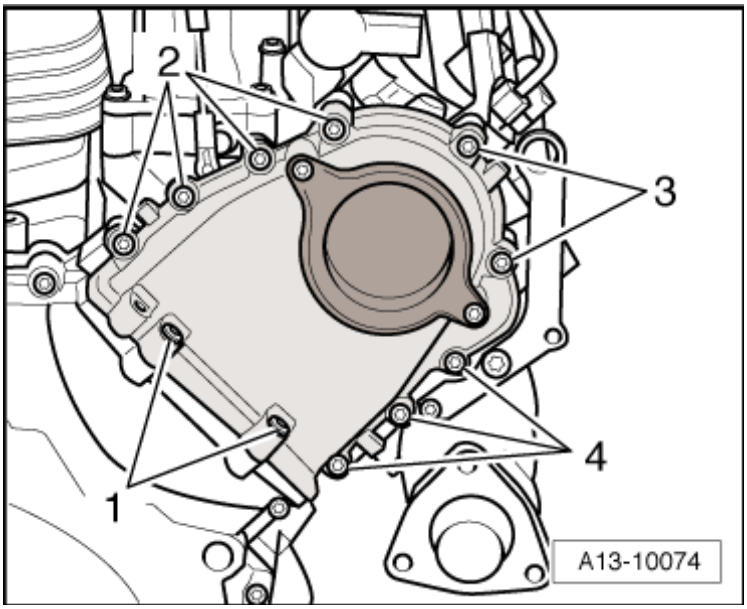


Fig. 59: Bolt Tightening Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

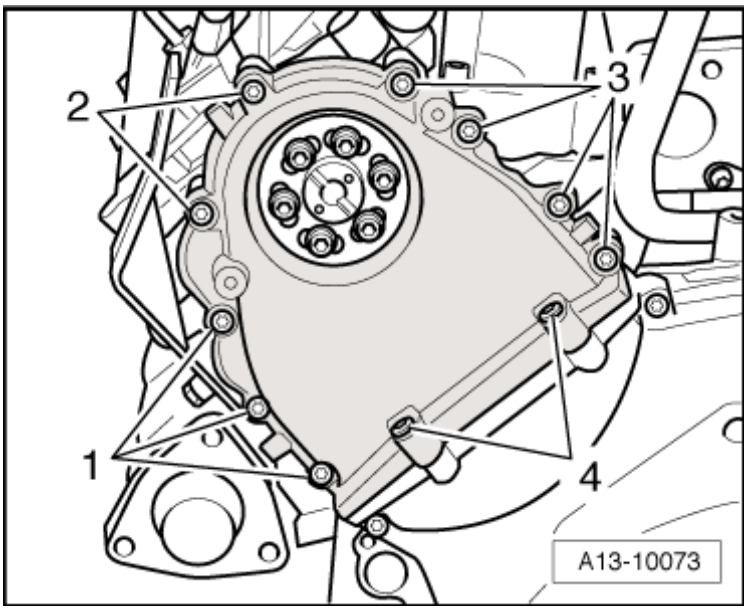


Fig. 60: Bolt Tightening Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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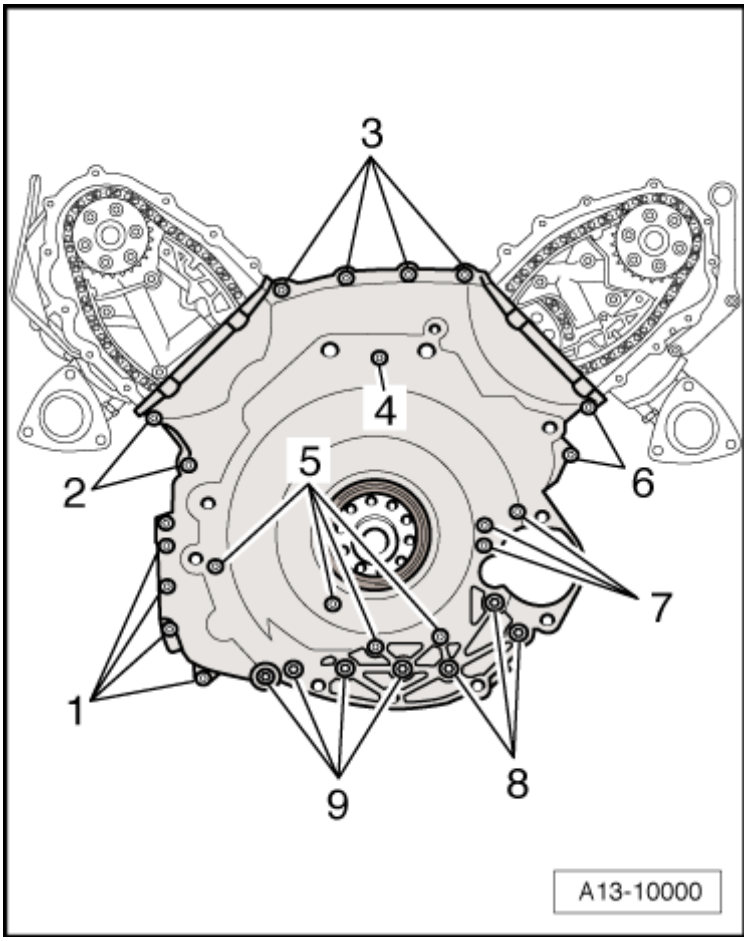


Fig. 61: Lower Timing Chain Cover Bolt Tightening Sequence and Specification
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Press the seal for the crankshaft out of the lower timing chain cover.

Installing

NOTE: Replace gaskets, seals and O-rings.

During installation, all cable ties must be reinstalled 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 sealant residue on the timing chain covers and on the cylinder block or head with a rotating plastic brush.

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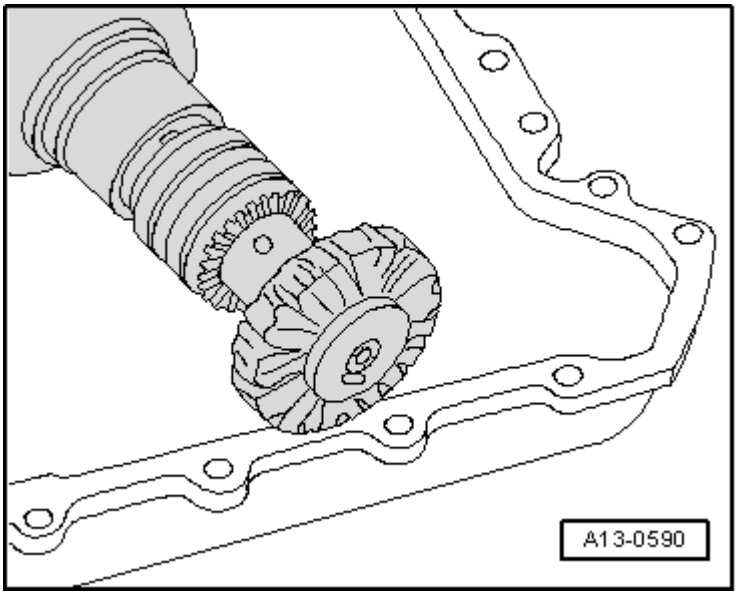


Fig. 62: Identifying Rotating Plastic Brush To Remove Sealant Residue From Sealing Flange, Cylinder Block And Upper Part Of Oil Pan
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Clean 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).

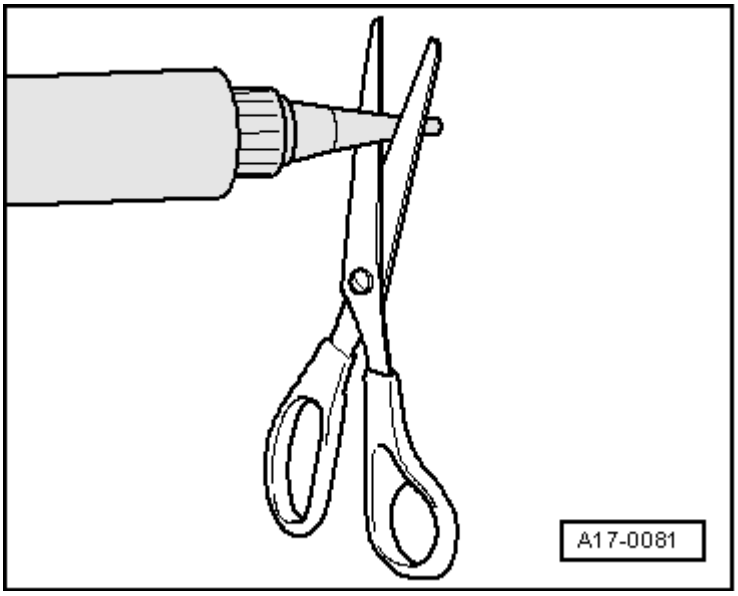


Fig. 63: Cut Tube Nozzle At Front Marking (Nozzle Diameter Approx. 3 Mm)
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

NOTE: The sealant bead must not be thicker than specified or the 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 sealant.

-- Install the seals -2 and 5-.

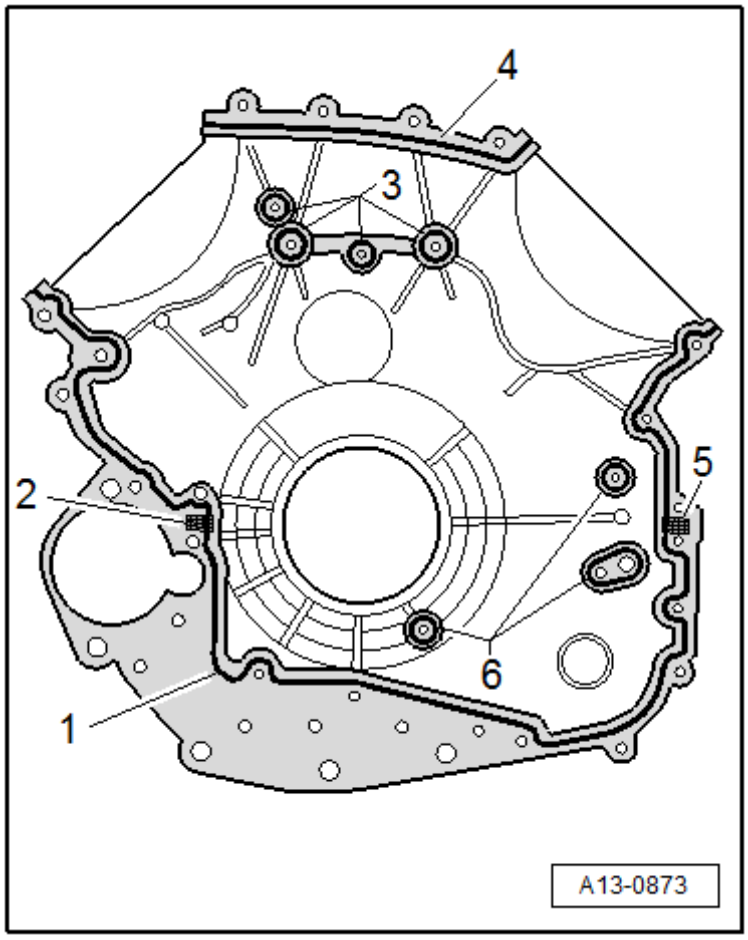


Fig. 64: Installing Seals -2 And 5-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Apply the sealant beads -1 and 4- to the clean sealing surfaces on 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 if necessary.

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

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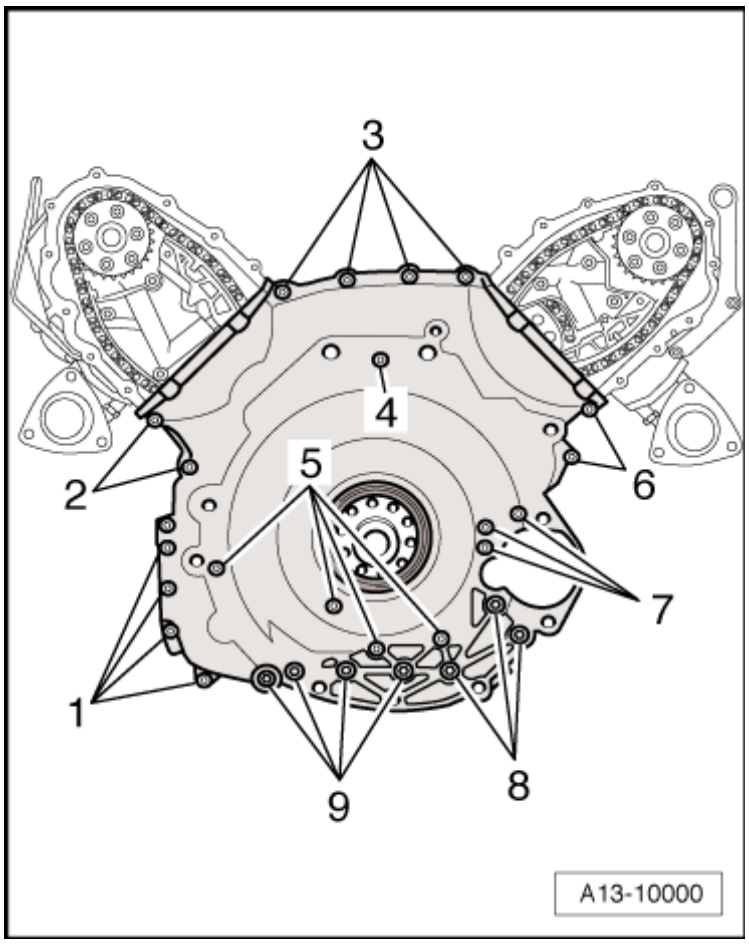


Fig. 65: Lower Timing Chain Cover Bolt Tightening Sequence and Specification
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Step	Tightening
I	-- Tighten the bolts -1 through 9- from the inside toward the outside diagonally to 5 Nm.
II	-- Tighten the bolts -1 through 7- from the inside toward the outside diagonally

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	to 9 Nm.
III	-- Tight the bolts -8 and 9- to 22 Nm.

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

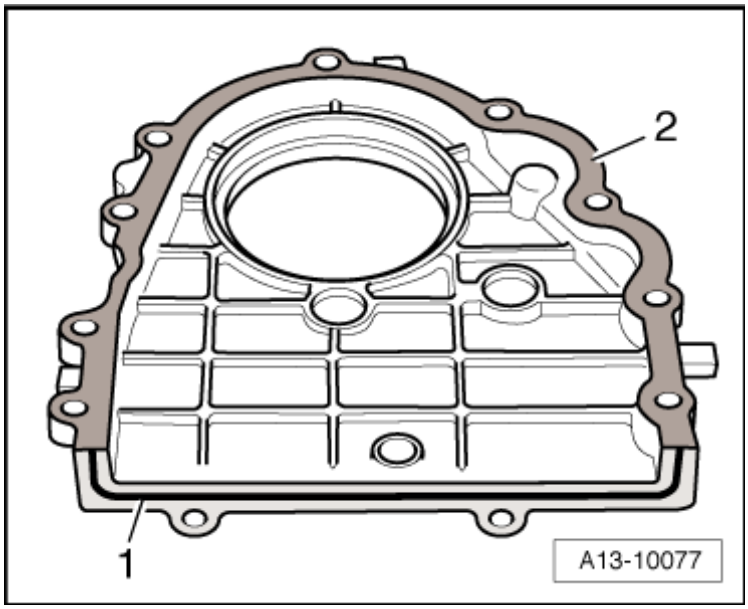


Fig. 66: Applying Sealant Bead To Clean Sealing Surfaces
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

-- Set the gasket -2- in place.

-- 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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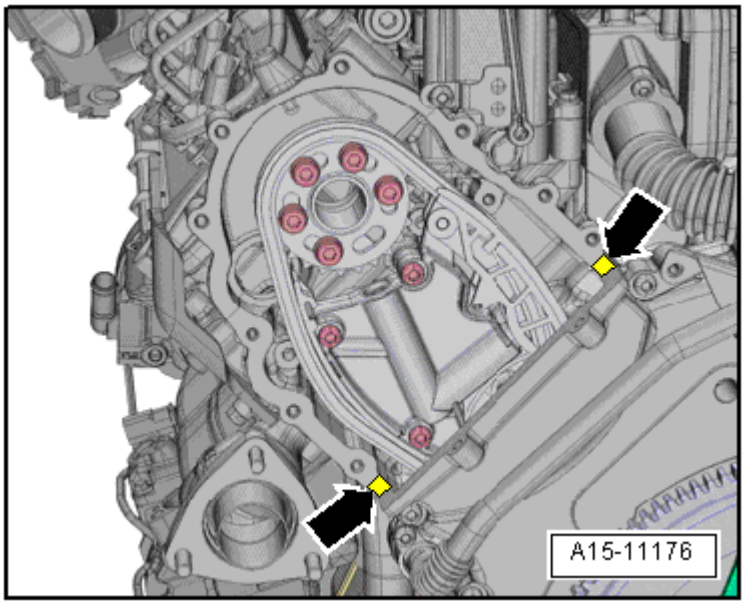


Fig. 67: Applying Sealant Bead
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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.

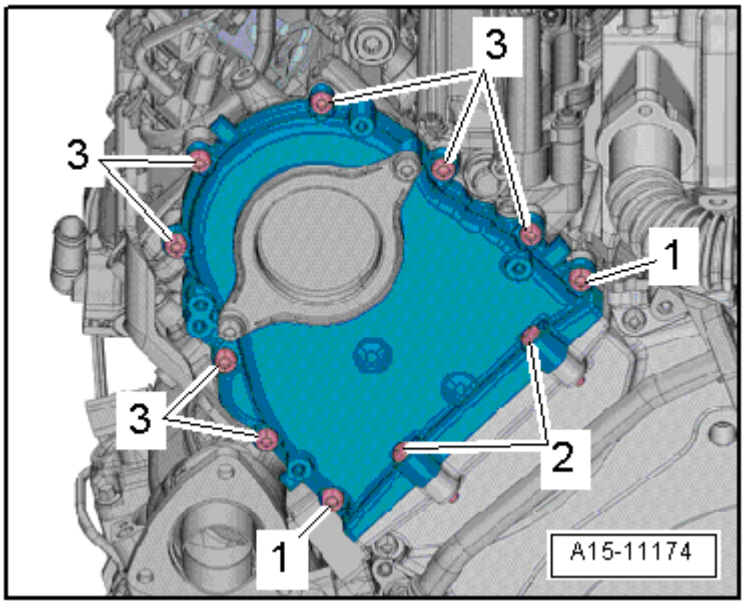


Fig. 68: Left Timing Chain Cover
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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NOTE: Replace the bolts that have been tightened to specification.

-- Tighten the bolts in 4 steps in the sequence shown:

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

Right Timing Chain Cover

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

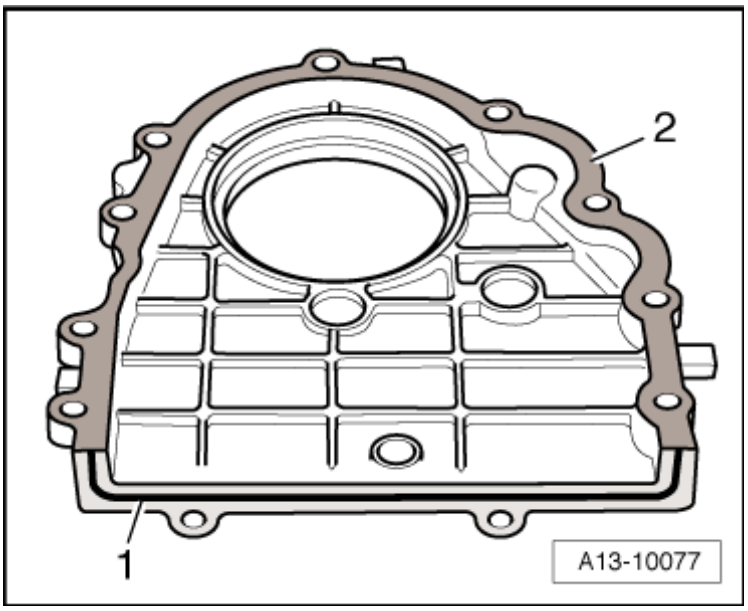


Fig. 69: Applying Sealant Bead To Clean Sealing Surfaces
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

-- Set the gasket -2- in place.

-- 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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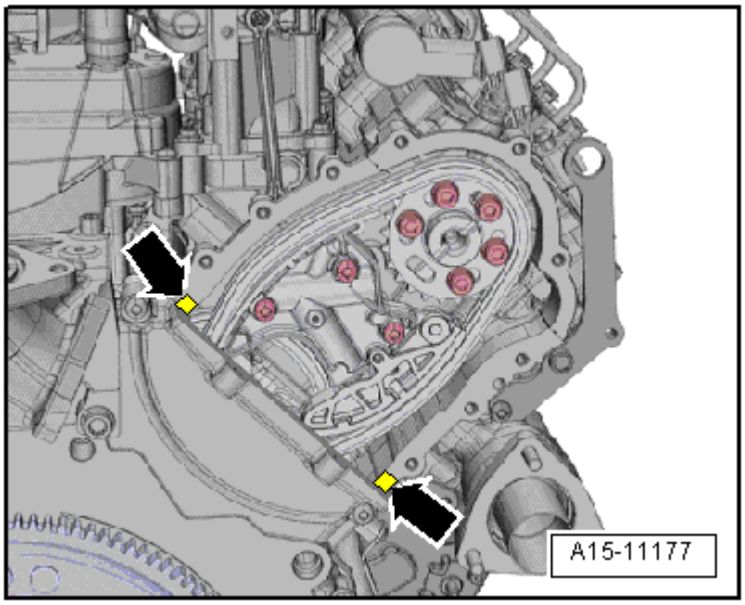


Fig. 70: Applying Sealant Bead
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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

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

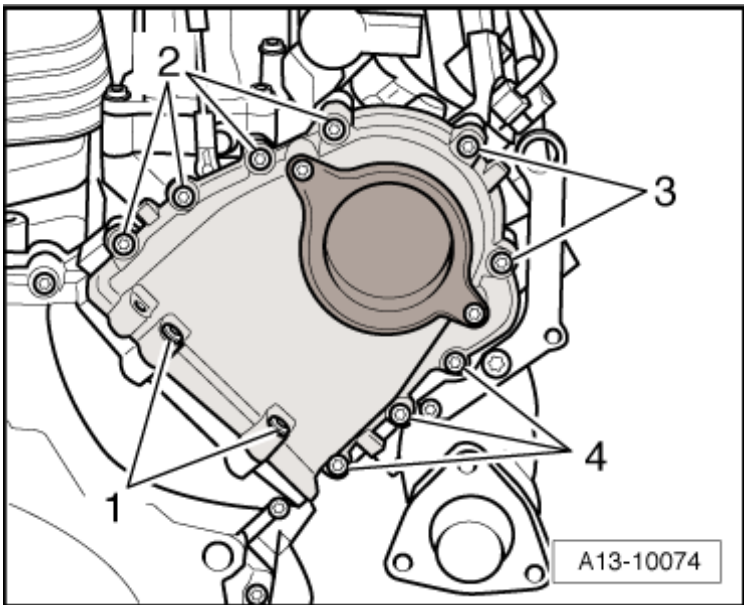


Fig. 71: Bolt Tightening Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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Step	Bolts	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
- Key T40049
- 3242

Removing

-- Drain the engine oil.

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

-- Separate the engine and transmission. Refer to **ENGINE, REMOVING FROM SCISSOR LIFT TABLE** .

-- Secure the engine to the assembly stand. Refer to **ENGINE, SECURING TO ASSEMBLY STAND** .

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

-- Remove the shim behind it.

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

-- Remove the front sealing flange. Refer to **SEALING FLANGE, BELT PULLEY SIDE**.

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

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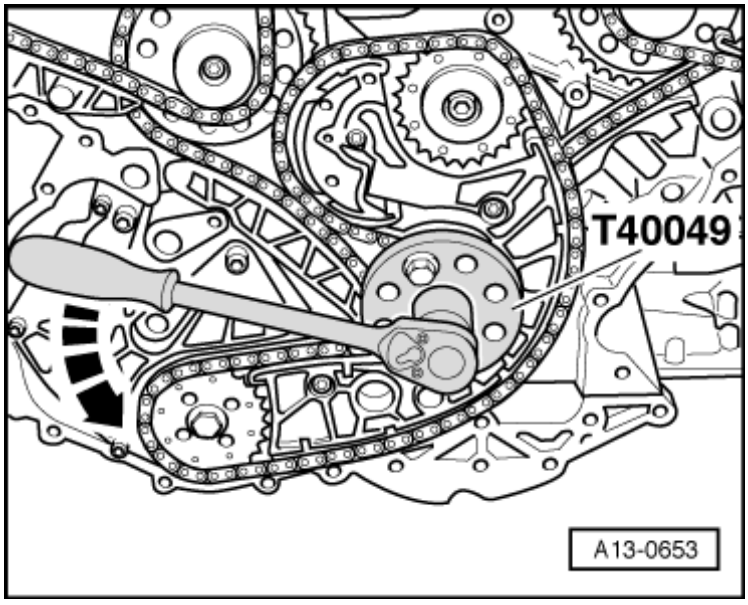


Fig. 72: Rotating Crankshaft To TDC Ignition Timing
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

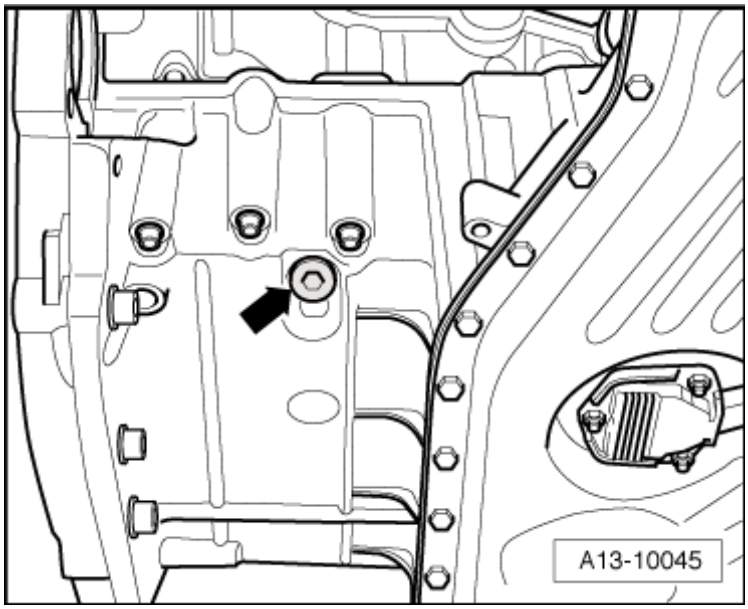


Fig. 73: Identifying Locking Bolt Of Upper Part Of Oil Pan
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

WARNING: Do not turn 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 (20 Nm). Rotate the crankshaft -1- back and forth slightly if necessary to center the crankshaft holder 3242 completely.

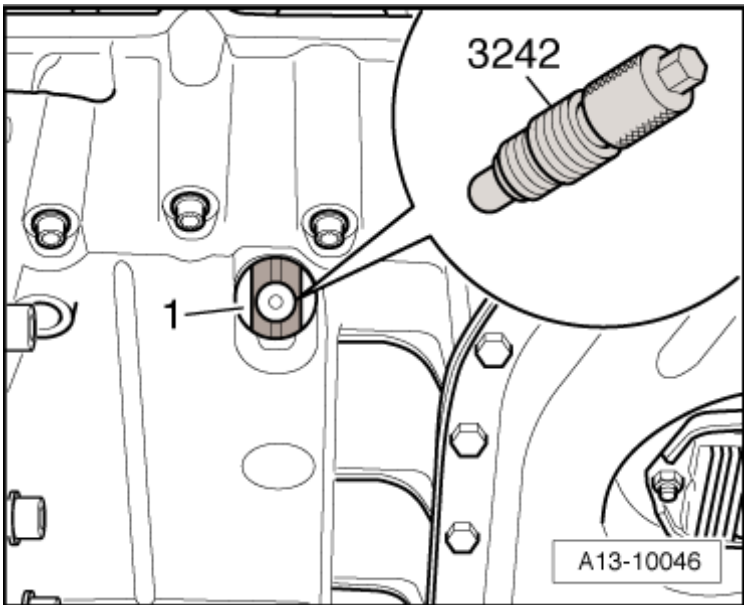


Fig. 74: Installing Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

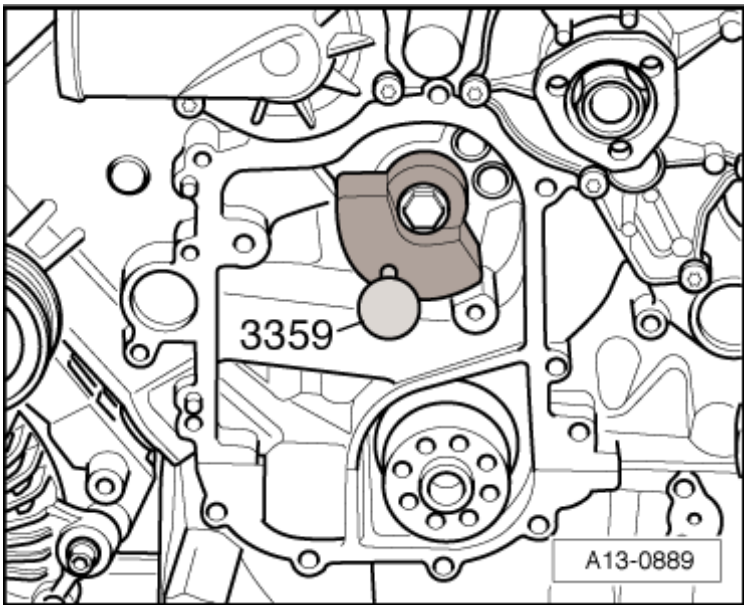


Fig. 75: Securing Balance Shaft Using Diesel Injection Pump Locking Pin 3359
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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

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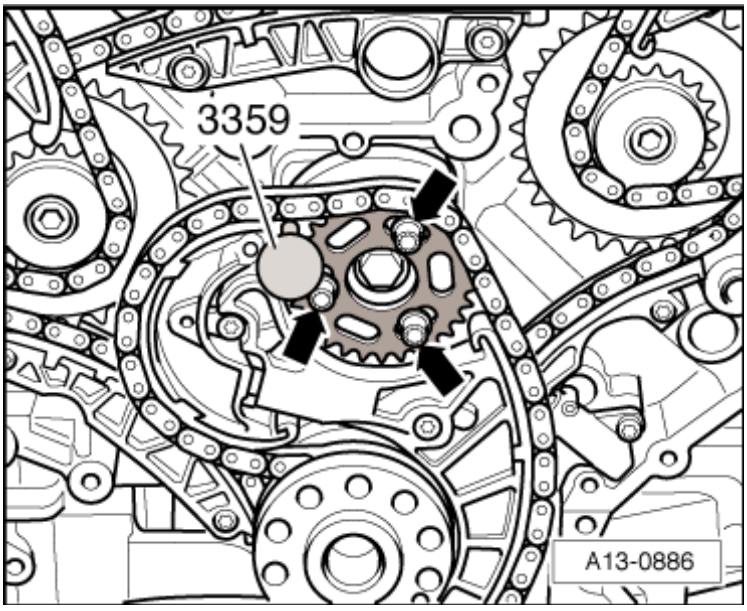


Fig. 76: Securing Balance Shaft At Rear Of Engine Using Diesel Injection Pump Locking Pin 3359
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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

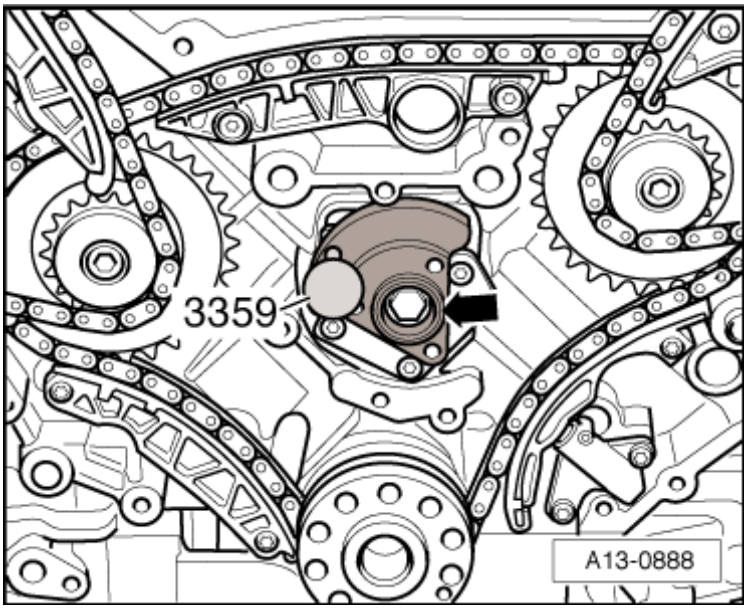


Fig. 77: Identifying Rear Balance Shaft -Arrow- And Diesel Injection Pump Locking Pin 3359
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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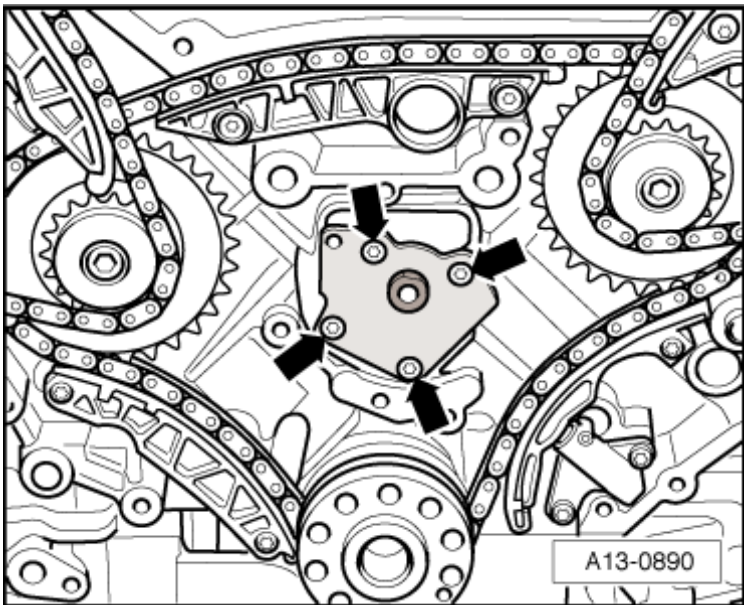


Fig. 78: Identifying Bolts -Arrows- And Balance Shaft Bearing End Bracket
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the balance shaft from the cylinder block.

Installing

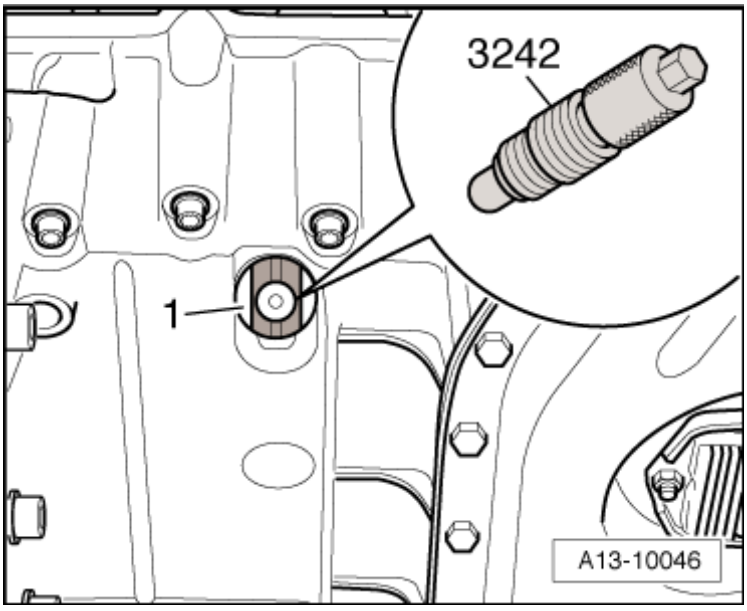


Fig. 79: Installing Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

Installation is performed in reverse order.

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TIMING MECHANISM DRIVE CHAIN

Special tools and workshop equipment required

- Locking Pin T40071
- 3.3 mm diameter drill bit

Removing

- Transmission 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 tensioner rail in the -direction of the arrow- and secure the chain tensioner using the locking pin T40071.

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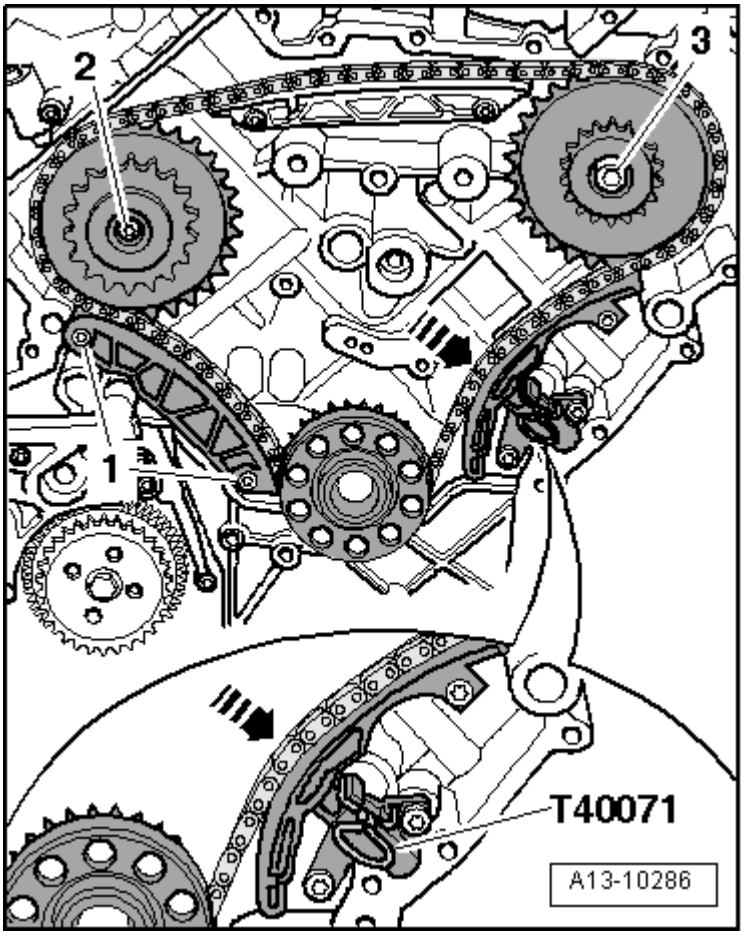


Fig. 80: Pressing And Securing Drive Chain Tensioner Rail Using Locking Pin T40071
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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

-- Remove the bolts -1- and the guide rail.

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

Installing

- Tightening specifications, refer to **TIMING MECHANISM DRIVE CHAIN OVERVIEW**.

Installation is performed in reverse order of removal, noting 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** .

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

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

-- Fill the engine oil and check the oil level. Refer to **Maintenance Procedures** .

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 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 crankshaft using two used drive plate bolts -arrows-.

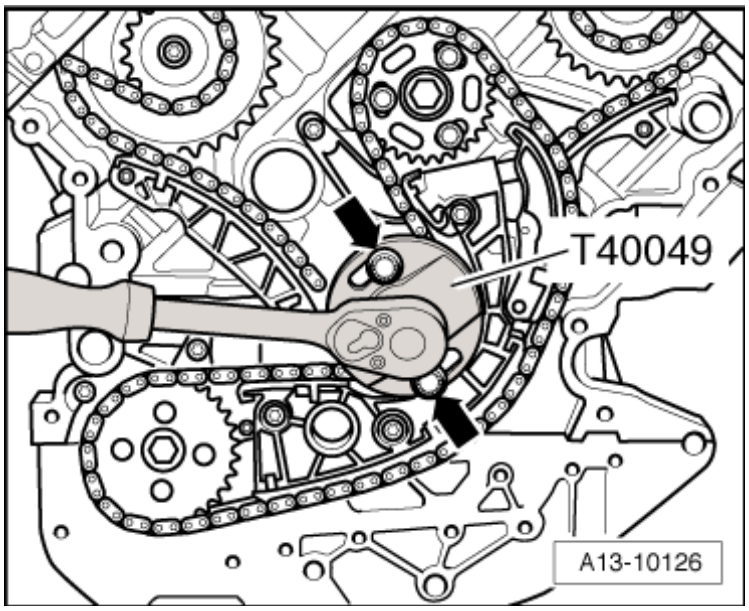


Fig. 81: Installing Key T40049 At Rear On Crankshaft Using 2 Old Bolts For Dual-Mass Flywheel
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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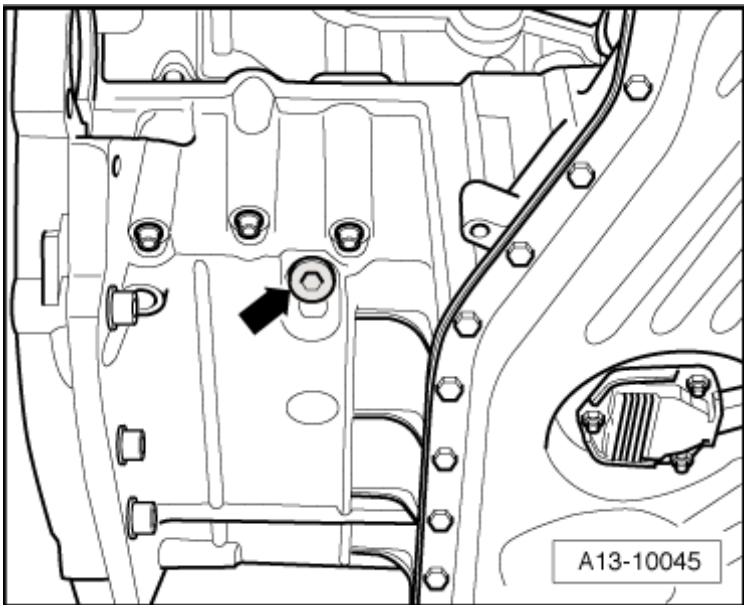


Fig. 82: Identifying Locking Bolt Of Upper Part Of Oil Pan
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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

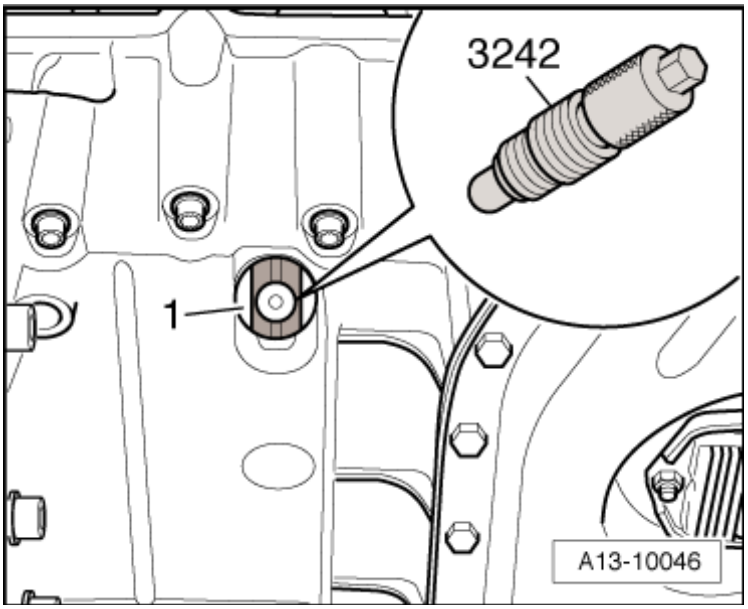


Fig. 83: Installing Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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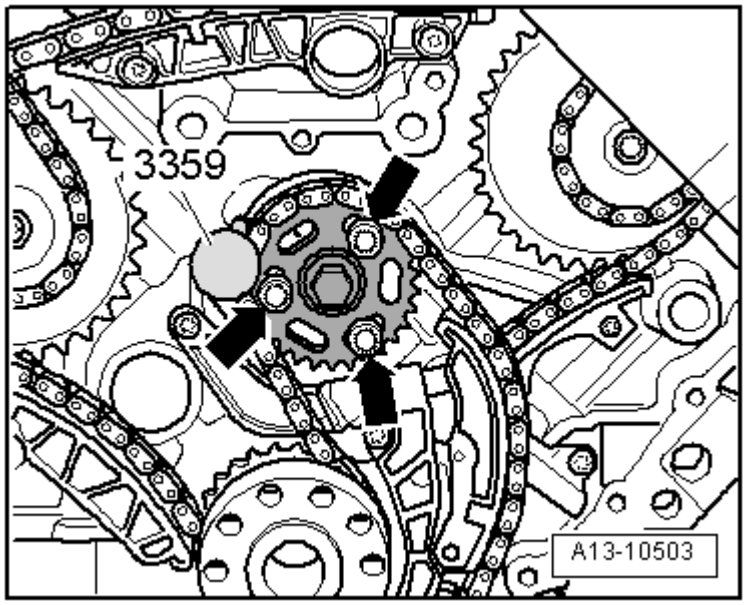


Fig. 84: Rotating Crankshaft Back And Forth Slightly To Center Crankshaft Holder 3242
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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

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

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

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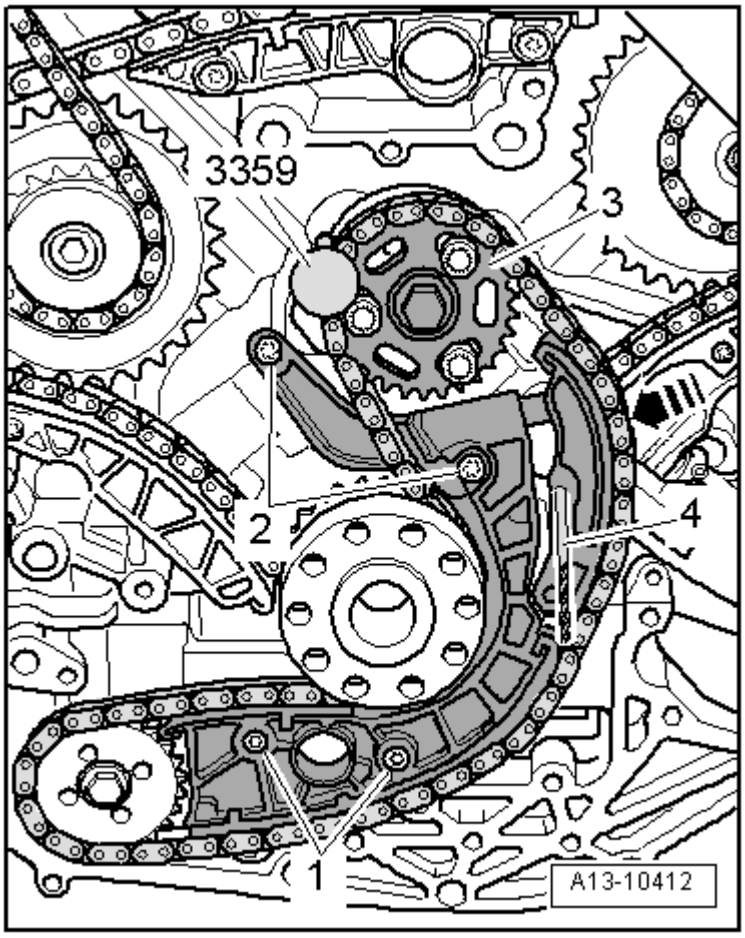


Fig. 85: Identifying Chain Tensioner, Drive Chain, And Balance Shaft -3- Chain Sprocket
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Push the chain tensioner guide rail in -direction of arrow- and lock the chain tensioner with the drill bit -4-.

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

Installing

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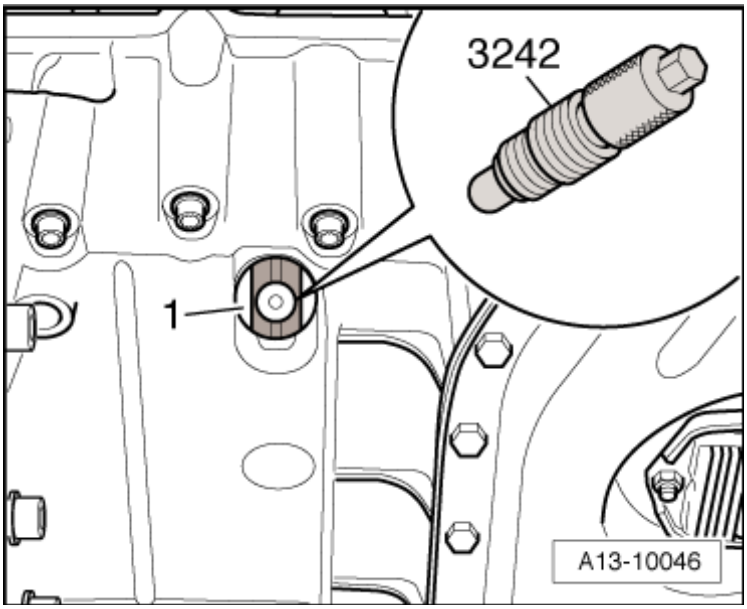


Fig. 86: Installing Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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

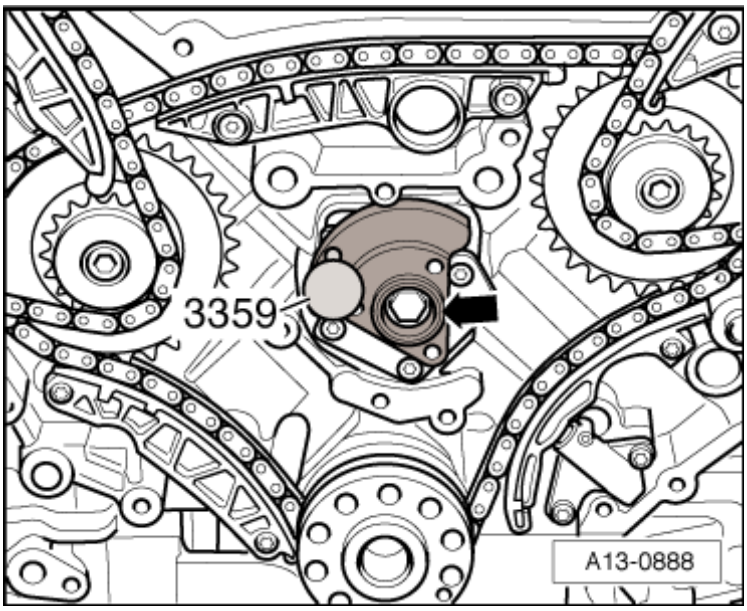


Fig. 87: Identifying Rear Balance Shaft -Arrow- And Diesel Injection Pump Locking Pin 3359
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Install the chain tensioner with the chain and the drive chain and the balance shaft -3- chain sprocket.

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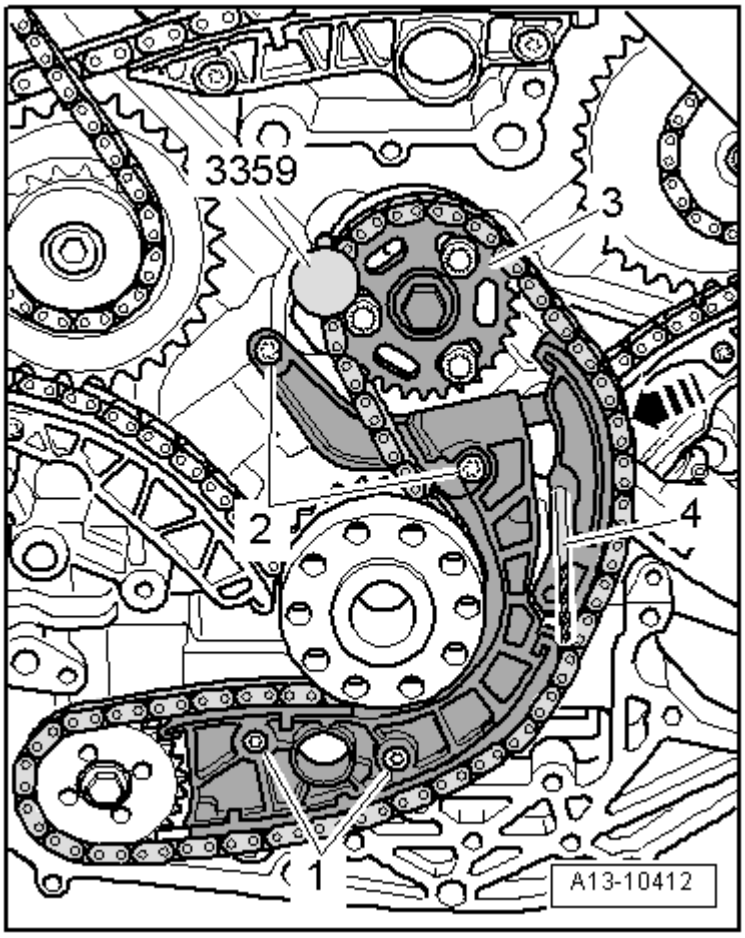


Fig. 88: Identifying Chain Tensioner, Drive Chain, And Balance Shaft -3- Chain Sprocket
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- The slots in the chain 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 -arrow-.

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

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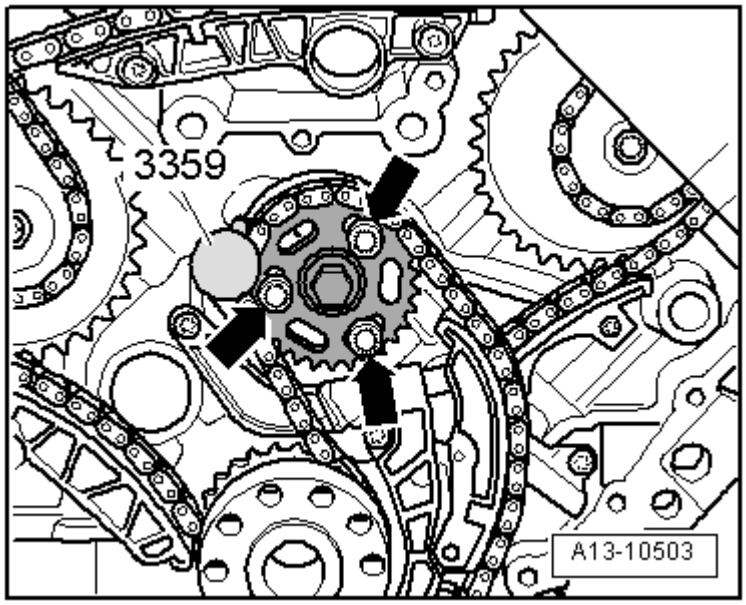


Fig. 89: Rotating Crankshaft Back And Forth Slightly To Center Crankshaft Holder 3242
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

-- Remove the drill bit from the alignment hole.

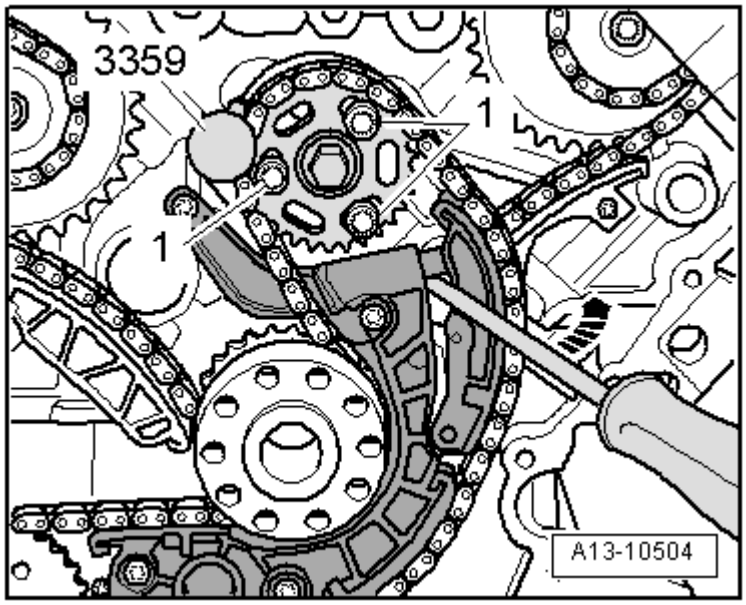


Fig. 90: Pushing Screwdriver In -Direction Of Arrow-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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

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

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

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

-- Fill the engine oil and check the oil level. Refer to **Maintenance Procedures** .

SPECIAL TOOLS

Special tools and workshop equipment required

- Dial Gauge Holder VW 387

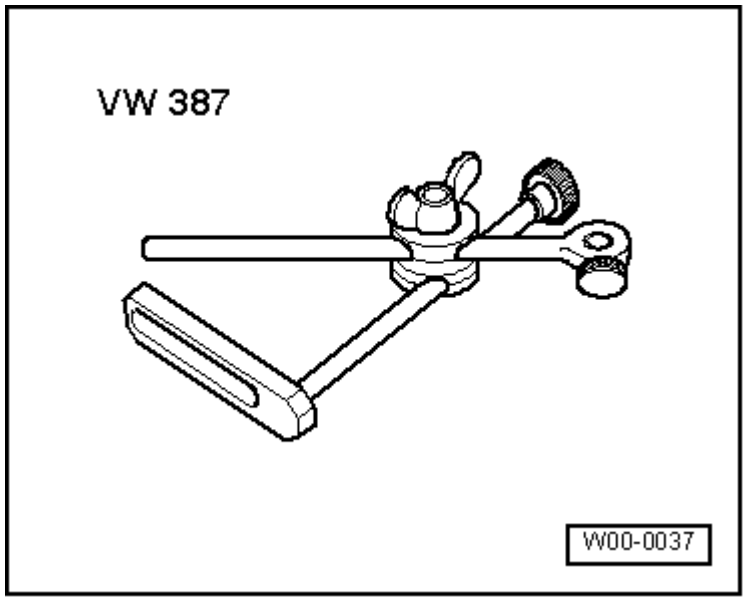


Fig. 91: Dial Gauge Holder VW 387
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Oil Seal Extractor T40019

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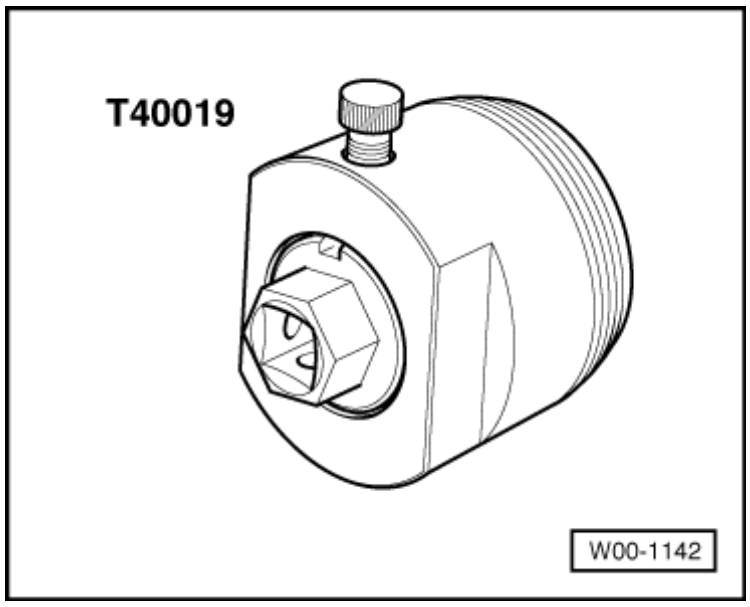


Fig. 92: Oil Seal Extractor T40019
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Assembly Device T40048

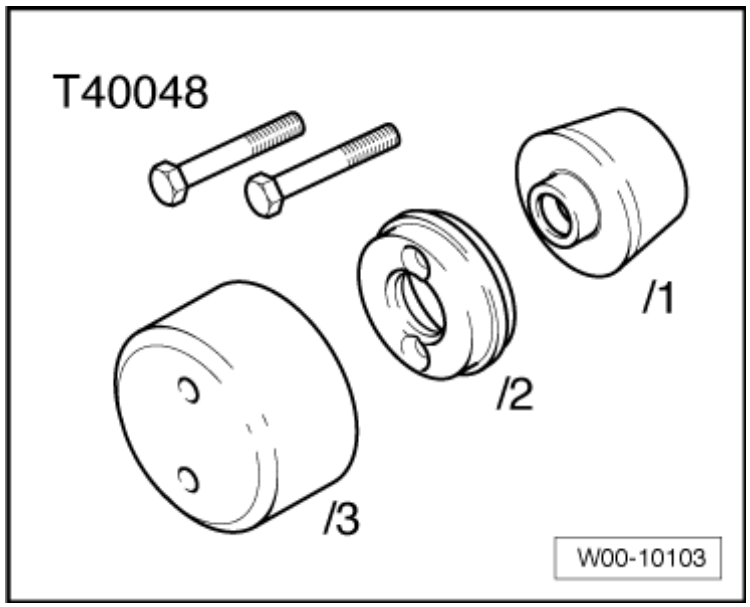


Fig. 93: Assembly Tool T40048
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Spanner Wrench 3212

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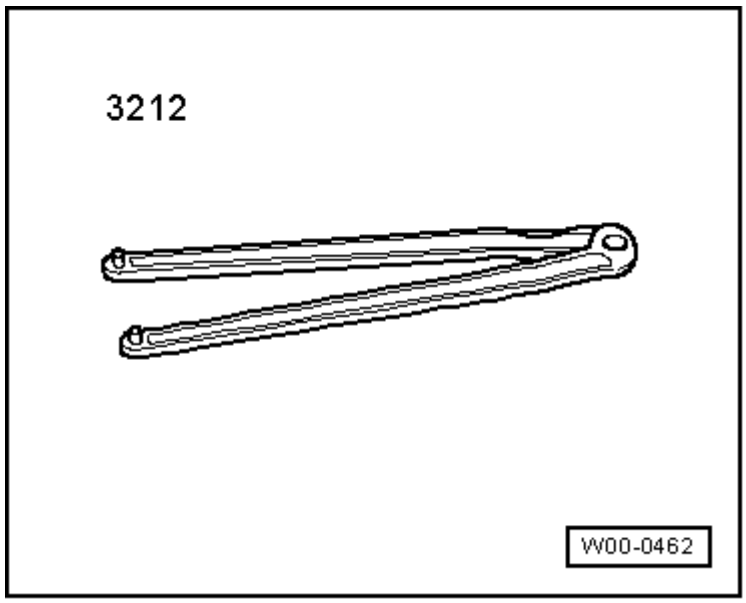


Fig. 94: Identifying Special Tool - Spanner Wrench 3212
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Counter Holder Tool 10-201

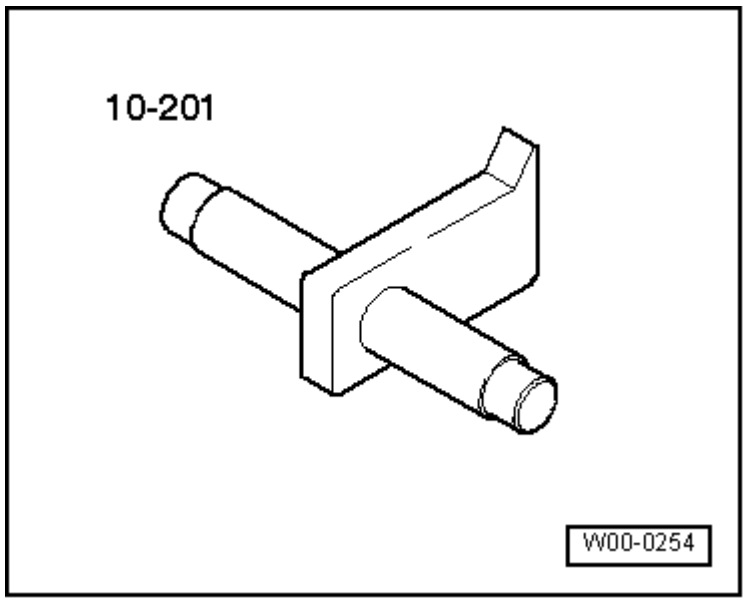


Fig. 95: Counter-Holder Tool 10 - 201
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Assembly Tool T10122

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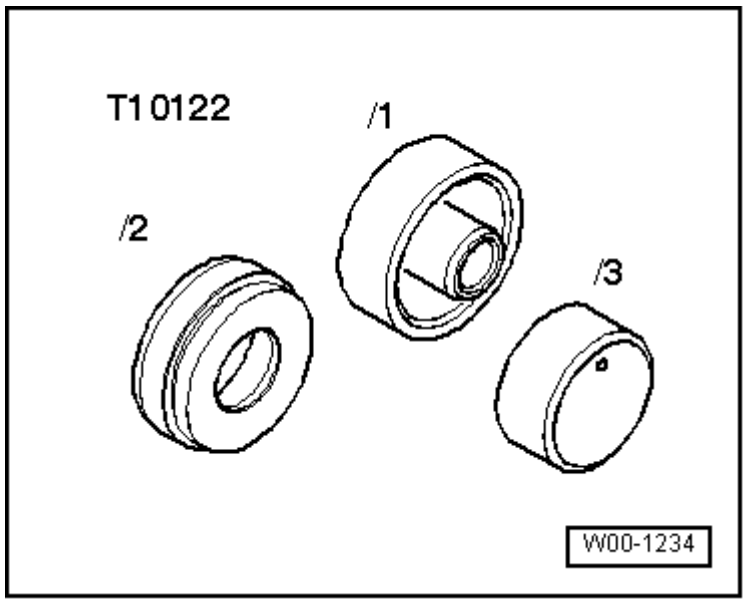


Fig. 96: Identifying Installation Tool T10122
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Pulling Hook T20143

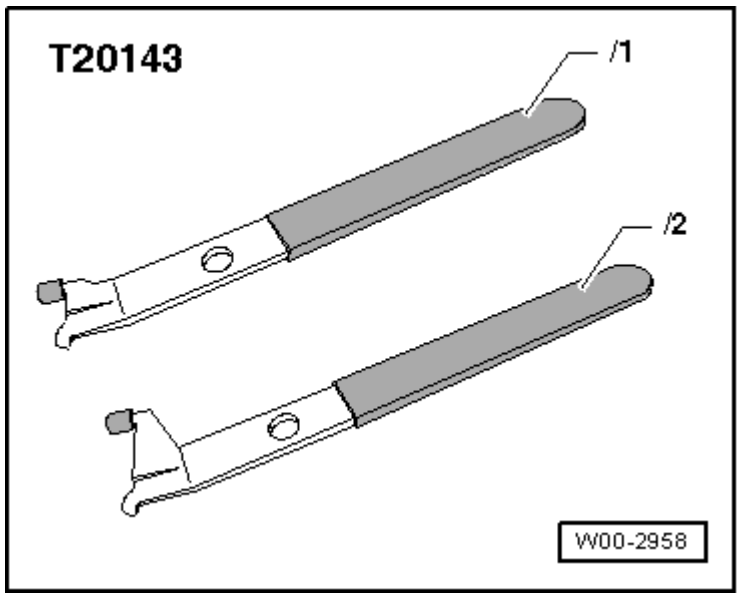


Fig. 97: Extractor Hook T20143
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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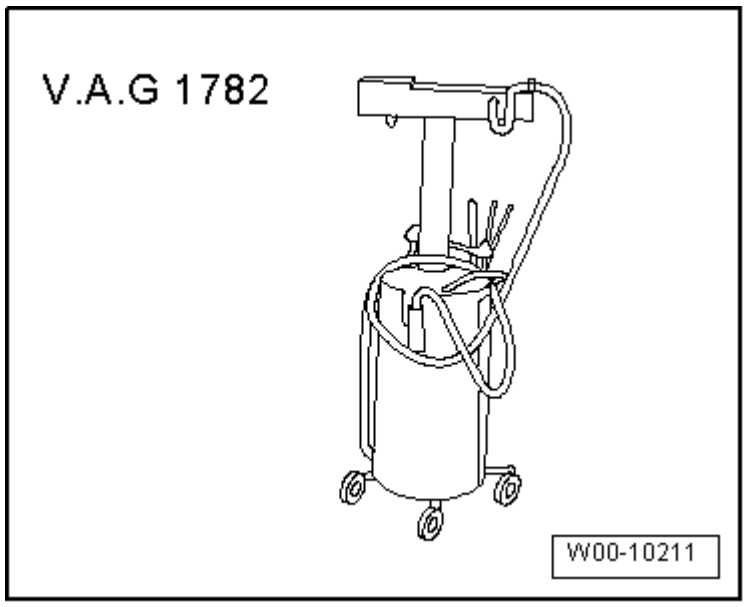


Fig. 98: Identifying Oil Extractor V.A.G 1782
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Locking Pin T40071

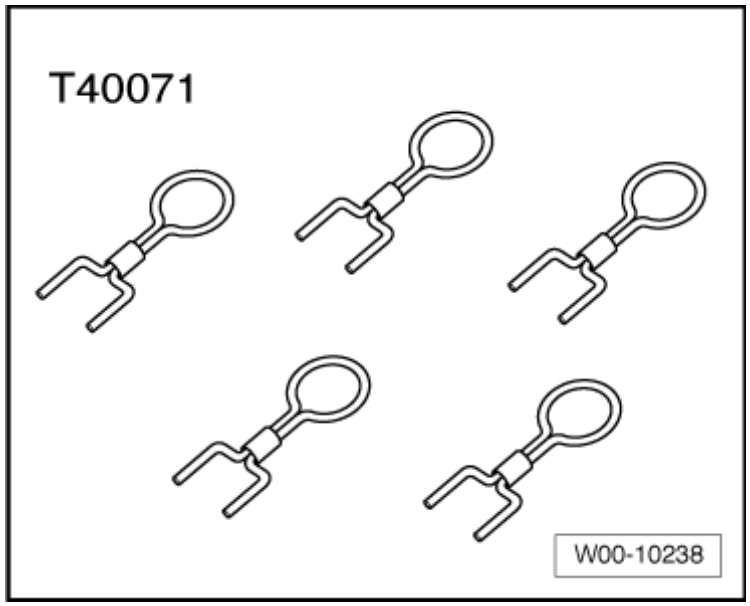


Fig. 99: Securing Pin T40071
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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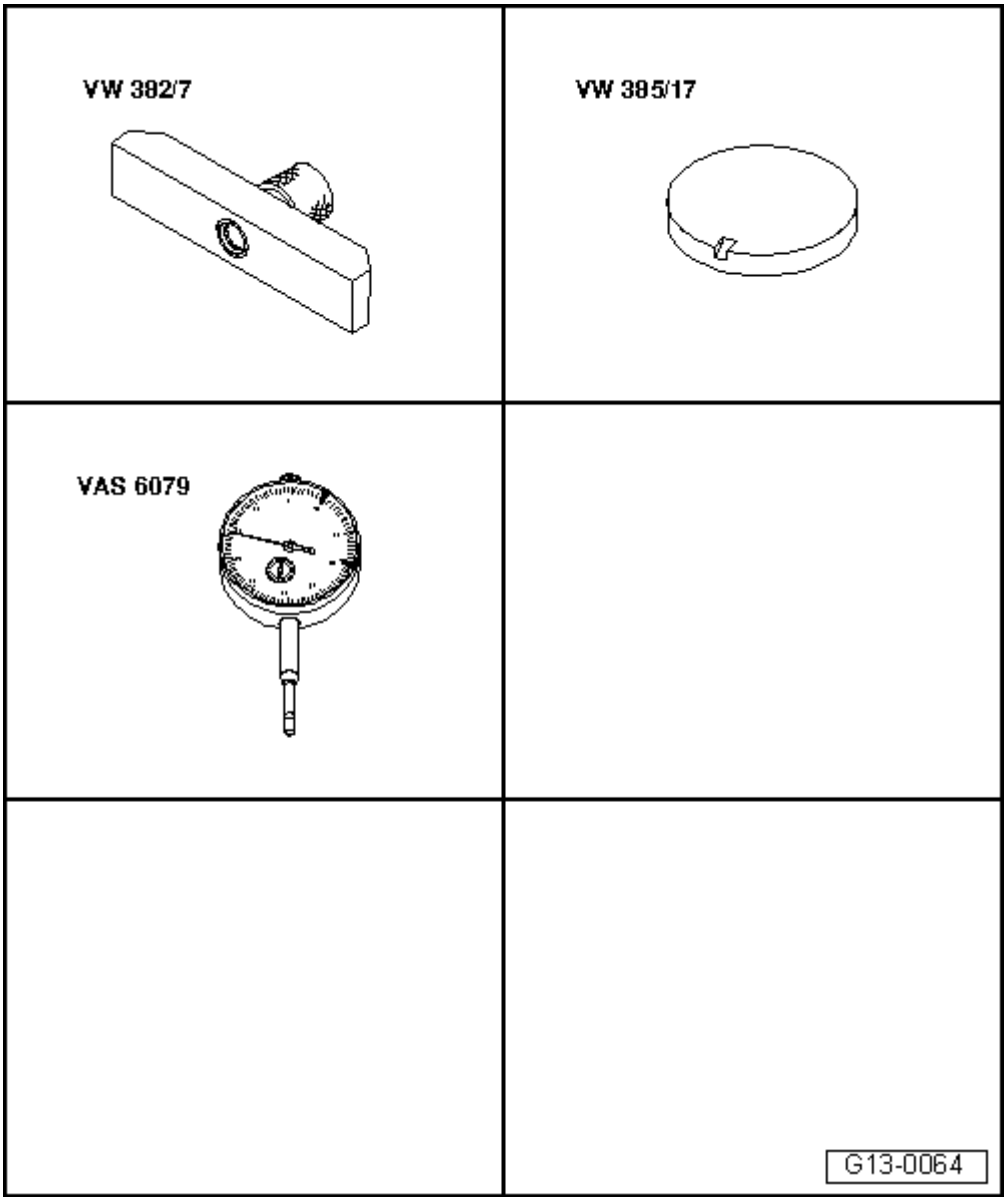


Fig. 100: VW 382/7, VW 385/17 And VAS 6079
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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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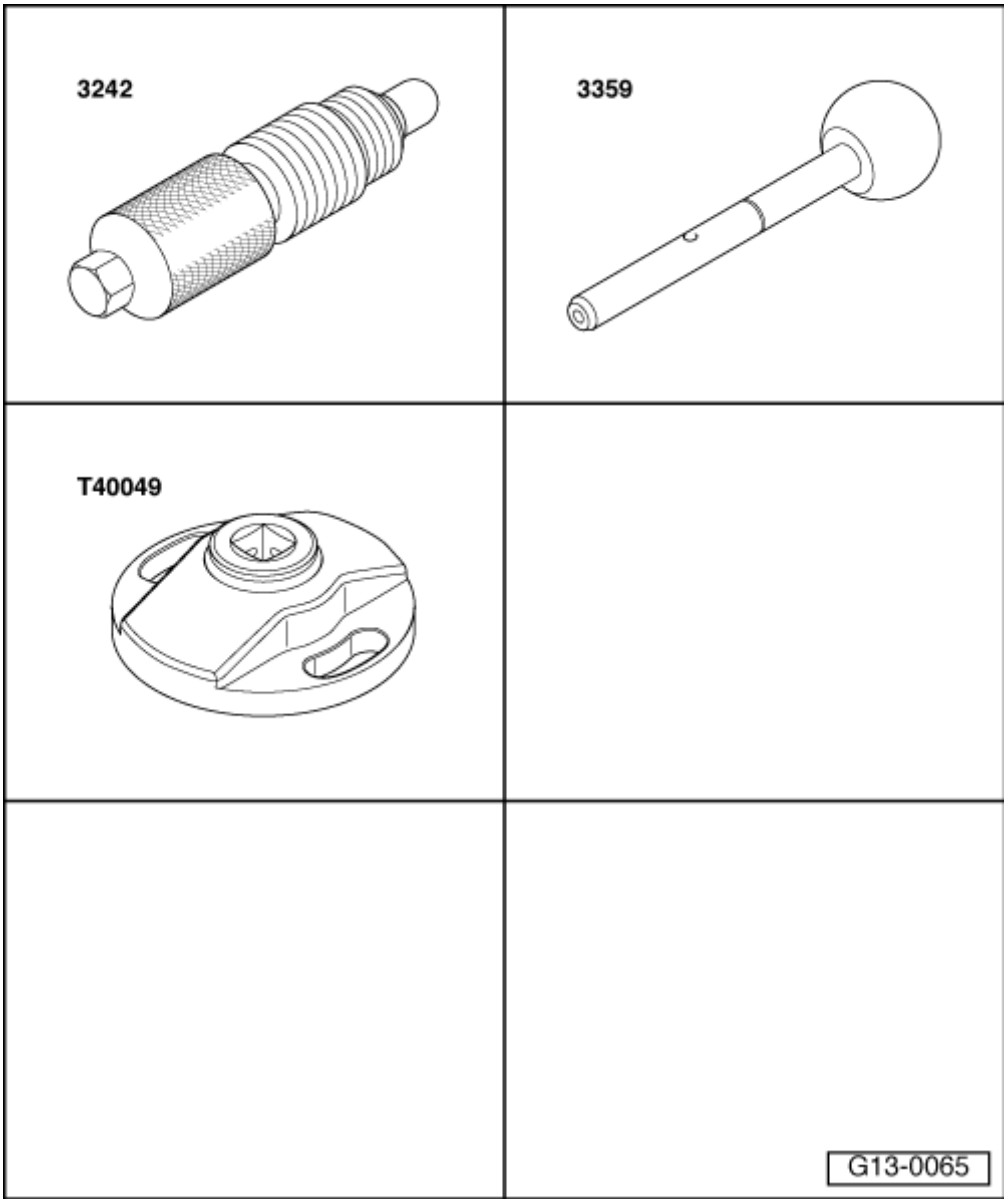


Fig. 101: Holder 3242, Pin 3359 And Key T40049
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

GENERAL INFORMATION

CYLINDER HEAD

NOTE: **When installing a replacement cylinder head, all of the contact surfaces between the supports, roller rocker levers and cam running surfaces on the camshafts must be lubricated before installing the cylinder head cover.**

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

When the cylinder head is replaced, all the coolant must also be replaced.

Remanufacturing diesel cylinder heads is not permitted.

DESCRIPTION AND OPERATION

CYLINDER HEAD COVER OVERVIEW

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

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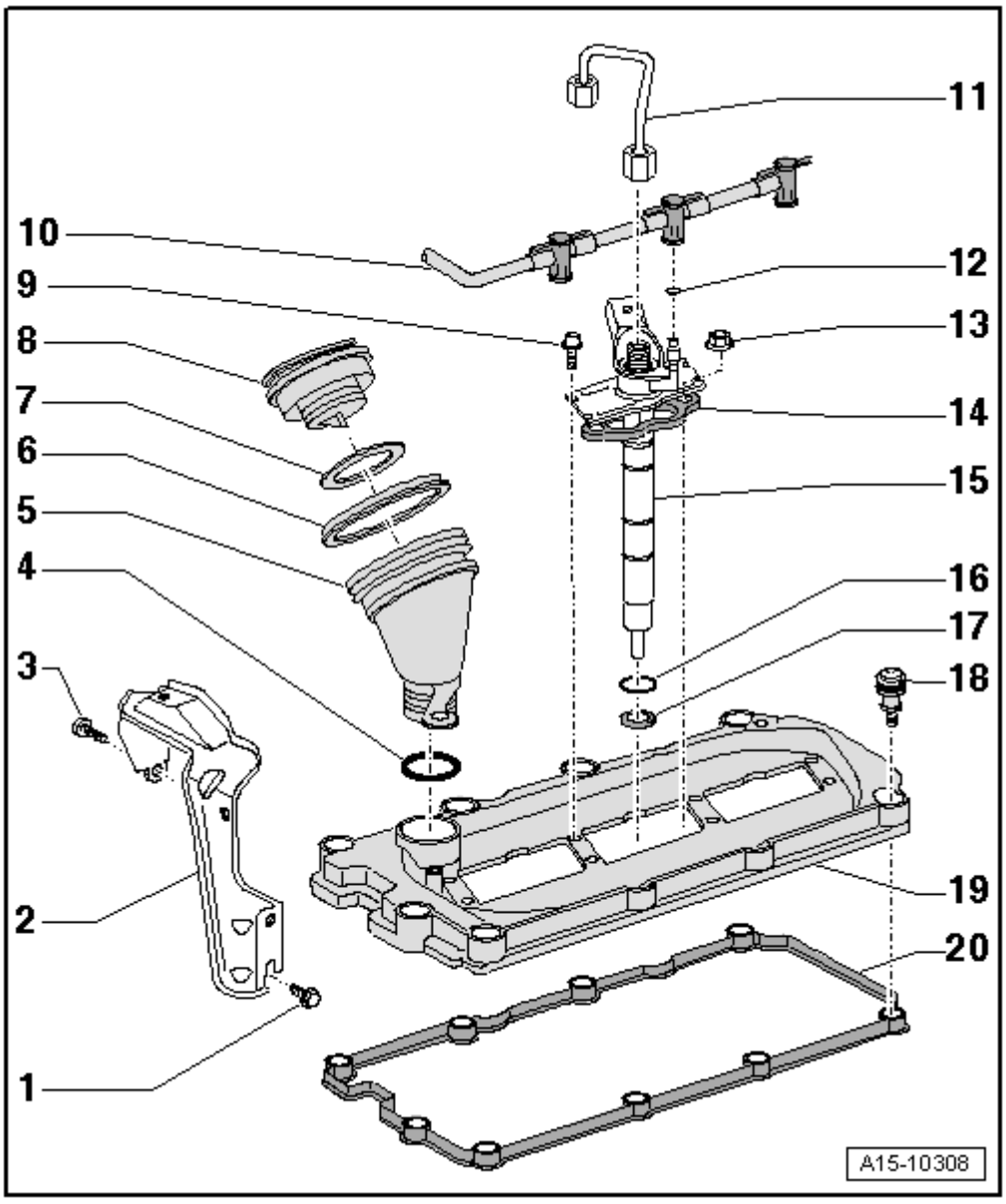


Fig. 1: Identifying Cylinder Head Cover Overview
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. **Bolt**
   - 9 Nm
2. **Intake Tube Bracket**
3. **Bolt**
   - 9 Nm
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.

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6. **Seal**
7. **Seal**
   - Replace if damaged or leaking.
8. **Cap**
9. **Bolt**
   - 5 Nm
10. **Fuel Return Line**
    - Note the rules of cleanliness. Refer to **CLEAN WORKING CONDITIONS** .
11. **High Pressure Line**
    - Note the rules of cleanliness. Refer to **CLEAN WORKING CONDITIONS** .
    - Mark the assignment of the high pressure lines to the injector units.
    - Do not change the angles of the high pressure lines.
    - Tighten the high pressure line to the fuel rail, with a 19 mm wrench. Refer to **TIGHTENING THE HIGH PRESSURE LINE TO THE FUEL RAIL WITH A 19 MM WRENCH**.
    - Tighten the high pressure line to the fuel rail, with a 14 mm wrench. Refer to **TIGHTENING THE HIGH PRESSURE LINE TO THE FUEL RAIL WITH A 14 MM WRENCH**.
    - Tighten the high pressure line to the fuel injector. Refer to **TIGHTENING THE HIGH PRESSURE LINE TO THE FUEL INJECTOR WITH A 17 MM WRENCH**.
12. **O-ring**
    - Always replace.
13. **Nut**
    - 9 Nm
    - Tighten in an alternating sequence and in stages.
14. **Tensioning Bracket**
    - Replace when replacing the fuel injector.
15. **Fuel Injector**
    - Note the rules of cleanliness. Refer to **CLEAN WORKING CONDITIONS** .
    - Removing and installing, refer to **CYLINDER HEAD COVER**.
    - The high pressure line and tensioning bracket must be replaced to replace the injector.
16. **O-ring**
    - Always replace.
17. **Copper Sealing Ring**
    - Always replace.
18. **Bolt**
    - 9 Nm
    - Replace if damaged or leaking
    - Tighten in a diagonal sequence and in steps.
19. **Cylinder Head Cover**

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- Removing and installing, refer to **CYLINDER HEAD COVER**.

20. **Cylinder Head Cover Gasket**
    - Replace if damaged or leaking.

TIGHTENING THE HIGH PRESSURE LINE TO THE FUEL RAIL WITH A 14 MM WRENCH

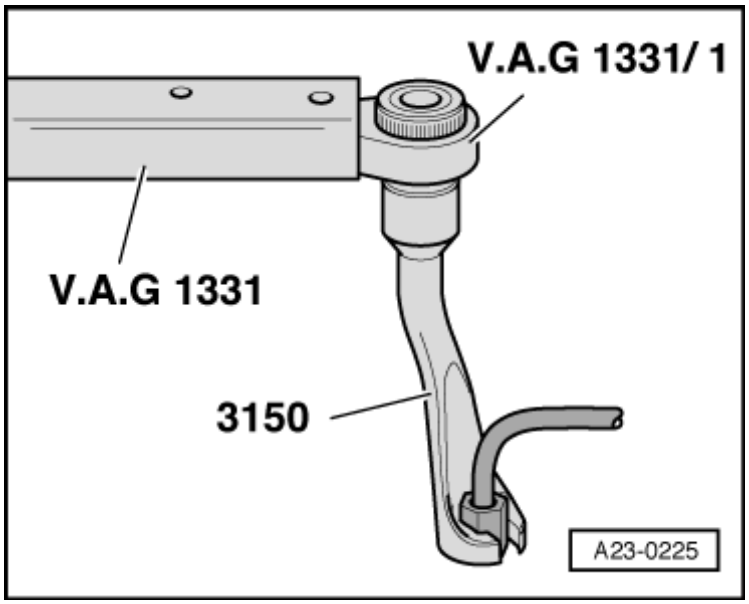


Fig. 2: Identifying High-Pressure Line (14 mm) At High Pressure Pump, Torque Wrench V.A.G 1331 With Ratchet V.A.G 1331/1 And Socket 14 mm 3150
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- 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 torque wrench (5-50 Nm) V.A.G 1331 and socket 14 mm 3150.

- Tightening specification: 25 Nm.

TIGHTENING THE HIGH PRESSURE LINE TO THE FUEL RAIL WITH A 19 MM WRENCH

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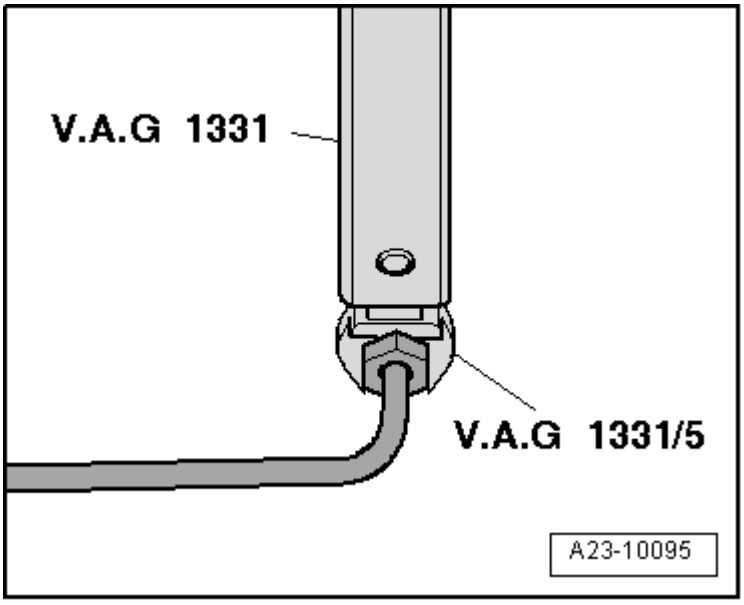


Fig. 3: Identifying High Pressure Line To Fuel Rail And 19 mm Wrench
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

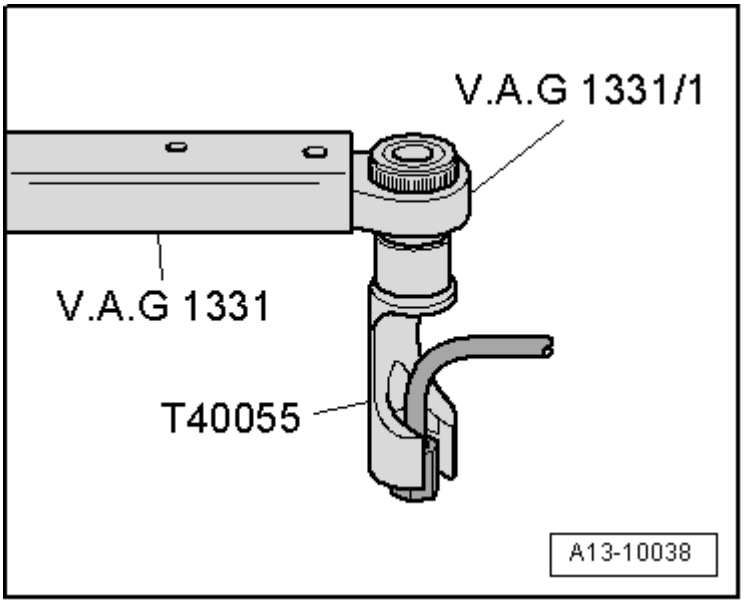
-- Tighten the union nut for the high pressure line by hand.

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

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

- Tightening specification: 25 Nm.

TIGHTENING THE HIGH PRESSURE LINE TO THE FUEL INJECTOR WITH A 17 MM WRENCH



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Fig. 4: Identifying Torque Wrench V.A.G 1331T, Reversible V.A.G 1331/1 And Socket 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 fuel injector using torque wrench (5-50 Nm) V.A.G 1331 with reversible ratchet V.A.G 1331/1 and socket T40055.

- Tightening specification: 25 Nm.

CYLINDER HEAD OVERVIEW

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

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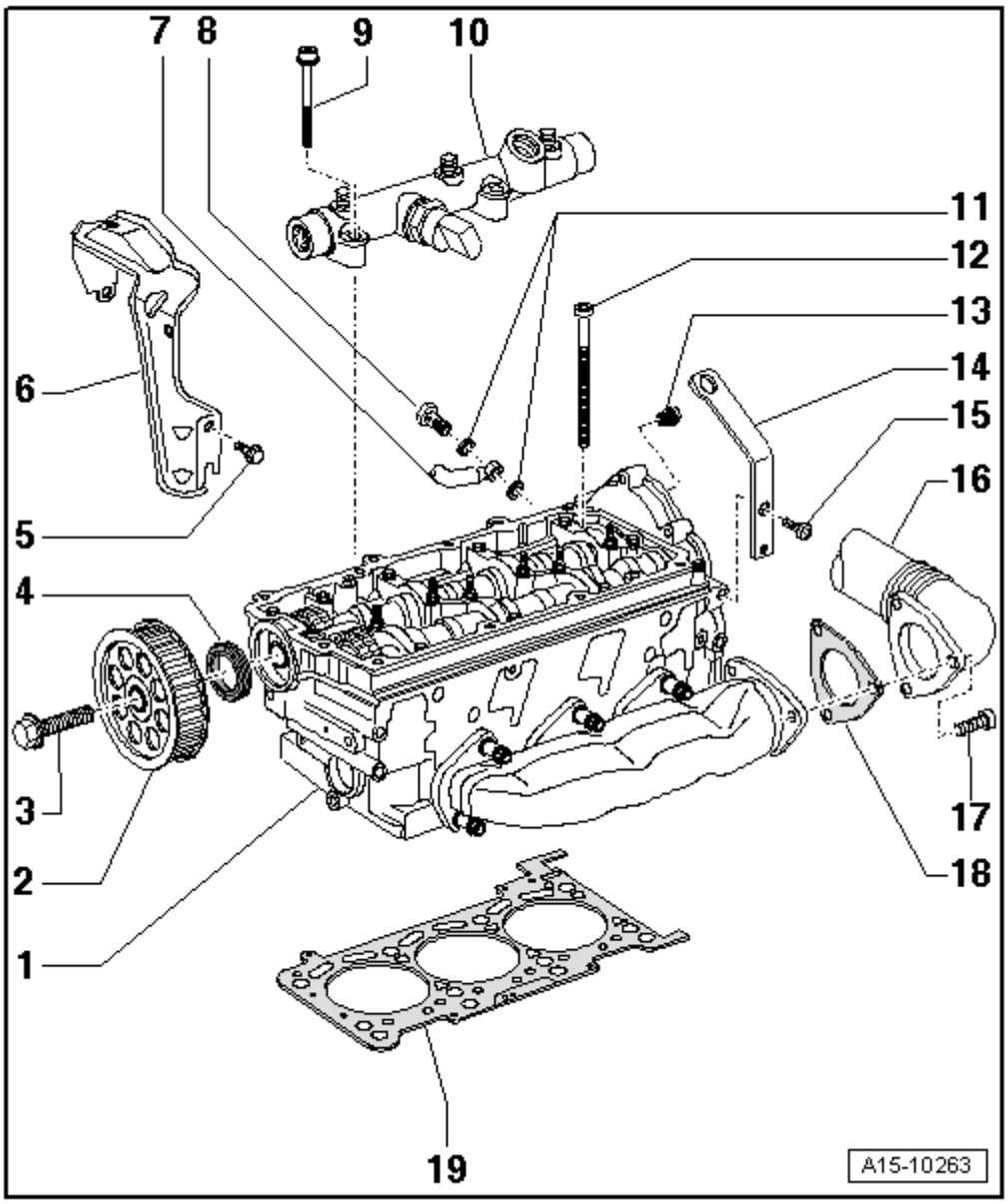


Fig. 5: Identifying Cylinder Head Overview
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. **Cylinder Head**
   - Only set the removed cylinder head down on a foam pad. Otherwise the glow plugs can be damaged.
   - Removing, refer to **CYLINDER HEAD**.
   - Check for distortion, refer to **CHECKING CYLINDER HEAD FOR DISTORTION**.
   - Do not rework diesel cylinder heads.
   - Installing, refer to **INSTALLING**
   - Replace the coolant after replacing.
2. **Toothed Belt Drive Gear**

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- Loosen and tighten the central bolt using Retainer 3036. Refer to **LOOSENING AND TIGHTENING THE CENTRAL BOLT FOR THE TOOTHED BELT DRIVE GEAR**.
- Remove using puller T10320. Refer to **REMOVING THE TOOTHED BELT DRIVE GEAR**.

3. **Bolt**
   - 75 Nm
   - Loosen and tighten using Retainer 3036. Refer to **LOOSENING AND TIGHTENING THE CENTRAL BOLT FOR THE TOOTHED BELT DRIVE GEAR**.
4. **High Pressure Pump Toothed Belt Sprocket Seal**
   - Replacing, refer to **CAMSHAFT SEAL**.
5. **Bolt**
   - 9 Nm
6. **Oil Dipstick Bracket**
7. **Coolant Ventilation Line**
   - Illustration does not correspond to version in vehicle.
8. **Banjo Bolt**
   - 15.5 Nm
9. **Bolt**
   - 23 Nm
10. **Fuel Rail**
    - Note the rules of cleanliness. Refer to **CLEAN WORKING CONDITIONS** .
    - Do not change the angles of the high pressure lines.
    - Tighten the high pressure line to the fuel rail. Refer to one of the following:

      Using a 14 mm wrench, refer to **TIGHTENING THE HIGH PRESSURE LINE TO THE FUEL RAIL WITH A 14 MM WRENCH**.

      Using a 19 mm wrench, refer to **TIGHTENING THE HIGH PRESSURE LINE TO THE FUEL RAIL WITH A 19 MM WRENCH**.

11. **Seals**
    - Always replace.
12. **Bolt**
    - Always replace.
    - Observe the sequence for loosening, refer to **LOOSEN THE CYLINDER HEAD BOLTS IN THE SEQUENCE SHOWN**.
    - Note the tightening sequence, refer to **TIGHTEN THE CYLINDER HEAD BOLTS IN SEQUENCE -1 THROUGH 8- AS FOLLOWS**.
13. **Oil Check Valve**
    - Tighten to 25 Nm.
14. **Lifting Eye**

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15. **Bolt**
    - M6 - 9 Nm
    - M8 - 23 Nm
16. **Left Intermediate Pipe**
    - Removing and installing, refer to **LEFT INTERMEDIATE PIPE** .
17. **Bolt**
    - 30 Nm + 90° (1/4) additional turn.
    - Always replace.
    - Lubricate with hot bolt paste.
18. **Gasket**
    - Always replace.
19. **Cylinder Head Gasket**
    - Replacing, refer to **CYLINDER HEAD**.
    - Identification, refer to **CYLINDER HEAD GASKET IDENTIFICATION**.
    - Installed position: the part number points toward the cylinder head.
    - Replace the coolant after replacing.

LOOSENING AND TIGHTENING THE CENTRAL BOLT FOR THE TOOTHED BELT DRIVE GEAR

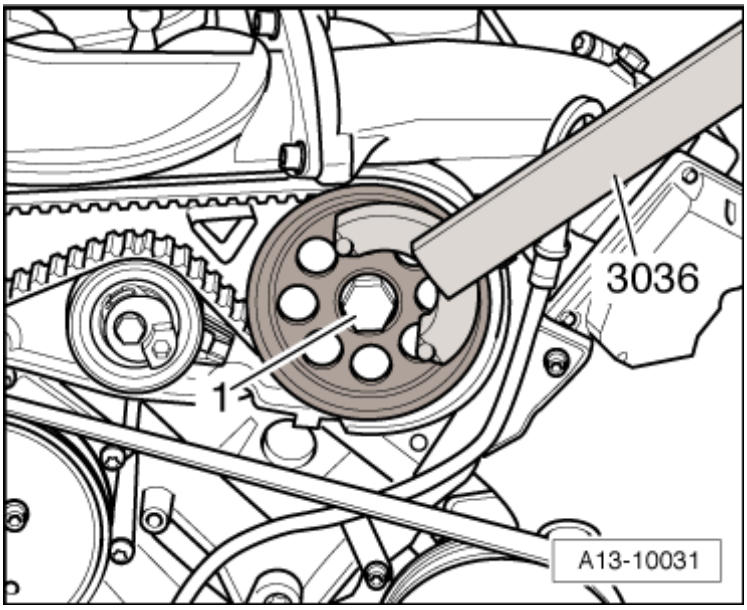


Fig. 6: Identifying Toothed Belt Drive Gear Bolt, Loosening and Tightening
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Loosen and tighten the central bolt -1- using the Retainer 3036.

REMOVING THE TOOTHED BELT DRIVE GEAR

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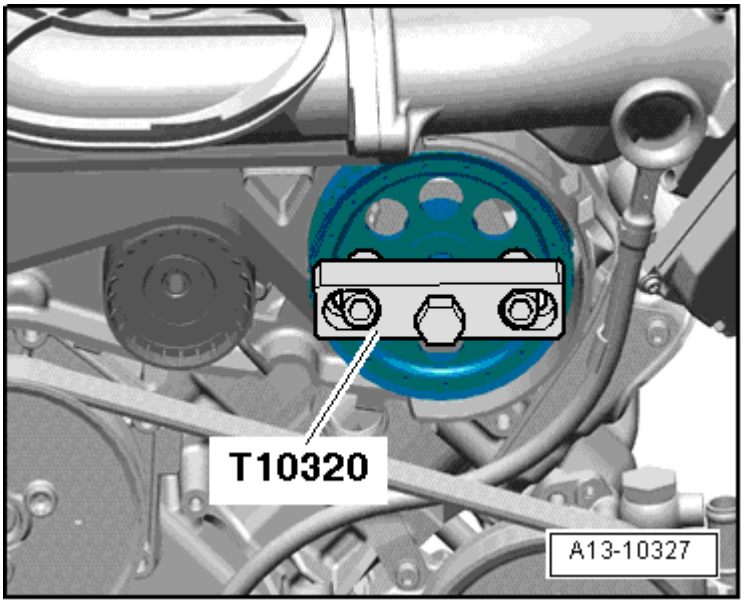


Fig. 7: Identifying Toothed Belt Drive Gear, Removing
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

CHECKING CYLINDER HEAD FOR DISTORTION

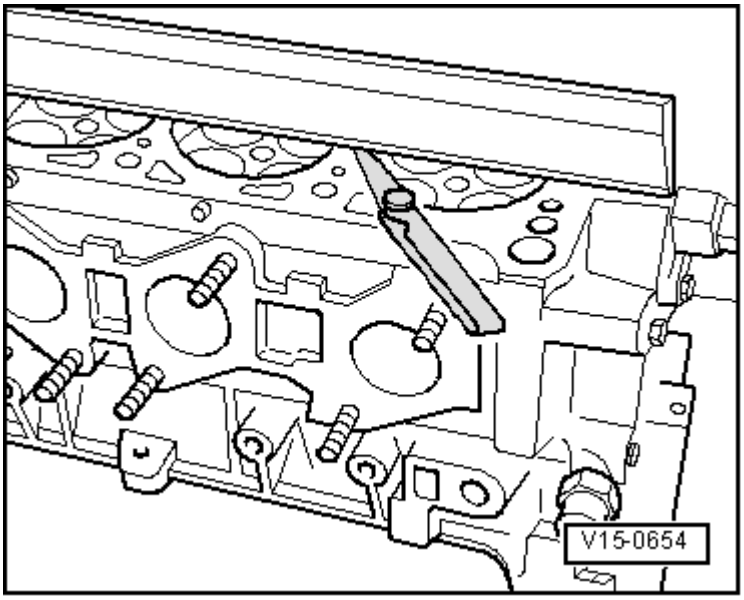


Fig. 8: Identifying Check Of Cylinder Head For Distortion
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Check the cylinder head at multiple points for distortion, using a straightedge and feeler gauge.

- Max. permissible distortion: 0.1 mm

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CYLINDER HEAD GASKET IDENTIFICATION

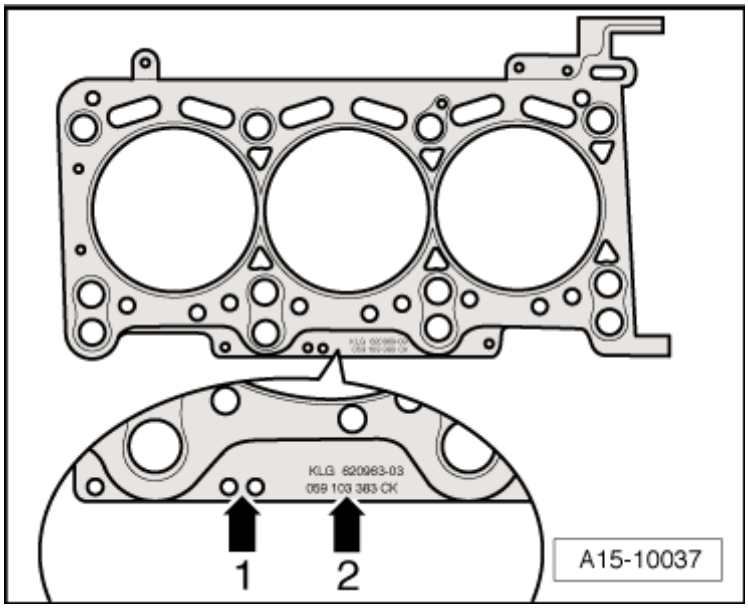


Fig. 9: Identifying Cylinder Head Gasket Identification
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. **Holes**
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.

VACUUM PUMP OVERVIEW

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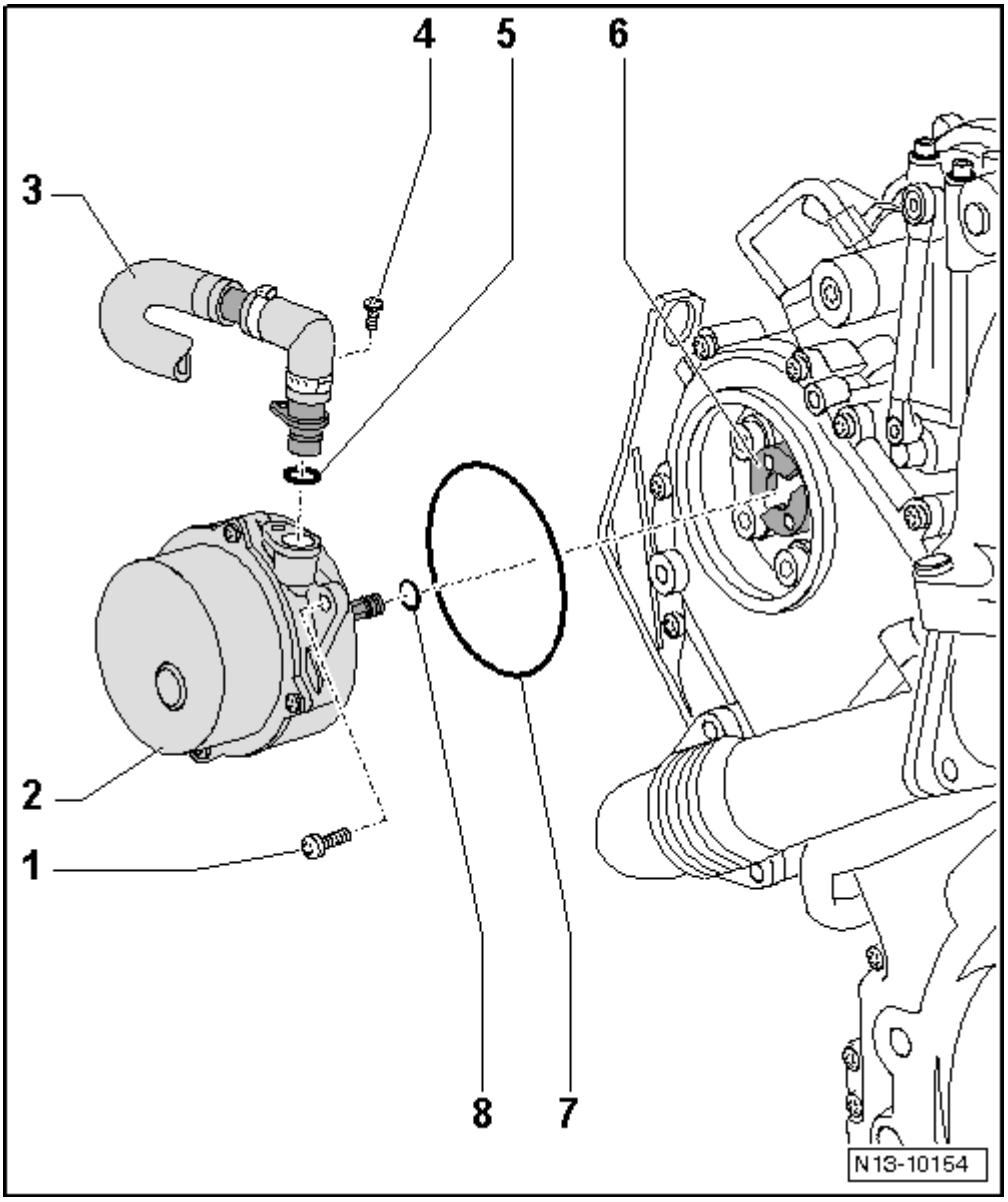


Fig. 10: Identifying Brake Booster Vacuum Pump Overview, Diesel Engine
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. **Bolt**
   - 9 Nm
2. **Vacuum Pump**
3. **Vacuum Hose**
4. **Bolt**
   - 5 Nm
5. **O-ring**
   - Always replace.
6. **Intake Camshaft**

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7. **O-ring**
   - Always replace.
8. **O-ring**
   - Always replace.

VALVETRAIN OVERVIEW

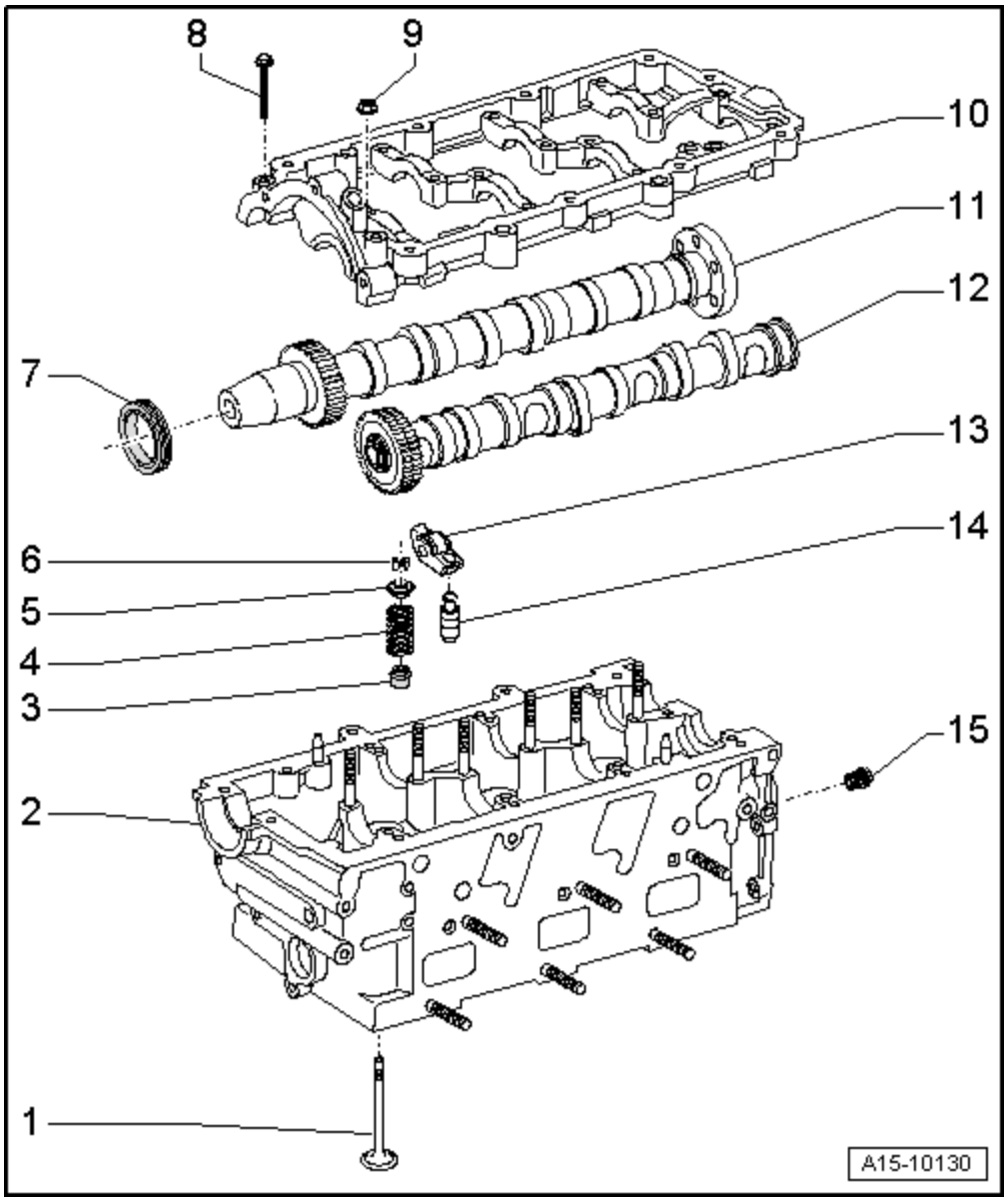


Fig. 11: Identifying Valvetrain Overview
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. **Valve**
   - Replace if there are signs of wear on the stem and seating surface.
   - Do not grind, only lapping is permitted.

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- Mark the installed position for installation later.
- Valve dimensions, refer to **VALVE DIMENSIONS**.
- Valve guide checking, refer to **VALVE GUIDE, CHECKING**.

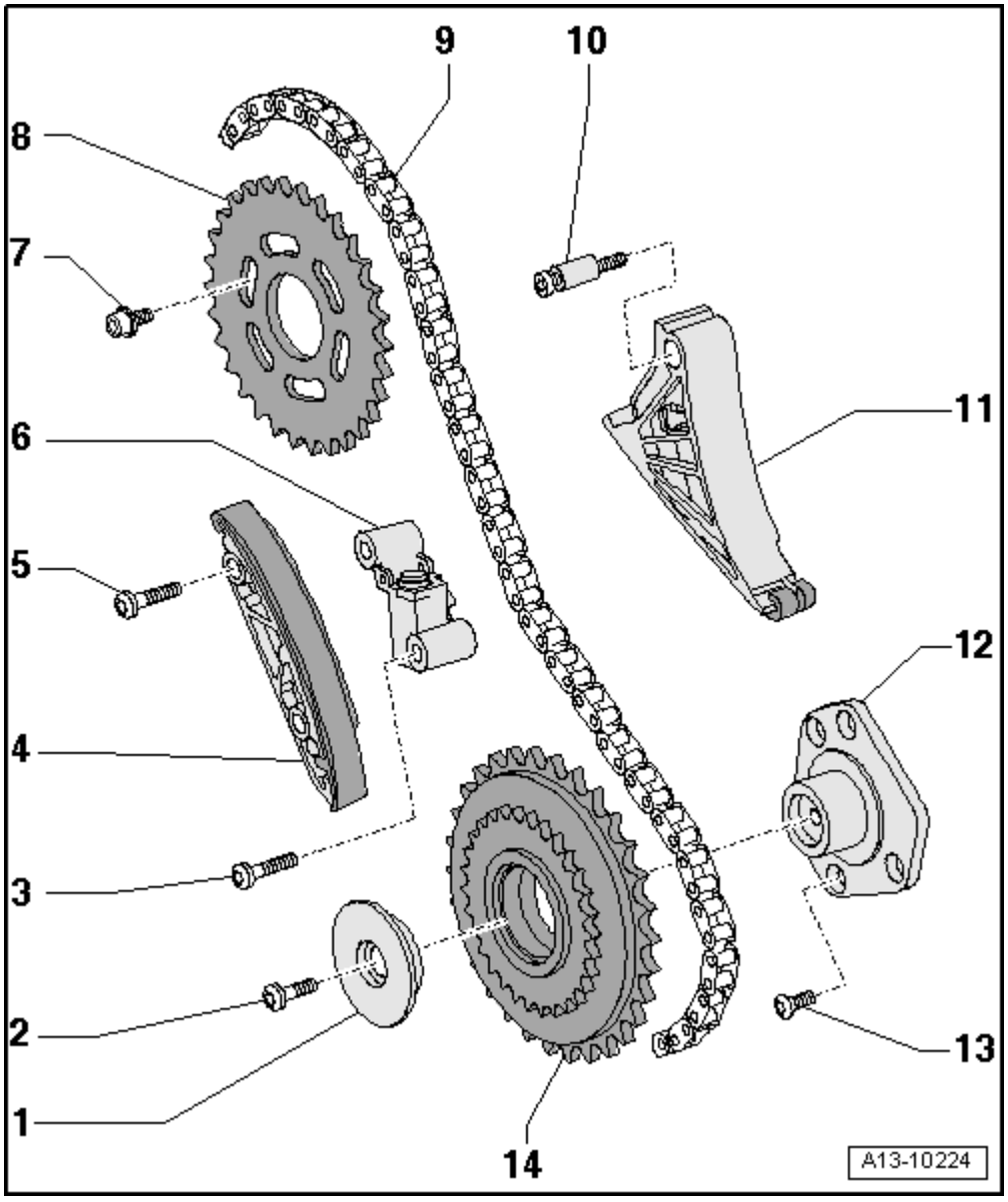
2. **Cylinder Head**
   - Removing and installing, refer to **CYLINDER HEAD**.
3. **Valve Stem Seal**
   - Replacing, refer to **VALVE STEM SEALS**.
4. **Valve Spring**
5. **Valve Spring Plate**
6. **Valve Retainers**
7. **Camshaft Seal**
   - Replacing, refer to **CAMSHAFT SEAL**.
8. **Bolt**
   - 9 Nm
   - Observe the tightening sequence, refer to **CAMSHAFTS**.
9. **Nut**
   - 9 Nm
   - Observe 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 lever removed).
    - New radial clearance: 0.035 to 0.085 mm
    - Radial clearance wear limit: 0.1 mm
    - Runout: maximum 0.01 mm
12. **Exhaust Camshaft**
    - Removing and installing, refer to **CAMSHAFTS**.
    - Checking axial play **CAMSHAFT AXIAL CLEARANCE, CHECKING**.
    - Check radial clearance using Plastigage® (roller rocker lever removed).
    - New radial clearance: 0.035 to 0.085 mm
    - Radial clearance wear limit: 0.1 mm
    - Runout: maximum 0.01 mm
13. **Roller Rocker Lever**
    - Mark the installed position.
    - Do not interchange.

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- Check the roller for ease of movement.
- Lubricate the contact surface.

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 -item 4- under **TIMING MECHANISM DRIVE CHAIN OVERVIEW** .
3. **Bolt**
   - 5 Nm + 90° (1/4) additional turn.
   - Always replace.
4. **Guide Rail**
   - Note the installed position.
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 Chain Sprocket**
   - For the intake camshaft.
   - Installed position: the side with the writing on it faces forward.
9. **Left Camshaft Timing Chain**
   - Removing from the camshafts, refer to **CAMSHAFT TIMING CHAINS, REMOVING FROM CAMSHAFTS**.
   - Before removing, mark the direction of rotation with paint.
   - Removing and installing, refer to **CAMSHAFT TIMING CHAINS**.
10. **Bolt**
    - 5 Nm + 90° (1/4) additional turn.
    - Always replace.
    - With a sleeve.
11. **Tensioning Rail**
12. **Bracket**
    - For the drive sprocket.
13. **Bolt**
    - Tightening specification -item 10- under **TIMING MECHANISM DRIVE CHAIN OVERVIEW** .
14. **Drive Sprocket**

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- For the left camshaft timing chain.

RIGHT CAMSHAFT TIMING CHAIN OVERVIEW

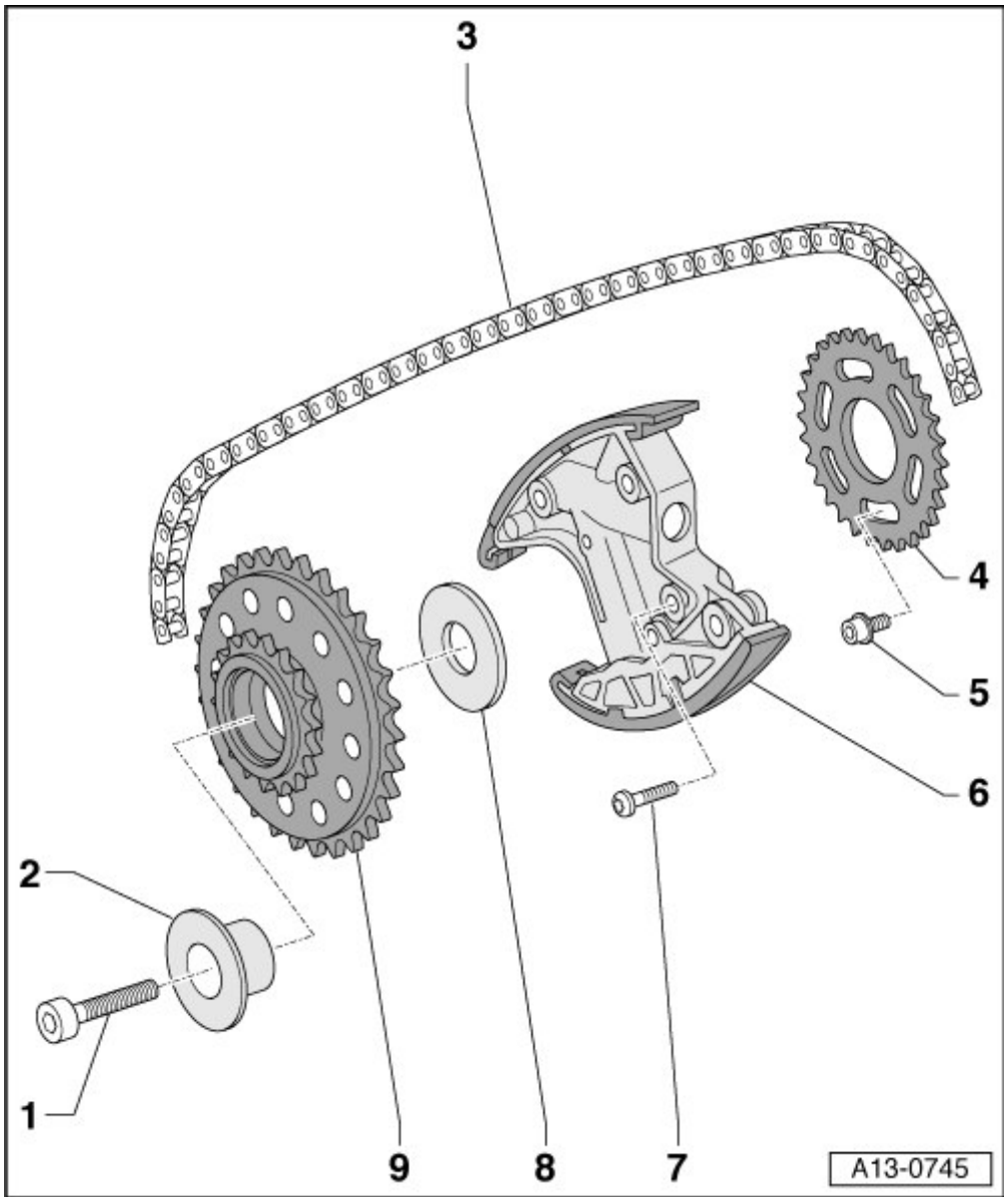


Fig. 13: Identifying Right Camshaft Timing Chain Overview
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. **Bolt**
   - Tightening specification **TIMING MECHANISM DRIVE CHAIN OVERVIEW => Bolt** .
2. **Mounting Pin**
   - For the drive sprocket.
3. **Right Camshaft Timing Chain**
   - Removing from the camshafts, refer to **CAMSHAFT TIMING CHAINS, REMOVING FROM**

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CAMSHAFTS.

- Before removing, mark the direction of rotation with paint.
- Removing and installing, refer to **CAMSHAFT TIMING CHAINS**.

4. **Camshaft Chain Sprocket**
   - For the intake camshaft.
   - Installed position: the side with the writing on it 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.
8. **Thrust Washer**
   - For the drive sprocket.
9. **Drive Sprocket**
   - For the right camshaft timing chain.

SPECIFICATIONS

VALVE DIMENSIONS

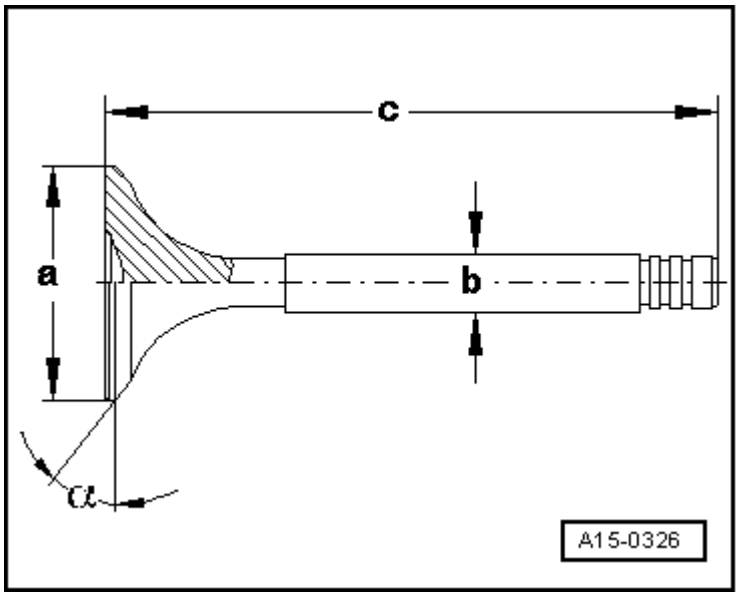


Fig. 14: Identifying Valve Dimensions
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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 to 28.80	26.70 to 26.90
Diameter b	mm	5.968 to 5.982	5.958 to 5.972
c	mm	97.25 to 97.45	97.35 to 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, the valves must be cut into two pieces between the shaft center and valve head. While doing this, do not come into contact with water. At the very most, throw 10 of the prepared valves into a bucket filled with water. Then, move quickly away, because a sudden chemical reaction will occur during which the sodium is burnt away.**
- **The treated parts may then be discarded through conventional disposal channels.**

FASTENER TIGHTENING SPECIFICATIONS

Component	Fastener Size	Nm
Camshaft Chain Sprocket to Camshaft Bolt	-	23
Camshaft Timing Chain Tensioner Bolt (1)	-	5 + 90°
Coolant Ventilation Line to Cylinder Head Banjo Bolt	-	15.5
Cylinder Head Cover Bolt (2)	-	9
Fuel Injector Cover Bolt	-	5
Fuel Injector Tensioning Bracket Nut	-	10
Fuel Rail to Cylinder Head Bolt	-	23
Fuel Return Line to High Pressure Pump Banjo Bolt	-	25
Fuel Supply Line to High Pressure Pump Banjo Bolt	-	25
High Pressure Fuel Line to Fuel Injector Union Nut	-	25
High Pressure Fuel Line to Fuel Rail Union Nut	-	25
Hose Clamp, 13 mm Wide	-	5.5
Intermediate Exhaust Pipe to Exhaust Manifold Bolt (1)	-	30 + 90°
Intake Tube Bracket to Cylinder Head Bolt	-	9
Left Timing Chain Guide Rail Bolt (1)	-	5 + 90°
Left Timing Chain Tensioning Rail Bolt (1)	-	5 + 90°
Lifting Eye Bolt		
	M6	9
	M8	23
Oil Check Valve to Cylinder Head	-	25
Oil Dipstick Tube Bracket Bolt	-	9

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Pressure Relief Valve to Cylinder Head	-	25
Rear Toothed Belt Guard to Engine Bolt	-	9
Right Coolant Pipe to Cylinder Head Bolt	-	9
Throttle Valve Control Module with Intake Tube to Bracket Bolt	-	9
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 Bolt	-	75
Vacuum Hose to Vacuum Pump Bolt	-	5
Vacuum Pump to Cylinder Head Bolt	-	9
Wiring Harness Bracket to Cylinder Head Bolt	-	9
(1) Always replace (2) Tighten in a diagonal sequence and in stages		

Cylinder Head Bolt Tightening Sequence and Specifications

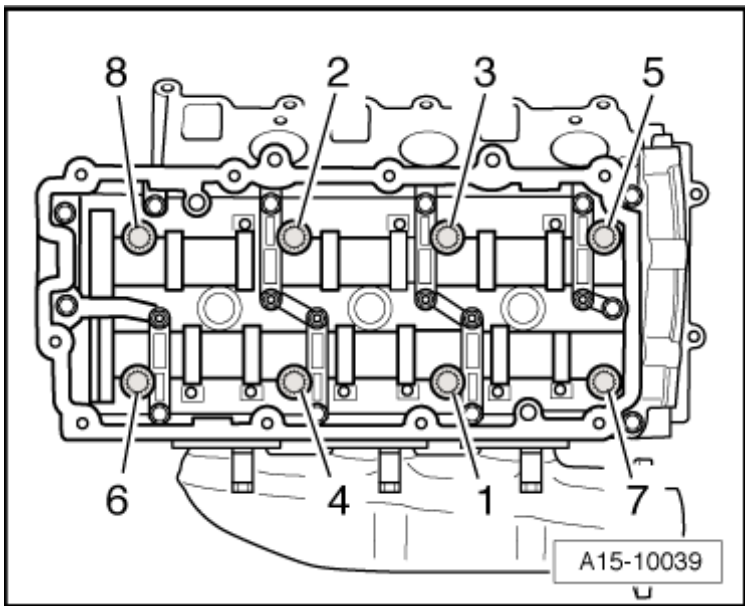


Fig. 15: Identifying Cylinder Head, Tightening Specifications and Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Tighten the cylinder head bolts in the 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).

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

Guide Frame Bolt Tightening Sequence and Specification

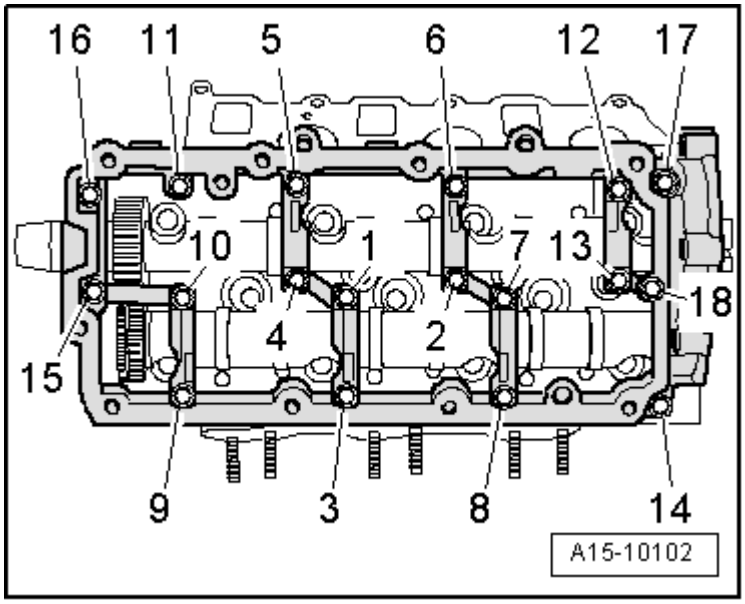


Fig. 16: Identifying Left Cylinder Head Guide Frame, Tightening Specifications and Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

-- Tighten the guide frame bolts/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 approximately 80 °C (176 °F).
- Battery voltage min. 12.5 volts.

-- Carefully pull the engine cover off the 4 studs one after the other -arrows-.

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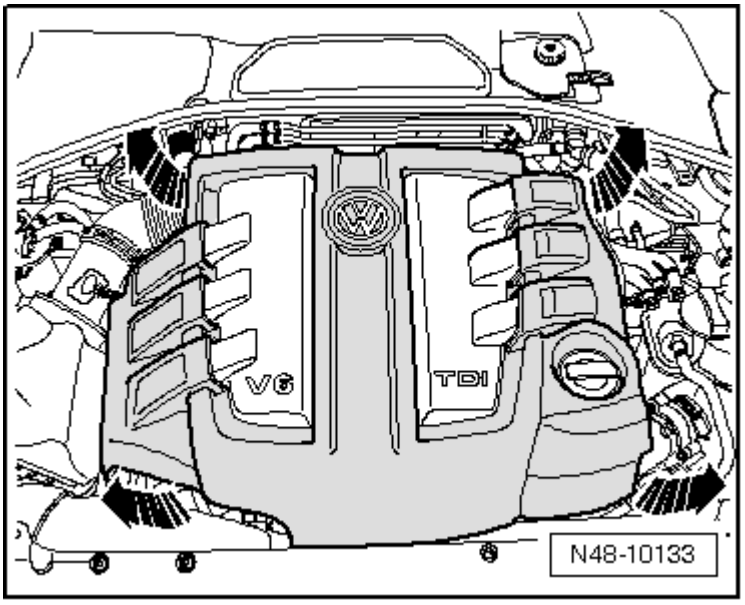


Fig. 17: Identifying Removal Of Engine Cover From 4 Ball Studs -Arrow-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Disconnect the connectors from the glow plugs.

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

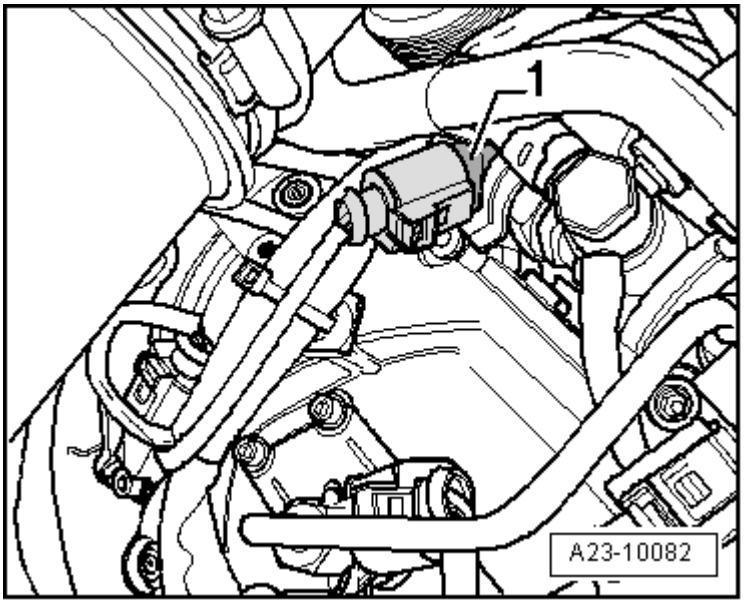


Fig. 18: Identifying Connector From Fuel Pressure Regulator Valve -1-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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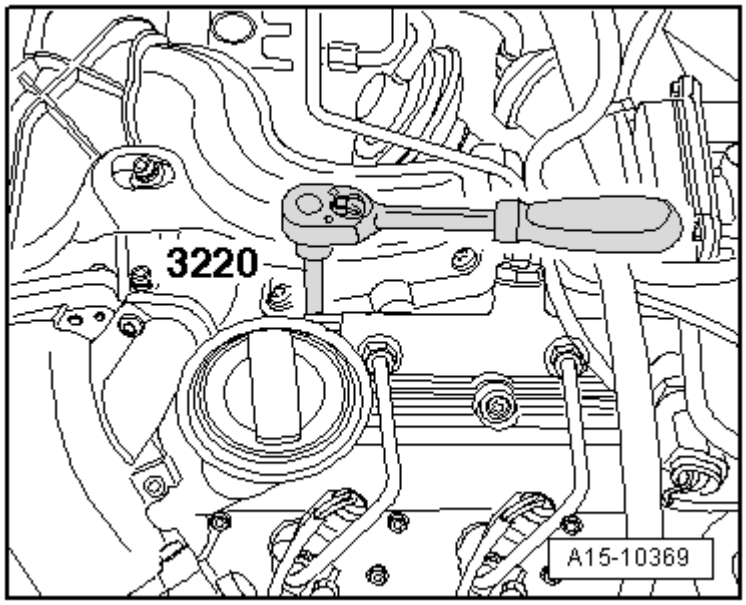


Fig. 19: Identifying Socket 3320 To Remove Glow Plugs
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

CERAMIC GLOW PLUGS .

METAL GLOW PLUGS .

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

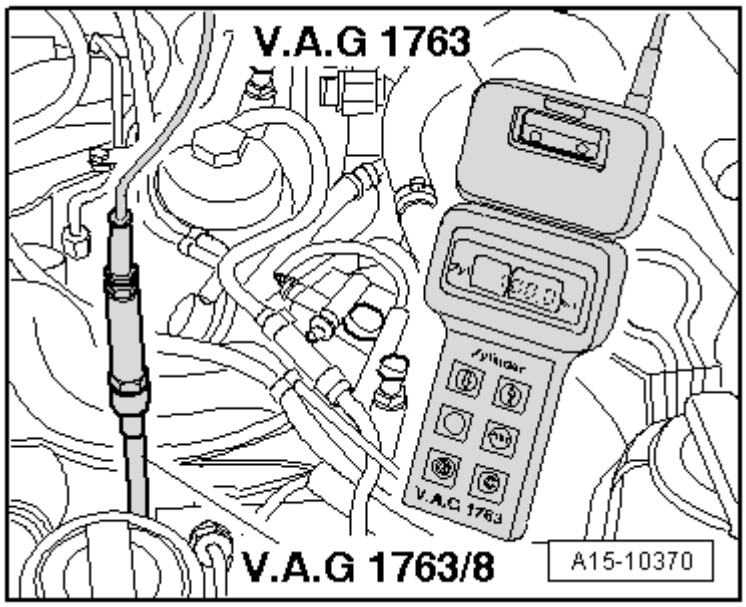


Fig. 20: Identifying Adapter V.A.G 1763/8 And Compression Tester V.A.G 1763
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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NOTE: Using 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 to 33
Wear limit	21
Difference between cylinders	Max. 5

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

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

CERAMIC 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
- Dial Gauge (0-10 mm) VAS 6079

Intake Camshaft

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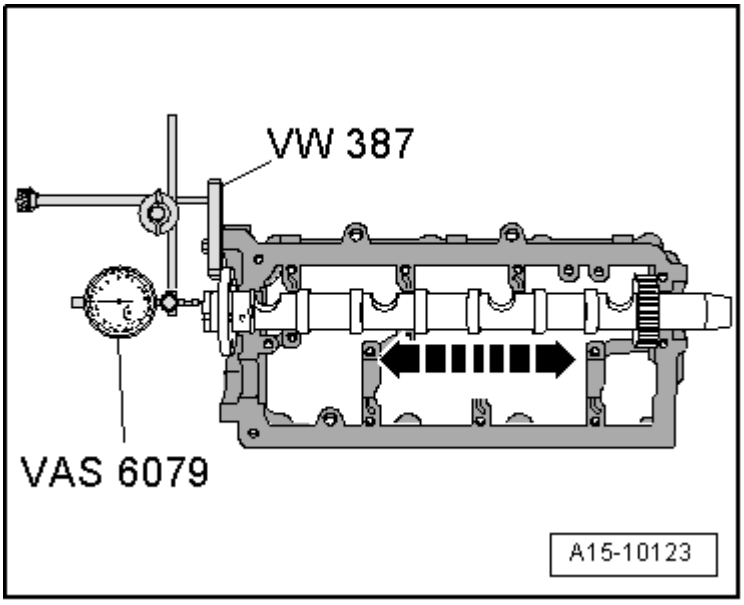


Fig. 21: Identifying Dial Gauge Holder VW387 And Dial Gauge (0-10 mm) VAS6079, Intake Camshaft Check
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

- Target value: 0.03 to 0.08 mm
- Wear limit 0.12 mm

Exhaust Camshaft

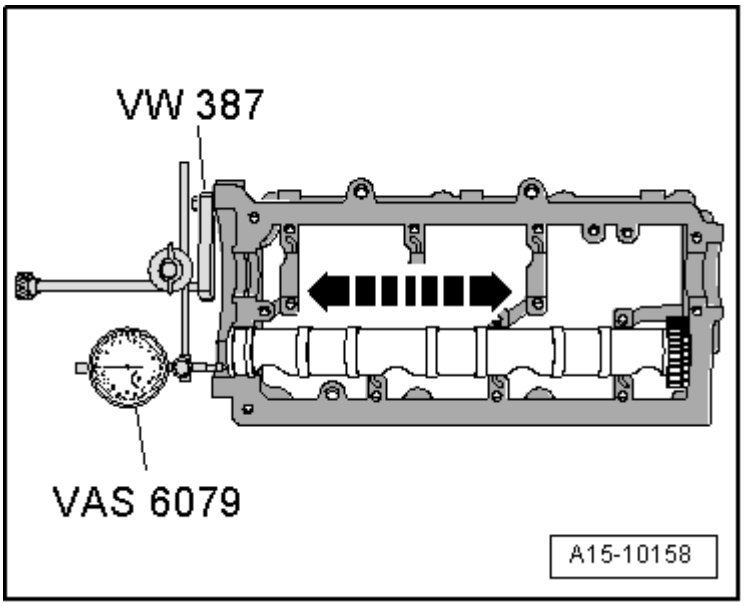


Fig. 22: Identifying Dial Gauge Holder VW387 And Dial Gauge (0-10 mm) VAS6079, Exhaust Camshaft Check
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

- Target 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: Hydraulic lash adjusters cannot be repaired.

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.

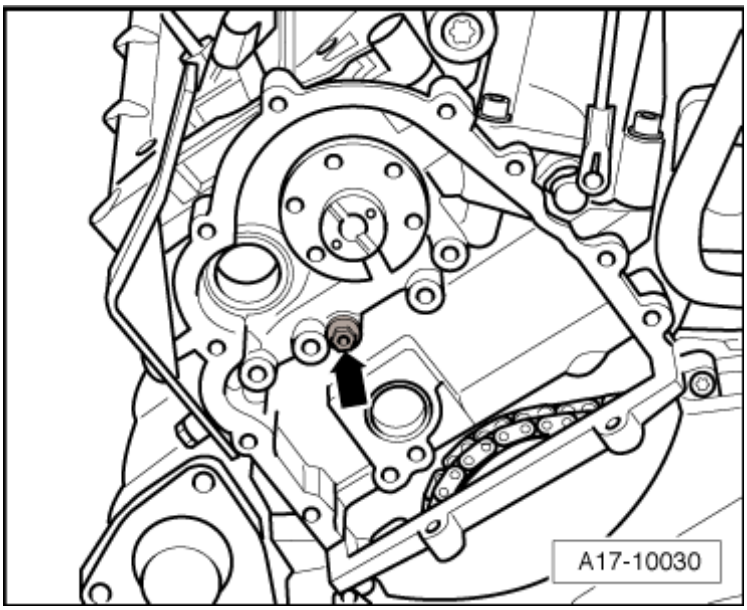


Fig. 23: Identifying Oil Check Valve
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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

-- Rotate the crankshaft until the cams on the hydraulic lash adjuster to be checked is at the top. To do this:

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

-- Determine the play between the cams and the roller rocker lever.

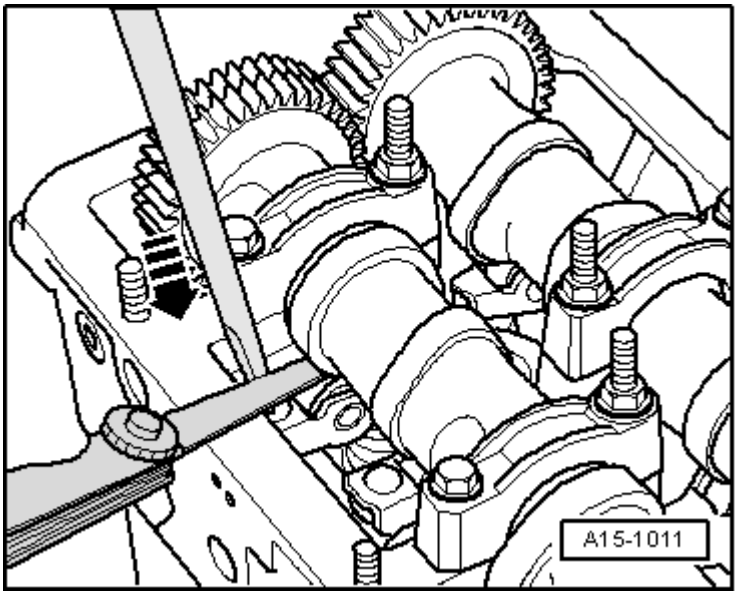


Fig. 24: Identifying Play Between Cams With Screwdriver -Arrow- And 0.20 mm Feeler Gauge
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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

-- 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

Sequence

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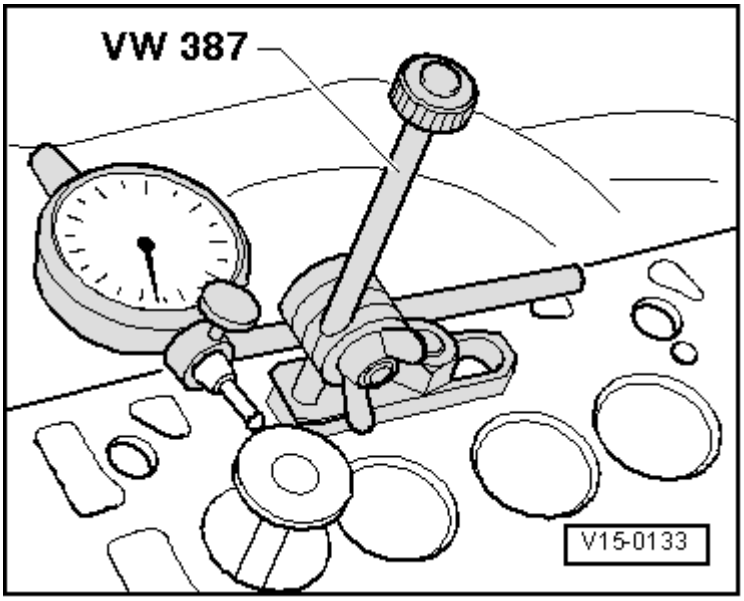


Fig. 25: Identifying Determining Valve Rock (Wear Limit)
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Insert valve into the valve guide.

- Valve stem tip must seal with 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 tilt clearance.

- Tilt clearance wear limit: intake and exhaust valve guide 1.0 mm

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

If the valve is to be replaced as part of a repair, use a 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

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- Puller T10055
- Socket T40055

Removing

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

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

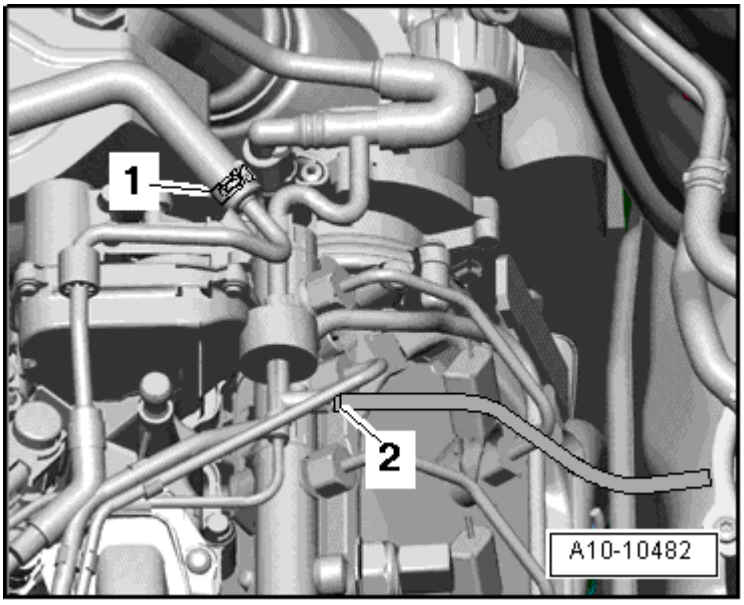


Fig. 26: Identifying Vacuum Hose -2-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

NOTE: Ignore -1-.

-- Place a clean cloth under the separating location to catch any fuel that may leak out.

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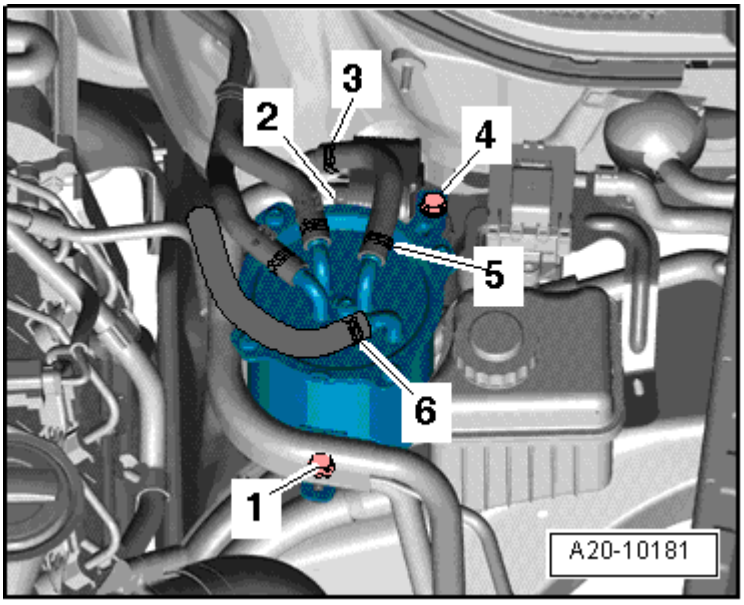


Fig. 27: Identifying Bolts -1 & 2-, Fuel Hose -3 & 5-, Fuel Supply Hose -6- And Nut -4-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CAUTION: Always observe the rules for cleanliness when working on the injection system. Refer to CLEAN WORKING CONDITIONS .

-- Remove the fuel supply hose -6- from the fuel filter.

-- Remove the fuel hose -3 and 5- to the fuel cooler.

-- Remove the bolts -1 and 2- and the nut -4-.

-- Free up the fuel lines at the plenum chamber bulkhead and lay the fuel filter aside with the fuel hoses connected.

-- Remove the wiring connector -1-.

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

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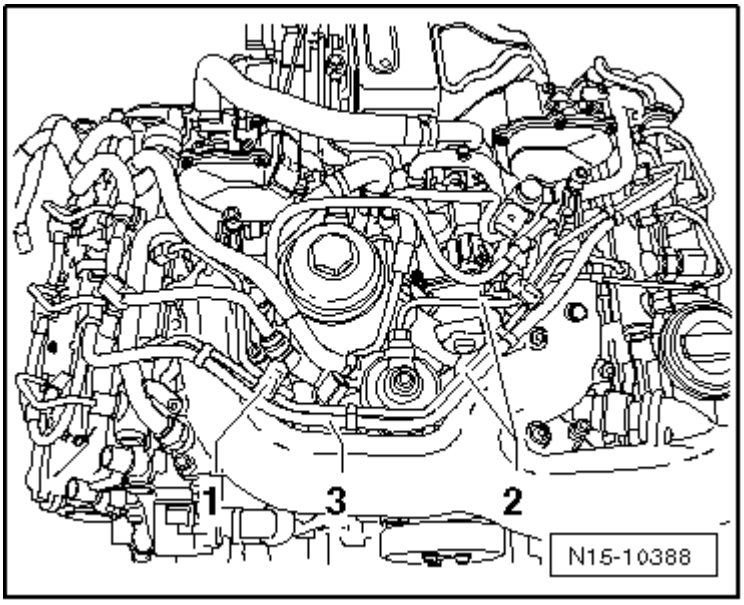


Fig. 28: Identifying Wiring Connector -1-, High Pressure Fuel Lines -2- And The Overflow Oil Line -3-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

For the Left Cylinder Head Cover

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

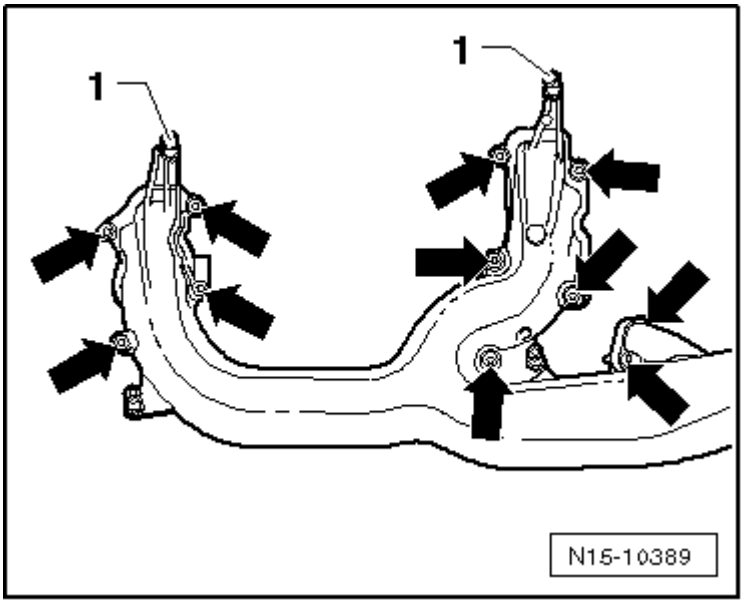


Fig. 29: Identifying Engine Cover Bracket -1-, Bolts -Arrows- And Upper Intake Manifold
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Continuation for All

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

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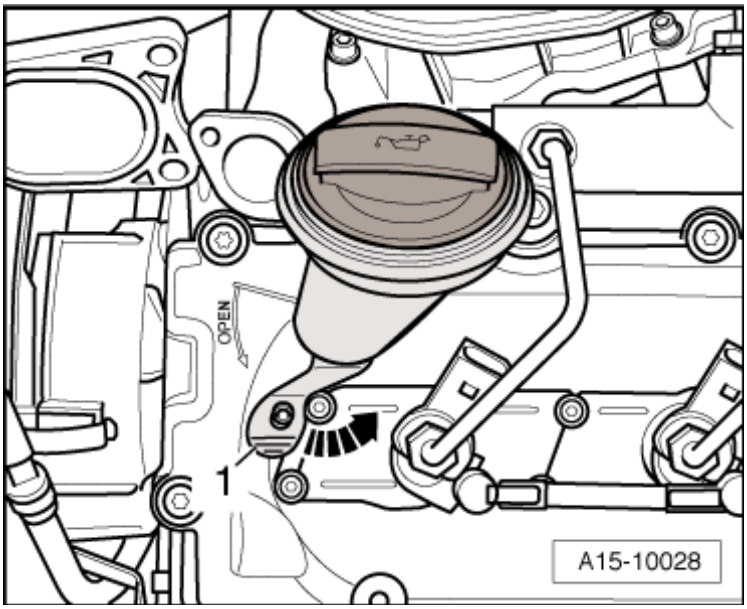


Fig. 30: Identifying Tab -1- And Position To Turn Oil Filler Tube (Counterclockwise -Arrow-)
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

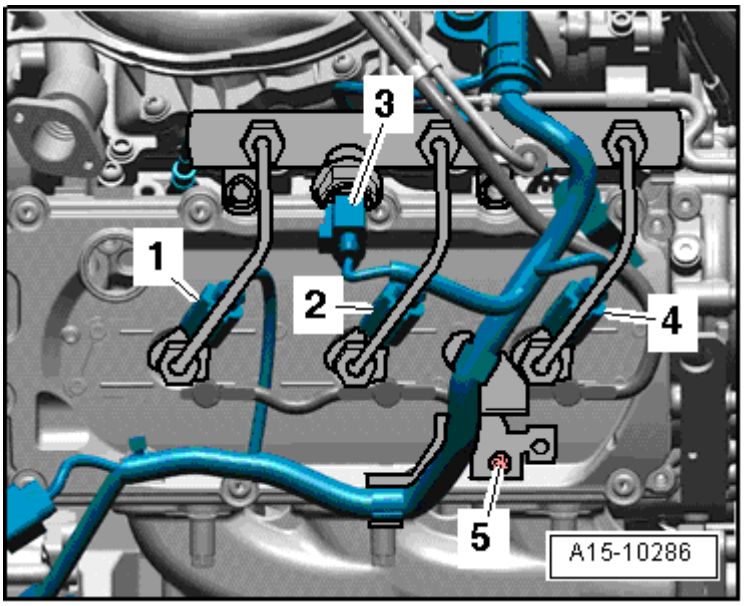


Fig. 31: Identifying Connectors -1 Through 4- To Fuel Injectors
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

-- Free up the wiring harness.

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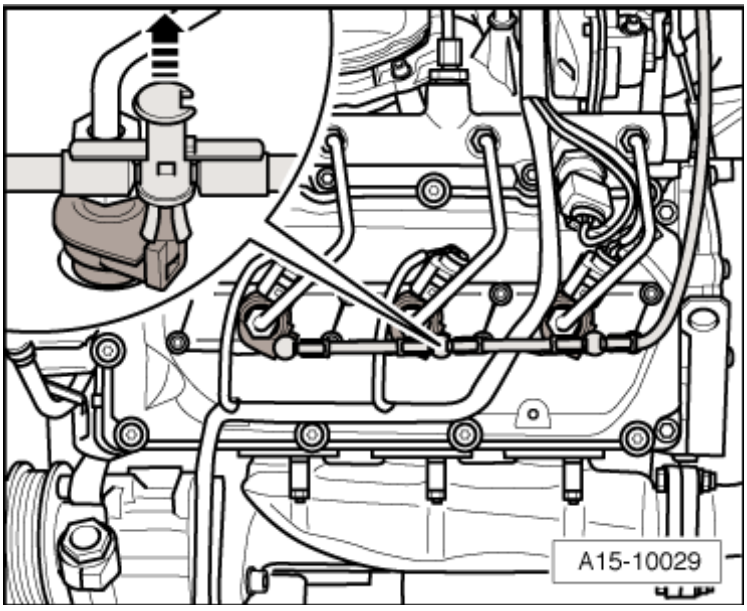


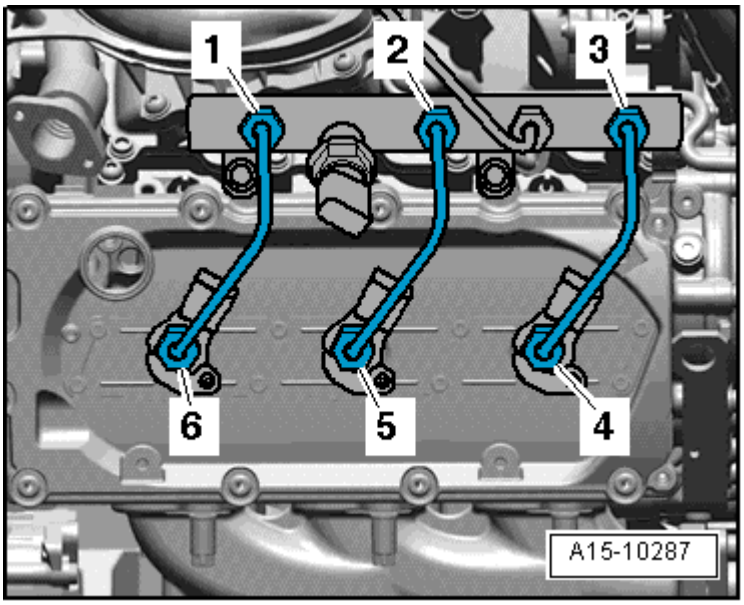
Fig. 32: Identifying Release Pins Upward -Arrow-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CAUTION: Always observe the rules for cleanliness when working on the injection system. Refer to CLEAN WORKING CONDITIONS .

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

-- Remove the high pressure lines.

-- Remove the injector covers bolts -arrows-.

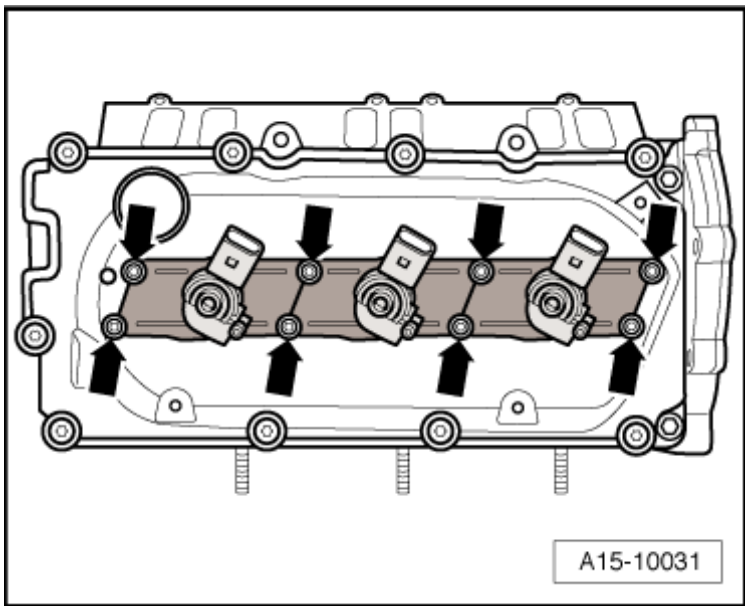


Fig. 34: Identifying Injector Cover Bolts -Arrows-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Pull the covers upward and rotate them 90° (1/4 turn).

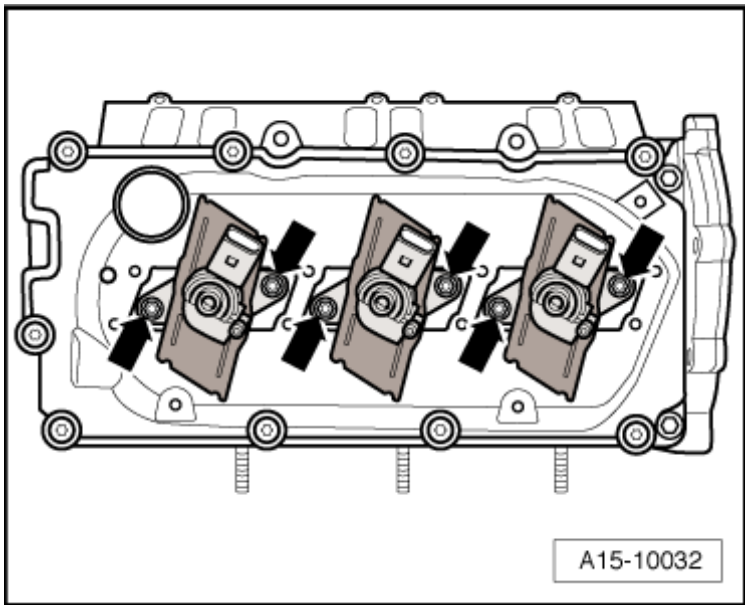


Fig. 35: Identifying Injector Tensioning Bracket Nuts -Arrows-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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-- Remove the injector tensioning plate nuts -arrows-.

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

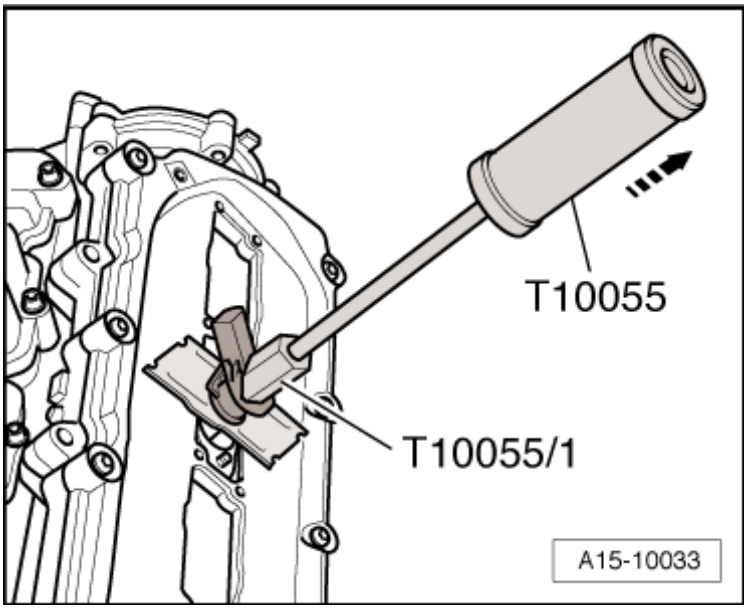


Fig. 36: Identifying Puller T10055 With Adapter T10055/1
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

-- Loosen the cylinder head cover bolts -arrows- in a diagonal sequence.

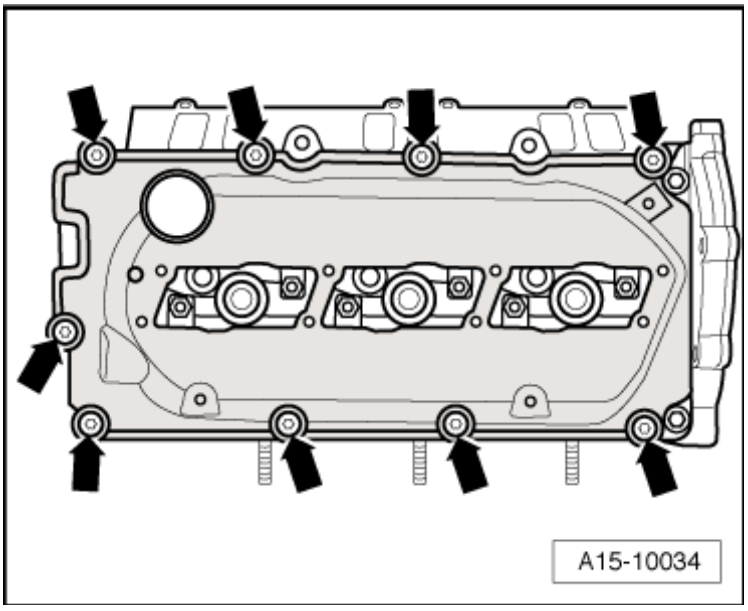


Fig. 37: Identifying Cylinder Head Cover, Tightening Specifications and Sequence

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Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Remove the bolts and the cylinder head cover.

Installing

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

NOTE: Replace the cylinder head cover gaskets if 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 in a diagonal sequence and in stages.

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.
- The fuel injectors must not be damaged. To remove the used copper sealing ring from the fuel injector, clamp the sealing ring carefully in a vise until the clamping jaws on the vise prevent the ring from turning. Pull the fuel injector out of the copper sealing ring by hand with a slight twisting and pulling motion.
- The high pressure line and tensioning bracket must be replaced when replacing the injector.
- When installing, the fuel injectors and injection lines may only be installed on 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:

Using a 14 mm wrench, refer to **TIGHTENING THE HIGH PRESSURE LINE TO THE FUEL RAIL WITH A 14 MM WRENCH**.

Using a 17 mm wrench, refer to **TIGHTENING THE HIGH PRESSURE LINE TO THE FUEL INJECTOR WITH A 17 MM WRENCH**.

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Using a 19 mm wrench, refer to **TIGHTENING THE HIGH PRESSURE LINE TO THE FUEL RAIL WITH A 19 MM WRENCH**.

-- Inspect the fuel system for leaks. Refer to **FUEL SYSTEM, PERFORMING LEAK TEST** .

Tightening Specifications

Component		Nm
Cylinder head cover to cylinder head		9
Injector to cylinder head		9
Injector cover to cylinder head		5
High pressure lines		25
Wiring harness bracket to cylinder head		9
Intake tube bracket to cylinder head		9
Throttle valve control module 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

Special tools and workshop equipment required

- Retainer 3036 for the left cylinder head
- Puller T10320 for the left cylinder head
- Puller T40064 for the left cylinder head

REMOVING

-- Drain the coolant. Refer to **DRAINING AND FILLING** .

Left Cylinder Head

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

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

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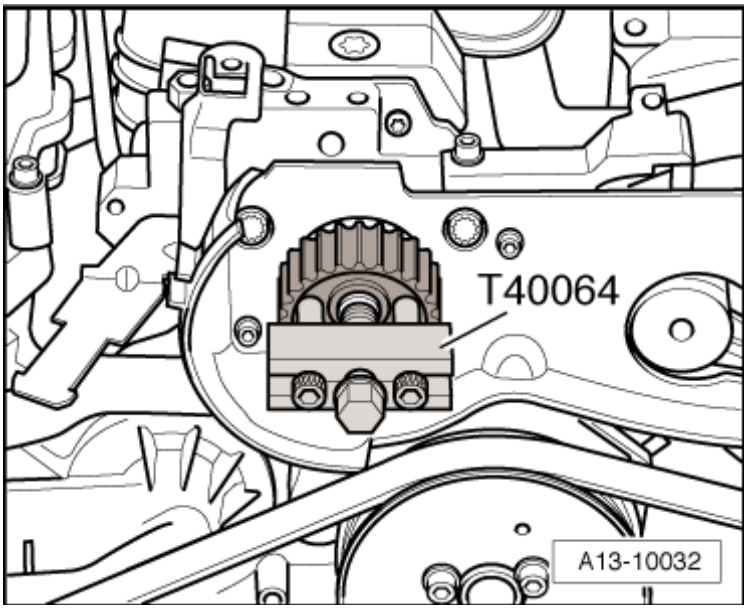


Fig. 38: Identifying High Pressure Pump Toothed Belt Sprocket, Removing
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Using Retainer 3036, loosen the central bolt -1- for the toothed belt drive sprocket approximately two turns.

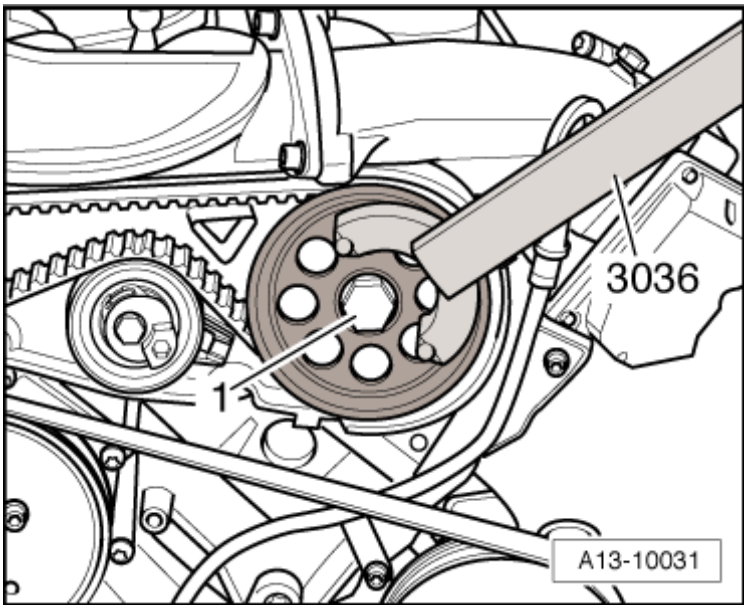


Fig. 39: Identifying Toothed Belt Drive Gear Bolt, Loosening and Tightening
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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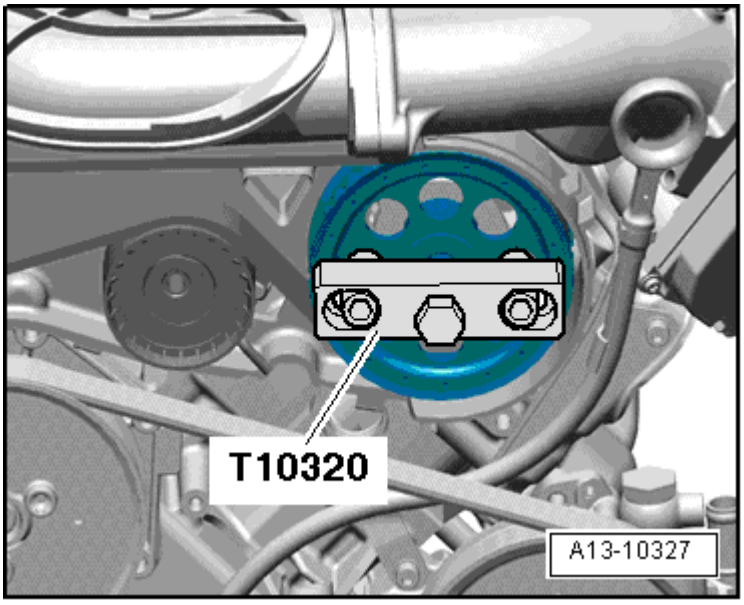


Fig. 40: Identifying Toothed Belt Drive Gear, Removing
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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

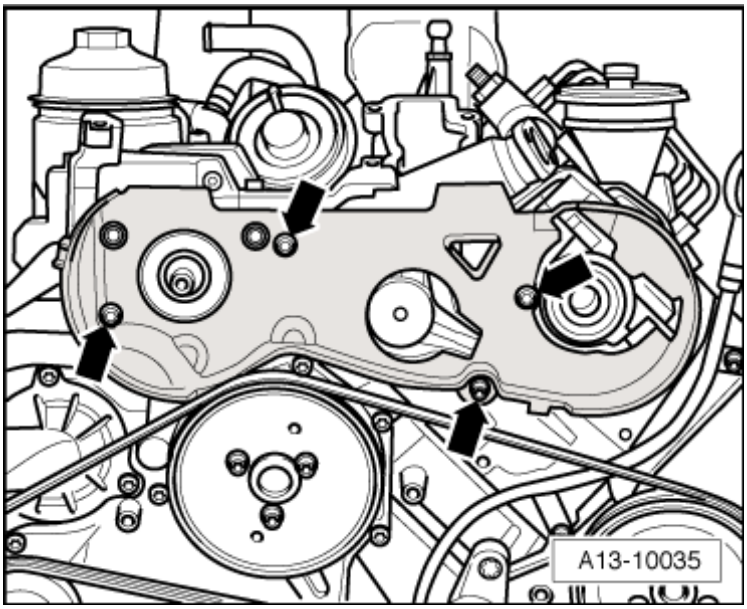


Fig. 41: Identifying Bolts -Arrows- And Rear Toothed Belt Guard
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Right Cylinder Head through 10.05

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

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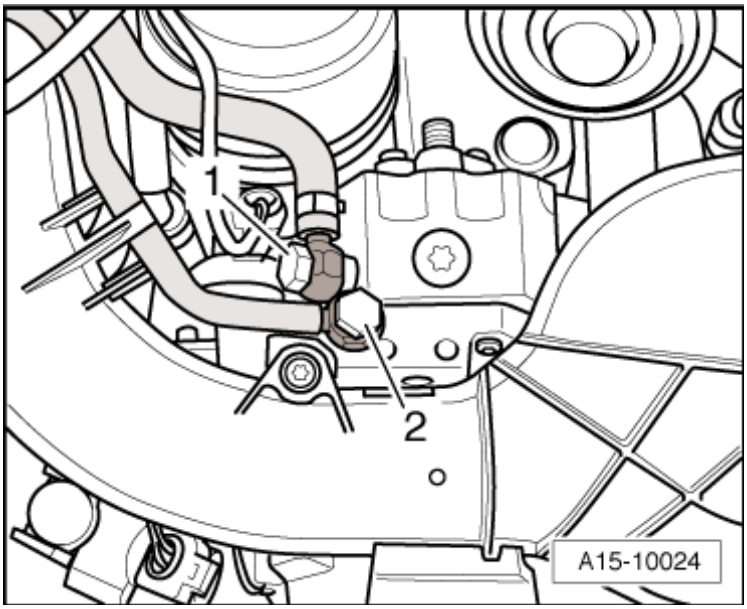


Fig. 42: Identifying Fuel Supply Line Banjo Bolt -2- And Fuel Return Line Banjo Bolt -1-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Right Cylinder Head from 11.05

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

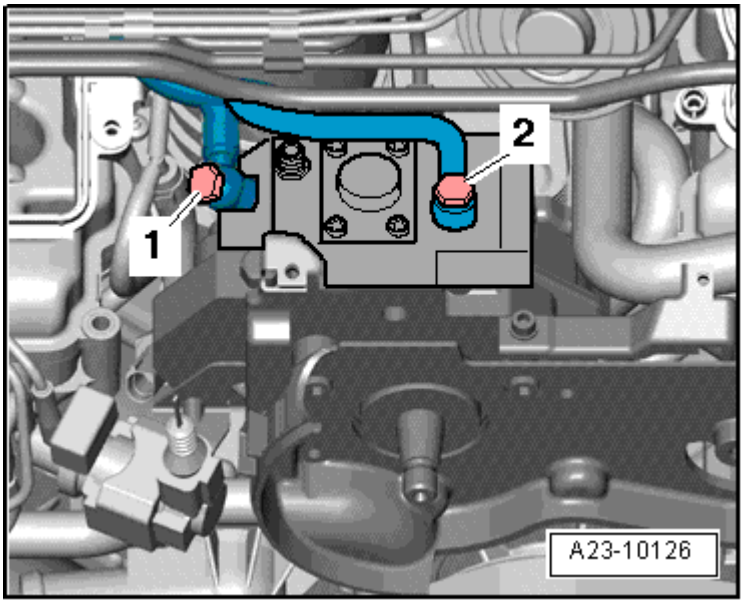


Fig. 43: Identifying Fuel Supply Line Banjo Bolt -2- And Fuel Return Line Banjo Bolt -1-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Continuation for Both Sides

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

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

LOWER LEFT INTAKE MANIFOLD

LOWER RIGHT INTAKE MANIFOLD

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

-- Remove the coolant ventilation line banjo bolt and the coolant ventilation line, refer to -item 8- under **CYLINDER HEAD OVERVIEW**.

-- Remove the intermediate exhaust pipes. Refer to:

LEFT INTERMEDIATE PIPE

RIGHT INTERMEDIATE PIPE

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

Right Cylinder Head

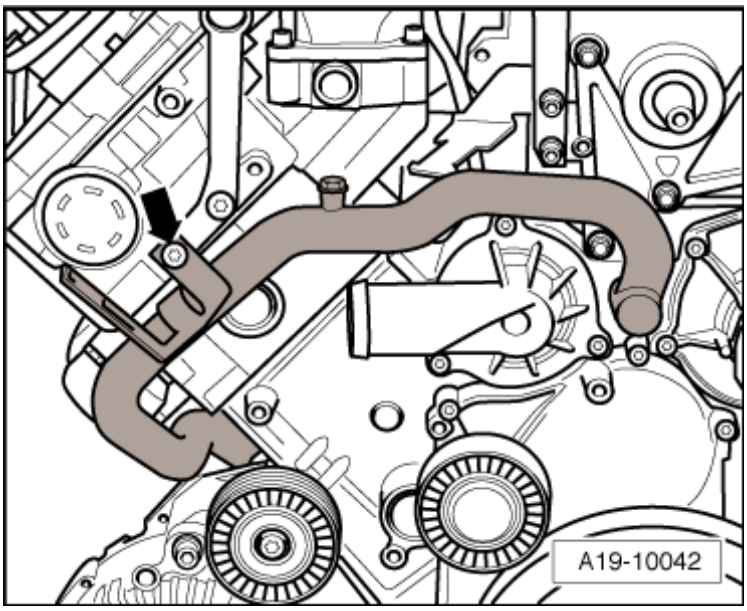


Fig. 44: Identifying Right Coolant Pipe Bolt -Arrow- From Cylinder Head
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

LOOSEN THE CYLINDER HEAD BOLTS IN THE SEQUENCE SHOWN.

Continuation for Both Sides

-- Remove the bolts and carefully remove cylinder head.

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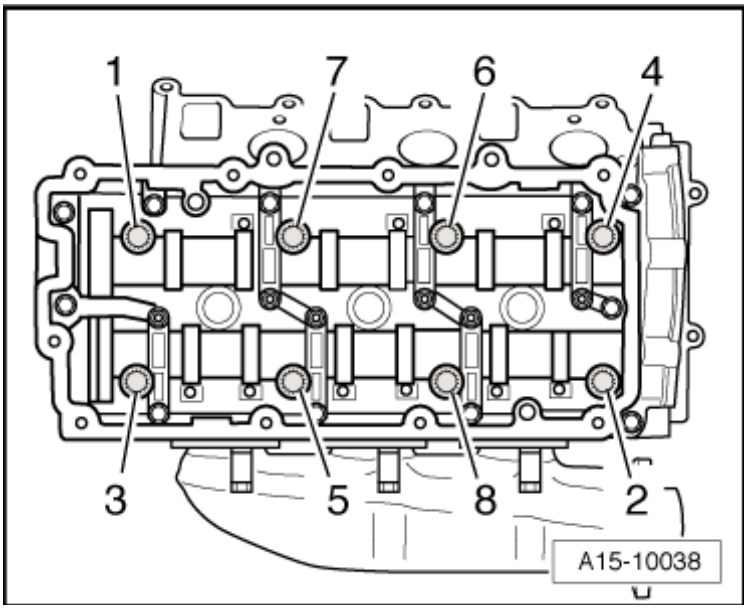


Fig. 45: Identifying Bolt Removal Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CAUTION: Do not set the cylinder head down on the ends of the glow plug elements.

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 an angle specification as well as O-rings and gaskets.

Carefully remove 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 blind holes for the cylinder head bolts in the cylinder block.

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

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

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Do not remove plastic sleeves 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 levers 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 the 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.

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

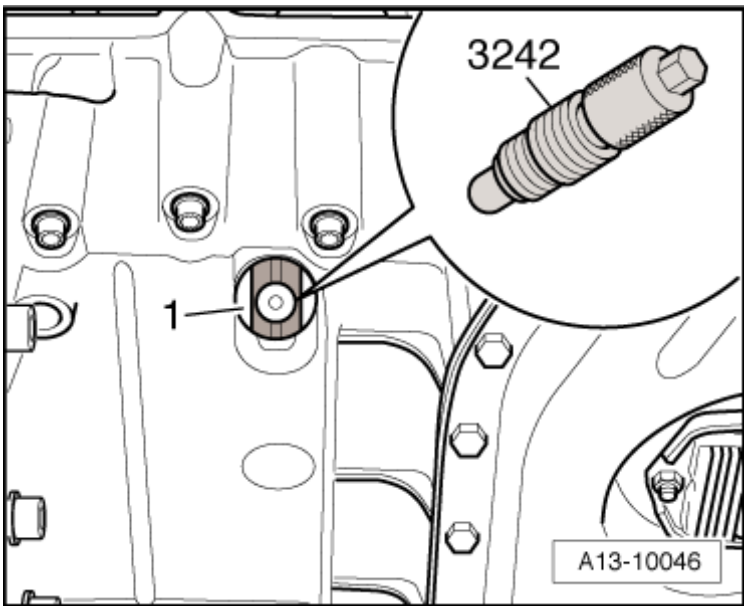


Fig. 46: Identifying Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Rotate 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 crankshaft -1- TDC opening.
- The camshafts in the cylinder head must be secured using the adjustment pin T40060.

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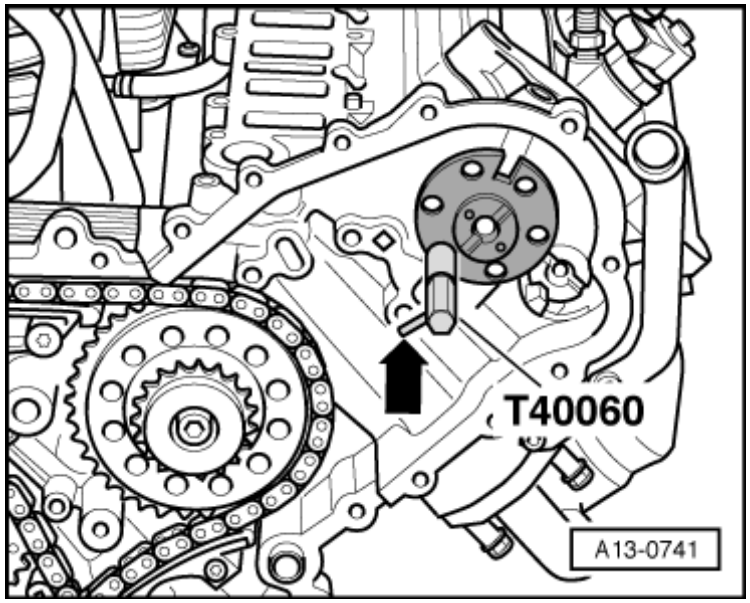


Fig. 47: Identifying Check Of Camshafts For Both Cylinder Heads In TDC Position And Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Note the cylinder head gasket identification:

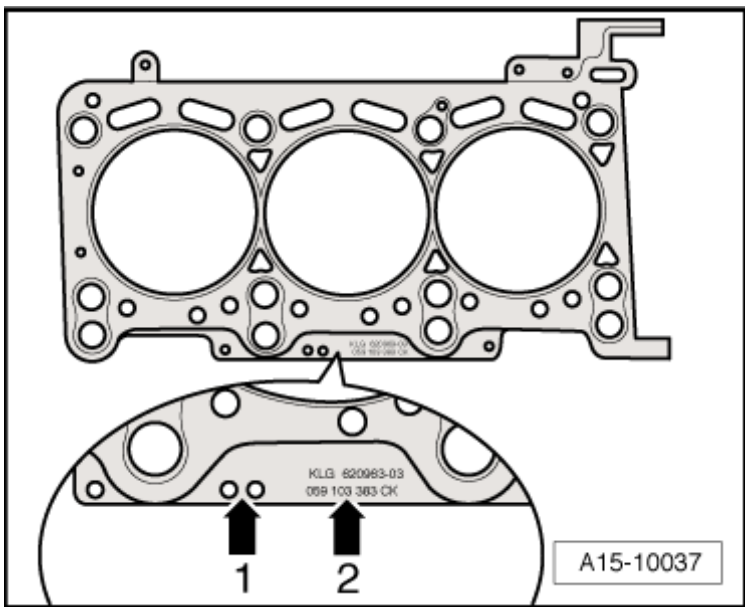


Fig. 48: Identifying Cylinder Head Gasket Identification
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

1. **Holes**
2. **Part number**

NOTE: If the cylinder head gasket or the cylinder head were replaced, select a new

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cylinder head gasket with the same number of holes as the old gasket.

If the crankshaft drive is replaced, measure the piston projection in TDC to determine the new cylinder head. Refer to PISTON PROJECTION IN TOP DEAD CENTER, 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 from the sealing surfaces.

NOTE: Note the expiration date of the sealant.

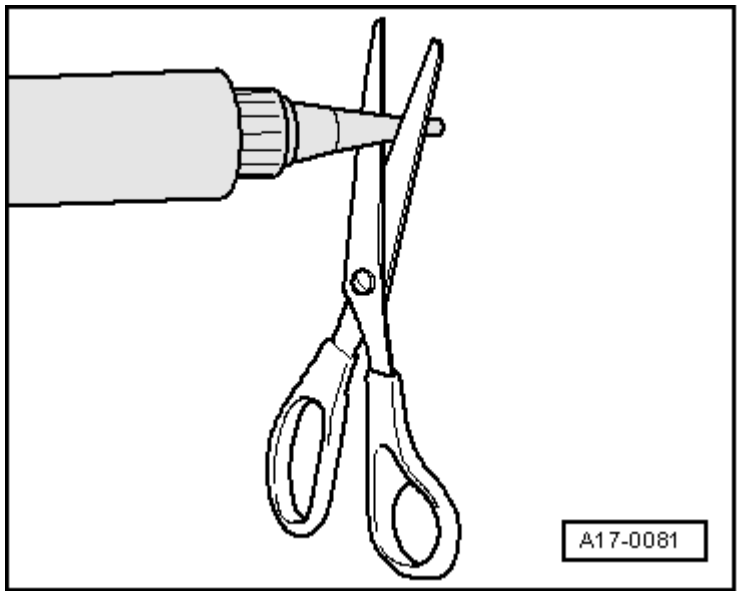


Fig. 49: Identifying Scissors To Cut Tube Nozzle At Front Marking (Nozzle Diameter Approx. 3 mm)
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

Left Cylinder Head

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

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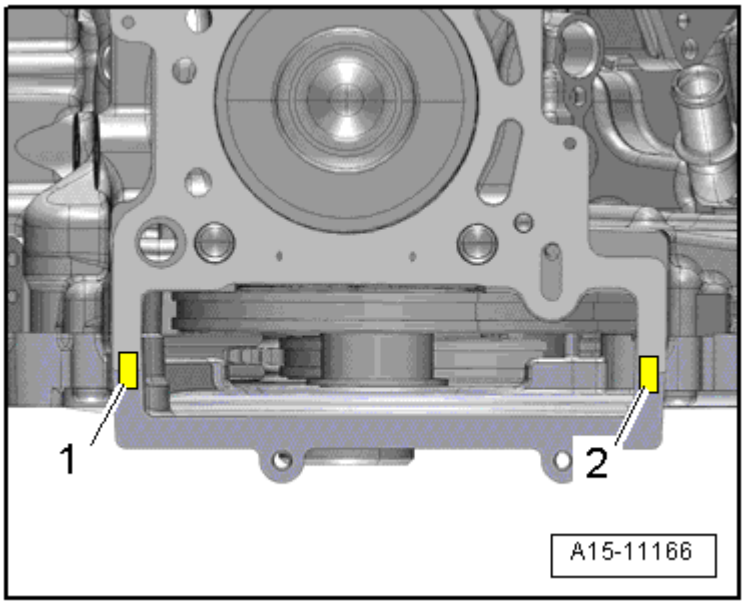


Fig. 50: Identifying Areas -1 And 2- To Apply Bead Of Sealant
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Apply the sealant in the amounts specified.

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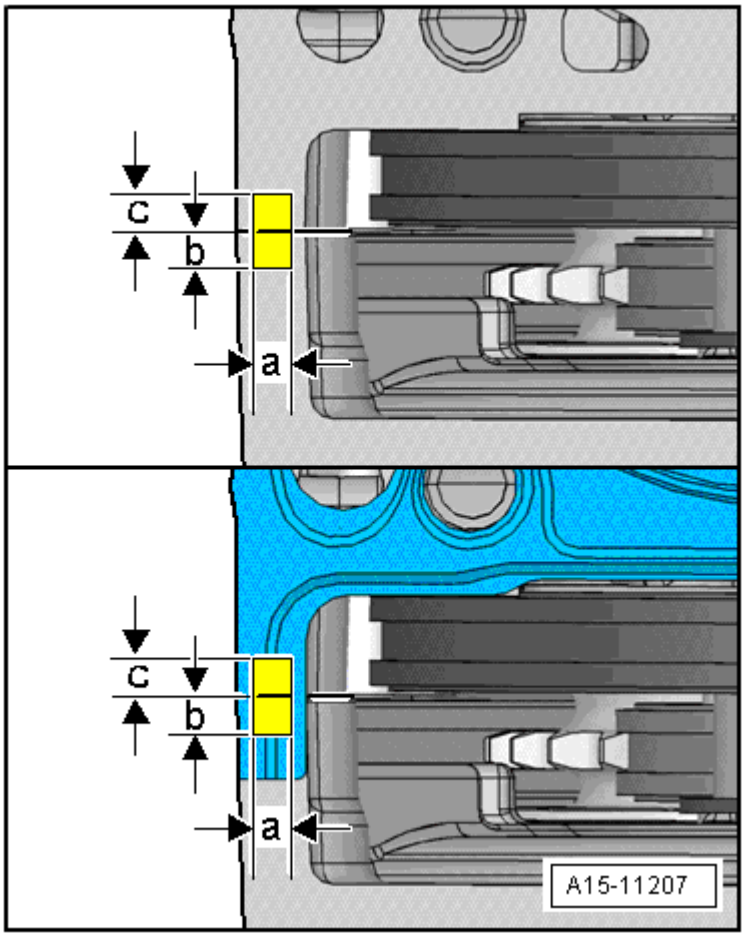


Fig. 51: Identifying Dimensions -a to c-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- 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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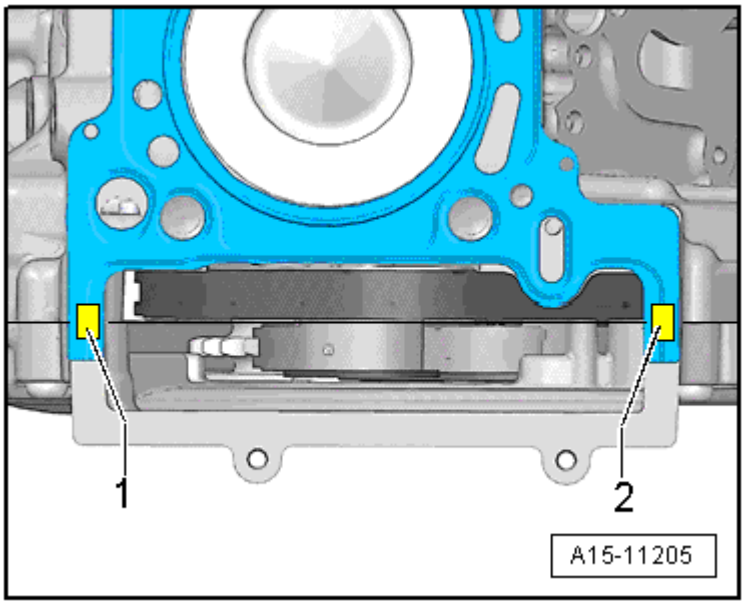


Fig. 52: Identifying Areas -1 And 2- To Apply Bead Of Sealant
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Right Cylinder Head

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

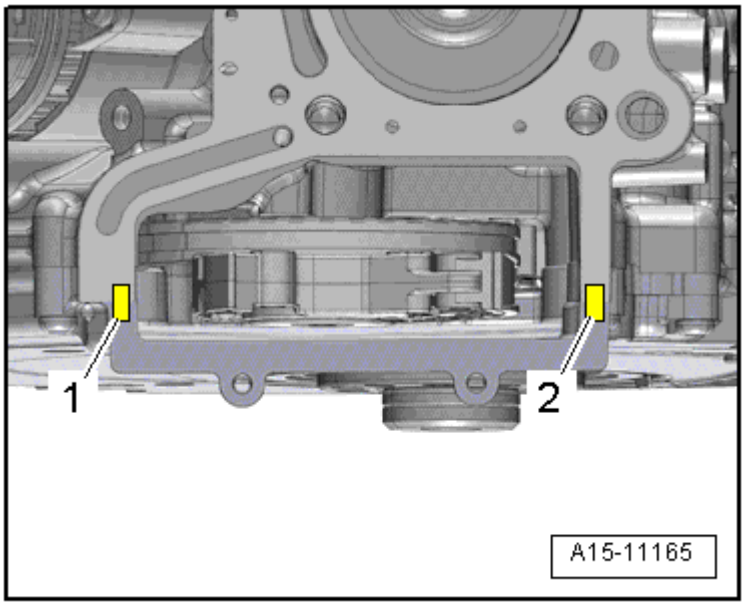


Fig. 53: Identifying Areas -1 And 2- To Apply Bead Of Sealant
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Apply the sealant in the amounts specified.

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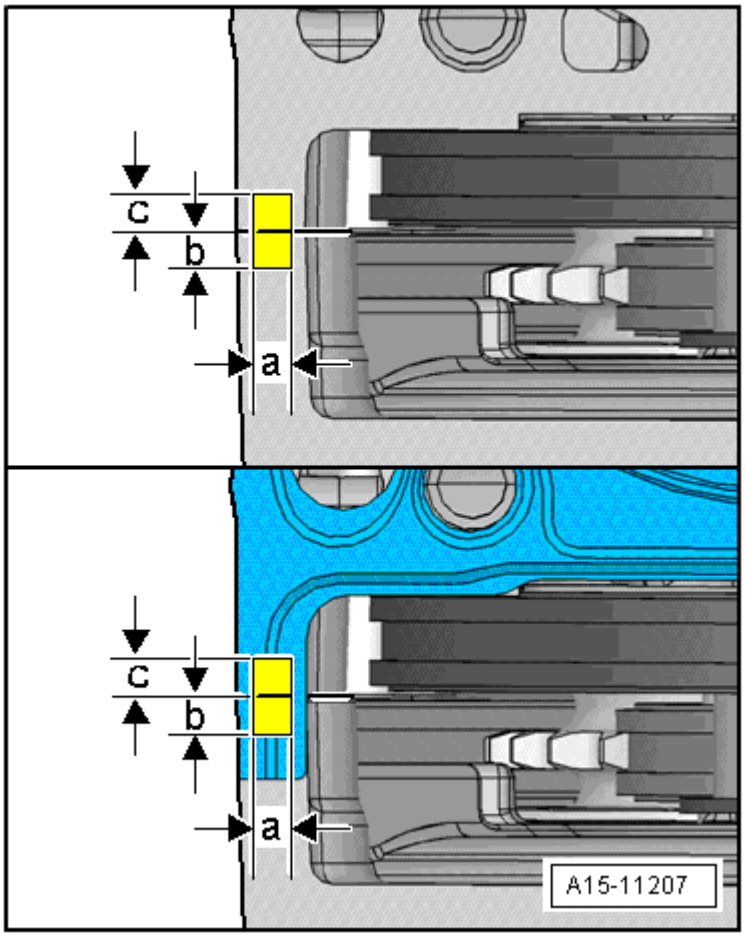


Fig. 54: Identifying Dimensions -a to c-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- 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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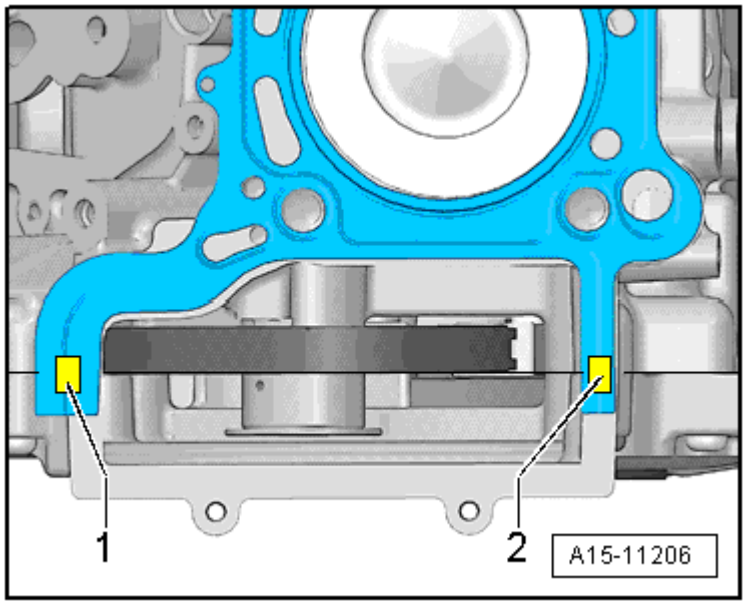


Fig. 55: Identifying Sealant Beads -1 And 2-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Continuation for Both Sides

-- Install the cylinder head gasket.

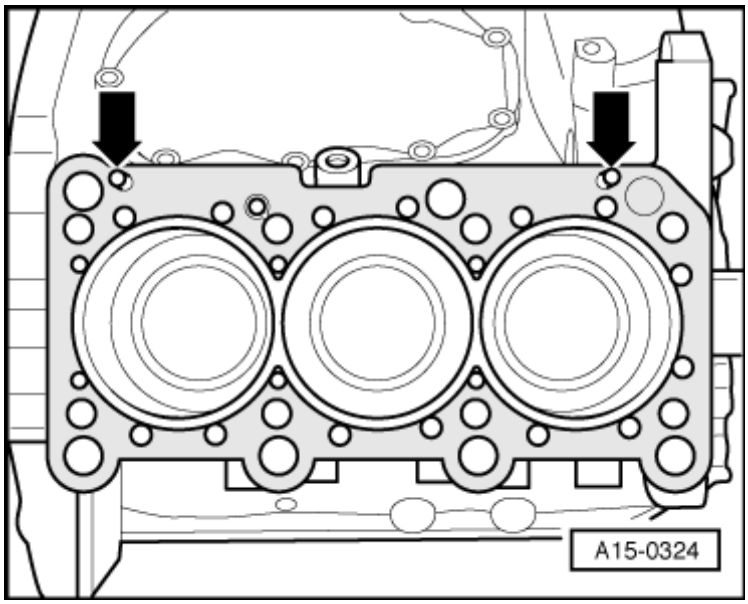


Fig. 56: Identifying Cylinder Head Gasket
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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-- Install the cylinder head.

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

TIGHTEN THE CYLINDER HEAD BOLTS IN SEQUENCE -1 THROUGH 8- AS FOLLOWS:

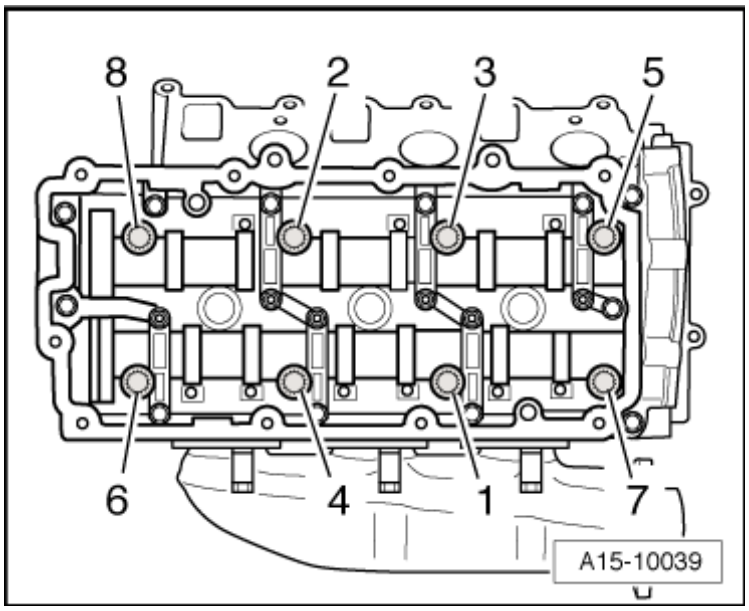


Fig. 57: Identifying Cylinder Head, Tightening Specifications and Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- 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.

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 exhaust pipe. Refer to:

LEFT INTERMEDIATE PIPE

RIGHT INTERMEDIATE PIPE

-- Install 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

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

Left Cylinder Head

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

Continuation for Both Sides

-- Change the engine oil. Refer to **Maintenance Procedures** .

-- Replace the coolant. Refer to **DRAINING AND FILLING** .

-- Inspect the fuel system for leaks. Refer to **FUEL SYSTEM, PERFORMING LEAK TEST** .

Tightening Specifications

Component	Nm
Coolant line to cylinder head	15.5
Right coolant pipe to cylinder head	9
Toothed belt drive sprocket to camshaft	75
Rear toothed belt guard to engine	9
Fuel supply and return line to high pressure pump	25

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

Removing

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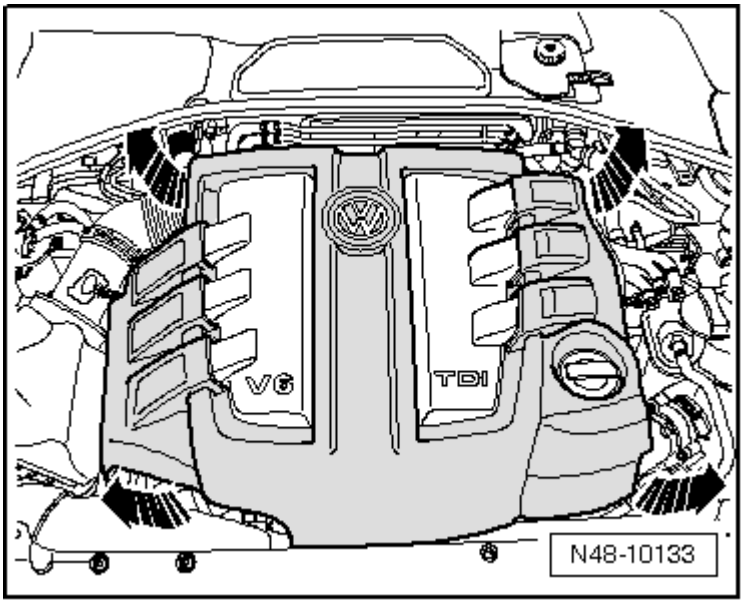


Fig. 58: Identifying Removal Of Engine Cover From 4 Ball Studs -Arrow-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Carefully remove the engine cover from the 4 studs -arrows- one after the other.

-- Disengage the clamps -arrows-.

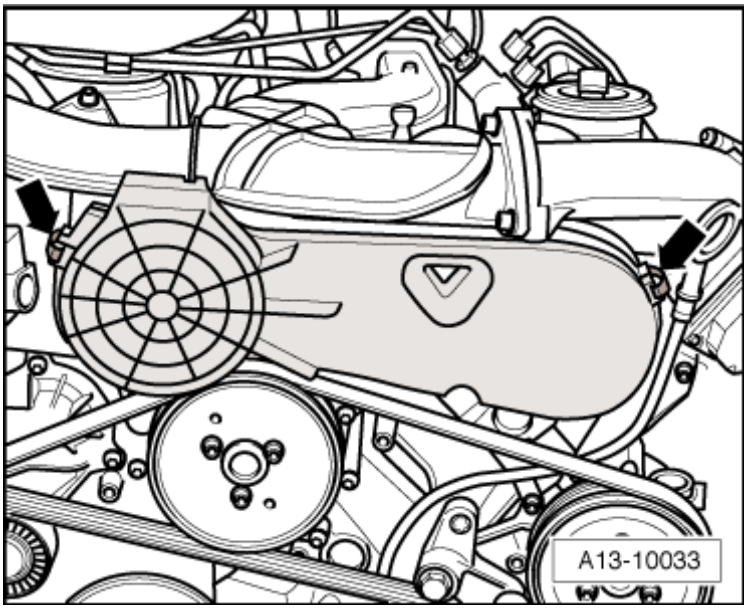


Fig. 59: Identifying Clamps -Arrows-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

-- Loosen the tensioner bolt -arrow- approximately two turns.

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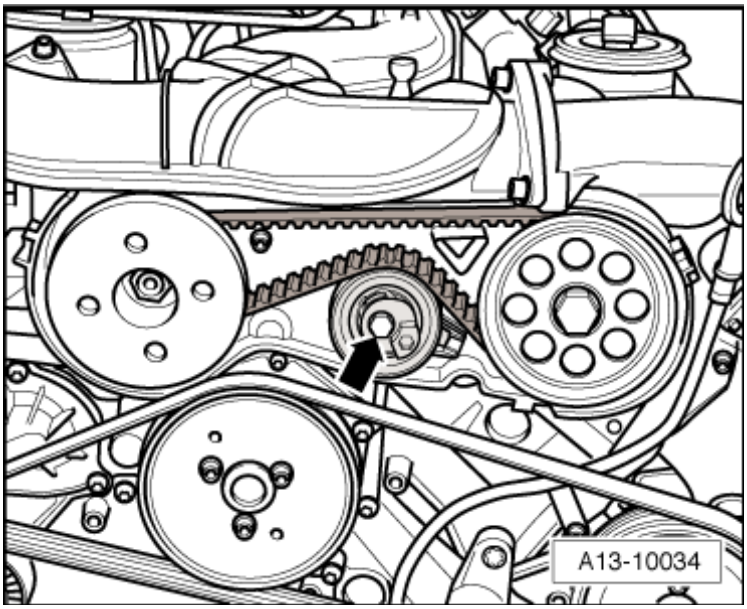


Fig. 60: Identifying Tensioner Bolt -Arrow-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Using the Retainer 3036, loosen the central bolt -1- for the toothed belt drive sprocket approximately two turns.

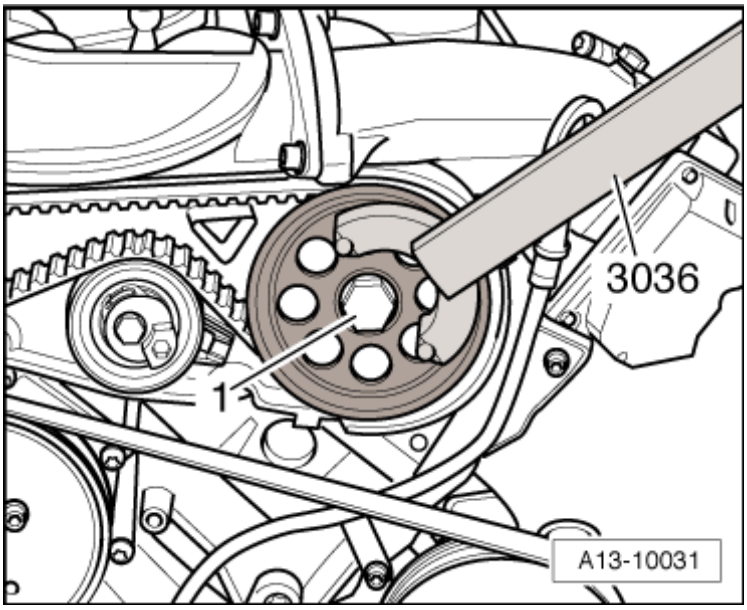


Fig. 61: Identifying Toothed Belt Drive Gear Bolt, Loosening and Tightening
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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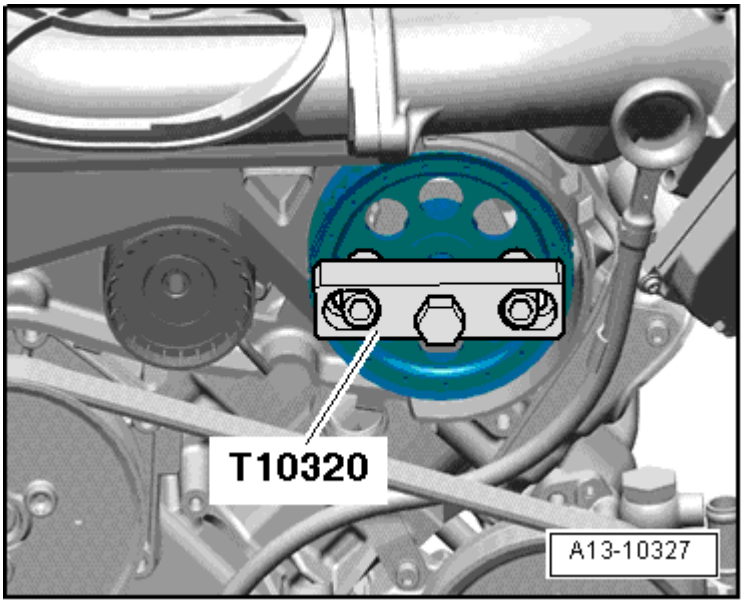


Fig. 62: Identifying Toothed Belt Drive Gear, Removal
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

-- Move the inner section of the 2085 three turns out of the outer section and secure the inner section with the knurled bolt.

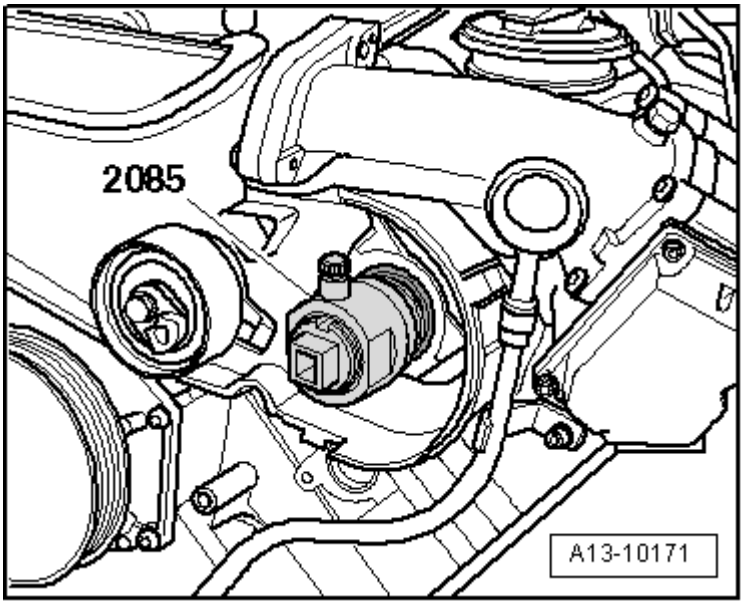


Fig. 63: Identifying Seal Puller 2085
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Lubricate the threaded head of the seal puller - general usage 2085, place it against the seal, and with strong force screw into the seal as far as possible.

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

-- Secure the seal puller - general usage 2085 in a vice at the mounting points and remove the seal with pliers.

Installing

-- Clean the running and sealing surfaces.

-- Press the new seal in until it stops using the thrust sleeve from the assembly tool T10053 and the M10 x 1.25 x 40 bolt -arrow- from the seal installer 3241.

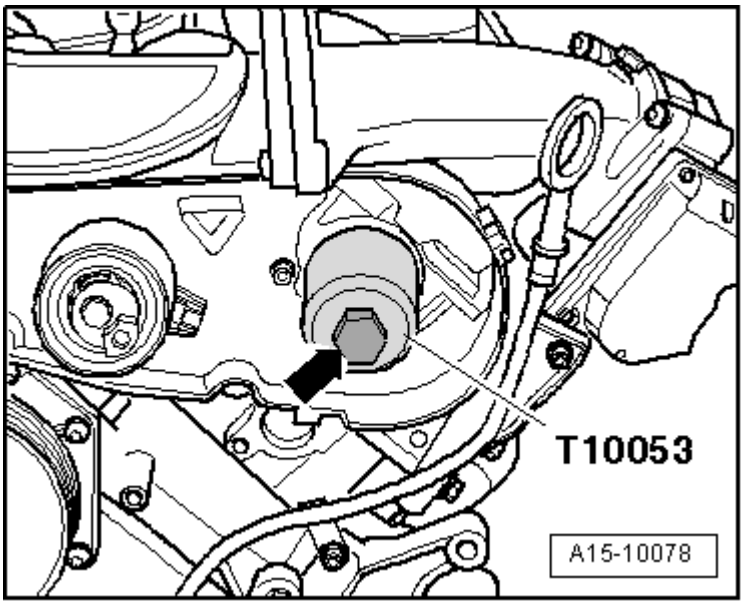


Fig. 64: Identifying Assembly Tool T10053 And M10 x 1.25 x 40 Bolt -Arrow- From Seal Installer 3241
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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

CAMSHAFTS

Special tools and workshop equipment required

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

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- 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** .

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

-- Using the Retainer 3036, loosen the central bolt -1- for the toothed belt drive sprocket approximately two turns.

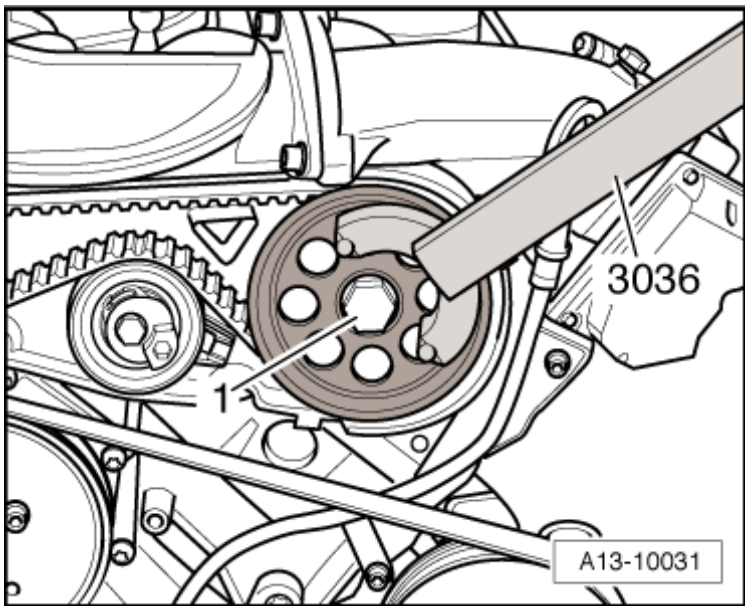


Fig. 65: Identifying Toothed Belt Drive Gear Bolt, Loosening and Tightening
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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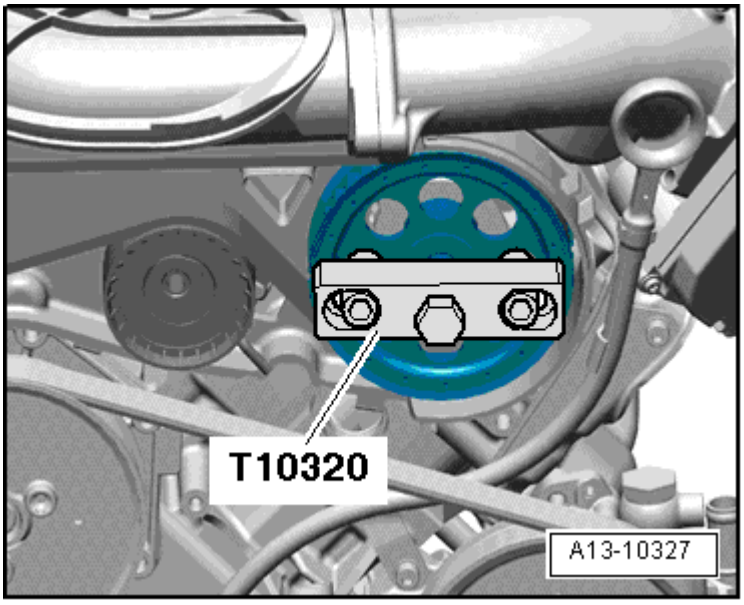


Fig. 66: Identifying Toothed Belt Drive Gear, Removal
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Continuation for Both Sides

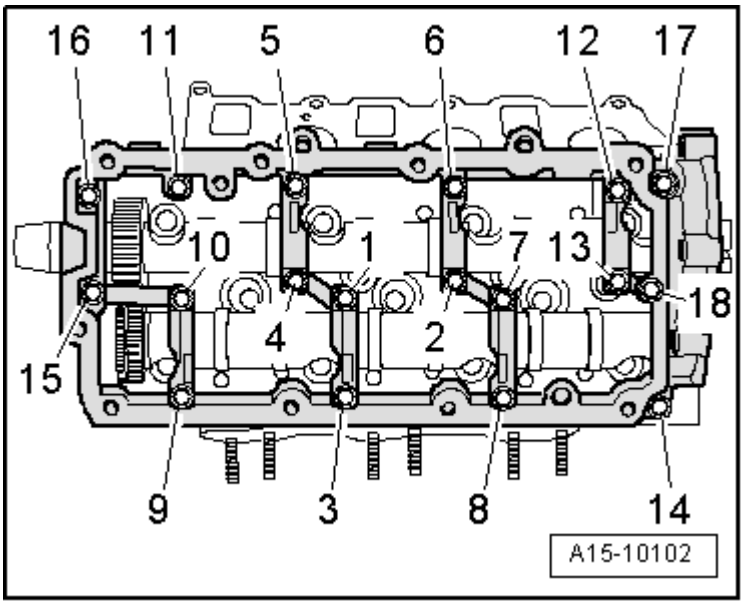


Fig. 67: Identifying Left Cylinder Head Guide Frame, Tightening Specifications and Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- 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 levers and the adjusters when removing the camshafts.

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-- Carefully remove the guide frame and the camshafts.

Installing

CAUTION: Only install the camshafts with 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 any sealant residue from the cylinder head and guide frame with 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.

-- Oil the journal surfaces of the camshafts.

Assemble the camshaft insertion tool T40094 as follows:

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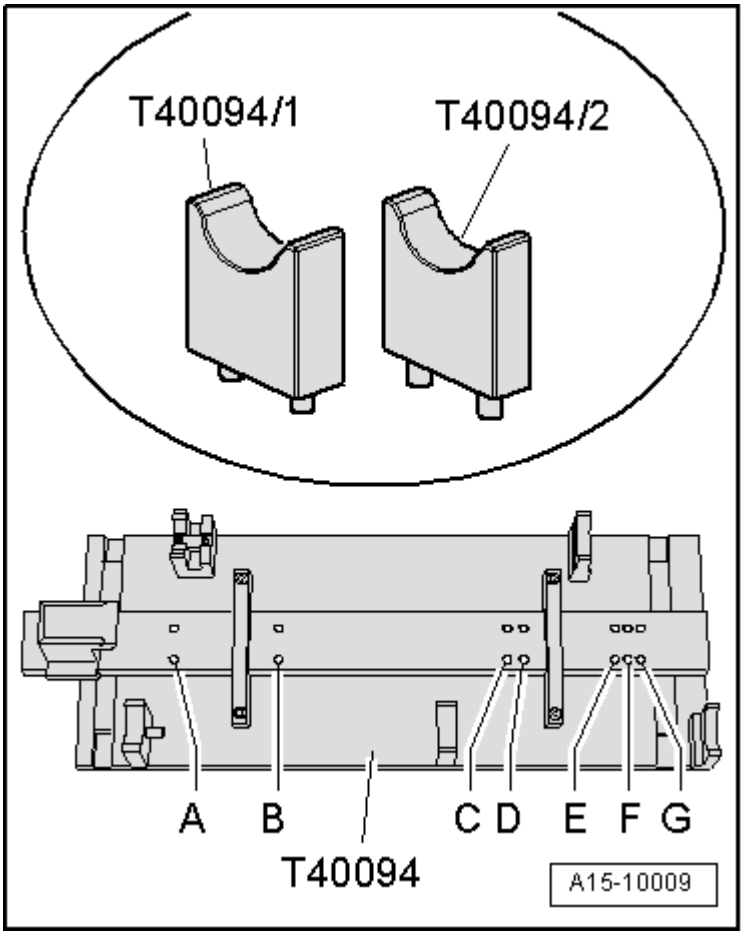


Fig. 68: Identifying Bracket T40094/1 And Bracket T40094/2
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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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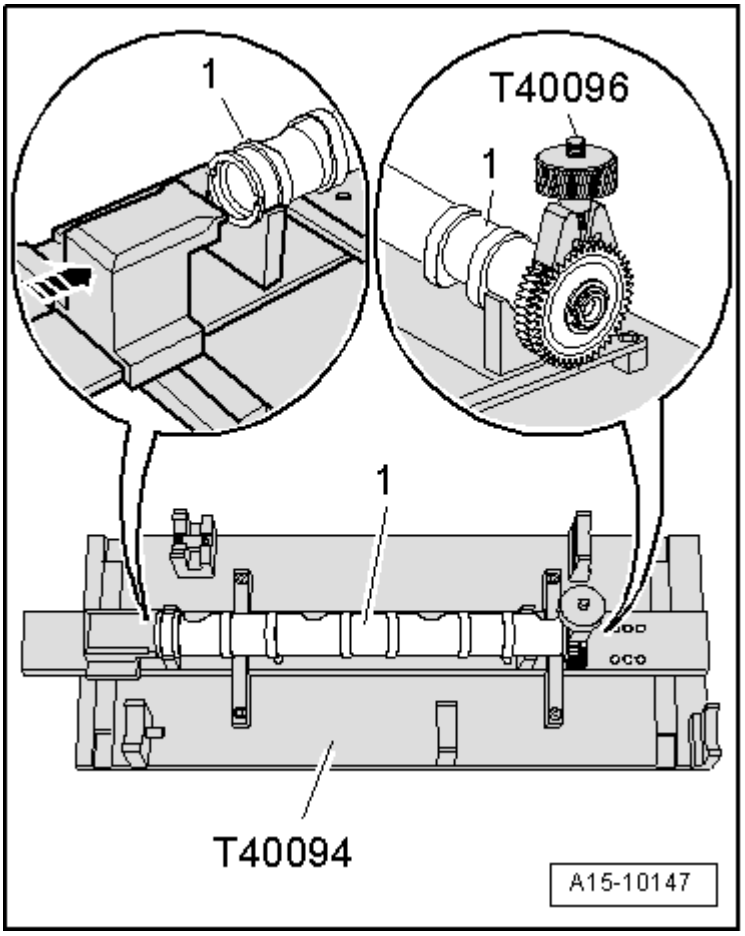


Fig. 69: Identifying Camshaft Insertion Tools T40094 And T40096
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

NOTE: The following procedure describes the left cylinder head. The procedure is performed in the same order for the right cylinder head.

-- Install 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-.

-- Install the camshaft insertion tool T40096 on the camshaft splines so each of the arms on the camshaft insertion tool T40096l engages in half of the sprocket.

-- Tighten the camshaft insertion tool T40096 with the knurled bolt until the tooth faces align.

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

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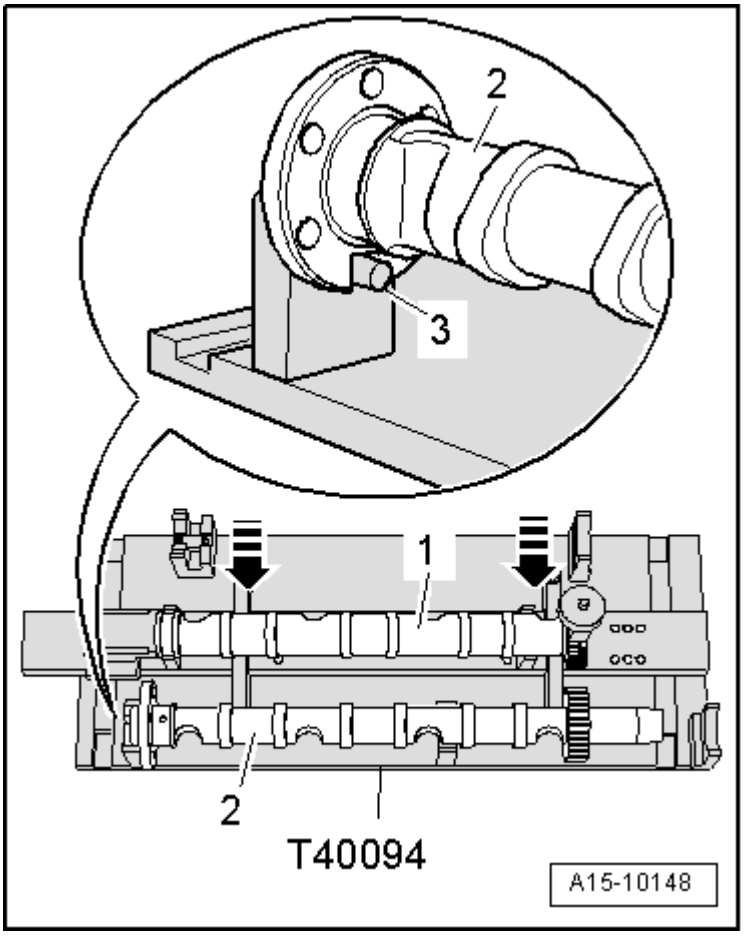


Fig. 70: Identifying Intake Camshaft -2- In Camshaft Insertion Tool T40094
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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

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

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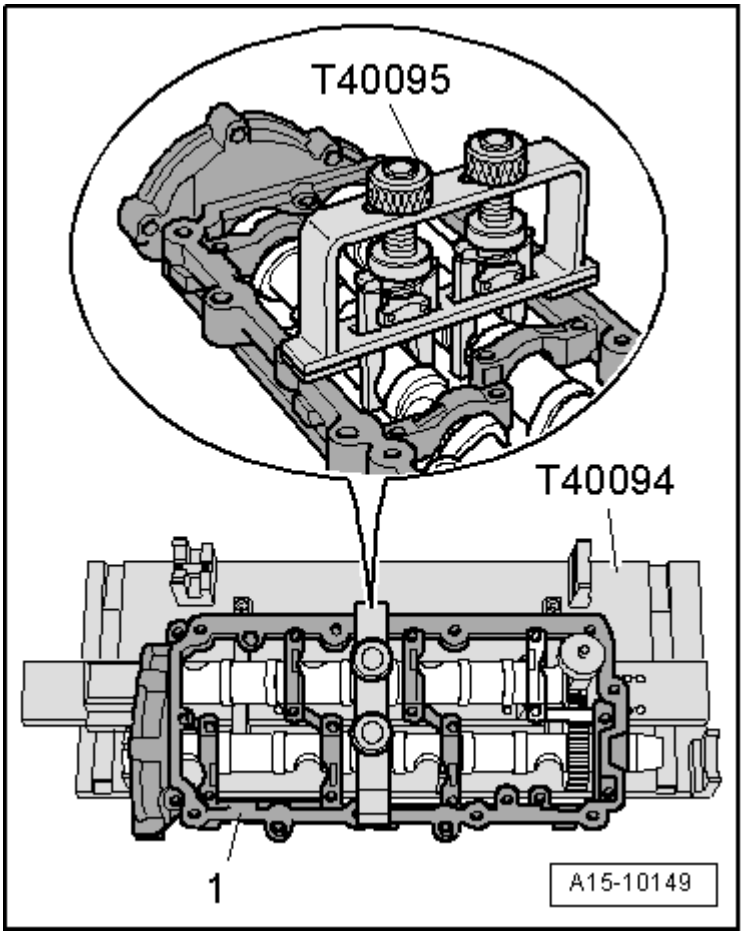


Fig. 71: Identifying Guide Frame -1- On Camshafts
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- All the camshaft bearings must lie on the camshafts.

-- Align the grips and tighten with the knurled nuts to install the camshaft insertion tool T40095 on the camshafts.

- Note that the intake and exhaust camshafts have different shapes.

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

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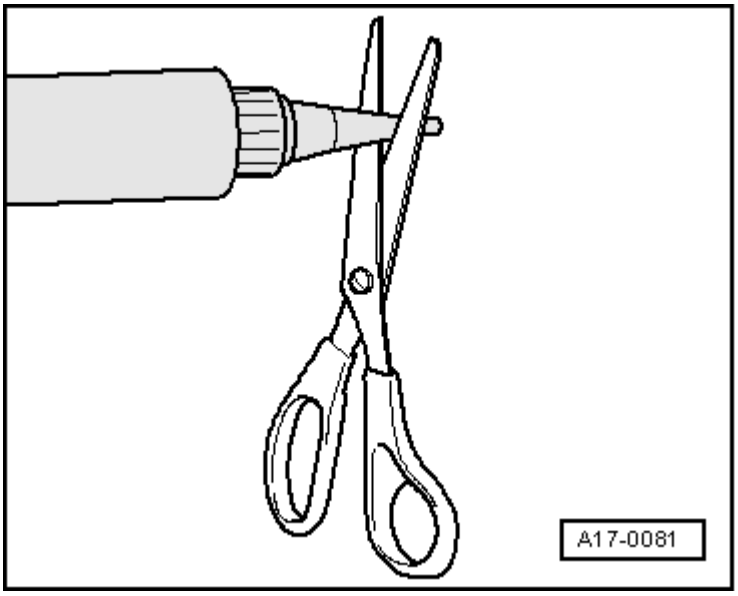


Fig. 72: Identifying Scissors To Cut Tube Nozzle At Front Marking (Nozzle Diameter Approx. 3 mm)
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

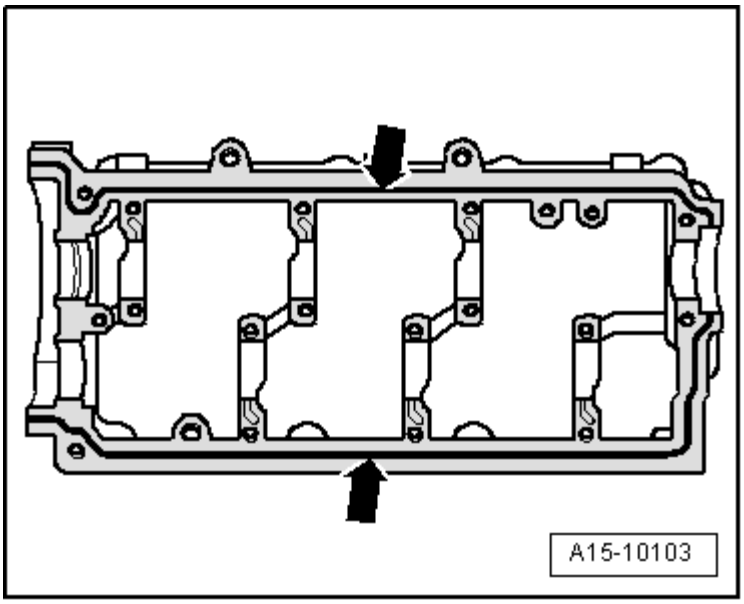


Fig. 73: Identifying Sealant Beads -Arrows- On Clean Sealing Surfaces Of Guide Frame
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Turn the guide frame over.

-- Apply 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.

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

NOTE: Sealant beads must not be thicker than specified, otherwise extra sealant can enter the camshaft bearings.

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

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

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

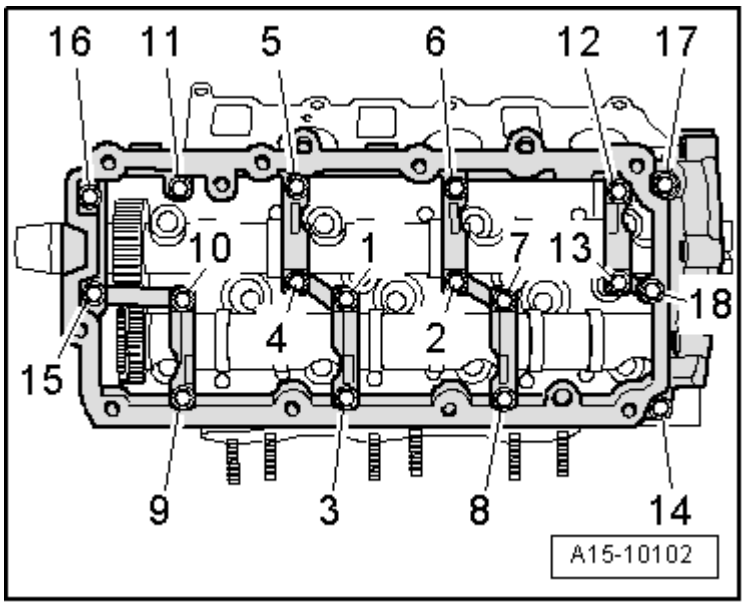


Fig. 74: Identifying Left Cylinder Head Guide Frame, Tightening Specifications and Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

TIGHTEN THE GUIDE FRAME BOLTS BY HAND EVENLY IN SEQUENCE -1 THROUGH 18-

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

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

-- Remove the camshaft insertion tool T40095 and the camshaft insertion tool T40096.

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

NOTE: After installing the camshafts, the engine may not be started for approximately 30 minutes. The hydraulic adjusting elements must seat themselves (otherwise

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the valves will seat themselves on the pistons).

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

Left Cylinder Head

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

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

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

Right Cylinder Head

-- Replace the front cover on the cylinder head.

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

Continuation for Both Sides

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

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

Tightening Specifications

Component	Nm
Guide frame to cylinder head	9
Toothed belt drive sprocket 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 3.0 Liter TDI Engine VAS 5161/23

Removing

With Ceramic Glow Plugs

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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 one of the following:**
- **CERAMIC GLOW PLUGS**
- **METAL GLOW PLUGS**

With Metal Glow Plugs

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

Continuation for All

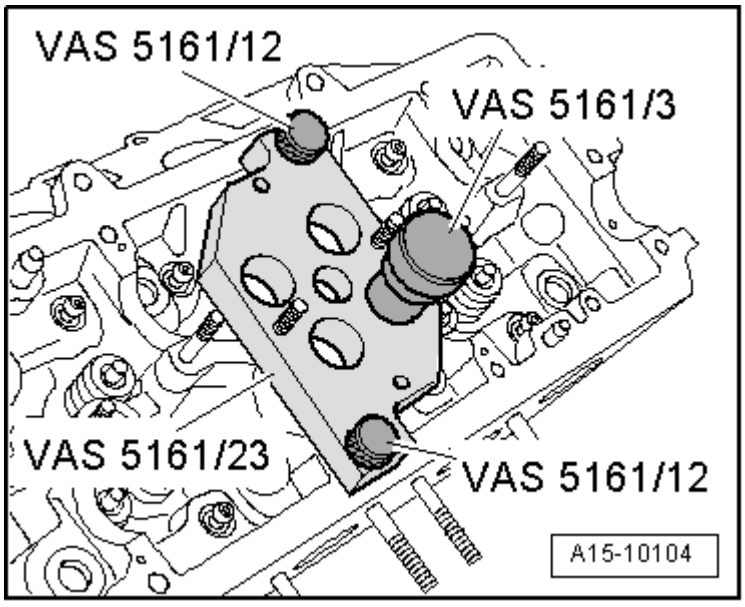


Fig. 75: Identifying Punch VAS 5161/3, Knurled Thumb Screws VAS 5161/12 And Guide Plate For 3.0 Liter TDI Engine VAS 5161/23
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

-- Install the guide plate for 3.0 liter TDI engine VAS 5161/23 to the cylinder head.

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

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

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

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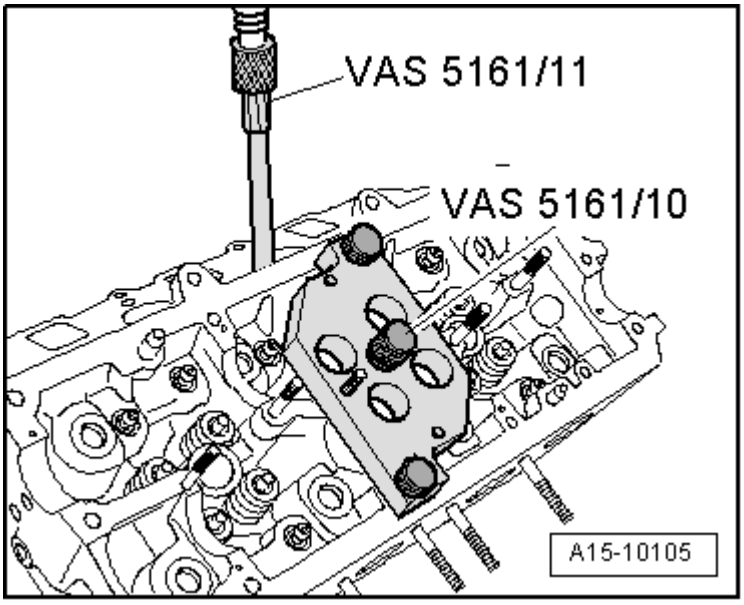


Fig. 76: Identifying Compression Stud VAS 5161/10 And Compressed Air Connection VAS 5161/11
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Install the adapter for compressed air connection VAS 5161/11 in the 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 for 3.0 liter TDI engine VAS 5161/23.

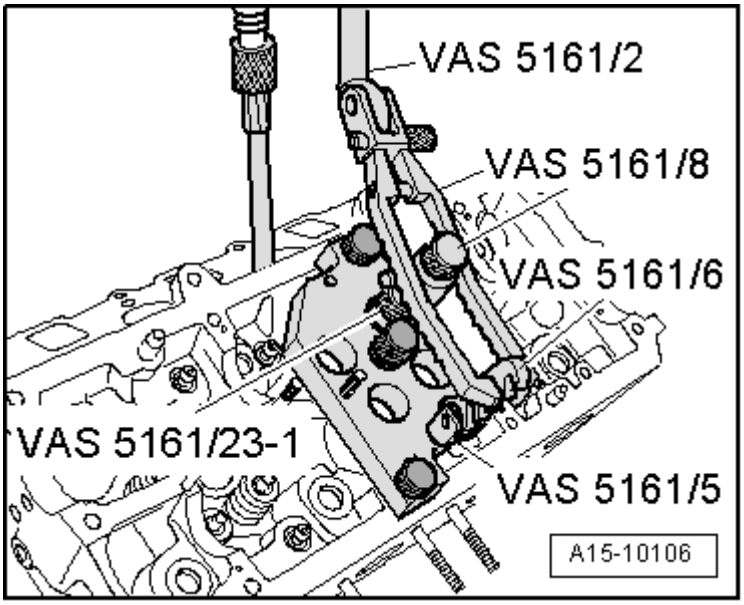


Fig. 77: Identifying Valve Insertion Device VAS 5161/8 Inserted In Guide Plate For 3.0 Liter TDI Engine VAS 5161/23
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Push the sleeve VAS 5161/23-1 onto the assemble cartridge VAS 5161/8.

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-- Connect compressed air to the adapter for compressed air connection VAS 5161/11 with a commercially available connector and apply constant pressure.

- Minimum pressure: 6 bar

-- Engage the pressure fork with lever for assembly cartridge VAS 5161/2 at sleeve VAS 5161/23-1 and press down the assembly cartridge VAS 5161/8.

-- At the same time, turn the knurled bolt on the assembly cartridge VAS 5161/8 to the right, until the points engage in the valve retainers.

-- Lightly move the knurled bolt back and forth, causing the valve retainers to be pressed apart and be captured in the assembly cartridge VAS 5161/8.

-- Release the pressure fork.

-- Remove the assembly cartridge VAS 5161/8 with the spacer ring, the valve plate and the valve spring.

-- Pull off valve stem seals using the valve seal removal tool 3364.

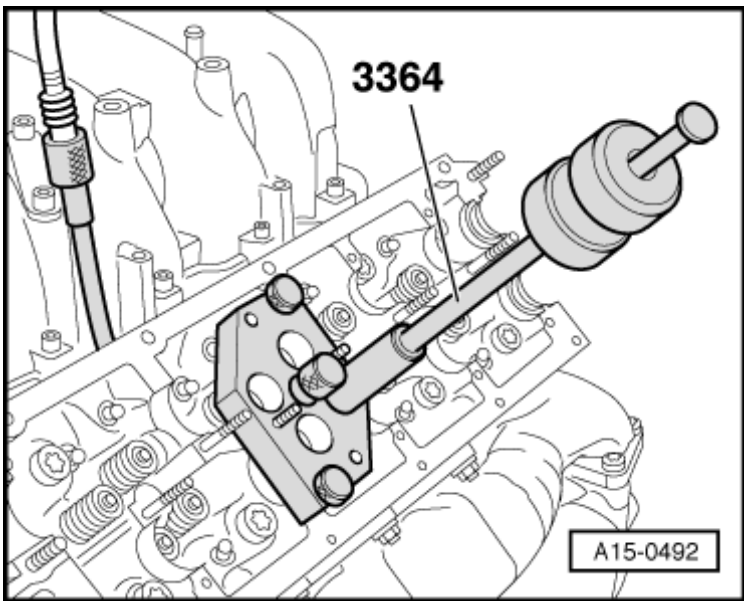


Fig. 78: Identifying Valve Seal Removal Tool 3364
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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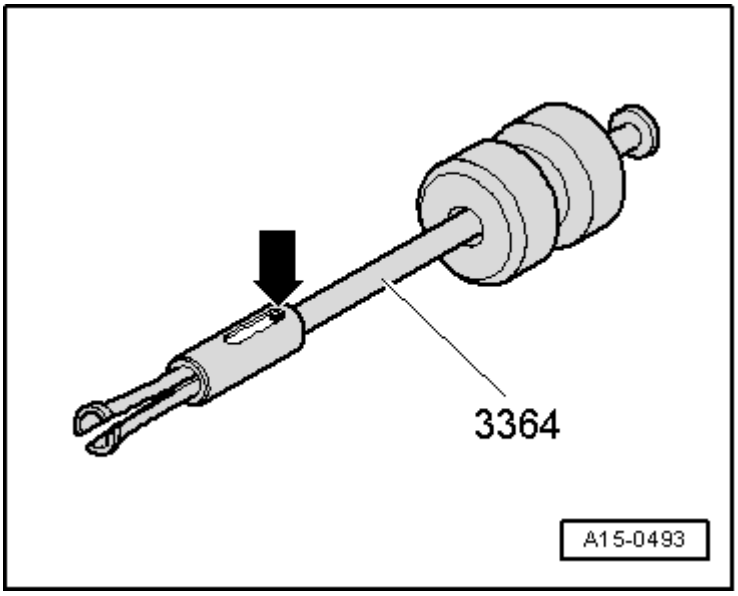


Fig. 79: Identifying Spring Dowel Sleeve
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Drive the roll pin -arrow- in the valve seal removal Tool 3364 out with a drift and remove the impact puller attachment.

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

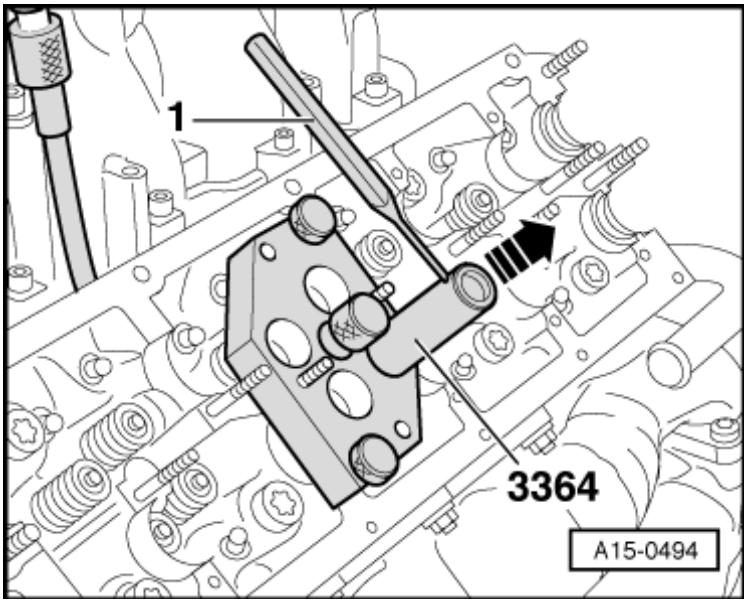


Fig. 80: Identifying Lower Section Of Valve Seal Removal Tool 3364 On Valve Stem Seal
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Using a drift or punch -1- insert it into the valve seal removal Tool 3364 as illustrated.

-- Using the drift or punch -1- and the valve seal removal Tool 3364, remove the seal -arrow-.

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NOTE: A plastic sleeve -A- is supplied with the new valve shaft seals.

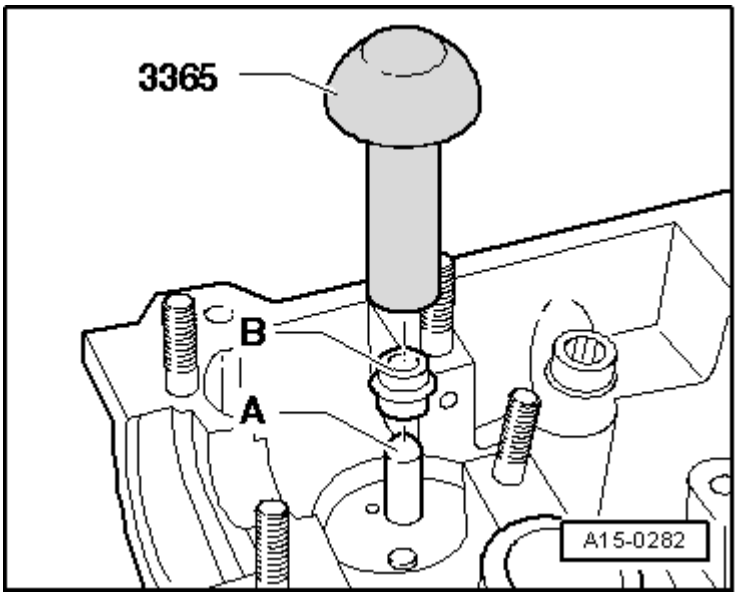


Fig. 81: Identifying Plastic Sleeve, New Valve Stem Oil Seals & Valve Stem Seal Driver 3365
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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

-- Push the valve stem seal onto plastic sleeve.

-- Carefully press the valve stem oil seal onto valve guide using Valve Stem Seal Driver 3365.

-- Remove the plastic sleeve again.

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

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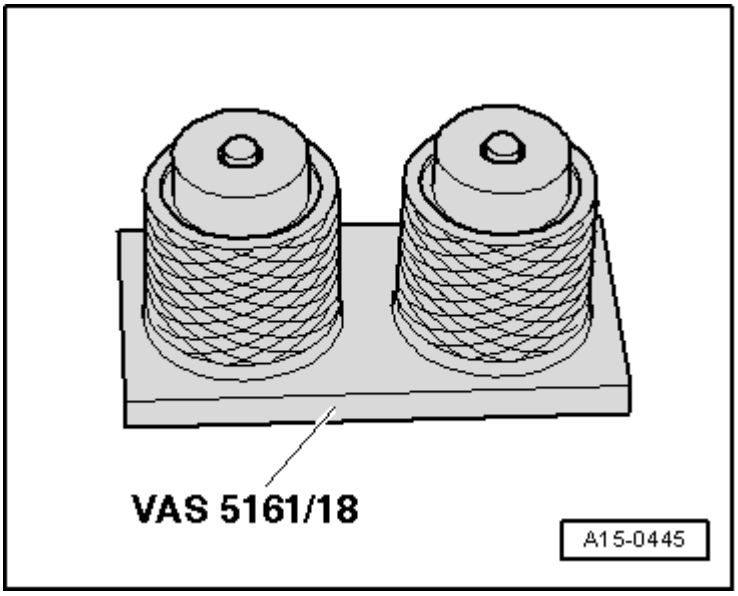


Fig. 82: Identifying Installation Cartridge VAS 5161/8
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

-- Press the valve insertion device VAS 5161/18 onto the insertion tool from above and install the valve retainers.

-- Insert the valve insertion device VAS 5161/8 in the guide plate for 3.0 liter TDI engine VAS 5161/23.

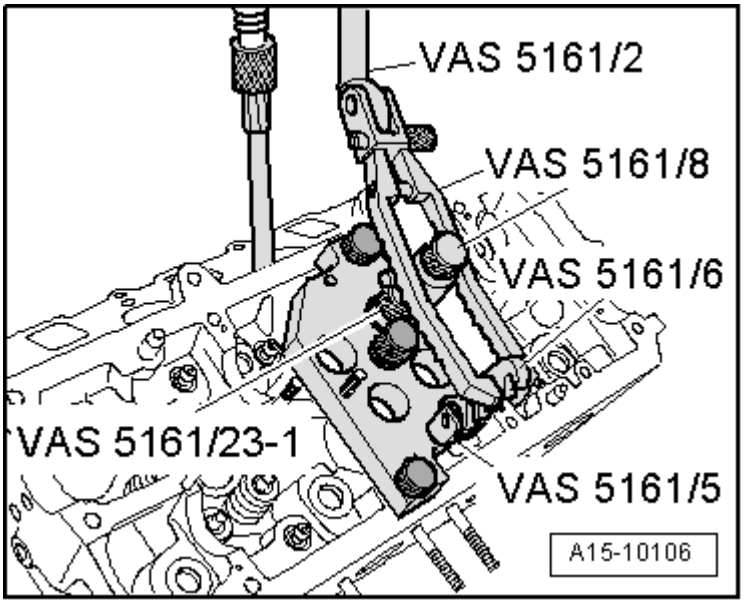


Fig. 83: Identifying Valve Insertion Device VAS 5161/8 Inserted In Guide Plate For 3.0 Liter TDI Engine VAS 5161/23
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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-- Press the pressure fork down and pull the knurled bolt upward while turning it left and right to insert the valve retainers.

-- Release pressure fork with the knurled bolt still pulled.

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

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

CERAMIC GLOW PLUGS .

METAL GLOW PLUGS .

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

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

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

CAMSHAFT TIMING CHAINS

Special tools and workshop equipment required

- Crankshaft Holder 3242
- Key T40049
- Adjustment Pin T40060 (Quantity: 2)
- Adapter T40061
- Adapter T40062
- 3.3 mm Diameter Drill Bit (Quantity: 2)

REMOVING

- Transmission removed.

CAUTION: Risk of damaging valves and piston crowns.

- **Turn 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-.

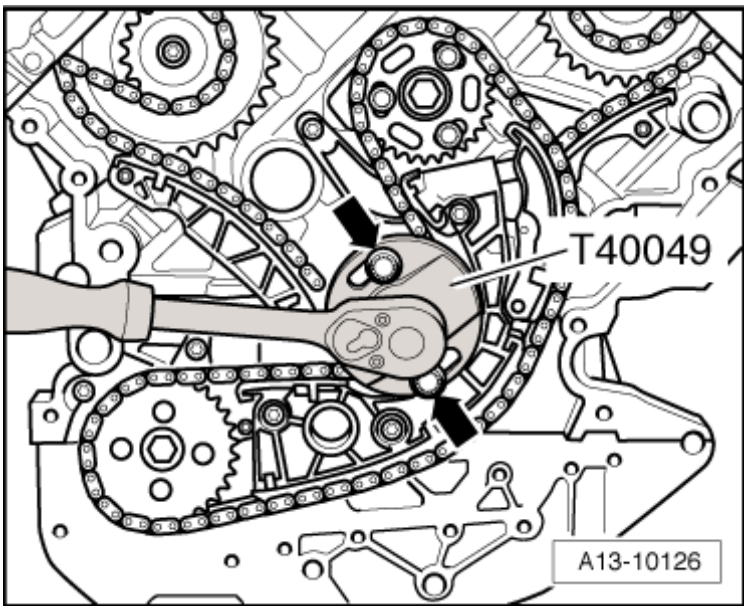


Fig. 84: Identifying Key T40049 At Rear On Crankshaft And 2 Old Bolts For Dual-Mass Flywheel
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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.

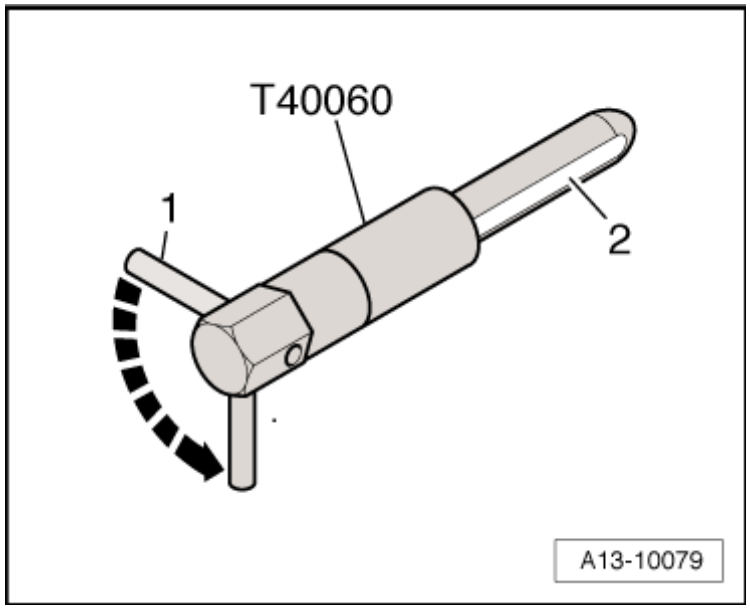


Fig. 85: Identifying Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Install the adjustment pin T40060 so that the pin -1- is perpendicular to the camshaft axis.

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Rotate the adjustment pin T40060 using 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.

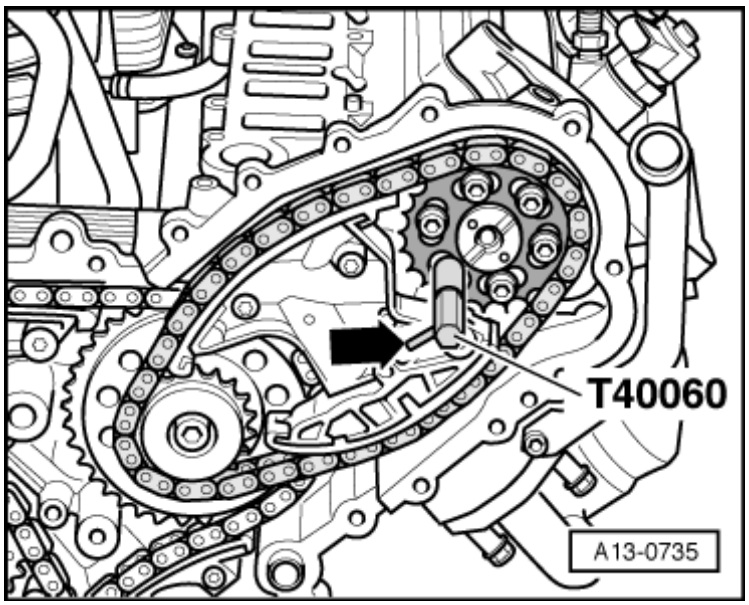


Fig. 86: Identifying TDC Position Of Camshafts
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CAUTION: Components could be destroyed by the camshaft timing chain jump 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 pin -arrow- on the adjustment pin T40060 must be perpendicular to the center axis of the cylinder bank 1 (right) camshaft.
- The pin -arrow- on the adjustment pin T40060 must be perpendicular to the center axis of the cylinder bank 2 (left) camshaft.

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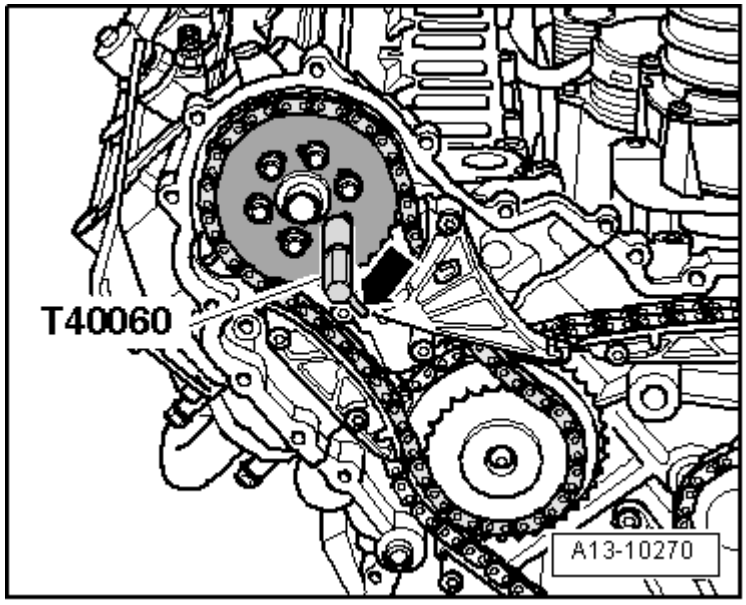


Fig. 87: Identifying Perpendicular Pin -Arrow- On Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

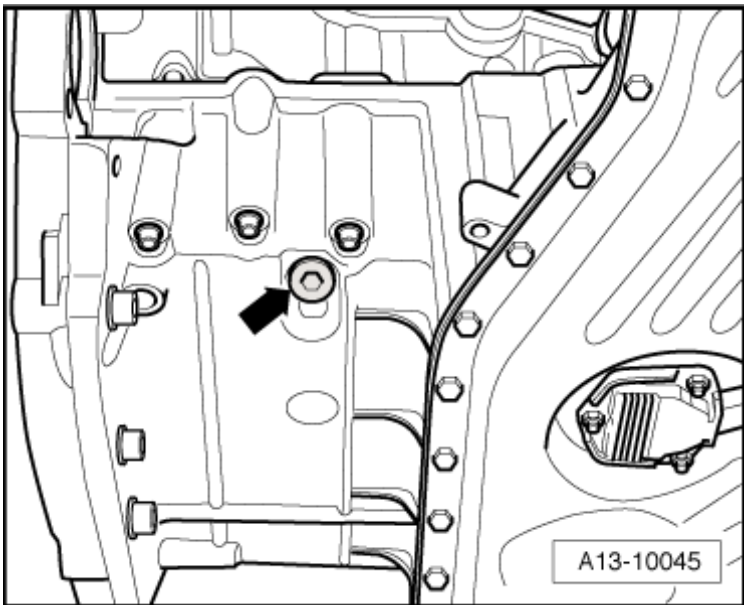


Fig. 88: Identifying Locking Bolt Of Upper Part Of Oil Pan
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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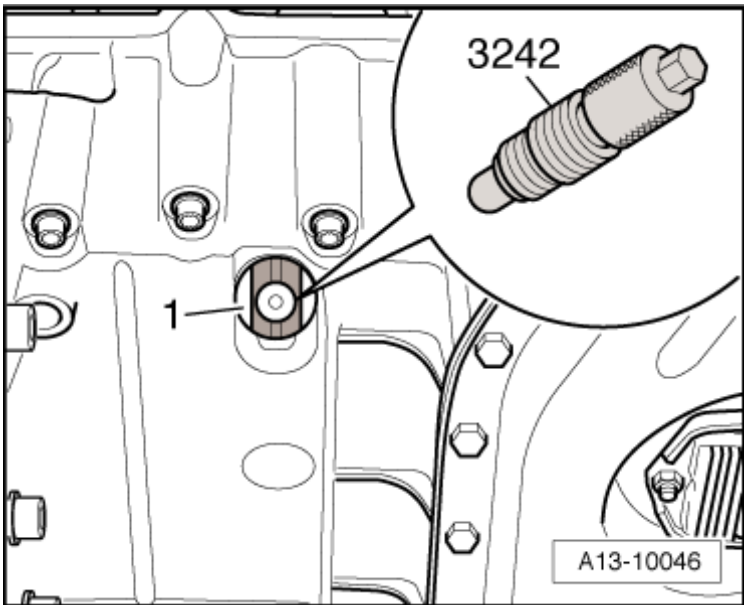


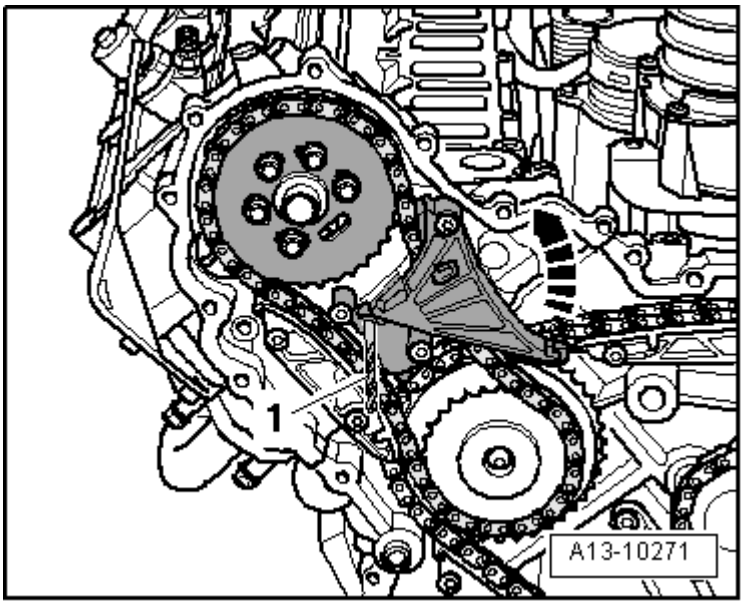
Fig. 89: Identifying Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

WARNING: Risk of injury when inserting your finger in the TDC hole.

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

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

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



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Fig. 90: Identifying Chain Tensioner Secured Using 3.3 Mm Diameter Drill Bit
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

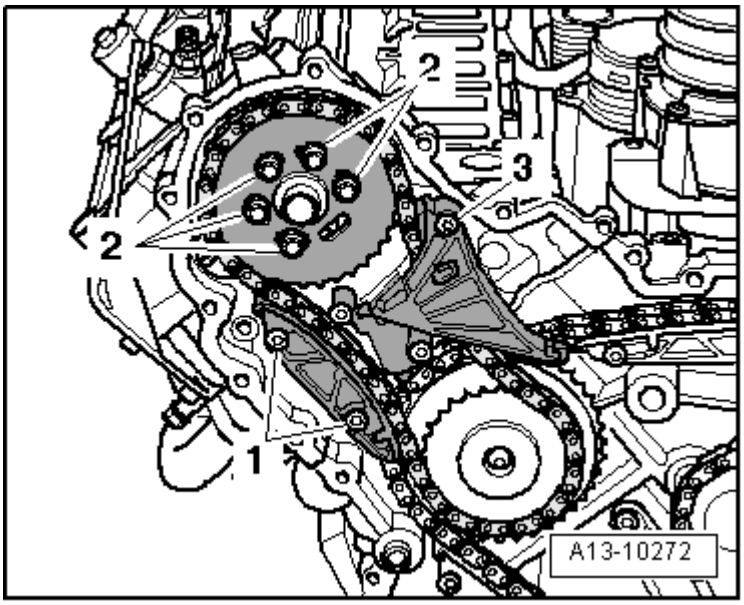


Fig. 91: Identifying Bolts -1- For Guide Rail And Bolts -2- For Camshaft Chain Sprocket
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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

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

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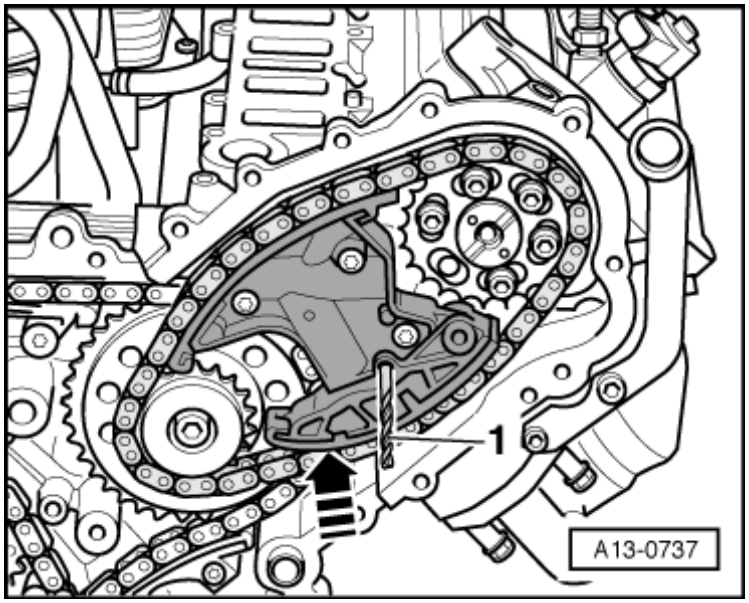


Fig. 92: Identifying 3.3 mm Diameter Drill Bit -1- To Install Chain Tensioner Guide Rail On Right Camshaft Timing Chain
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

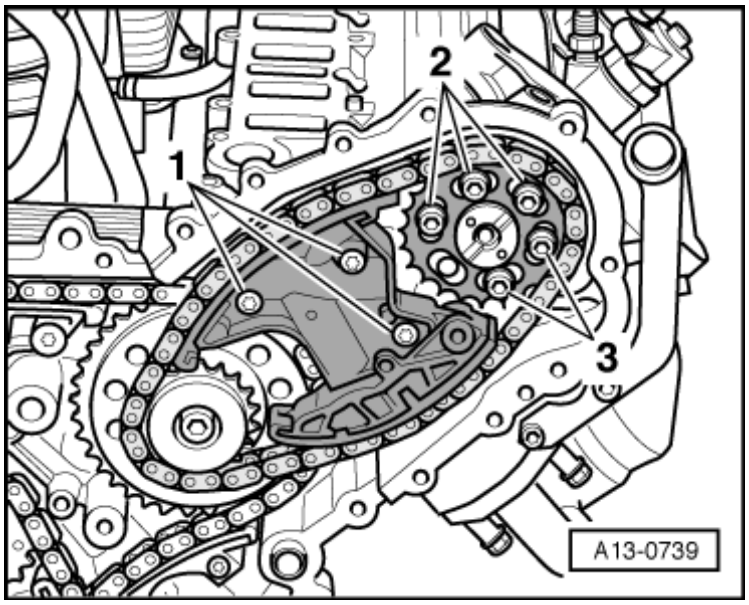


Fig. 93: Identifying Chain Tensioner Guide Rail Installed On Right Camshaft Timing Chain
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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 camshaft chain sprocket bolts -2 and 3-.

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

INSTALLING

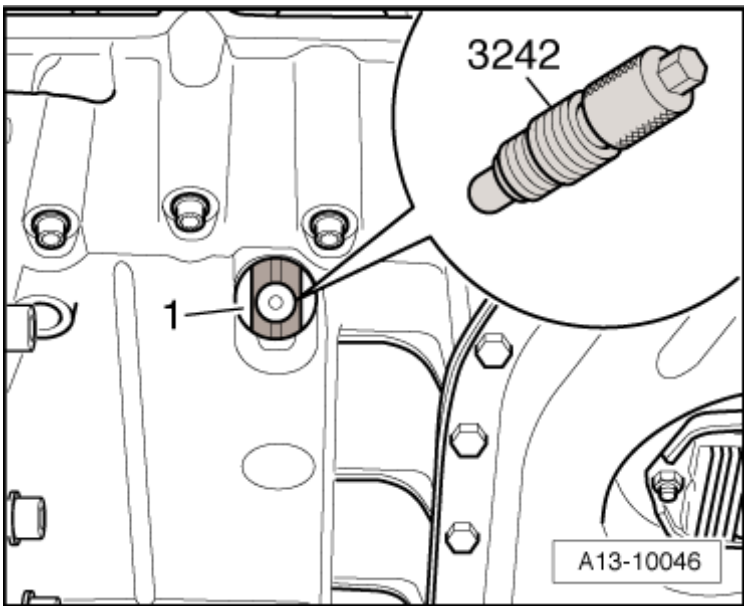


Fig. 94: Identifying Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Tightening specifications, refer to **LEFT CAMSHAFT TIMING CHAIN OVERVIEW**.
- Secure the crankshaft -1- in TDC position using the crankshaft Holder 3242.
- Install the balance shaft and oil pump chain. Refer to **BALANCE SHAFT AND OIL PUMP CHAIN** .

NOTE: Replace the plug in the upper oil pan for the TDC mark.

Replace bolts which have been tightened to a angle specification.

CAUTION: Risk of damaging valves and piston crowns.

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

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

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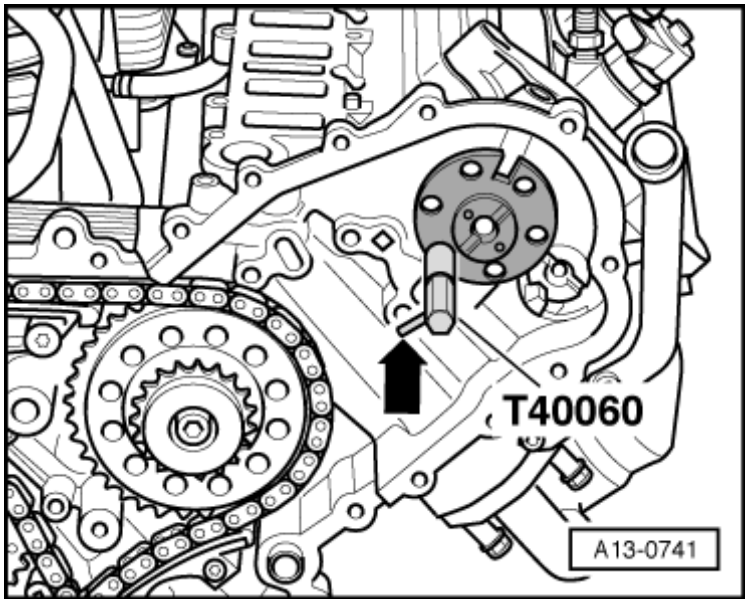


Fig. 95: Identifying Check Of Camshafts For Both Cylinder Heads In TDC Position And Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

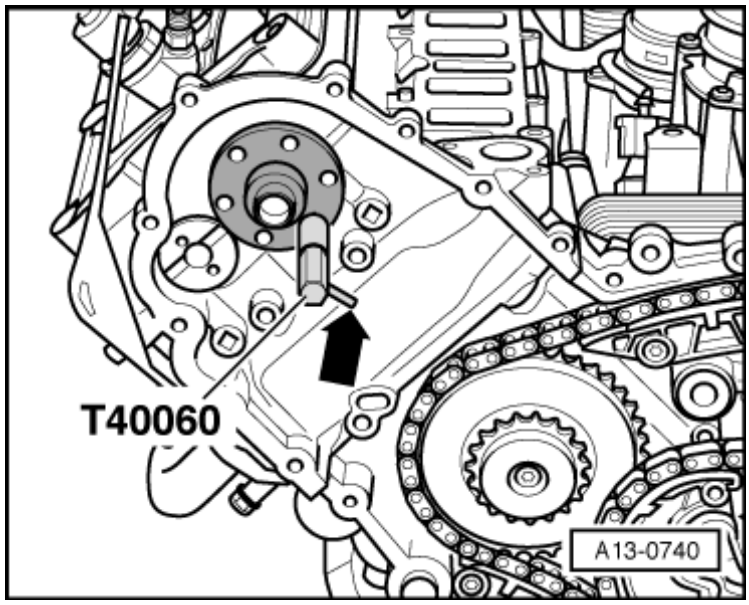


Fig. 96: Identifying Perpendicular Pin -Arrow- On Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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-- Remove the adjustment pin T40060 from both camshafts.

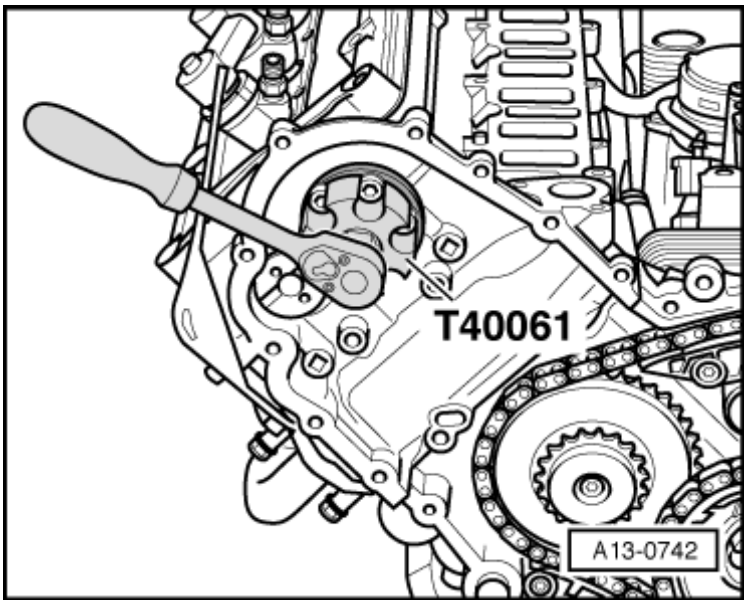


Fig. 97: Identifying Adapter T40061 And Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CAUTION: Risk of damaging valves and piston crowns.

- **If 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 adapter T40061 by installing the camshaft chain sprocket on the camshaft.

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

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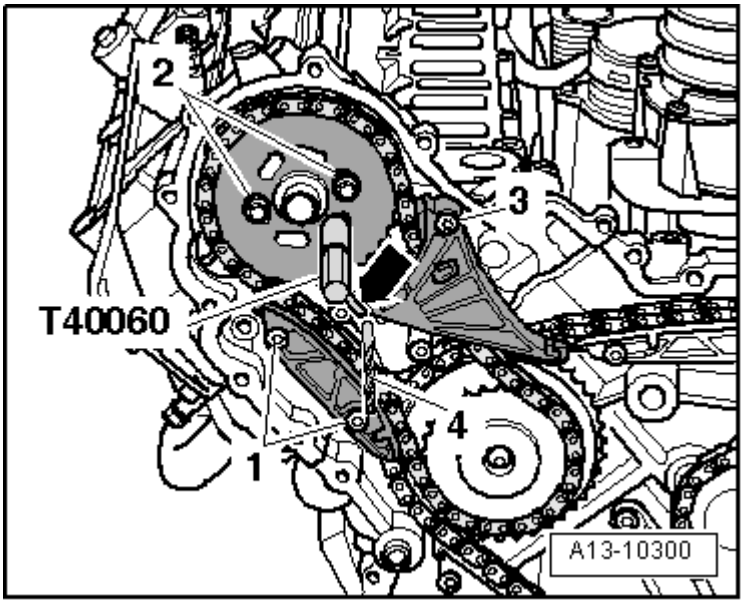


Fig. 98: Identifying Left Camshaft Timing Chain, Camshaft Chain Sprocket, Guide Rail And Tensioning Rail
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- The slots in the camshaft chain 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 both camshaft chain sprocket bolts -2- loosely.

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

-- Secure the left camshaft using adjustment pin T40060.

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

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

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

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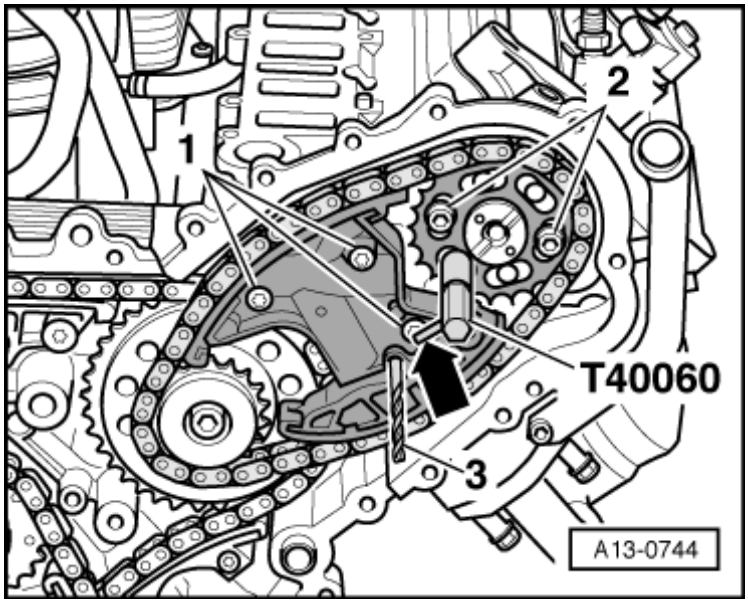


Fig. 99: Identifying Drill Bit -4- And Alignment Hole
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

-- Tighten the chain tensioner bolts -1-.

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

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

-- Secure the right camshaft using adjustment pin T40060.

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

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

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

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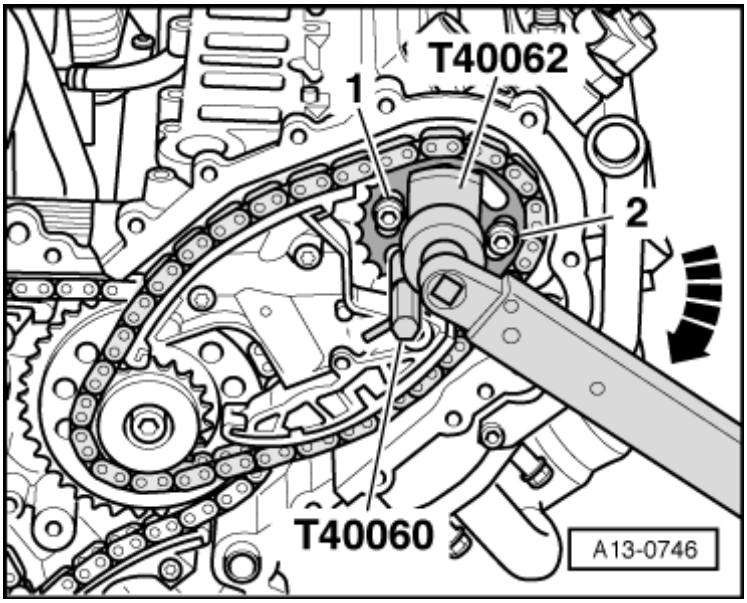


Fig. 100: Identifying Bolts -1 And 2-, Torque Wrench, Adapter T40062 And Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Tighten the bolts -1 and 2-.

-- Remove the adapter T40062 and the adjustment pin T40060.

-- Install and tighten the remaining bolts for the right camshaft chain sprocket.

-- Tighten the left camshaft chain sprocket using the adapter T40062 and a torque wrench to 15 Nm in the -direction of the arrow- and hold it.

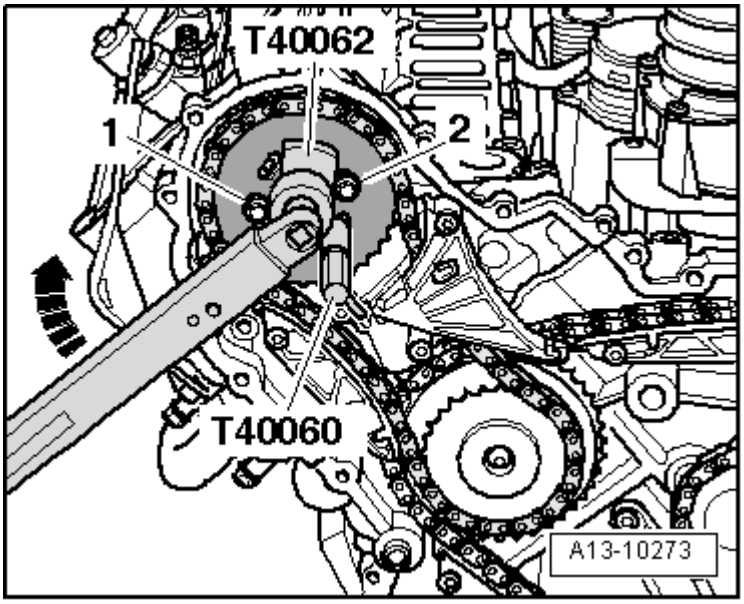


Fig. 101: Identifying Adapter T40062 On Left Camshaft Chain Sprocket
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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-- Tighten the bolts -1 and 2-.

-- Remove the adapter T40062 and adjustment pin T40060.

-- Install and tighten the remaining bolts for the left camshaft chain sprocket.

-- Remove the crankshaft Holder 3242.

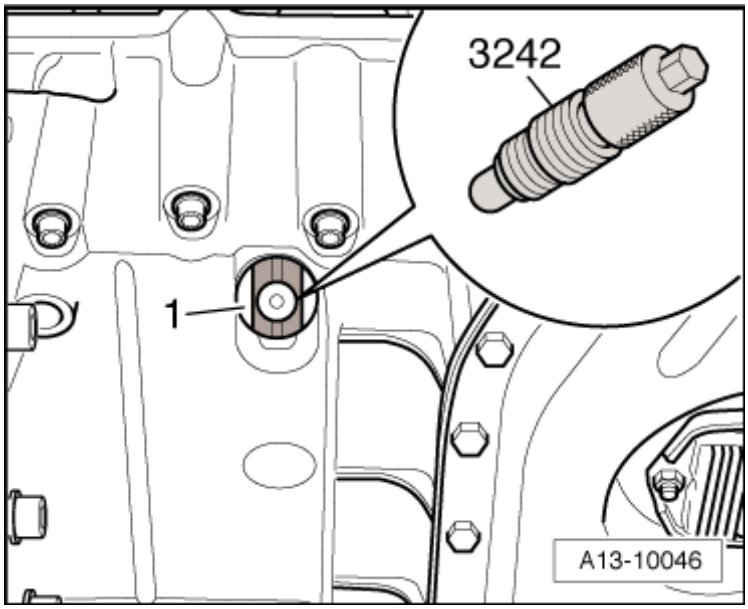


Fig. 102: Identifying Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CHECKING THE VALVE TIMING

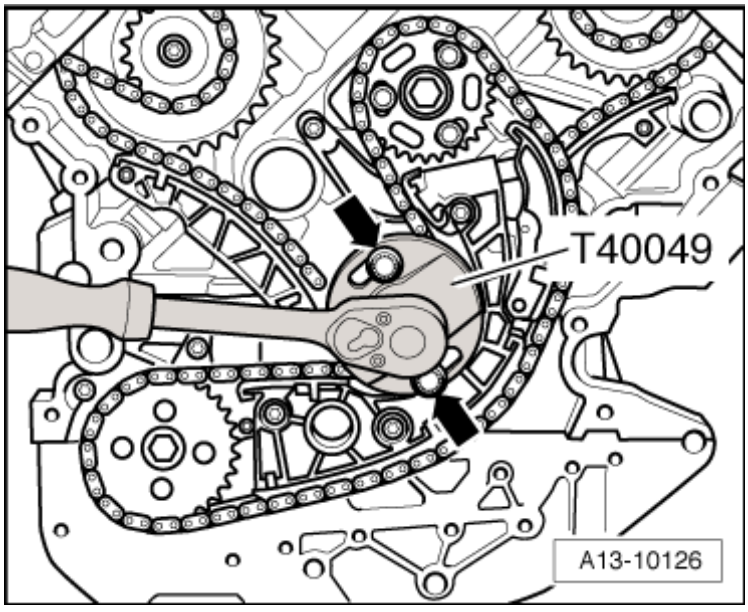


Fig. 103: Identifying Key T40049 At Rear On Crankshaft And 2 Old Bolts For Dual-Mass Flywheel

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Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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

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

-- Lock the crankshaft -1- from turning using the crankshaft Holder 3242 and tighten it to 20 Nm.

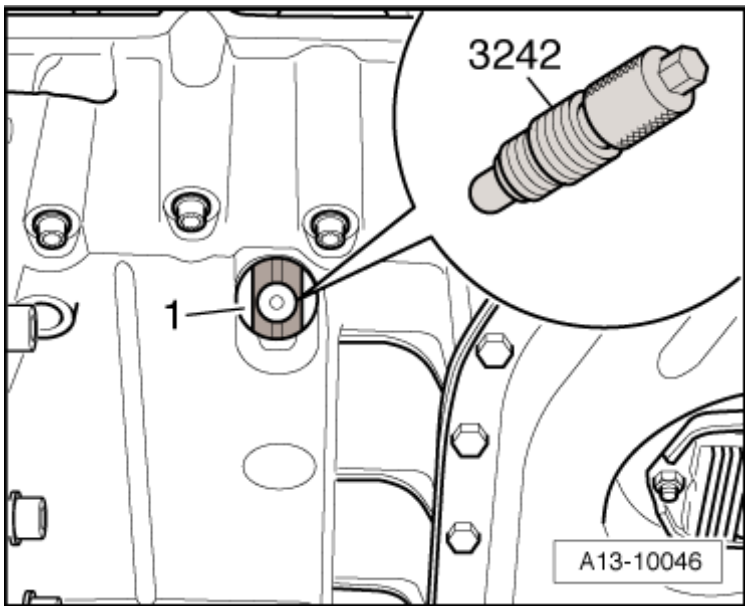


Fig. 104: Identifying Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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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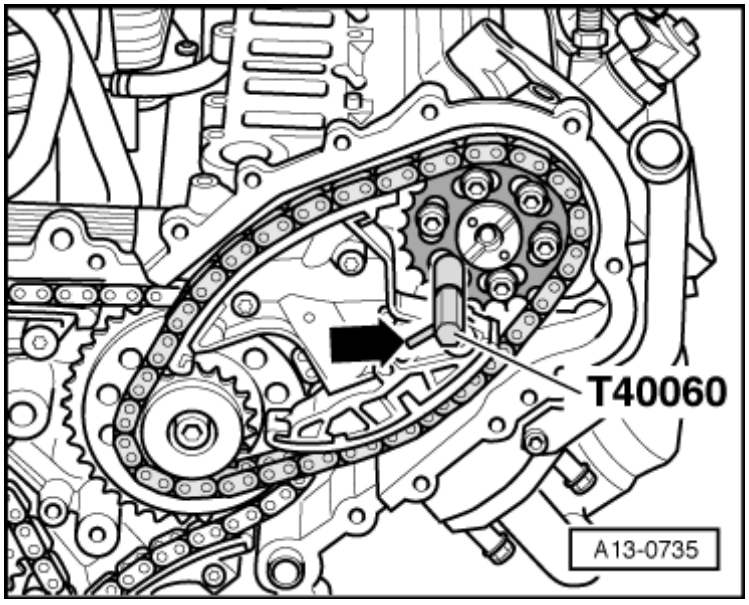


Fig. 105: Identifying TDC Position Of Camshafts
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

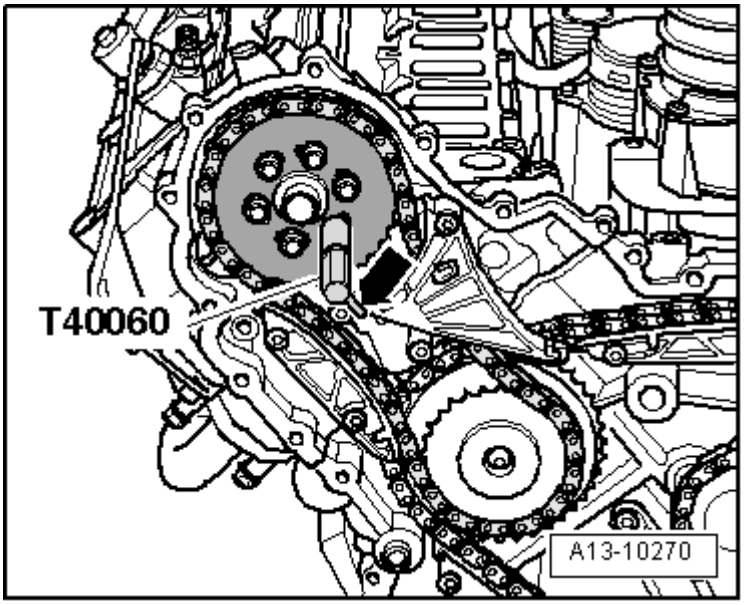


Fig. 106: Identifying Perpendicular Pin -Arrow- On Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CORRECTING THE VALVE TIMING

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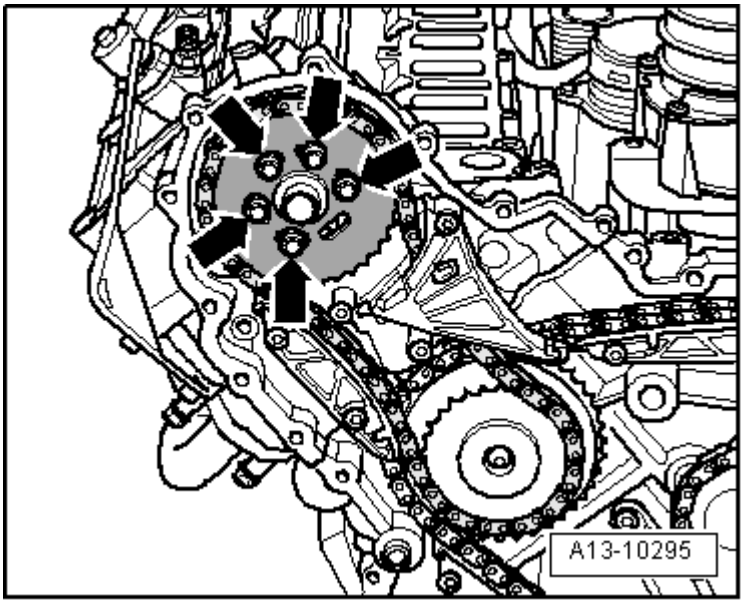


Fig. 107: Identifying Bolts -Arrows-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- If one of the camshafts does not lock, loosen all the bolts -arrows- for that particular camshaft chain sprocket about 1 turn.

-- Install the adapter T40061 over the bolt heads.

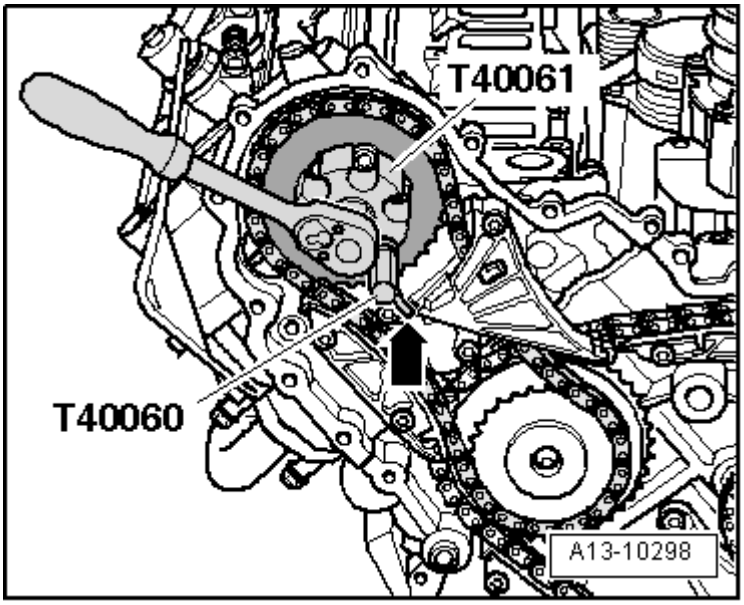


Fig. 108: Identifying Adapter T40061 And Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Turn the camshaft using the adapter T40061 just a little back and forth until it is possible to install the T40060.

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

-- Tighten the bolts for the camshaft chain sprocket using adapter T40061 with 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 the final specification.

-- Repeat the procedure on the other cylinder bank if necessary.

-- Remove the crankshaft Holder 3242.

-- Check the valve timing once again, refer to **CHECKING THE VALVE TIMING**.

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

-- Install the plug -arrow- in the upper oil pan.

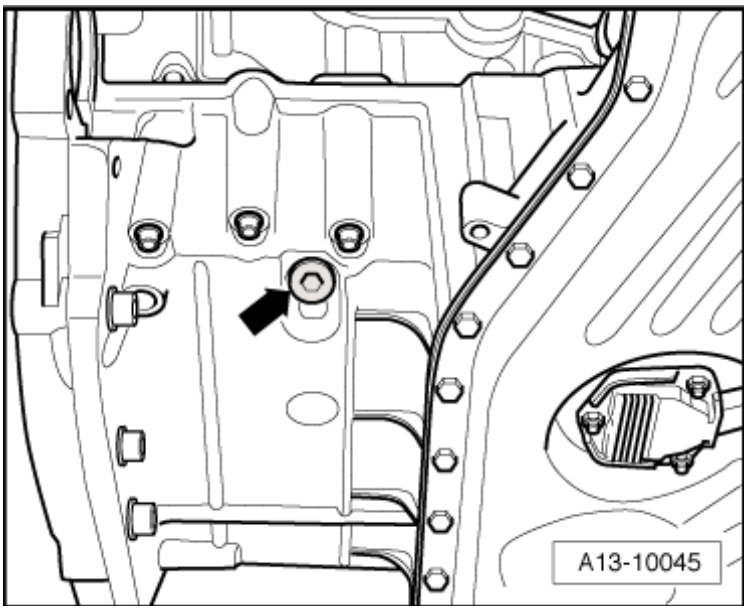


Fig. 109: Identifying Locking Bolt Of Upper Part Of Oil Pan
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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

-- Fill the engine oil and check the oil level. Refer to **Maintenance Procedures**

CAMSHAFT TIMING CHAINS, REMOVING FROM CAMSHAFTS

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Special tools and workshop equipment required

- Crankshaft Holder 3242
- Socket T40058
- Adjustment Pin T40060 (Quantity: 2)
- Adapter T40061
- Adapter T40062
- 3.3 mm Diameter Drill Bit (Quantity: 2)

REMOVING

- Engine and transmission installed.

NOTE: If work will only be done on one cylinder head, it is only necessary to adjust the valve timing on the cylinder bank that was repaired.

-- Drain the coolant. Refer to **DRAINING AND FILLING** .

-- Remove the primary catalytic converter. Refer to **EXHAUST SYSTEM COMPONENTS** .

-- Remove the vacuum pump. Refer to **VACUUM PUMP OVERVIEW**.

-- Remove the 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 on the drive chains from behind with the engine removed.

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

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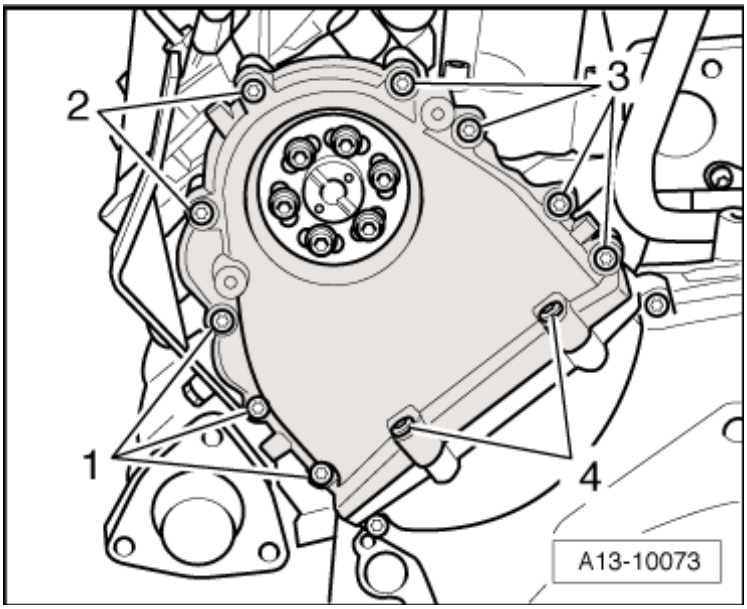


Fig. 110: Identifying Bolt Tightening Sequence
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

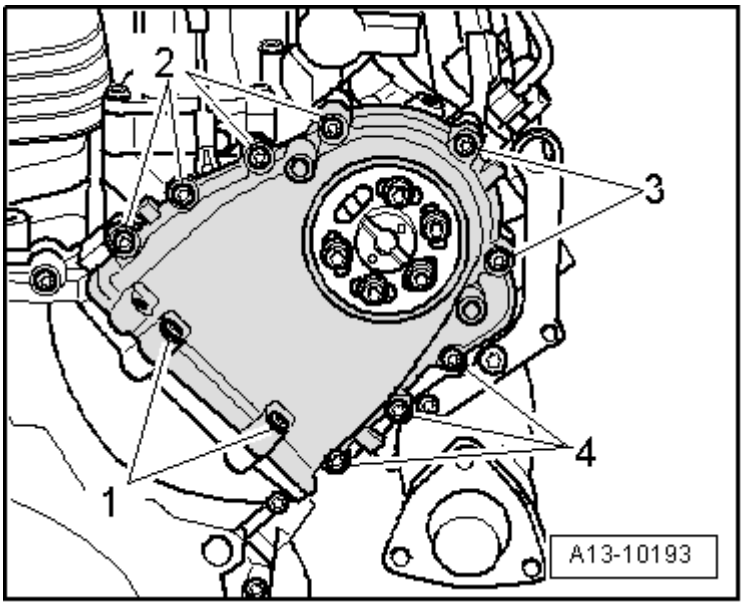


Fig. 111: Identifying Bolts -1 Through 4-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Assemble the socket T40058 as follows:

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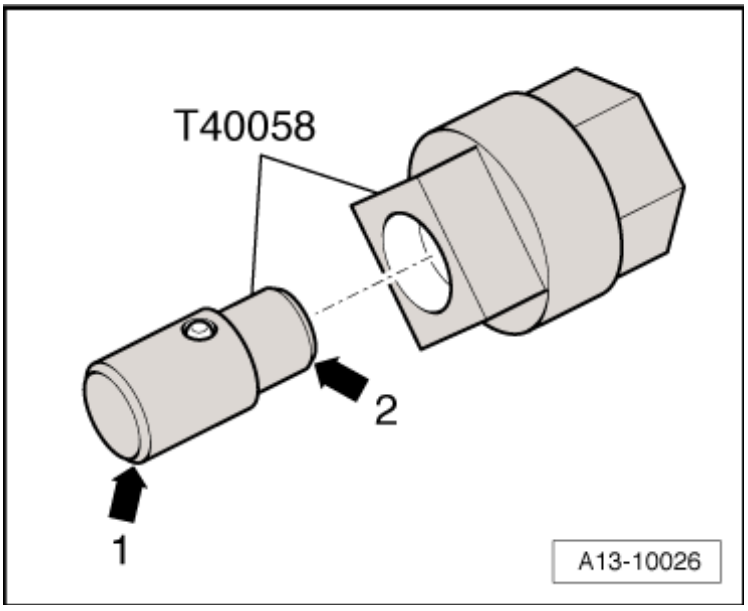


Fig. 112: Identifying Guide Pin Of Adapter T40058
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- The large diameter -arrow 1- faces the engine.
- The small diameter -arrow 2- points to the adapter.

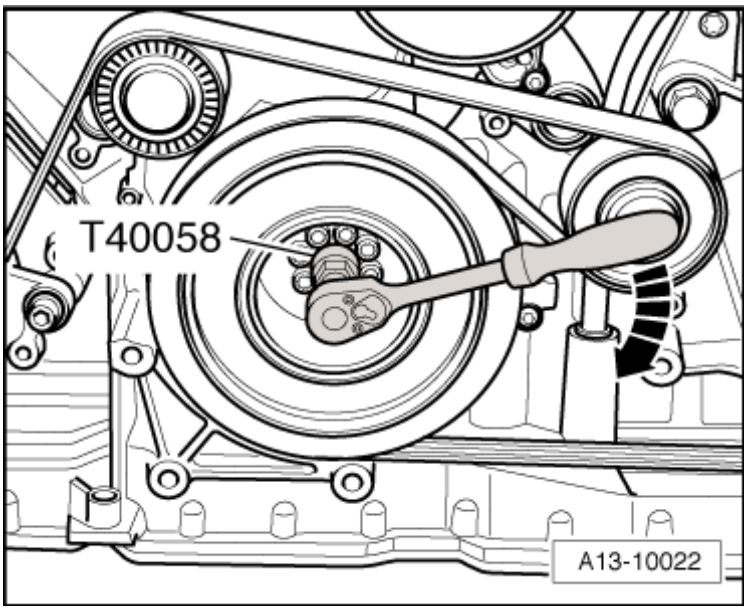


Fig. 113: Identifying Torque Converter Bolts Using Adapter T40058
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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

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-- Using the socket T40058, 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.

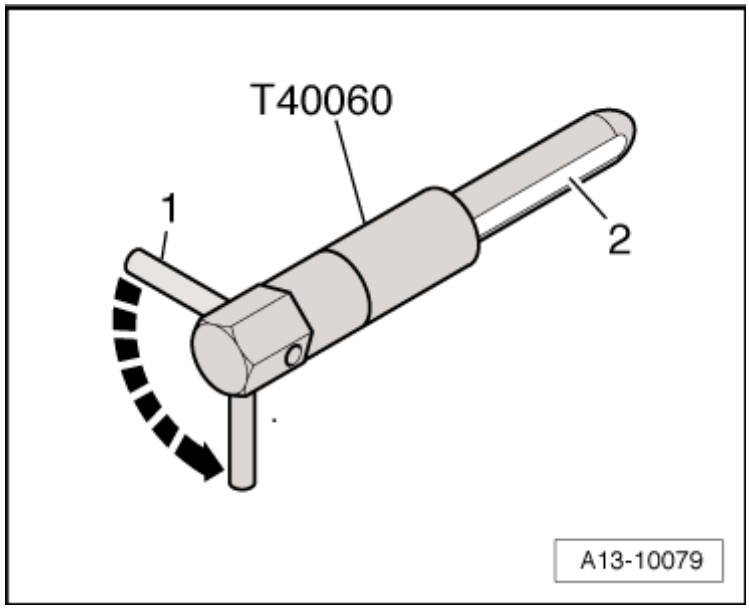


Fig. 114: Identifying Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Install the adjustment pin T40060 so that the pin -1- is perpendicular to the camshaft axis.

Rotate the adjustment pin T40060 using the pin -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 for both cylinder heads are in TDC position.

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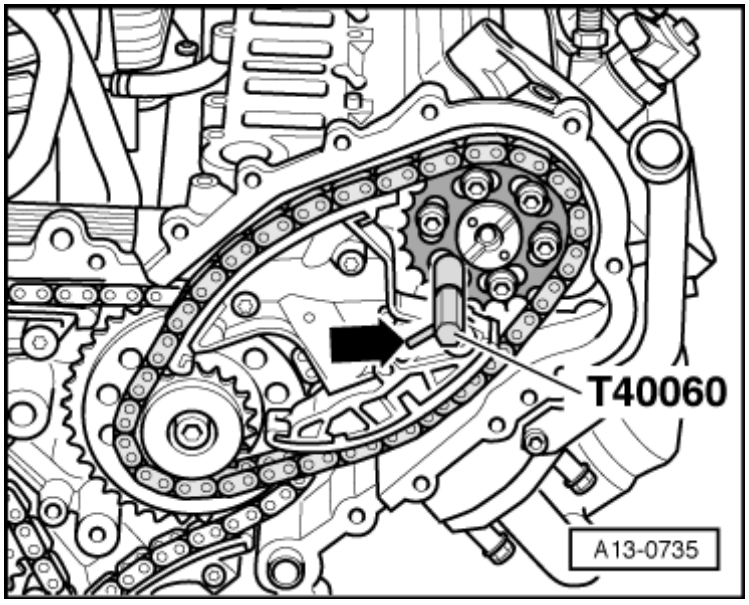


Fig. 115: Identifying TDC Position Of Camshafts
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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

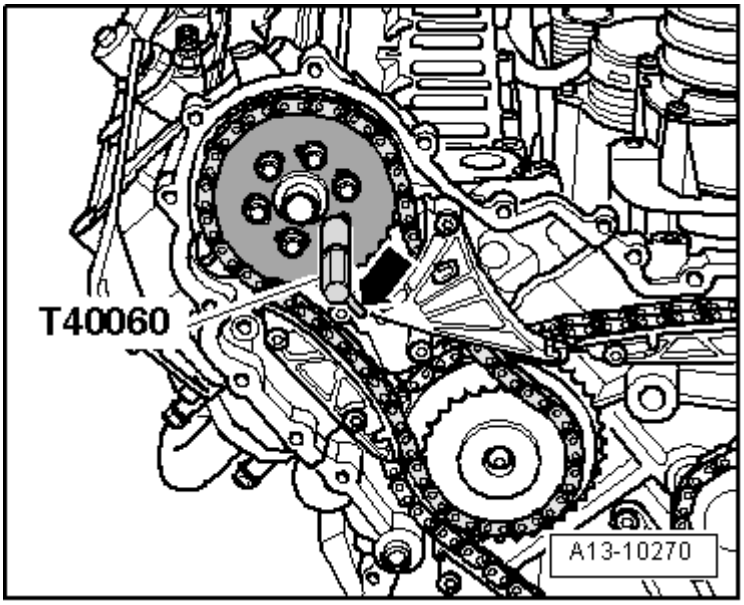


Fig. 116: Identifying Perpendicular Pin -Arrow- On Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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NOTE: To collect any leaking engine oil, place a clean cloth under the upper oil pan.

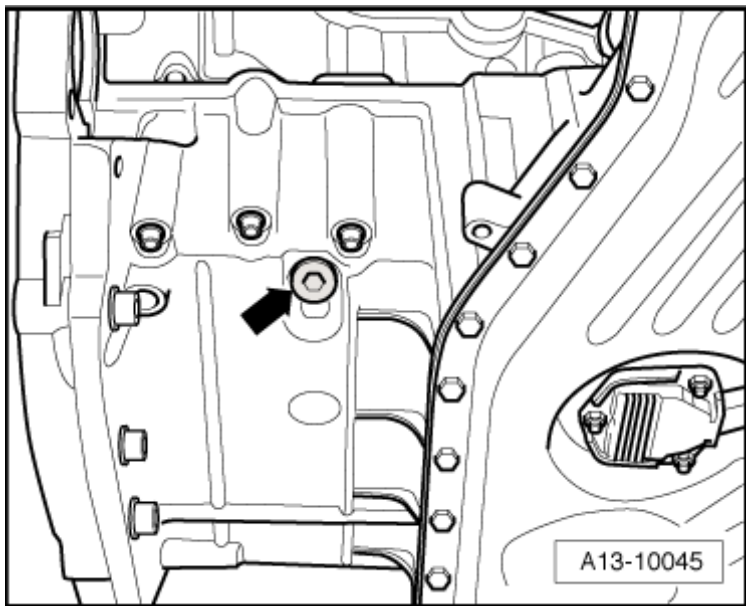


Fig. 117: Identifying Locking Bolt Of Upper Part Of Oil Pan
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

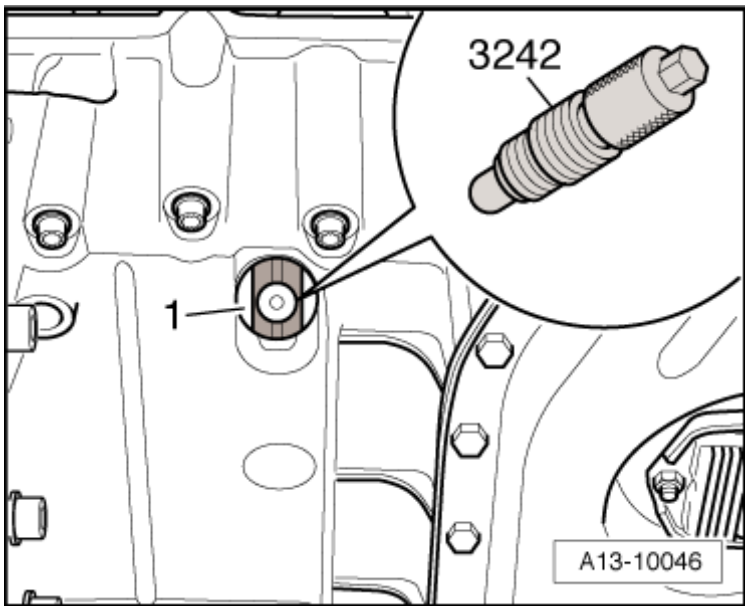


Fig. 118: Identifying Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

WARNING: Risk of injury when inserting your finger in the TDC hole.

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

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

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

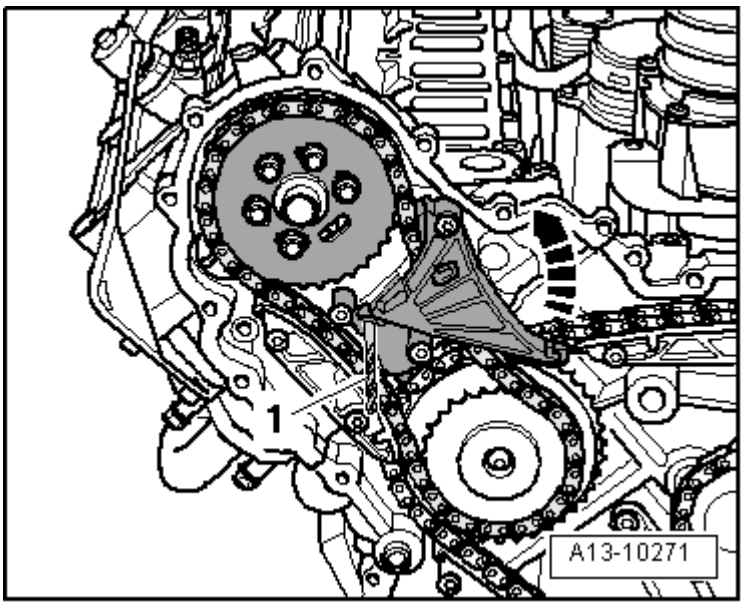


Fig. 119: Identifying Chain Tensioner Secured Using 3.3 Mm Diameter Drill Bit
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

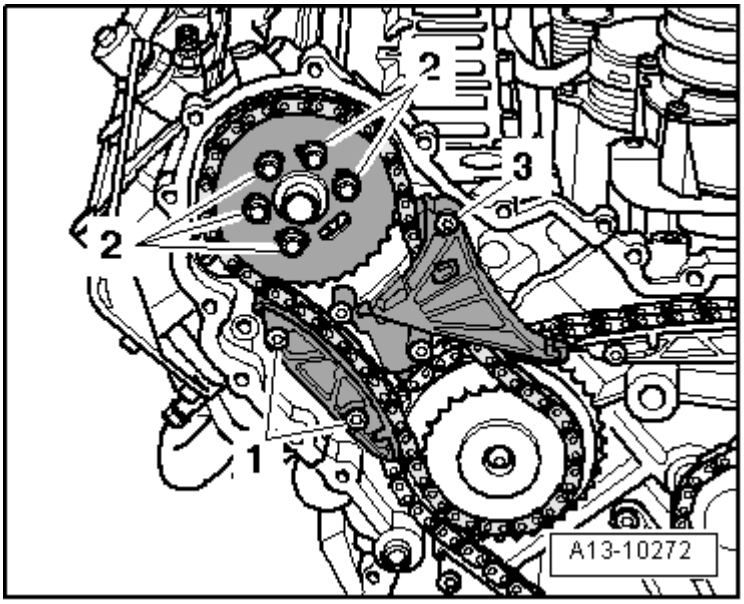


Fig. 120: Identifying Bolts -1- For Guide Rail And Bolts -2- For Camshaft Chain Sprocket
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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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 chain sprocket.

-- Remove the camshaft chain sprocket and guide rail.

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

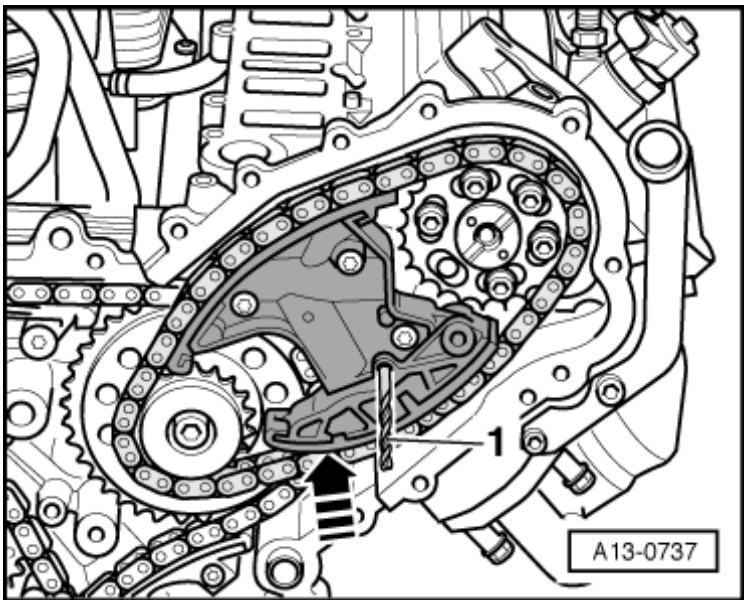


Fig. 121: Identifying 3.3 mm Diameter Drill Bit -1- To Install Chain Tensioner Guide Rail On Right Camshaft Timing Chain
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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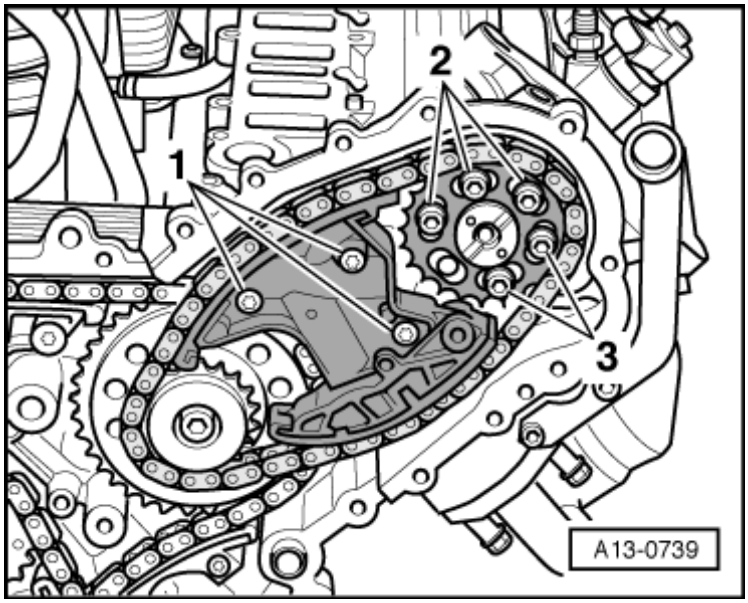


Fig. 122: Identifying Chain Tensioner Guide Rail Installed On Right Camshaft Timing Chain
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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 camshaft chain sprocket bolts -2 and 3-.

-- Remove the camshaft chain sprocket and chain tensioner.

INSTALLING

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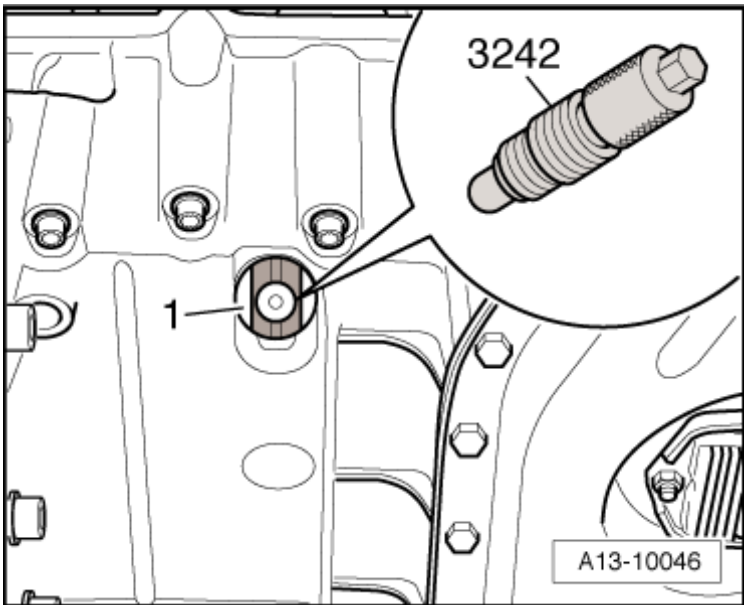


Fig. 123: Identifying Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Tightening specifications, refer to **LEFT CAMSHAFT TIMING CHAIN OVERVIEW**.
- Secure the crankshaft -1- in TDC position using the crankshaft 3242.

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

Replace the plug in the upper oil pan.

CAUTION: Risk of damaging valves and piston crowns.

- **If the camshafts are rotated, 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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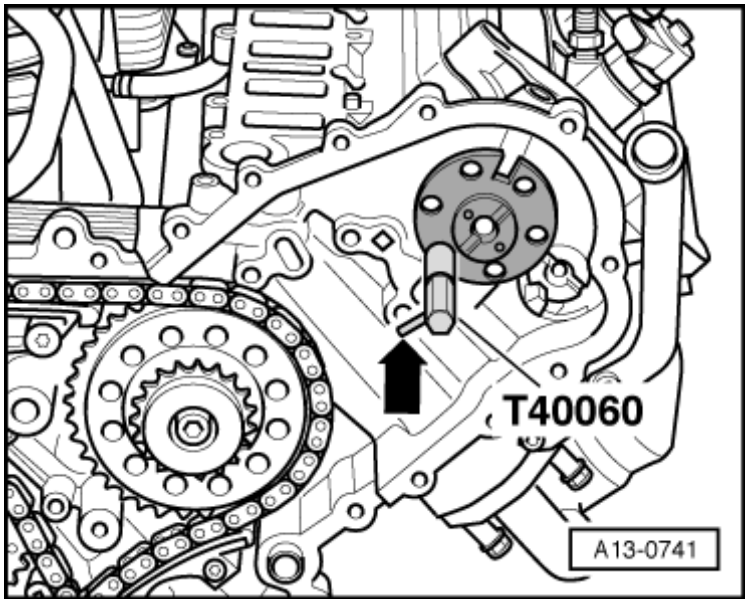


Fig. 124: Identifying Check Of Camshafts For Both Cylinder Heads In TDC Position And Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

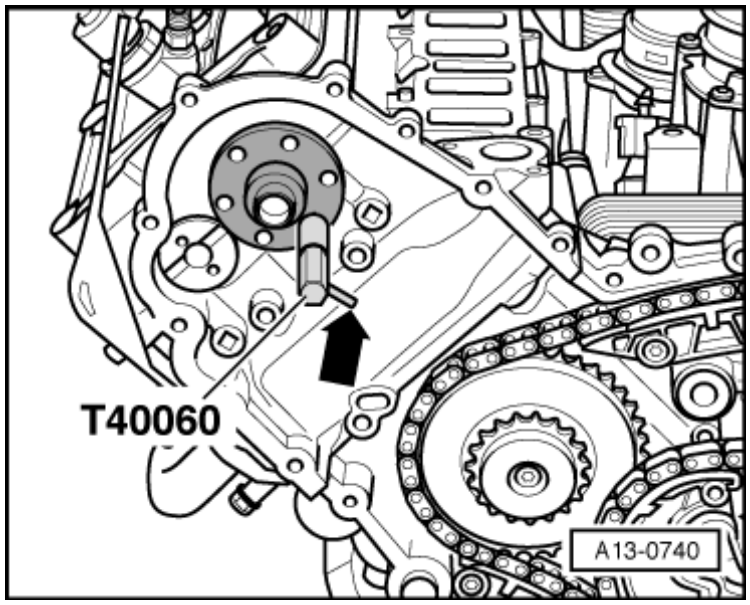


Fig. 125: Identifying Perpendicular Pin -Arrow- On Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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-- Remove the adjustment pin T40060 from both camshafts.

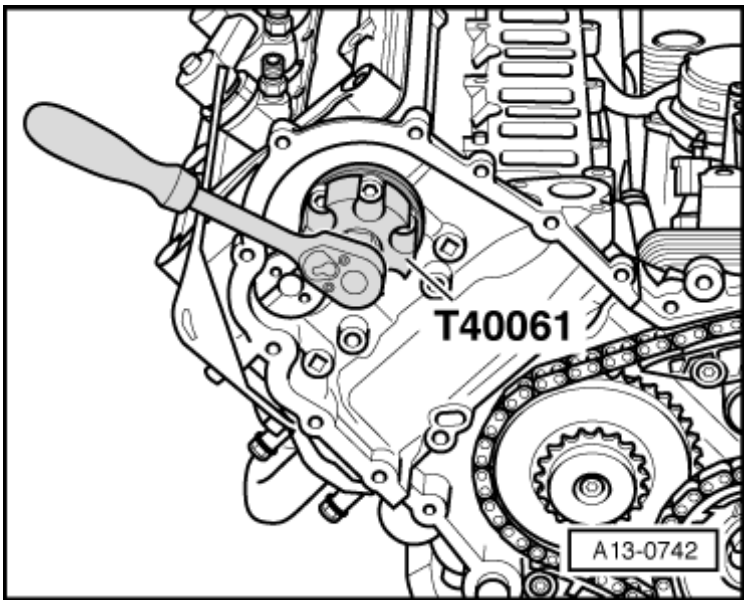


Fig. 126: Identifying Adapter T40061 And Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CAUTION: Risk of damaging valves and piston crowns.

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

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

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

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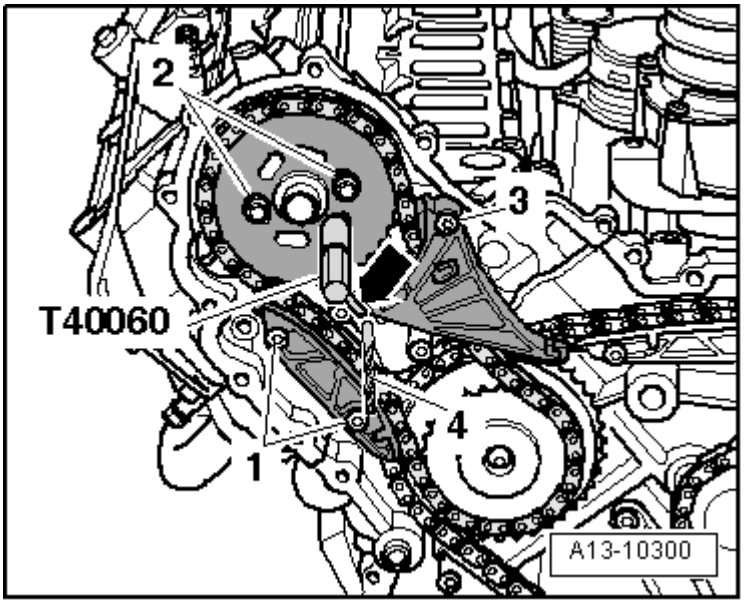


Fig. 127: Identifying Left Camshaft Timing Chain, Camshaft Chain Sprocket, Guide Rail And Tensioning Rail
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- The slots in the camshaft chain 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 both camshaft chain sprocket bolts -2- loosely.

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

-- Secure the left camshaft using adjustment pin T40060.

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

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

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

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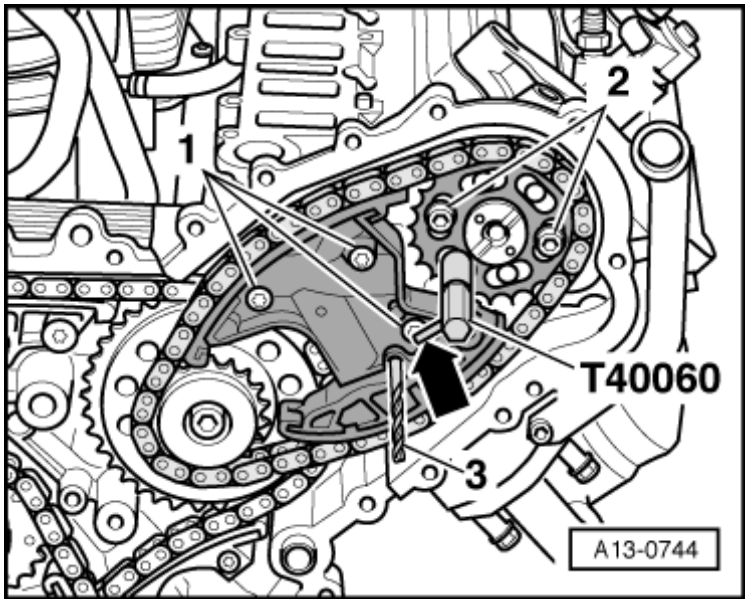


Fig. 128: Identifying Drill Bit -4- And Alignment Hole
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

-- Tighten the chain tensioner bolts -1-.

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

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

-- Secure the right camshaft using adjustment pin T40060.

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

-- Remove the drill -3- out of the alignment hole, thereby releasing the right chain tensioner.

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

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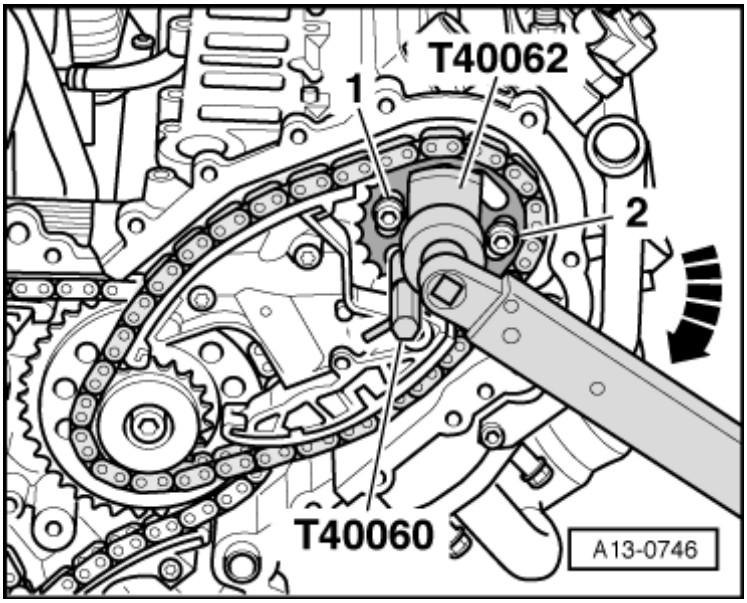


Fig. 129: Identifying Bolts -1 And 2-, Torque Wrench, Adapter T40062 And Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Tighten the bolts -1 and 2-.

-- Remove the adapter T40062 and adjustment pin T40060.

-- Install and tighten the remaining bolts for the right camshaft chain sprocket.

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

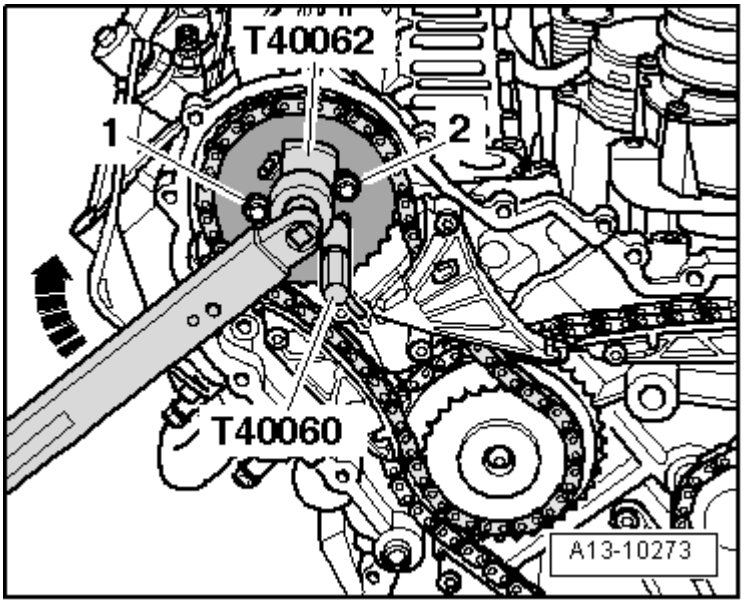


Fig. 130: Identifying Adapter T40062 On Left Camshaft Chain Sprocket
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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-- Tighten the bolts -1 and 2-.

-- Remove the adapter T40062 and adjustment pin T40060.

-- Install and tighten the remaining bolts for the left camshaft chain sprocket.

-- Remove the crankshaft Holder 3242.

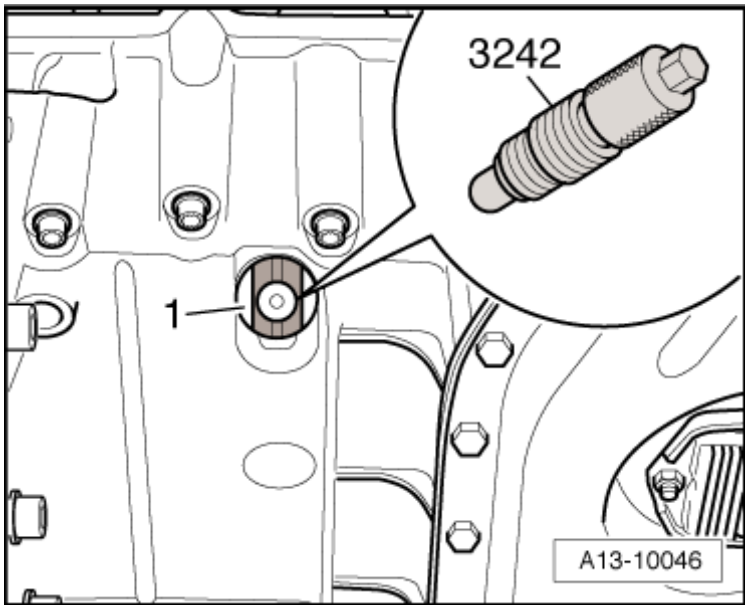


Fig. 131: Identifying Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CHECKING THE VALVE TIMING

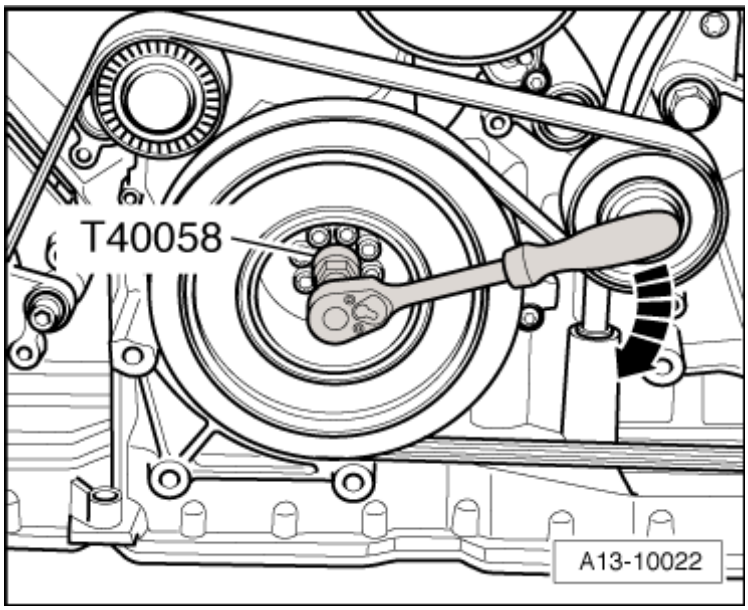


Fig. 132: Identifying Torque Converter Bolts Using Adapter T40058

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Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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

-- Turn the crankshaft two turns until the crankshaft is just in front of TDC.

-- Lock the crankshaft -1- from turning using the crankshaft Holder 3242 and tighten it to 20 Nm.

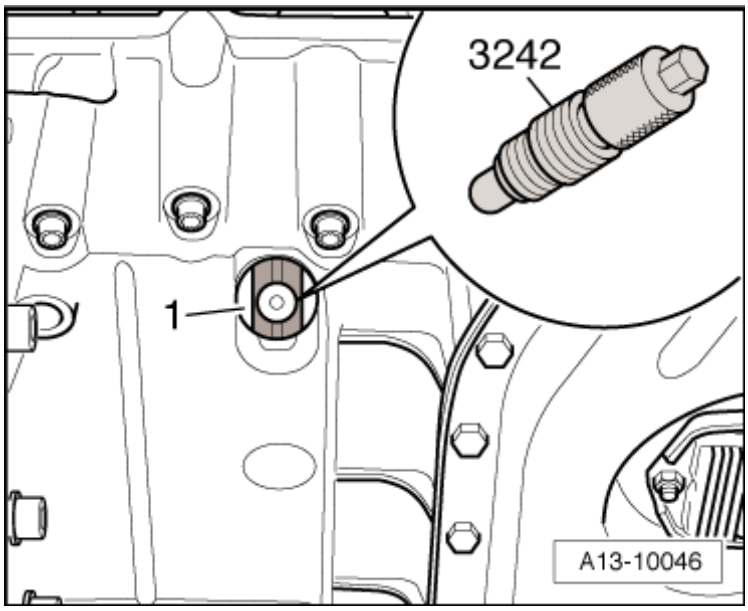


Fig. 133: Identifying Crankshaft Holder 3242 In Bore
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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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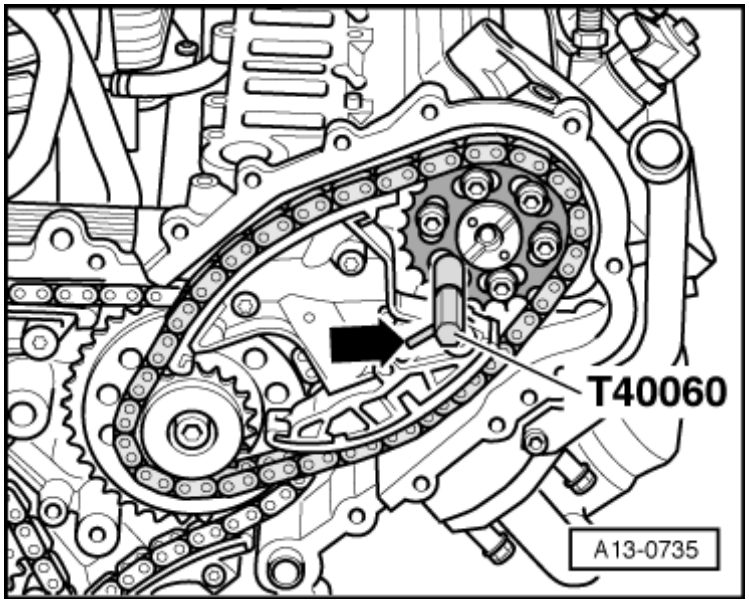


Fig. 134: Identifying TDC Position Of Camshafts
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

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

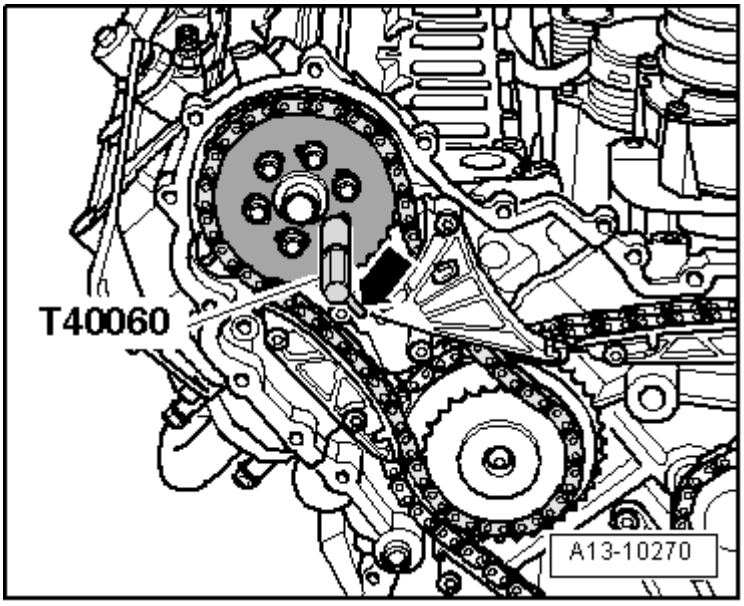


Fig. 135: Identifying Perpendicular Pin -Arrow- On Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

CORRECTING THE VALVE TIMING

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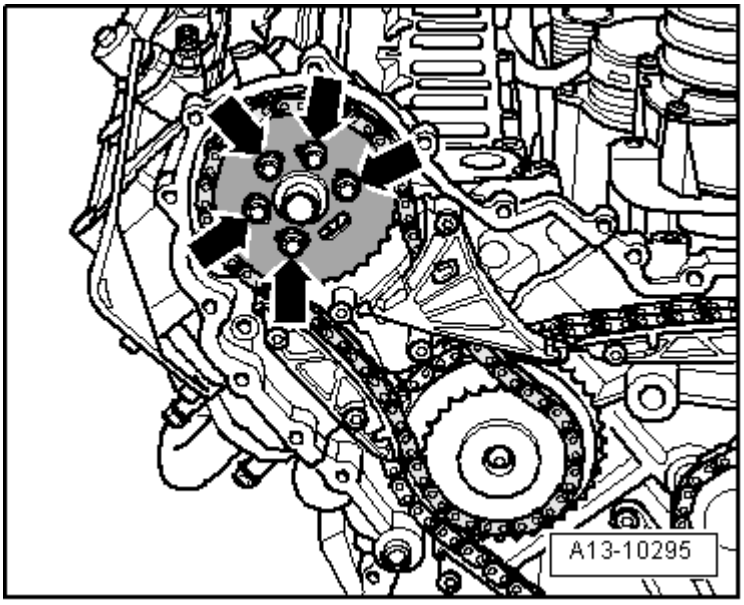


Fig. 136: Identifying Bolts -Arrows-
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- If one of the camshafts does not lock, loosen all the bolts -arrows- for that particular camshaft chain sprocket about 1 turn.

-- Install the adapter T40061 over the bolt heads.

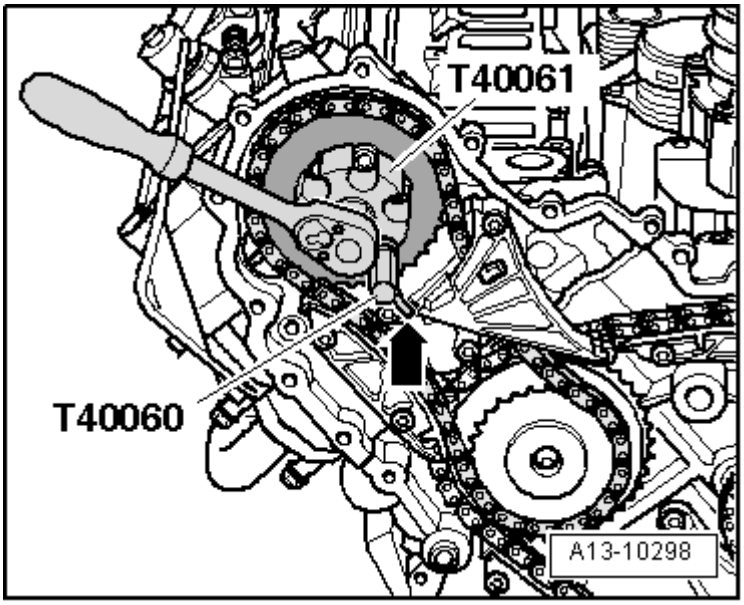


Fig. 137: Identifying Adapter T40061 And Adjustment Pin T40060
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

-- Turn the camshaft by the adapter T40061 just a little back and forth until it is possible to install the adjustment pin T40060.

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

-- Tighten the bolts for the camshaft chain sprocket using the adapter T40061 with the adjustment pin T40060 still attached to approximately 5 Nm.

-- Remove the adjustment pin T40060 and the adapter T40061.

-- Tighten the camshaft chain sprocket bolts to the final specification.

-- Repeat the procedure on the other cylinder bank if necessary.

-- Remove the crankshaft Holder 3242.

-- Check the valve timing once again. Refer to **CHECKING THE VALVE TIMING**.

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

-- Install the plug -arrow- to the upper oil pan.

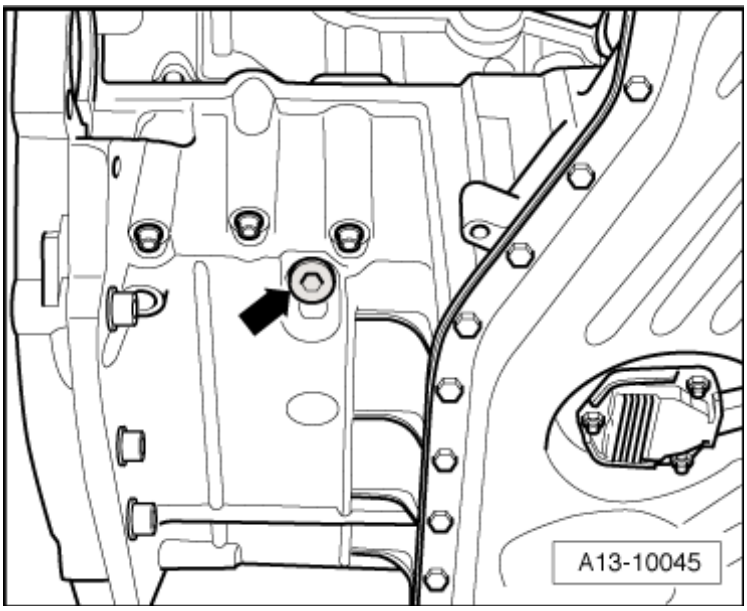


Fig. 138: Identifying Locking Bolt Of Upper Part Of Oil Pan
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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

SPECIAL TOOLS

Special tools and workshop equipment required

- Seal Puller - General Usage 2085
- M10 x 1.25 x 40 Bolt from Seal Installer 3241

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- Assembly Tool T10053
- Camshaft Insertion Tool T40094
- Camshaft Insertion Tool T40095
- Camshaft Insertion Tool T40096
- Socket T40058
- Compression Tester V.A.G 1763

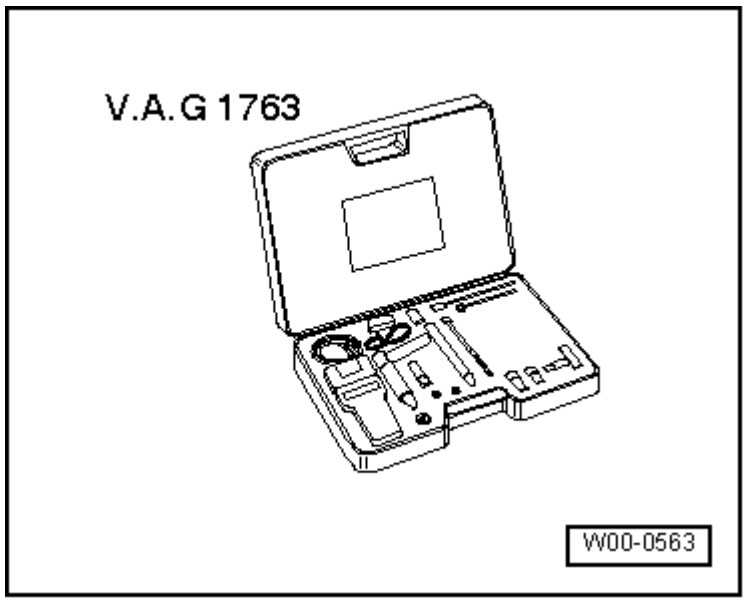


Fig. 139: Identifying Compression Tester V.A.G 1763
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Dial Gauge Holder VW 387

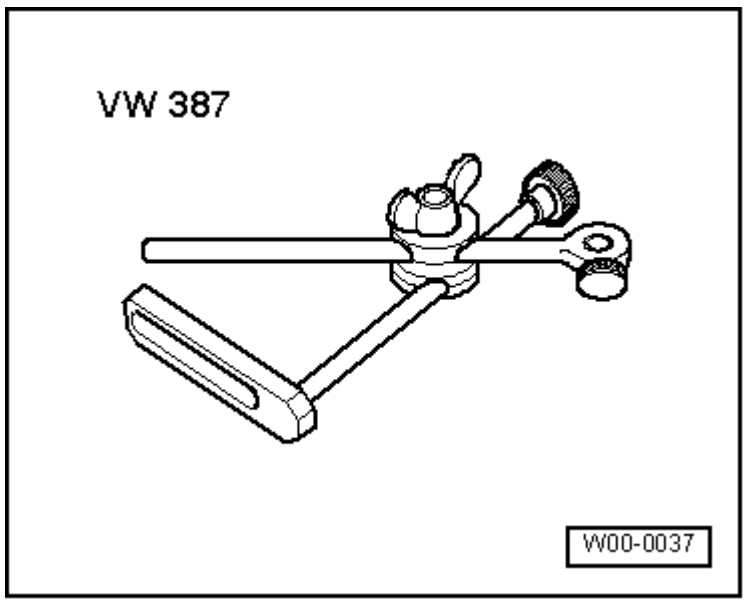


Fig. 140: Identifying Dial Gauge Holder VW 387

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Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

- Dial Gauge (0-10 mm) VAS 6079

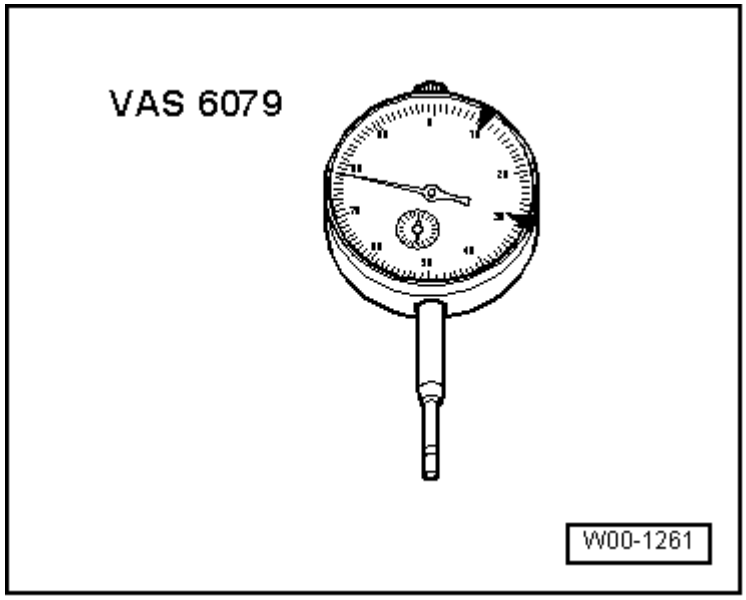


Fig. 141: Identifying Dial Gauge VAS 6079
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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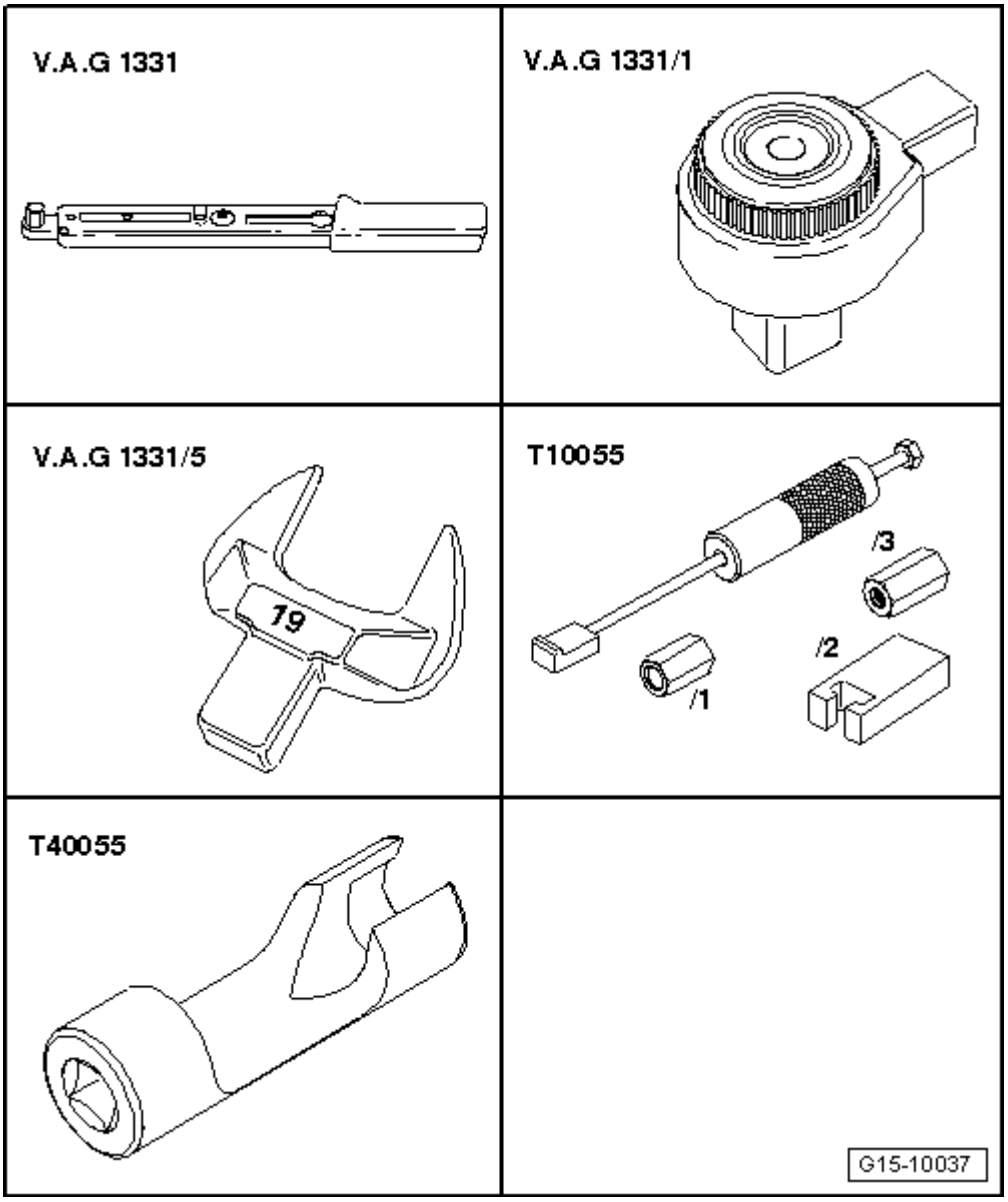


Fig. 142: Identifying Special Tools - Torque Wrench, Ratchet And Puller
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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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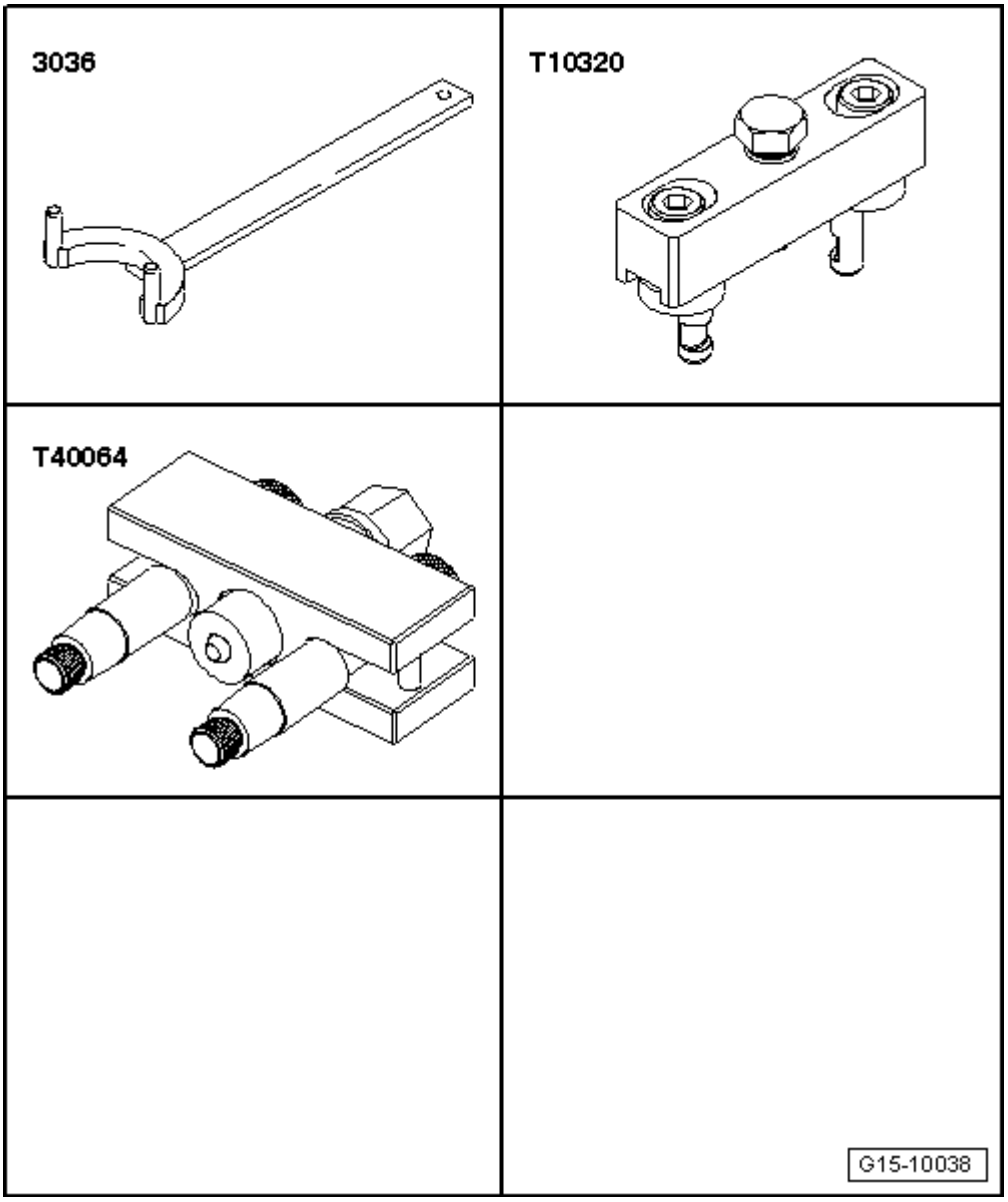


Fig. 143: Identifying Special Tools - Retainer And Pullers
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Special tools and workshop equipment required

- Retainer 3036
- Puller T10320
- Puller T40064

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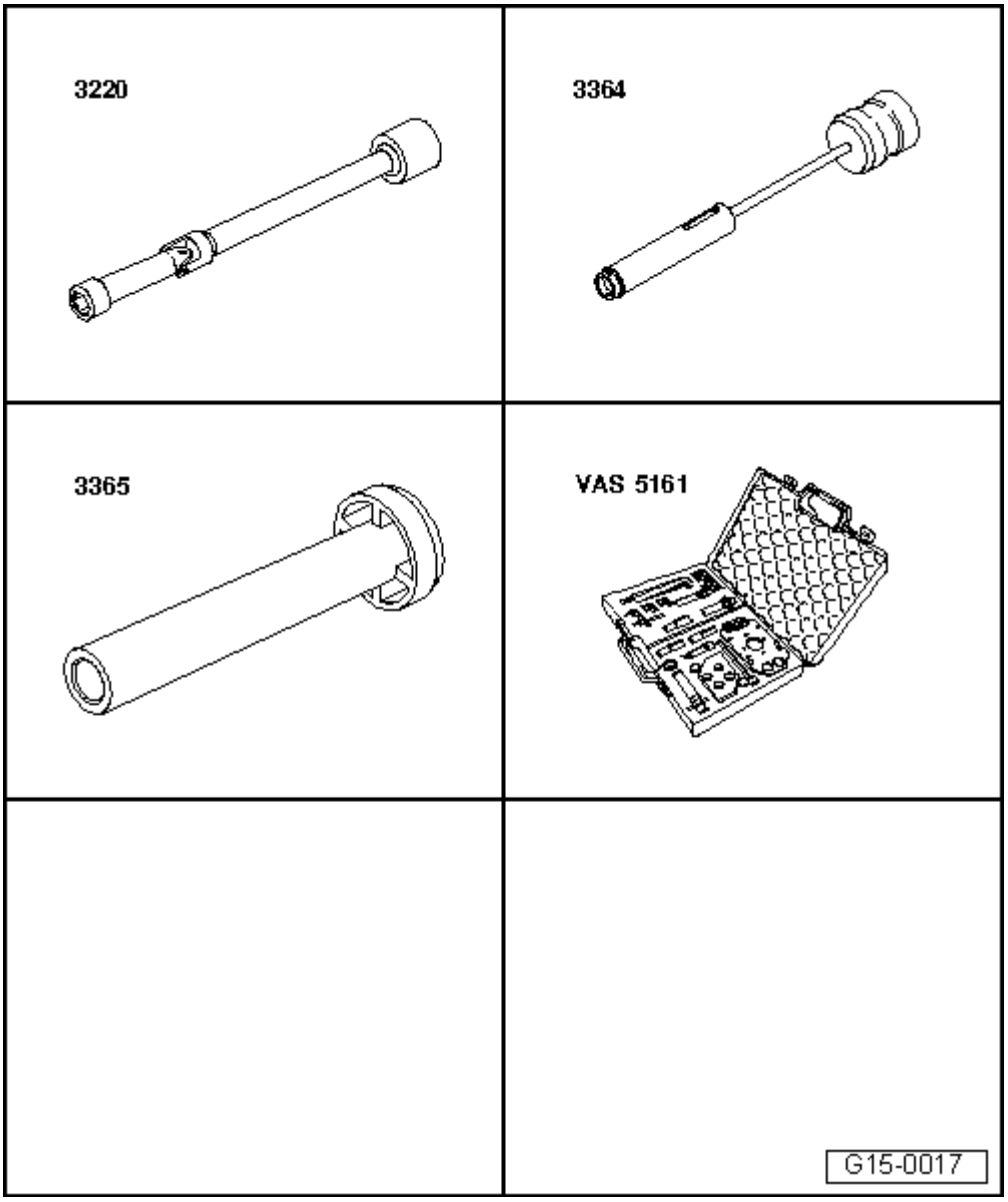


Fig. 144: Identifying Special Tools - 3220, 3364, 3365 And VAS 5161
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

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 with
- Guide Plate for 3.0 Liter TDI Engine VAS 5161/23

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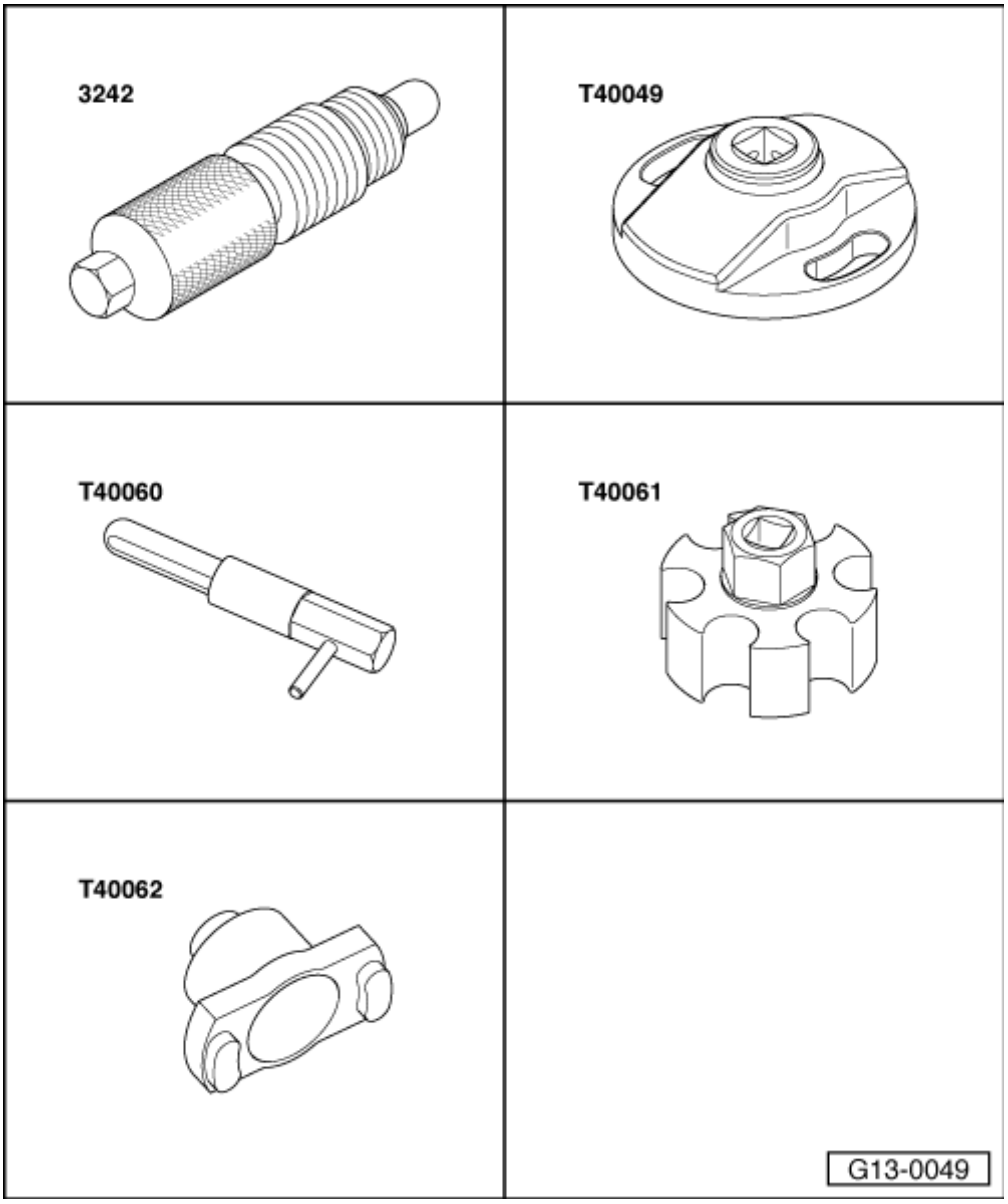


Fig. 145: Identifying Special Tools - Crankshaft Holder And Accessories
Courtesy of VOLKSWAGEN GROUP OF AMERICA, INC.

Special tools and workshop equipment required

- Crankshaft Holder 3242
- Key T40049
- Adjustment Pin T40060
- Adapter T40061
- Adapter T40062

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