



Valve train

Note:

- *Cylinder heads with cracks between valve seats or between valve seat and spark plug thread can still be used without loss of service life if the cracks are minute (max. 0.3 mm width) or only the first four threads of a spark plug thread are cracked.*
- *Cylinder head and guide frame may only be replaced together.*
- *After installing camshafts, do not start engine for at least 30 minutes. The hydraulic valve lifters have to settle (otherwise valves will strike the pistons).*
- *After working on the valvetrain and lifters, carefully rotate the crankshaft by hand at least 2 full revolutions before starting to be sure that valves do not strike the pistons.*
- *Always replace gaskets, seals and O-rings.*

Valvetrain, assembly overview ⇒ [15-2, Valvetrain, assembly overview](#)

Valve dimensions ⇒ [15-2, Valve dimensions](#)

Checking valve guides ⇒ [15-2, Valve guides, checking](#)

Replacing valve stem oil seals ⇒ [15-2, Valve stem oil seals, replacing](#)

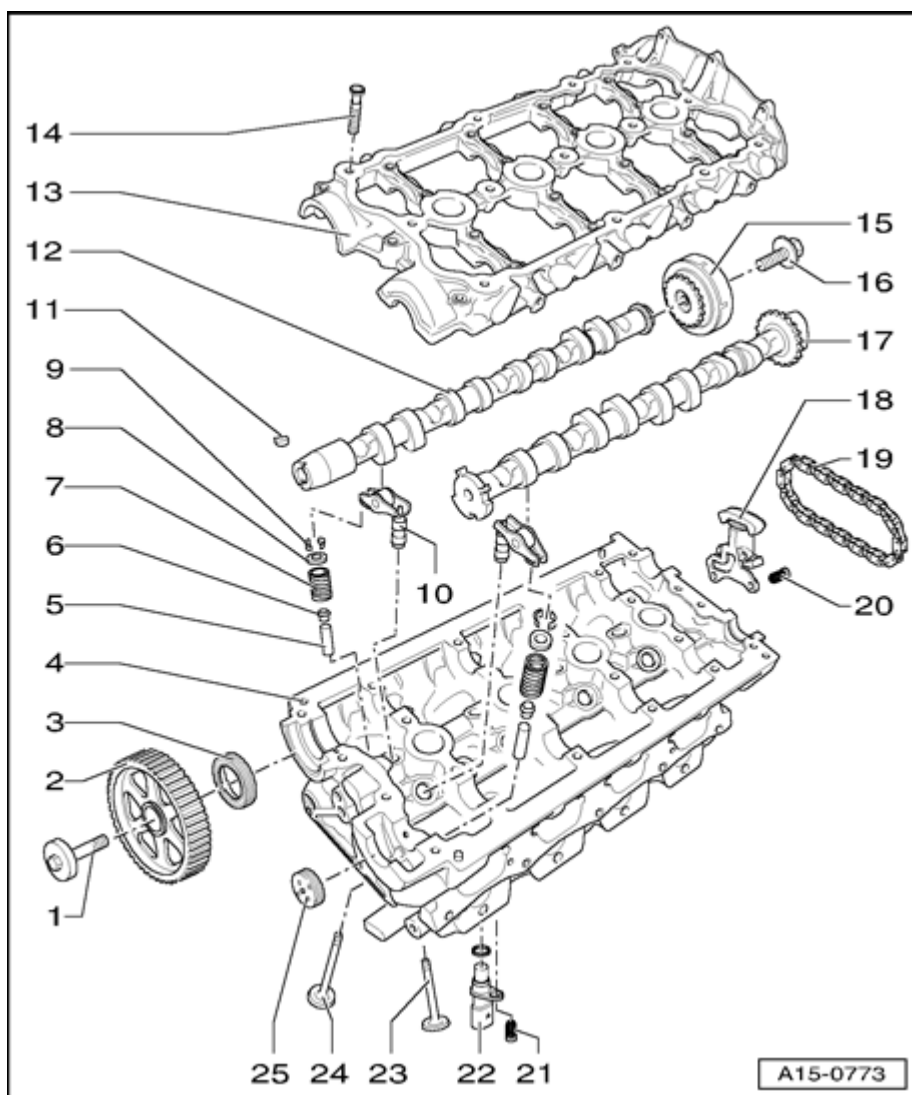
Replace sealing ring for exhaust camshaft ⇒ [15-2, Sealing ring for exhaust camshaft, replacing](#) .

Removing and installing camshaft adjuster ⇒ [15-2, Camshaft adjuster, removing and installing](#)

Removing and installing Camshaft Adjustment Valve 1 N205 ⇒ [15-2, Camshaft Adjustment Valve 1 N205, removing and installing](#)

Removing and installing camshaft ⇒ [15-2, Camshafts, removing and installing](#)

Valvetrain, assembly overview



- **65 Nm**
- **Camshaft gear**
 - Use retainer 3036 for loosening and tightening
- **Seal**
 - Replace ⇒ [15-2, Sealing ring for exhaust camshaft, replacing](#)
- **Cylinder head**
- **Valve guide**
 - Checking ⇒ [15-2, Valve guides, checking](#)

- **Valve stem oil seal**
 - Replace ⇒ [15-2, Valve stem oil seals, replacing](#)
- **Valve spring**
- **Upper valve spring plate**
- **Valve keepers**
- **Hydraulic valve play balancing element**
 - Do not interchange
 - Oil contact surface
- **Fitting key**
 - Check for secure fitting
- **Exhaust camshaft**
 - Check radial clearance using Plastigage (roller cam follower removed) wear limit: 0.1 mm
 - Max. run-out: max. 0.035 mm
- **Guide frame**
 - With integrated camshaft bearings
 - Clean sealing surface, reworking is not permitted.
 - Remove old sealant residue.
- **8 Nm plus an additional $1/4$ turn (90 °)**
 - Replace
- **Camshaft adjuster**
 - Removing and installing ⇒

[15-2, Camshaft adjuster,
removing and installing](#)

- **20 Nm plus an additional $\frac{1}{8}$ turn (45°)**
 - Use retainer 3036 for loosening and tightening

- **Intake camshaft**
 - Check radial play using Plastigage, Wear limit: 0.1 mm
 - Max. run-out: max. 0.035 mm

- **Chain tensioner**
 - Before removing, secure with locking pin T10115

- **Drive chain**
 - Removing and installing ⇒ [15-2, Camshaft adjuster, removing and installing](#)
 - Checking for wear

- **10 Nm**
- **10 Nm**
- **Camshaft Position (CMP) Sensor G40**
- **Exhaust valve**
 - Do not reface, only hand-lapping is permitted
 - Valve dimensions ⇒ [15-2, Valve dimensions](#)
 - Checking valve guides ⇒ [15-2, Valve guides, checking](#)

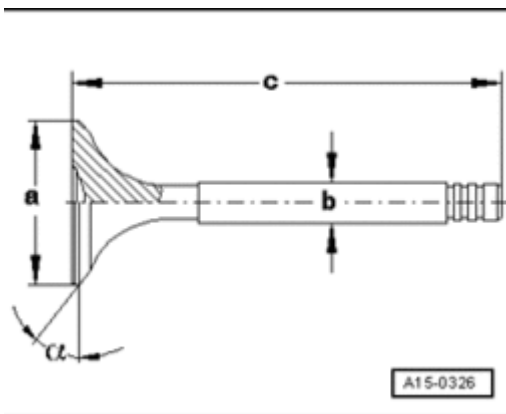
■ Intake valve

- Do not reface, only hand-lapping is permitted
- Valve dimensions ⇒ [15-2, Valve dimensions](#)
- Checking valve guides ⇒ [15-2, Valve guides, checking](#)

■ Cap

- Replace
- Removing: Insert a screwdriver into center of cap and pry out.
- Installing: Without sealant, press in with thrust piece 3334 1 to 2 mm deep.

Valve dimensions

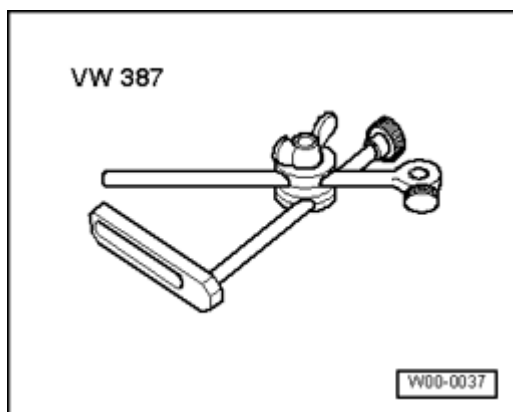


Intake and exhaust valves must not be refaced by grinding. Only hand-lapping is permitted.

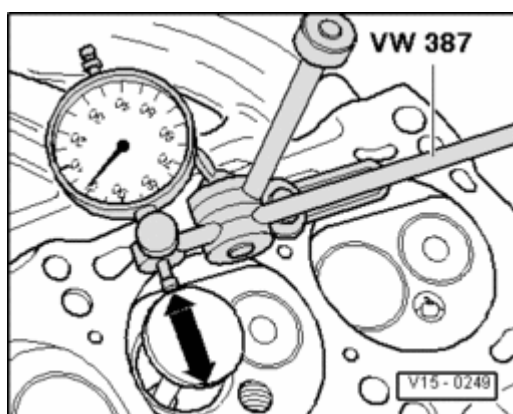
Dimension		Intake valve	Exhaust valve
Dia. a	mm	33.75 to 33.95	27.90 to 28.10
Dia. b	mm	5.98	5.95
c	mm	103.97	101.87
α	\square°	45	45

Valve guides, checking

Special tools, testers and auxiliary items required



- Dial gauge holder VW 387
- Dial gauge



- Insert new valve into guide. Valve stem tip must seal with guide. Due to differences in valve stem diameter, make sure that only intake valves are used to check intake guides, and only exhaust valves are used to check exhaust guides.

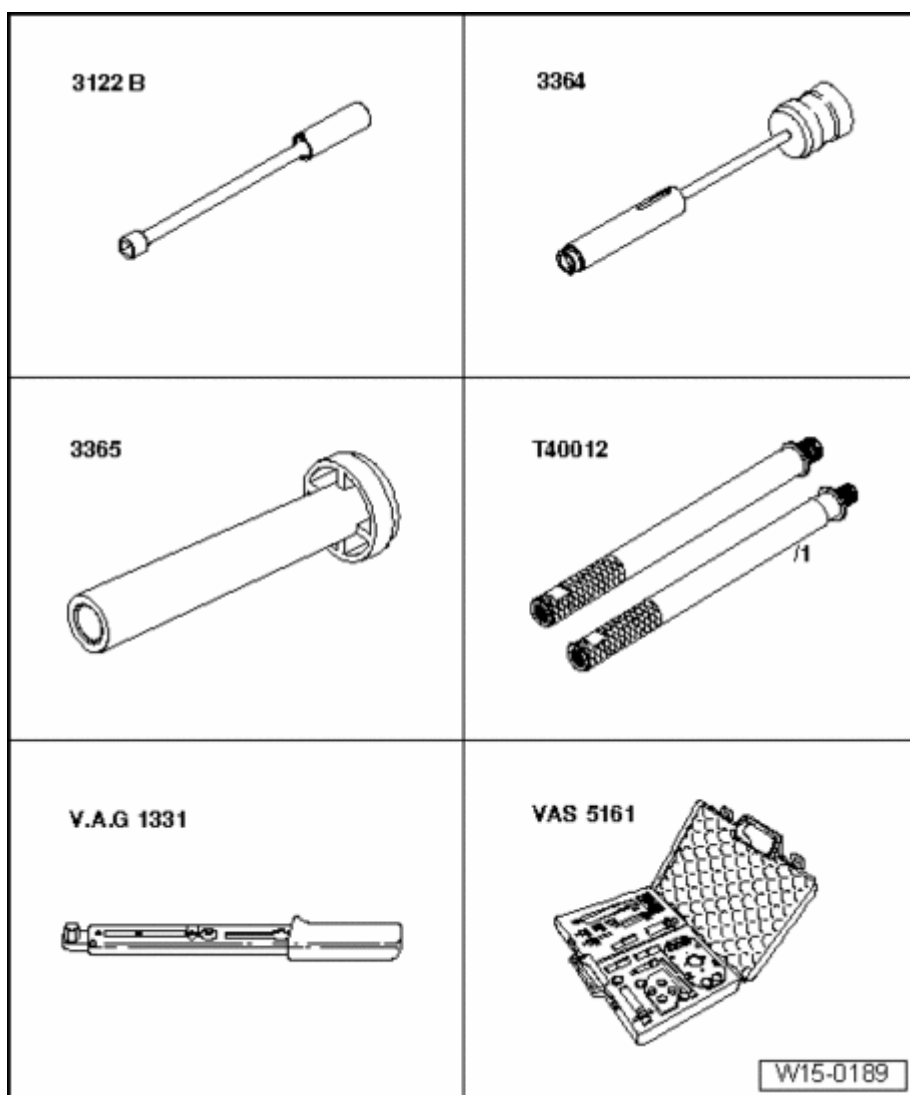
- Measure side play. Wear limit: 0.8 mm

If side play is exceeded:

- Replace cylinder head.

Valve stem oil seals, replacing

(with cylinder head installed)



Special tools, testers and auxiliary items required

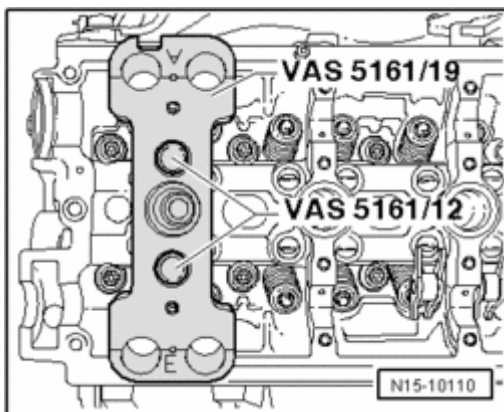
- Spark plug wrench 3122 B
- Valve seal removal tool 3364
- Valve stem seal driver 3365
- Adapter T40012
- Torque wrench V.A.G 1331
- Valve cotter disassembly and assembly device VAS 5161
- Guide plate VAS 5161/19

Removing valve stem oil seals ⇒ [15-2, Valve stem oil seals, removing](#)

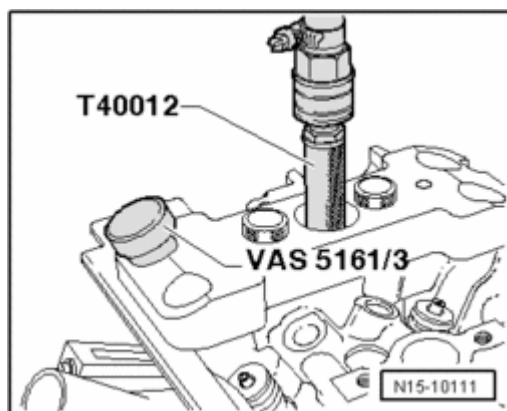
Installing valve stem oil seals ⇒ [15-2, Valve stem oil seals, installing](#)

Valve stem oil seals, removing

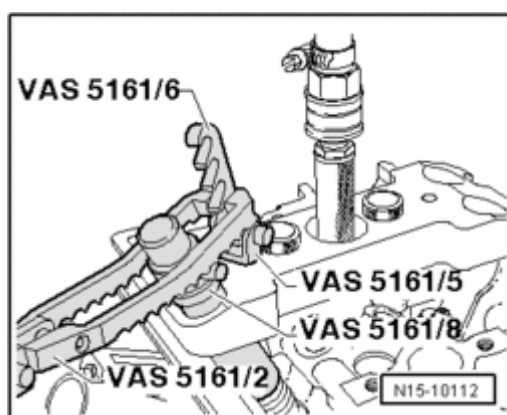
- Remove camshafts ⇒ [15-2, Camshafts, removing and installing](#) .
- Remove roller cam follower and set it down on a clean surface. Make sure that roller cam followers are not interchanged.
- Using spark plug removal tool 3122 B , remove spark plugs.



- Tightly bolt guide plate VAS 5161/19 with knurled bolts VAS 5161/12 on cylinder head as shown.
- Adjust piston of respective cylinder to "Bottom Dead Center position" .
- Screw adapter T40012 into spark plug thread and connect compressed air of at least 6 bar positive pressure.



- Using drift VAS 5161/3 and a plastic mallet, tap to loosen stuck valve keepers.

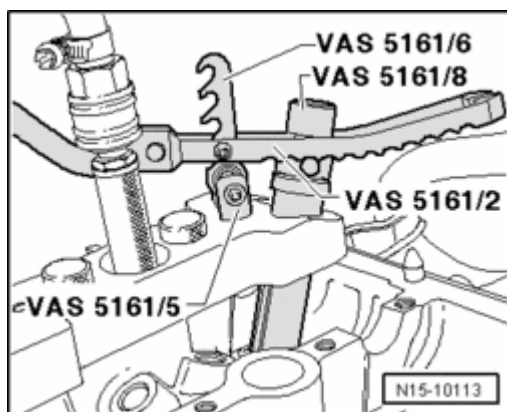


- Screw engaging device VAS 5161/6 with installation forks VAS 5161/5 into guide plate VAS 5161/19 .

- Insert installation cartridge VAS 5161/8 into guide plate VAS 5161/19 .

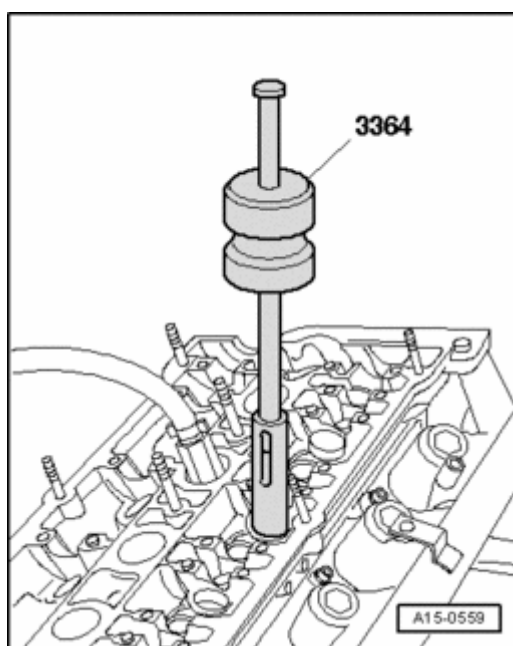
- Engage pressure fork VAS 5161/2 on engaging device VAS 5161/6 .

Note:

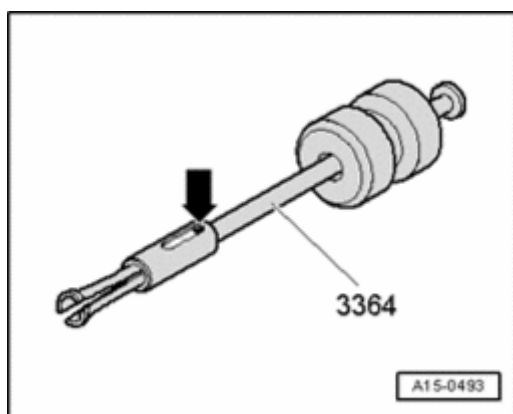


- *On the exhaust side, pressure forks VAS 5161/2 must be engaged as shown.*

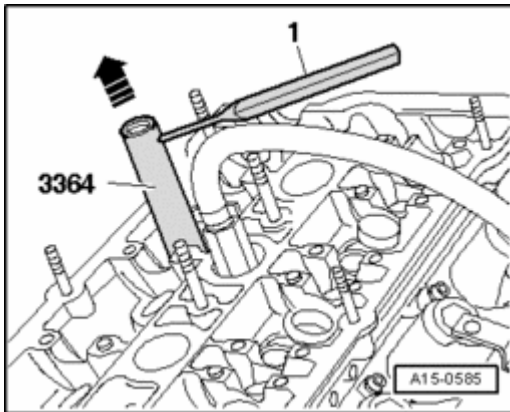
- Press down installation cartridge VAS 5161/8 . At the same time, turn knurled bolt of installation cartridge VAS 5161/8 clockwise until points engage in valve keepers.
- Lightly move knurled bolt back and forth, this causes the valve keepers to be pressed apart and captured in the installation cartridge.
- Release pressure fork VAS 5161/2 .
- Remove installation cartridge VAS 5161/8 .



- Remove valve stem oil seals using 3364 valve seal removal tool.

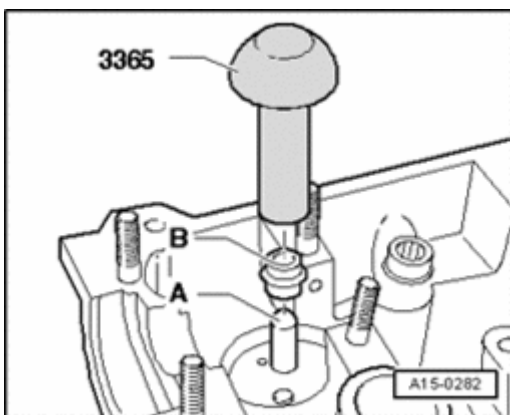


- If 3364 valve seal removal tool cannot be used due to restricted work area, drive out spring dowel sleeve - **arrow**
- using a drift and remove impact extractor device.

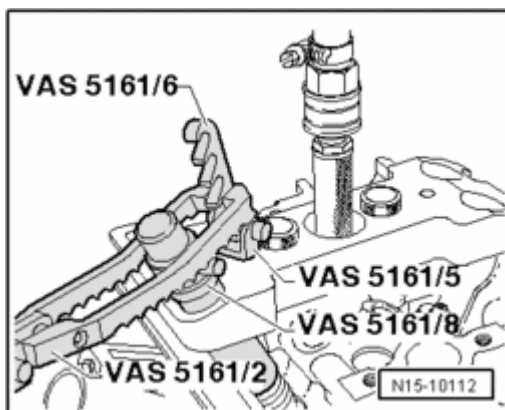


- Place lower part of 3364 valve seal removal tool on valve stem oil seal.
- Insert a drift - **1** - into bore in lower part of extractor device.
- Position a lever at assembly device and pull out valve stem oil seal - **arrow** - .

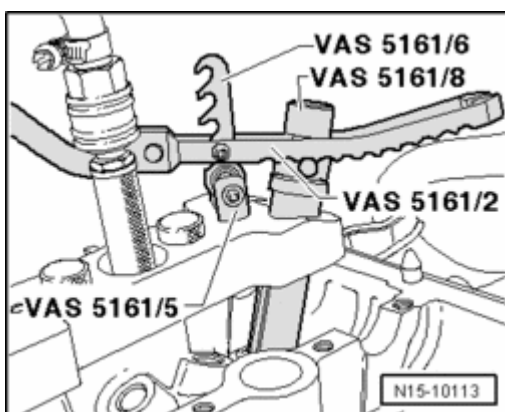
Valve stem oil seals, installing



- Place plastic sleeve - **A** - on valve stem to prevent damage to new valve stem oil seals - **B** - .
- Oil the sealing lip of valve stem oil seal - **B** - , insert into valve stem seal driver 3365 and carefully slide onto valve guide.
- Remove plastic sleeve - **A** - .
- Insert valve spring and valve spring retainer.
- Install valve cotter disassembly and assembly device VAS 5161 as shown.

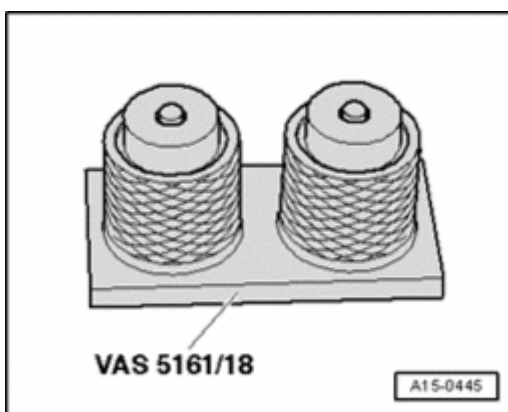


Intake side



Exhaust side

Note:



- If the valve keepers were removed from the installation cartridge, they must be inserted into insertion device VAS 5161/18 next.
- Press installation cartridge VAS 5161/8 onto

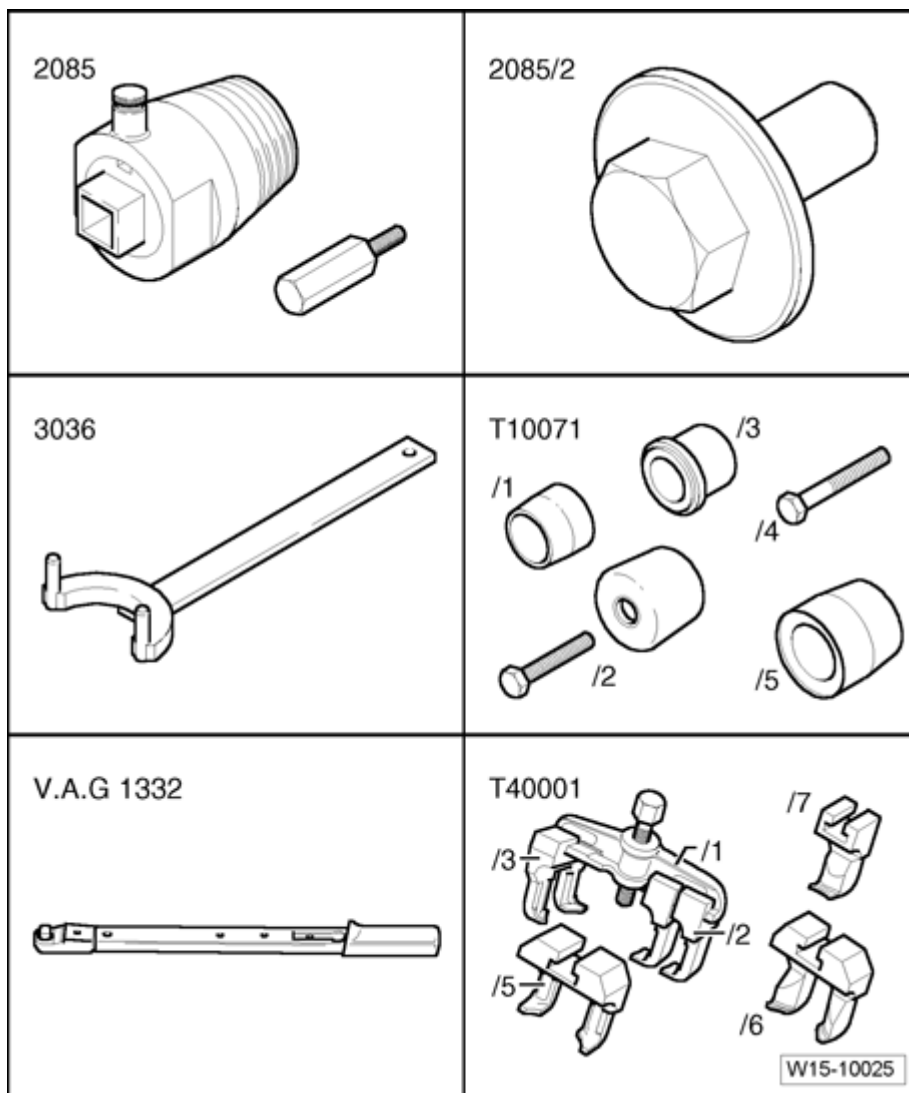
insertion device from above and take up valve keepers.

- Press down installation cartridge VAS 5161/8 using pressure fork VAS 5161/2 and turn knurled bolt of installation cartridge back and forth and upward.
- Release pressure fork VAS 5161/2 with the knurled bolt pulled.
- Remove valve cotter disassembly and assembly device VAS 5161 .

Installation is reverse of removal.

- Install camshafts ⇒ [15-2, Camshafts, installing](#) .

Sealing ring for exhaust camshaft, replacing



Special tools, testers and auxiliary items required

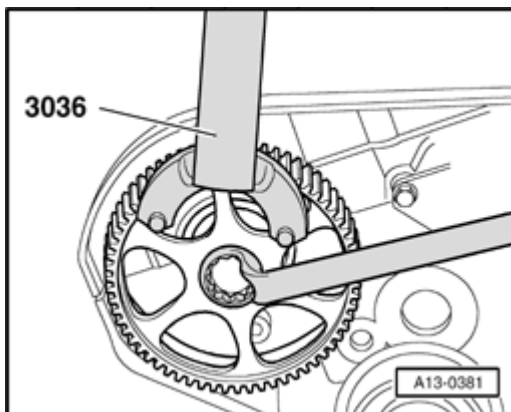
- Seal puller 2085
- Adapter 2085/2
- Retainer 3036
- Assembly tool T10071
- Two arm puller T40001 with claw T40001/6 and claw T40001/7
- Torque wrench V.A.G 1332

Removing sealing ring ⇒ [15-2, Removing seal](#)

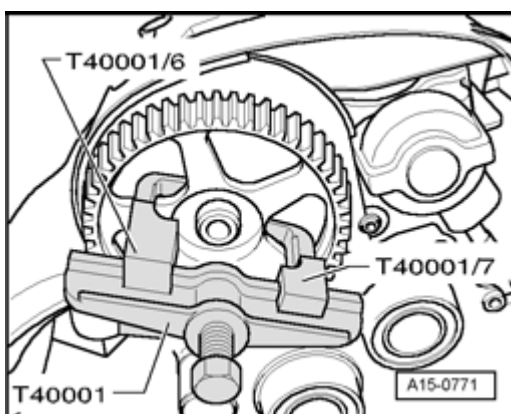
Installing sealing ring ⇒ [15-2, Installing sealing ring](#)

Removing seal

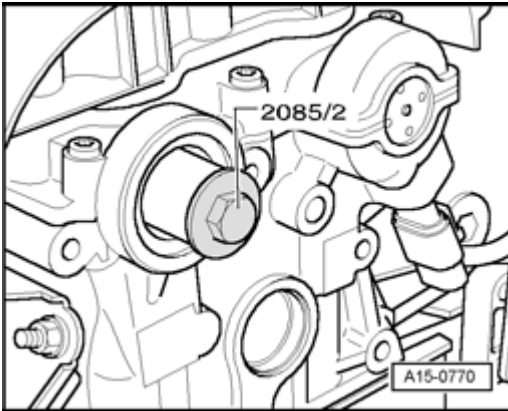
- Remove toothed belt ⇒ [15-1, Toothed belt, removing and installing](#) .



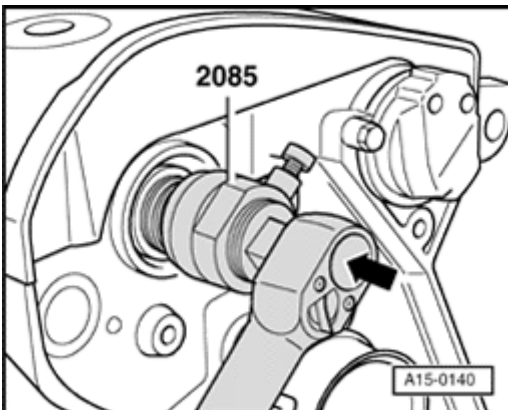
- Use retainer 3036 to loosen camshaft gear.



- Pull off camshaft gear using puller T40001 , claw T40001/6 and claw T40001/7 .



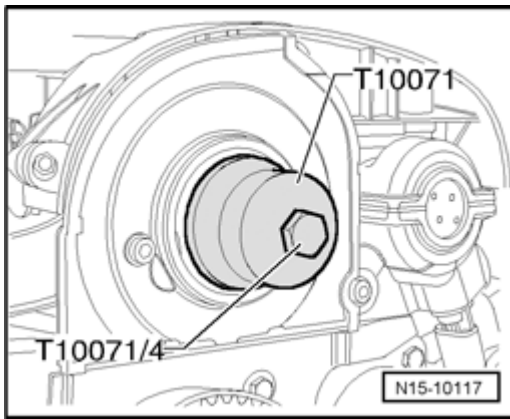
- To guide seal puller, thread adapter 2085/2 in crankshaft by hand until stop.
- Remove inner portion of seal puller 2085 two rotations (approx. 3 mm) from outer portion and secure with knurled-head screw.



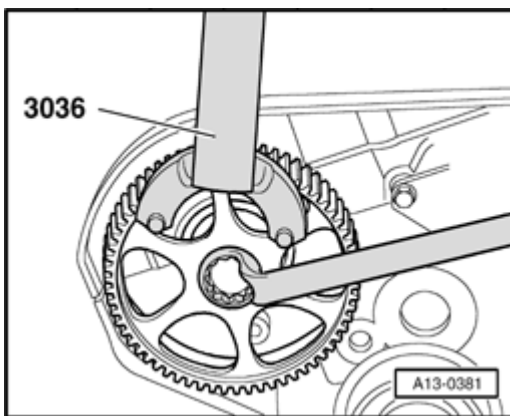
- Grease threaded head of seal puller 2085 , position and screw into oil seal as far as possible with forceful pressure.
- Loosen knurled bolt and turn inner part against crankshaft until O-ring is removed.

Installing sealing ring

- Remove oil residue at camshaft pin using a clean rag.
- Tape off groove at cone for crankshaft using commercially available tape (e.g. scotch tape).
- Slide dry sealing ring carefully on to camshaft pin



- Press in seal up to stop using pressure sleeve T10071 . To do so, use bolt T10071/4 .
- Insert fitting key into camshaft.



- Install camshaft gear. To tighten bolt, hold camshaft gear in place using retainer 3036 . Tightening torque: 65 Nm

Note:

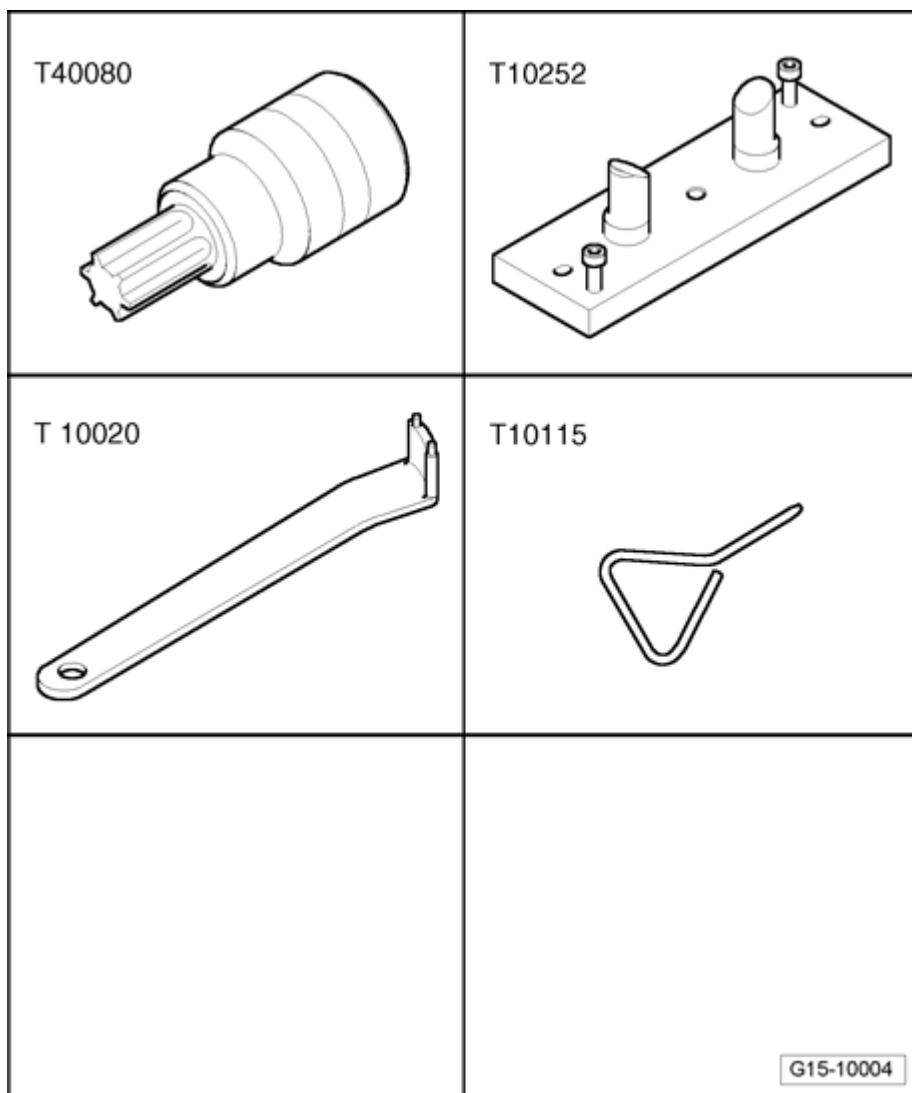
- *When turning camshaft, pistons may not be at TDC for any cylinder. Valves and/or pistons may be damaged.*
- *Be sure fitting keys are properly seated.*

- Install toothed belt ⇒ [15-1, Toothed belt, installing](#) .
- Install ribbed belt ⇒ [13-1, Ribbed belt, removing and installing.](#) .

Installation is in reverse order of removal.

How to fill with new coolant ⇒ [19-1, Coolant, draining and refilling](#) .

Camshaft adjuster, removing and installing



Special tools, testers and auxiliary items required

- Socket T40080
- Camshaft locator T10252
- Locking pin T10115
- Pin wrench T10020
- Torque wrench V.A.G 1332

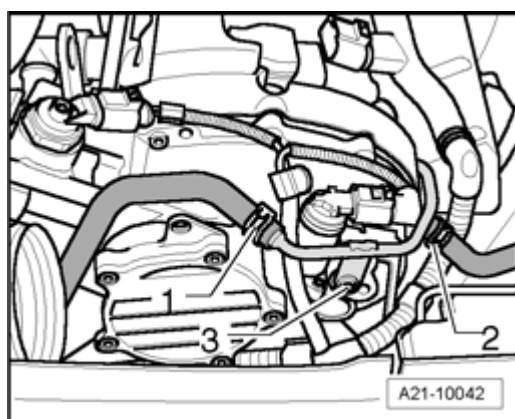
Camshaft adjuster, removing ⇒ [15-2, Camshaft adjuster, removing](#)

Camshaft adjuster, installing ⇒ [15-2, Camshaft adjuster,](#)

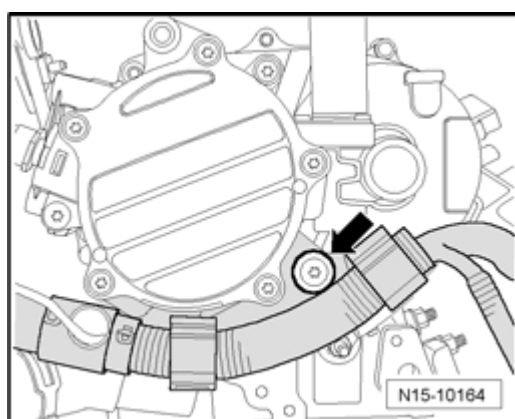
installing

Camshaft adjuster, removing

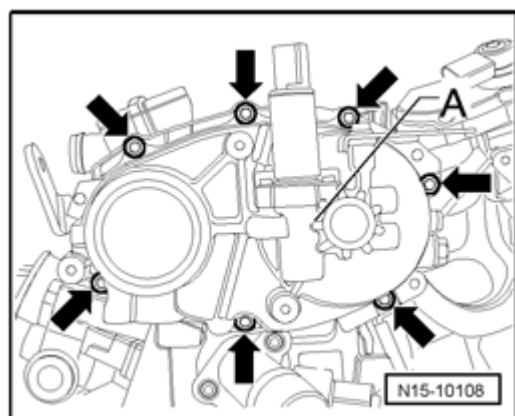
- Remove high pressure pump ⇒ [20-2, High pressure pump, removing and installing](#) .
- Remove cylinder head cover ⇒ [15-1, Cylinder head cover, removing and installing](#) .



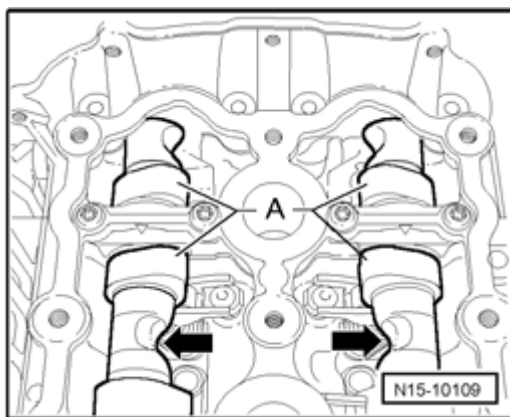
- Disconnect coolant hoses - **1 and 2** - , remove bolt - **3** - and disconnect coolant pipe from heat shield.



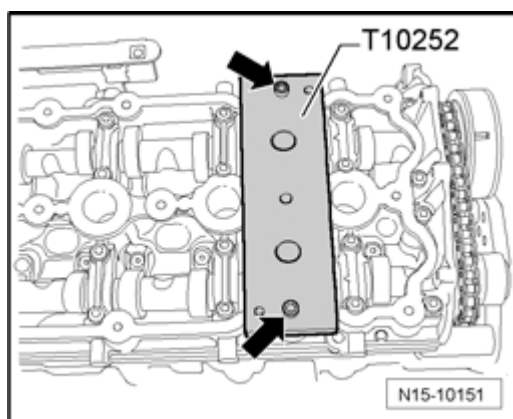
- Remove cable bracket - **arrow** - .



- Remove cover from camshaft adjuster - **arrows** - .

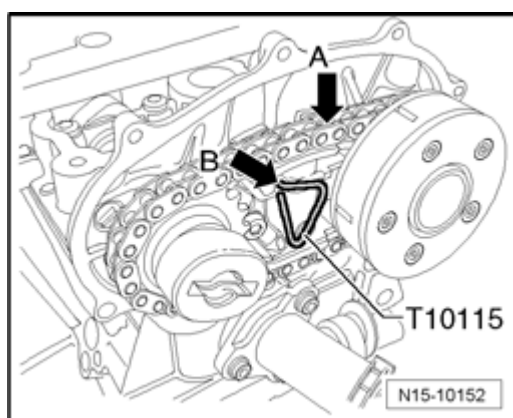


- Bring marking on camshaft gear to alignment with marking on toothed belt guard. Recesses - **arrows** - point to each other vertically.



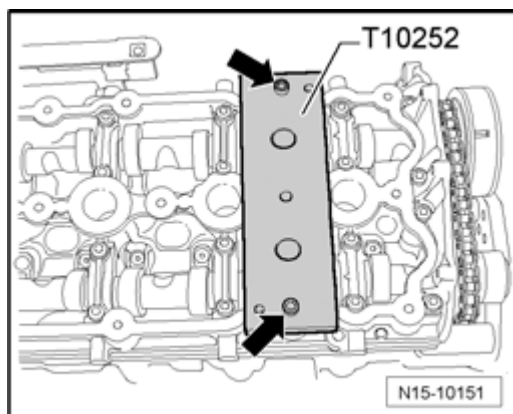
- Install camshaft locator T10252 as shown and secure - **arrows** - .

- Loosen mounting bolt from camshaft adjuster using socket insert T40080 .



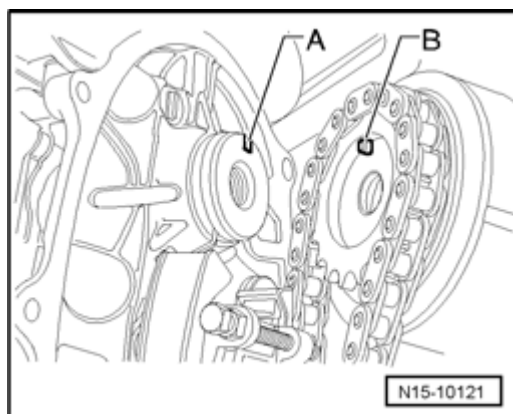
- Compress chain tensioner - **arrow A** - and secure it using drift T10115 - **arrow B** - .

- Remove mounting bolt from camshaft adjuster and remove it with chain.

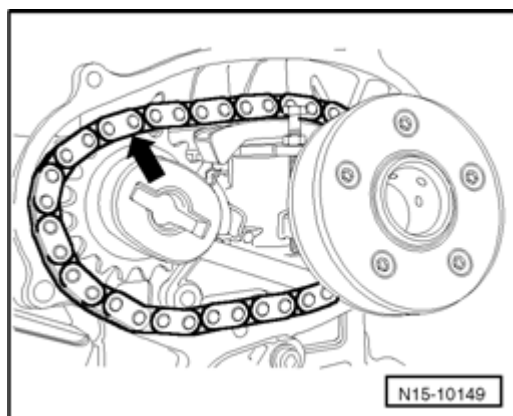
Camshaft adjuster, installing

- Camshafts are fixed using camshaft clamp T10252 .

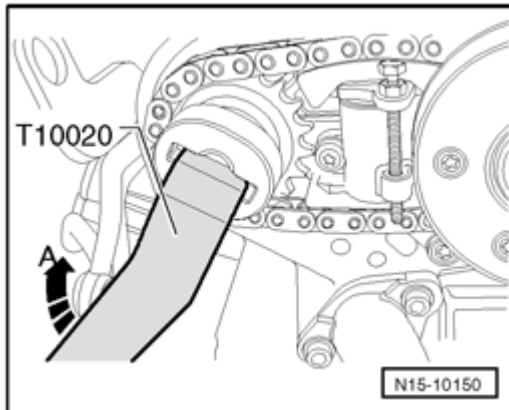
- Place chain on to camshaft adjuster.



- Hold camshaft adjuster in front of exhaust camshaft so that notch - **A** - and pin - **B** - face each other.



- Place chain in this position on to chain sprocket of intake camshaft, first at top - **arrow** - .

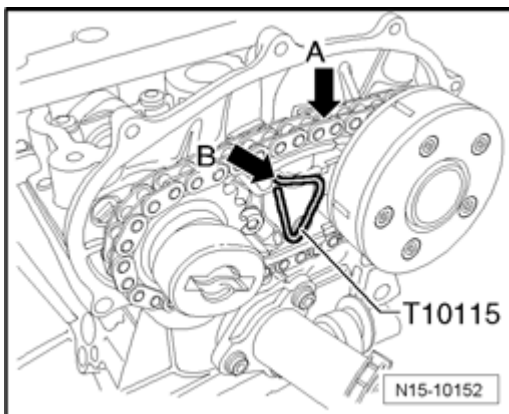


- Using pin wrench T10020 , slowly turn intake camshaft in direction of - **arrow A** - until camshaft adjuster fits onto camshaft.

Note:

- *If pin does not fit into notch: Remove chain and place chain on again.*

- Tighten securing bolt of camshaft adjuster to 100 Nm. To do so, use socket insert T40080 .

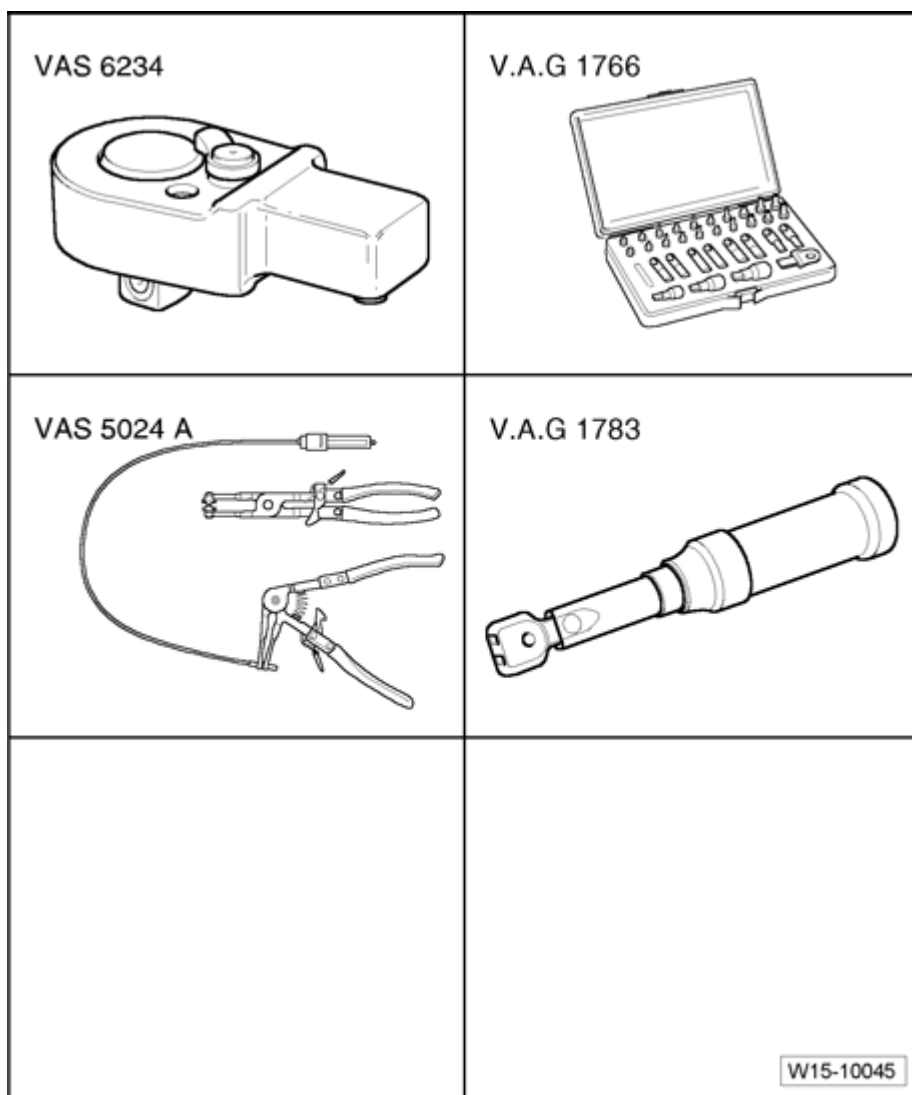


- Remove drift T10115 - **arrow B** - .

Installation is reverse of removal.

- Install high pressure pump ⇒ [20-2, High pressure pump, removing and installing](#) .

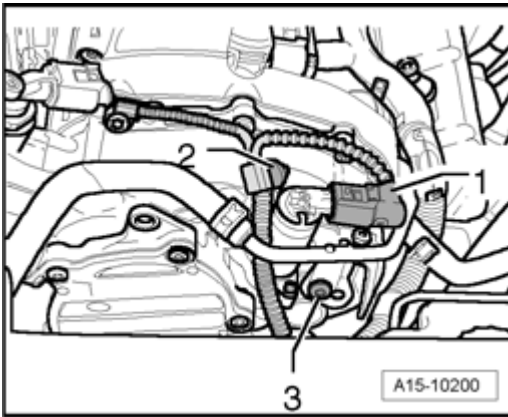
Camshaft Adjustment Valve 1 N205 , removing and installing



Special tools, testers and auxiliary items required

- Ratchet 1/4" VAS 6234
- Torx bit assortment V.A.G 1766
- Spring type clip pliers VAS 5024 A
- Torque wrench V.A.G 1783

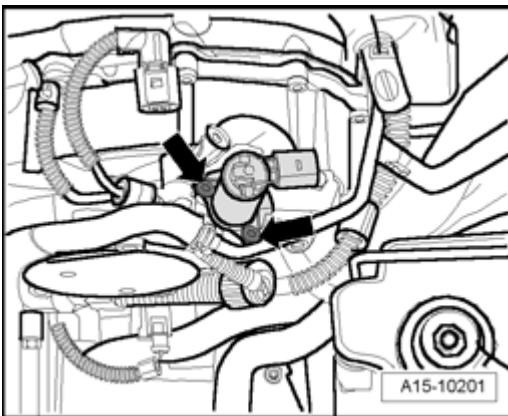
Removing



- Disconnect connector - **1** - .
- Remove wiring harness - **2** - from bracket.
- Remove bolt - **3** - .

Note:

- *Do not disconnect Camshaft Adjustment Valve 1 N205 at connector.*



- Remove bolts - **arrows** - and pull Camshaft Adjustment Valve 1 N205 out of housing.

Installing

Note:

- *Camshaft adjustment valve 1 N205 as well as housing must be free of dirt and contamination.*
- *Remove the new Camshaft Adjustment Valve 1 N205 from packaging only prior to installation.*

Caution!

- ***Camshaft Adjustment Valve 1 N205 must not be***

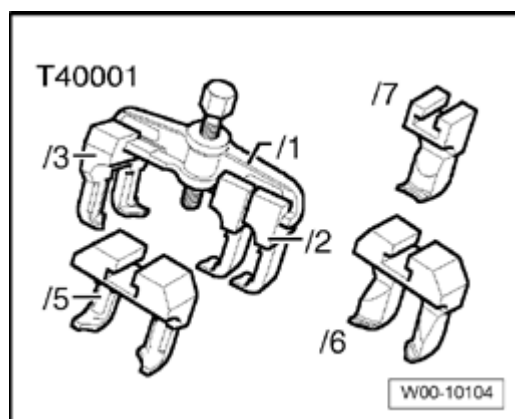
subjected to knocks and impacts.

- Coat sealing ring with engine oil.
- Carefully insert Camshaft Adjustment Valve 1 N205 into housing and press it in by hand until it stops.
- Tighten bolts to 4 Nm.

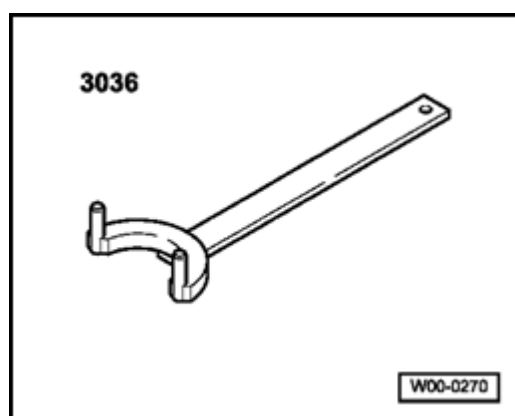
Installation is in reverse order of removal.

Camshafts, removing and installing

Special tools, testers and auxiliary items required



- Puller T40001



- Retainer 3036

Remove camshafts ⇒ [15-2, Camshafts, removing](#) .

Install camshafts ⇒ [15-2, Camshafts, installing](#) .

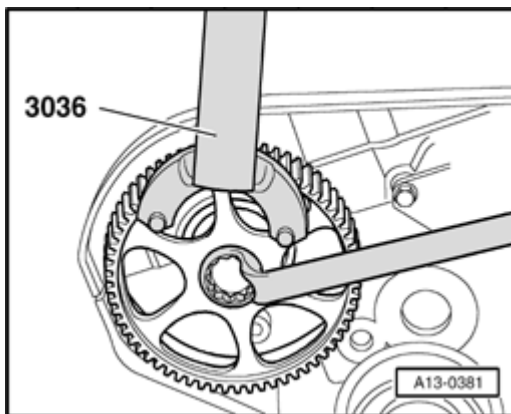
Camshafts, removing

Note:

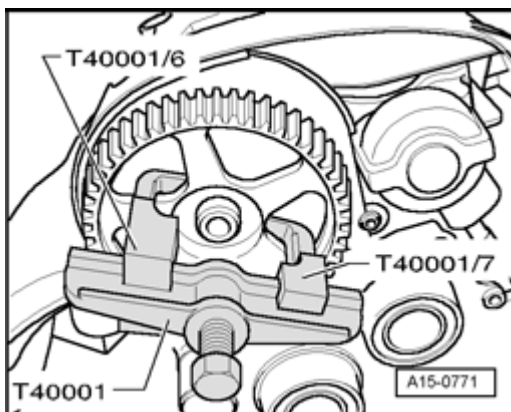
- *Sealing surfaces on guide frame at bottom and on cylinder head at top must not be worked.*
- *Camshaft bearings are integrated in cylinder head or in guide frame. Before removing guide frame, tension on toothed belt must be released.*
- *If guide frame was loosened, camshaft sealing ring and sealing cap must be replaced.*

- Remove camshaft adjuster ⇒ [15-2, Camshaft adjuster, removing and installing](#) .

- Remove toothed belt ⇒ [15-1, Toothed belt, removing and installing](#) .



- Loosen camshaft gear (use retainer 3036) .

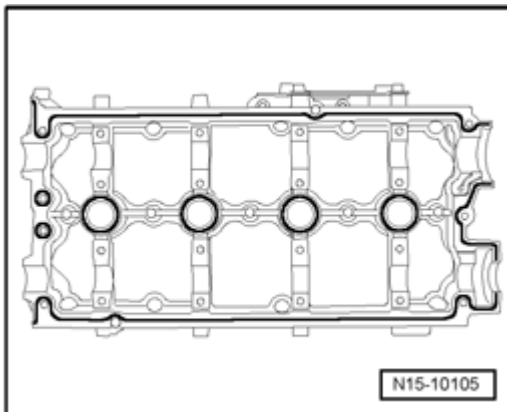


- Pull off camshaft gear using puller T40001 , claw T40001/6 and claw T40001/7 .

- Remove toothed belt guard at rear of cylinder head.

- Loosen bolts of guide frame evenly from outside toward inside and remove guide frame.

- Carefully remove camshaft upward and place on a clean surface.



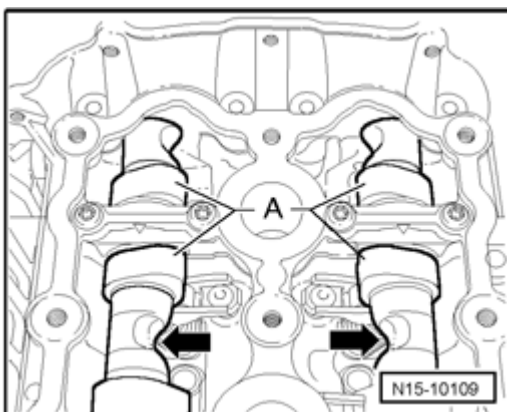
- Remove old sealant from guide frame groove as well as from sealing surfaces.
- Prevent dirt and adhesive residue from entering cylinder head.

Camshafts, installing

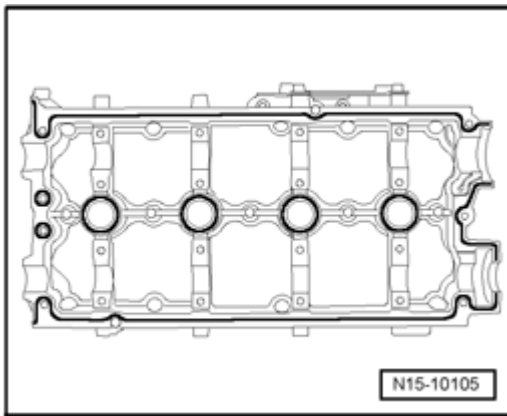
Note:

- *Sealing surfaces must be completely free of oil and grease.*
- *Pistons must not be at Top Dead Center (TDC).*
- *Make sure that all roller cam followers make contact correctly on valve stem ends.*

- Oil journal surfaces of camshafts.



- Carefully insert camshafts into camshaft bearings of cylinder head. Cams - **A** - of cylinder 4 must face each other.



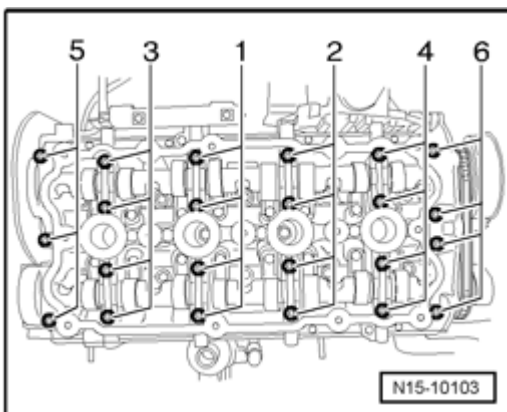
- Apply even, slightly raised sealant bead (D 188 800 A1) into clean grooves of guide frame. Apply sealant evenly onto sealing surface.

Note:

- Sealant must not be applied too thickly. Wipe off excess sealant if necessary using a lint-free cloth.
- Attaching and bolting the guide frame should be performed without interruption because the sealant begins to harden immediately as soon as it contacts the sealing surfaces.
- Note expiration date for sealant.

- Place guide frame on to cylinder head.

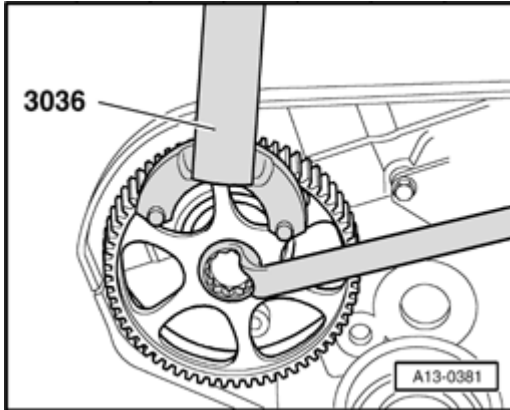
- Gently tighten bolts from inside working toward outside in several stages.



- Tighten bolts in sequence to 8 Nm as shown.

- Drive in cap ⇒ [Item - 25](#) - using pressure piece 3334 approx. 1 to 2 mm.

- Install camshaft sealing ring ⇒ [15-2, Installing sealing ring](#) .
- Install rear toothed belt cover.
- Insert fitting key into camshaft.



- Install camshaft gear. To tighten bolt, hold camshaft gear in place using retainer 3036 . Tightening torque: 65 Nm

Note:

- *When turning camshaft, pistons may not be at TDC for any cylinder. Valves and/or pistons may be damaged.*
 - *Be sure fitting keys are properly seated.*
- Install toothed belt ⇒ [15-1, Toothed belt, installing](#) .
 - Install camshaft adjuster ⇒ [15-2, Camshaft adjuster, installing](#) .
 - Install cylinder head cover ⇒ [15-1, Cylinder head cover, removing and installing](#) .

Installation is in reverse order of removal.