

Cylinder block, crankshaft and flywheel, servicing

Notes:

- ◆ Always replace seals and O-rings.
- ◆ The engine speed sensor is installed in the transmission bellhousing with a spacer washer underneath.

1 - Main bearing cap bolts

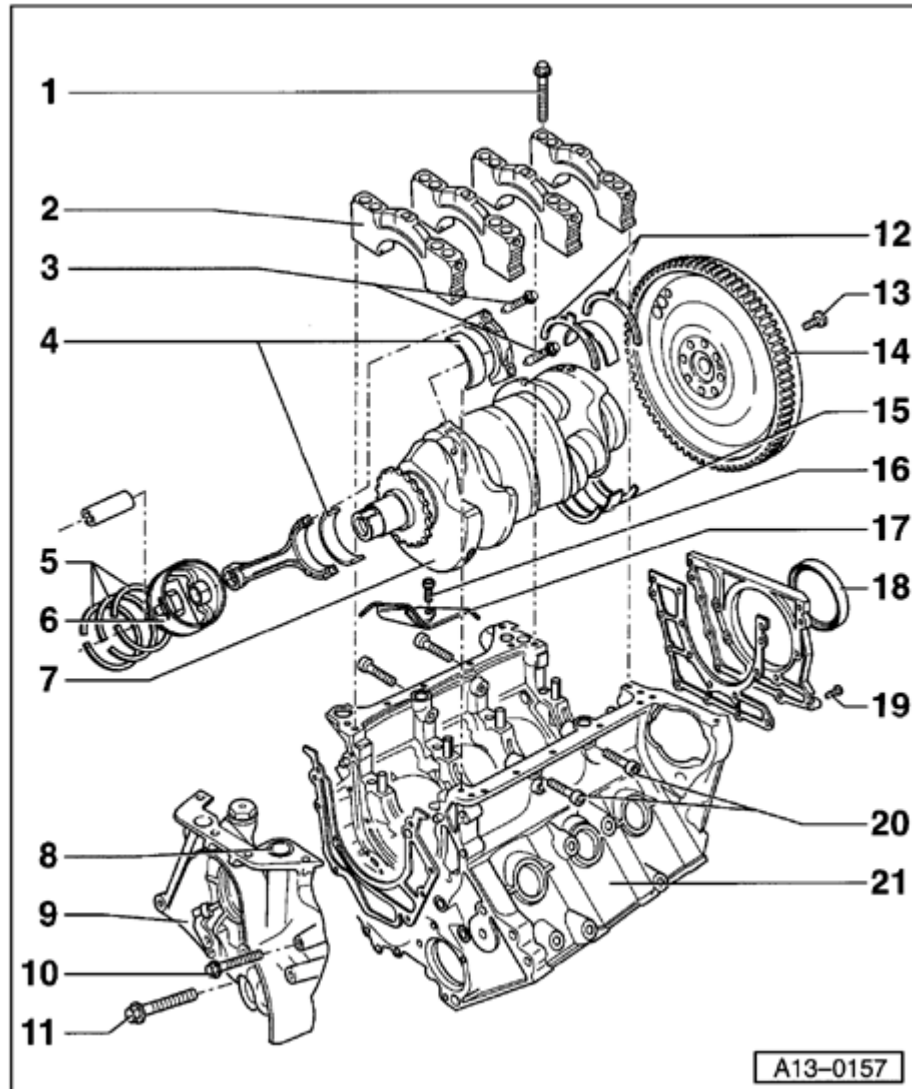
- ◆ Always replace
- ◆ 60 Nm (44 ft lb) + additional 180° (1/2 turn)

2 - Main bearing caps

- ◆ Always replace bolts
- ◆ Marking -1- on oil pump side
- ◆ Checking bearing clearance ⇒ [page 13-25](#)

3 - Connecting rod bearing bolts

- ◆ Always replace
- ◆ 30 Nm (22 ft lb) + additional 90° (1/4 turn)
- ◆ When measuring radial clearance, tighten to 20 Nm (15 ft lb), but do not turn further



4 - Connecting rod bearings

- ◆ Do not interchange used bearing shells
- ◆ Connecting rods, connecting rod bearings
⇒ [page 13-33](#)

5 - Piston rings

- ◆ Checking ⇒ [page 13-29](#)

6 - Pistons

- ◆ Checking ⇒ [page 13-29](#)

7 - Crankshaft

- ◆ Checking ⇒ [page 13-25](#)
- ◆ Chain gear for oil pump, removing and installing ⇒ [page 17-29](#)
- ◆ For vehicles with automatic transmission, always install bushing as pilot for converter
- ◆ Remove bushing using KUKKO 21/2 and 22/1

8 - Oil passage with seal

- ◆ Always replace seal

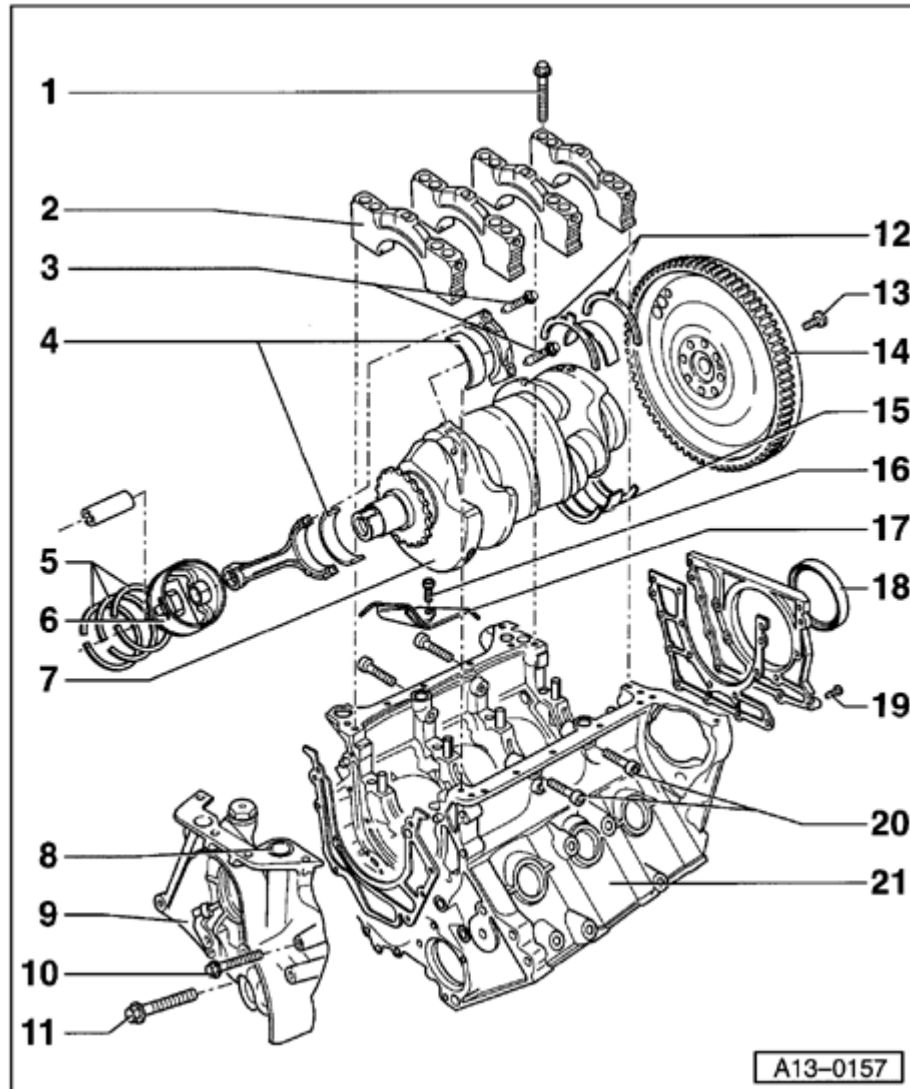
9 - Sealing flange, front

10 - Bolt

- ◆ 10 Nm (7 ft lb)

11 - Collar bolt

◆ 30 Nm (22 ft lb)



12 - Thrust washer

- ◆ Measuring crankshaft axial clearance ⇒ [page 13-25](#)
- ◆ Only on 4th crankshaft bearing

13 - Special bolt (12-sided)

- ◆ Always replace
- ◆ Driveplate: 60 Nm (44 ft lb) + additional 90° (1/4 turn)
- ◆ Dual-mass flywheel: 60 Nm (44 ft lb) + additional 180° (1/2 turn)

14 - Dual-mass flywheel or driveplate

- ◆ Removing and installing ⇒ [page 13-22](#)
- ◆ Needle bearing, removing and installing ⇒ [page 13-21](#)

15 - Crankshaft bearing

- ◆ Axial and radial clearance, checking ⇒ [page 13-25](#)

16 - Bolt

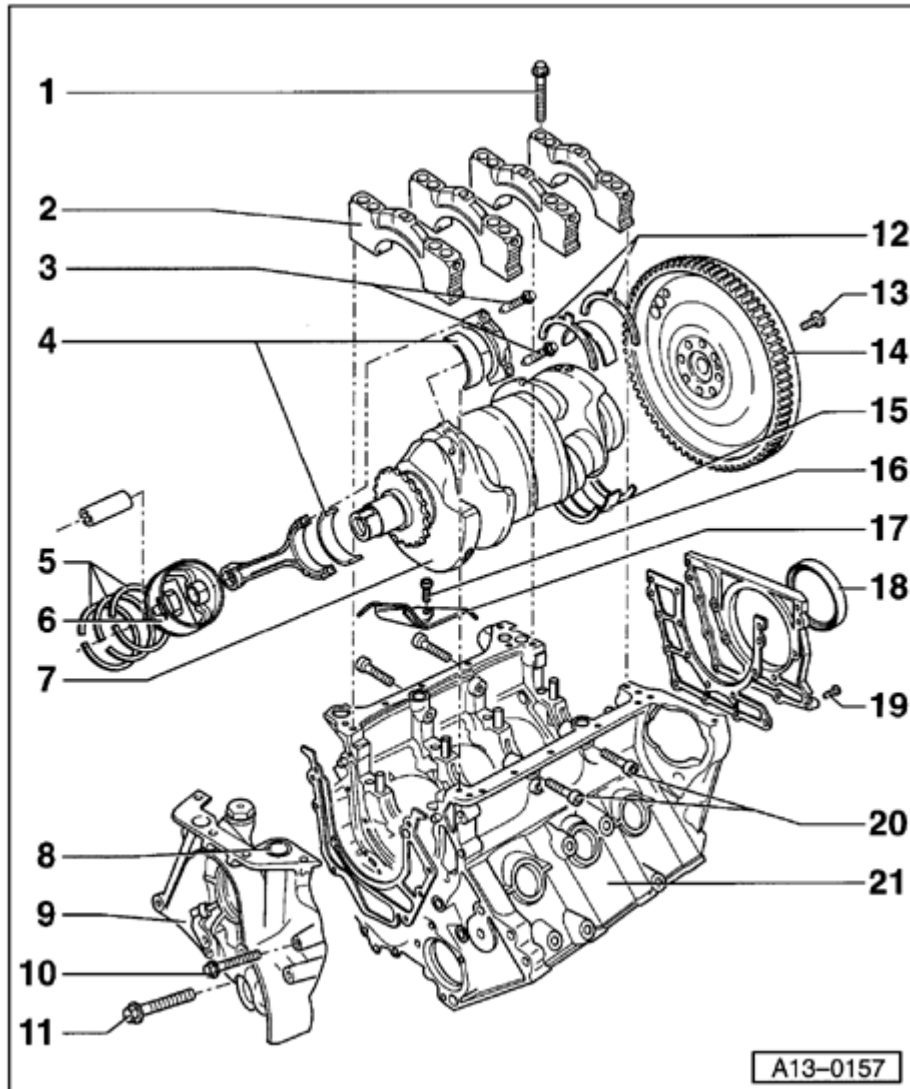
- ◆ 10 Nm (7 ft lb)

17 - Oil jet

- ◆ To cool pistons

18 - Seal for rear flange

◆ Replacing ⇒ [page 13-18](#)

**19 - Bolt**

◆ 10 Nm (7 ft lb)

20 - Bolt

◆ 25 Nm (18 ft lb)

◆ Install hand-tight before fully tightening

21 - Cylinder block

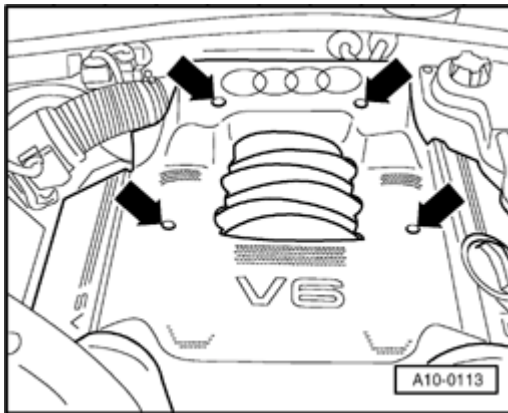
Ribbed belt, removing and installing

- Lock carrier in service position ⇒ [page 13-1](#)

CAUTION!

Before removing ribbed belt, note direction of rotation with chalk or felt-tip marker. Reversing the direction of rotation of a used belt can destroy the belt. When installing the ribbed belt, make sure it is seated correctly on the pulley.

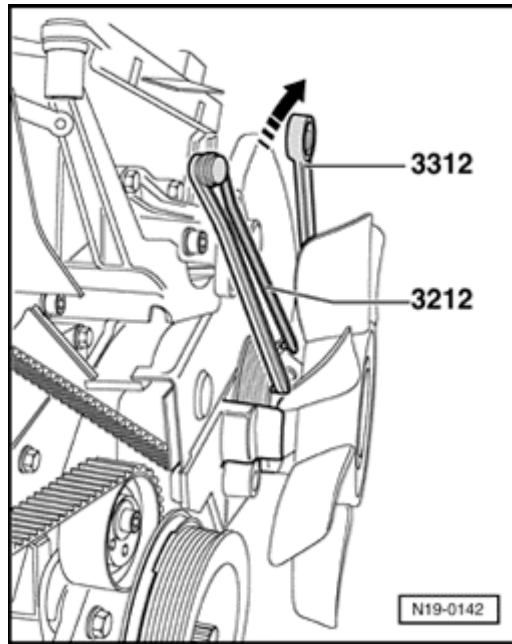
Removing



- Remove engine cover (arrows).



- Remove noise insulation panel (arrows).

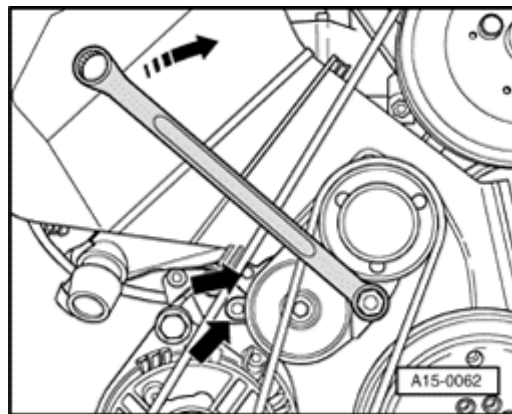


A

- Counterhold pulley for viscous fan using 3212 spanner wrench and remove viscous fan using 3312 open-end spanner (left thread).
- Carefully lift out viscous fan.

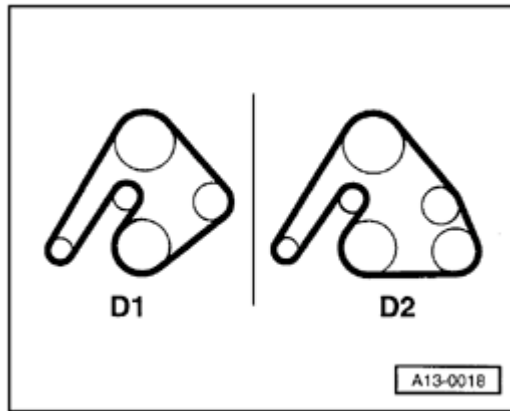
Note:

Observe previously marked direction of rotation of belt and that it is seated correctly on the pulley.



A

- To loosen ribbed belt, turn tensioner clockwise using 17 mm box wrench until two holes are aligned (arrows). Counterhold in position using 3204 drift.
- Remove ribbed belt.



Installing

A

- First install ribbed belt onto crankshaft pulley and idler wheel. Push belt onto tensioning roller last.

Note:

Observe previously marked direction of rotation of belt and that it is seated correctly on the pulley.

Routing of ribbed belt:

D1 - without air conditioning

D2 - with air conditioning

- Remove 3204 drift.
- Install engine cover.

Tightening torque for viscous fan	Tightening torque
1331 torque wrench and 3312 open-end spanner	37 Nm (27 ft lb)
1331 torque wrench without 3312 open-end spanner	70 Nm (52 ft lb)

Vibration damper, removing and installing

- Lock carrier in service position ⇒ [page 13-1](#)

Ribbed belt, removing and installing ⇒ [page 13-8](#).

Note:

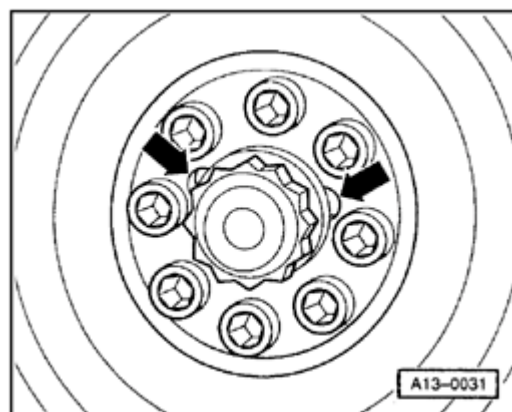
To remove the vibration damper, it is not necessary to remove the center bolt.

- Remove vibration damper.

A

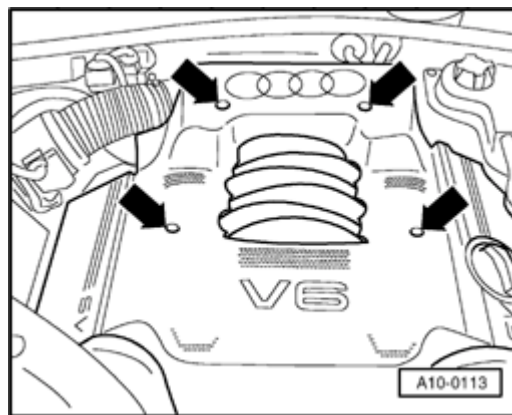
- When installing, make sure notches (arrows) in vibration damper are aligned with locating lugs on toothed belt sprocket.

Tightening torque (vibration damper to crankshaft): 20 Nm (15 ft lb)

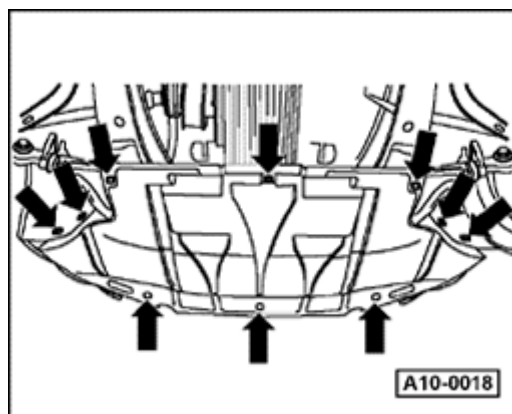


Toothed belt, removing and installing

Removing



- A
- Remove engine cover.

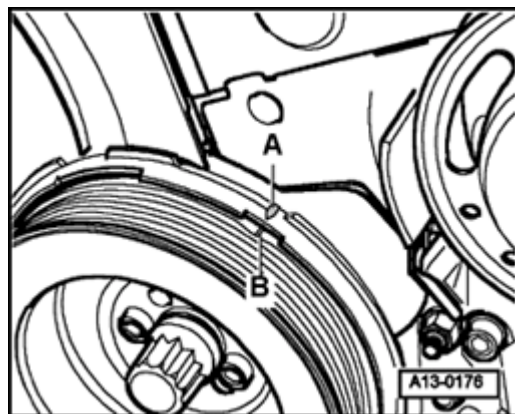


- A
- Remove noise insulation panel (arrows).

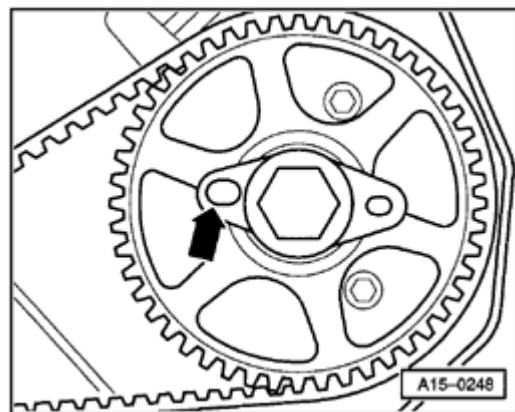
- Lock carrier in service position ⇒ [page 13-1](#)

Ribbed belt, removing and installing ⇒ [page 13-8](#) .

- Unclip toothed belt guard on both sides and remove.



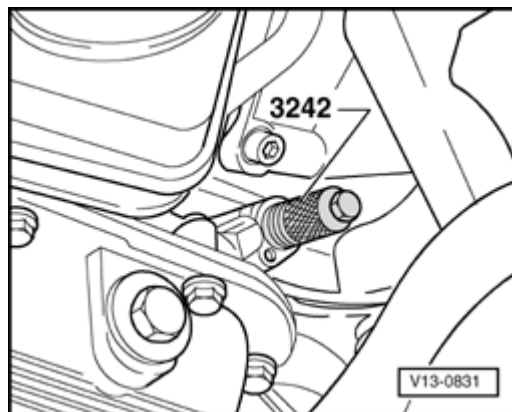
- A
- Turn crankshaft at central bolt of toothed belt gear in direction of engine rotation to cyl. 1 TDC. Timing marks -A- and -B- must be aligned.



- A
- Check position of camshafts. Large holes (arrow) of securing plates on camshaft sprockets must face toward inside and align.
If not, turn crankshaft one revolution further.
 - Remove sealing plug from left-side of cylinder block.
 - Top Dead Center (TDC) mark on crankshaft must be visible or be felt behind bore of removed sealing plug.

WARNING!

DO NOT turn crankshaft while checking for TDC mark. Personal injury may result.



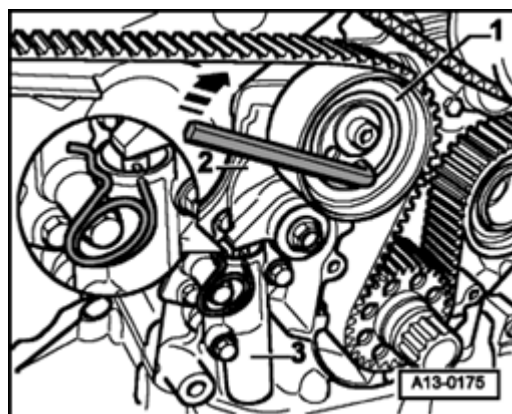
- A
- Install 3242 crankshaft holder into sealing plug opening.
 - Remove tensioner for ribbed belt.
 - Remove center and right toothed belt guards.

CAUTION!

Before removing ribbed belt, note direction of rotation with chalk or felt-tip marker. Reversing the direction of rotation of a used belt can destroy the belt. When installing the ribbed belt, make sure it is seated correctly on the pulley.

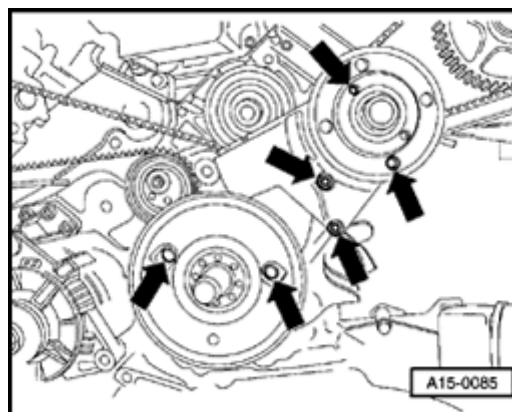
Notes:

- ◆ *The toothed belt tensioner is oil dampened. Compress it by slowly applying constant pressure.*
- ◆ *Use spring clamp from 2024A.*



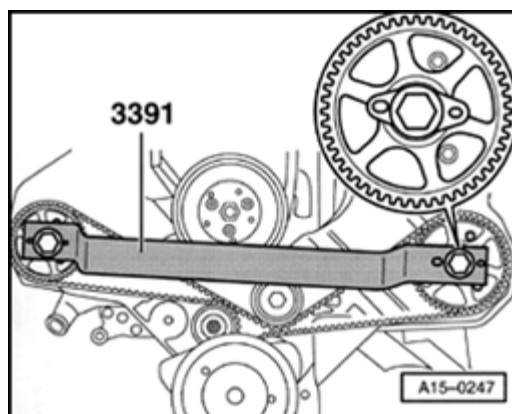
- A
- Using 8 mm hex wrench, turn toothed belt tensioning roller -1- counter-clockwise, opposite direction shown (arrow), until tensioning lever -2- compresses tensioner -3- so that spring clamp (2 mm dia.) can be inserted into bore and lifter.

- Insert pin and release tension.
- Remove vibration damper ⇒ [page 13-11](#) .
- A** - Remove idler wheel for ribbed belt (arrows).
- Remove toothed belt.

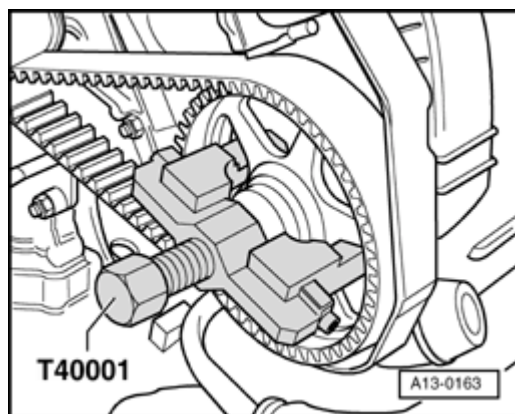


Installing

- A** - Install 3391 camshaft locator bar onto camshaft locking plates.
- Loosen both bolts for camshafts and back out bolts approx. 5 turns.
- Remove 3391 camshaft locator bar.



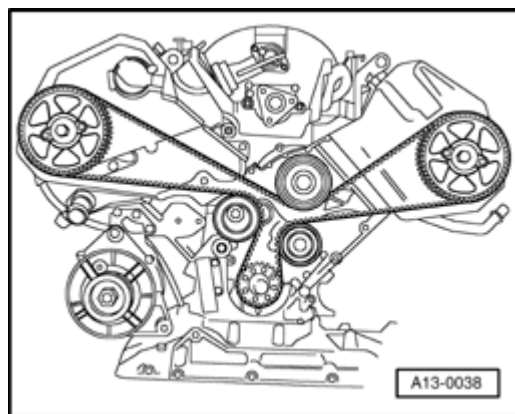
13-16



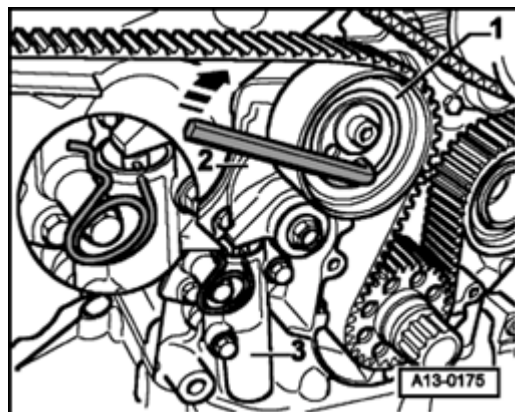
- A - Remove both camshaft sprockets using T40001 special tool.
- Reinstall both camshaft sprockets together with locking plates and hand-tighten.

Note:

The camshaft sprockets should be loose enough on the cone to be turned, but not so loose as to be tipped.



- A - Install toothed belt on all sprockets as shown in illustration.
- Install 3391 camshaft locator bar.



A

- Using 8 mm hex wrench, turn toothed belt tensioner roller -1- counter-clockwise, opposite direction shown (arrow) until tensioning lever -2- compresses tensioner -3- so that spring clamp can be removed and then remove clamp.
- Before starting engine, pre-load timing tensioning roller as follows:
 - Using a torque wrench with 8 mm hex bit, apply tension to toothed belt clockwise in direction shown (arrow) until a torque of 15 Nm is attained. This ensures tensioner has expanded completely and is properly engaging toothed belt.

Component	Tightening torque
Toothed belt sprocket to camshaft	55 (41 ft lb)
Idler wheel	45 (33 ft lb)
Toothed belt tensioning roller	20 (15 ft lb)
Belt pulley to crankshaft	20 (15 ft lb)
Toothed belt tensioner	10 (7 ft lb)
Center bolt 1) to crankshaft	200 (148 ft lb) + 180° 2)

1) Always replace the center bolt.

2) Two turns of 90° are permissible.

Crankshaft seal, replacing

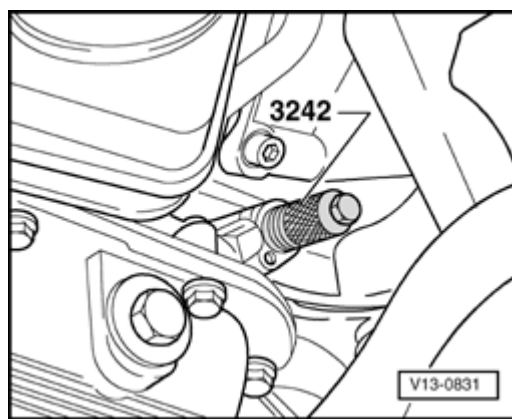
Toothed belt side

- Lock carrier in service position ⇒ [page 13-1](#)

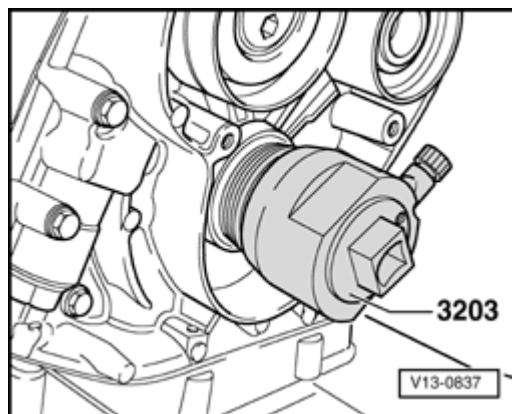
Ribbed belt, removing and installing ⇒ [page 13-8](#).

Toothed belt, removing and installing ⇒ [page 13-12](#).

- Remove sealing plug from left-side of cylinder block.
- Turn crankshaft to TDC for cylinder 3. The TDC mark on crankshaft must be visible or felt behind bore for sealing plug.
- Install 3242 crankshaft holder in bore to secure crankshaft.



- Remove crankshaft/toothed belt gear.
- Unscrew inner part of 3203 seal puller two turns (approx. 3 mm) and secure using knurled bolt.

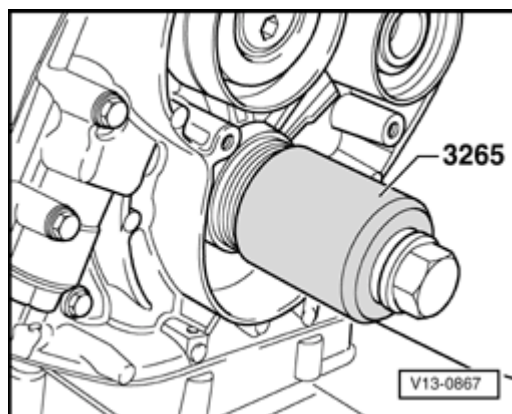


A

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

Installing

- Place 3202/1 guide sleeve on crankshaft pin.
- Slide dry oil seal over guide sleeve.



A

- Press in oil seal to stop using 3265 seal installer.

The rest of the installation follows is the reverse of removal.

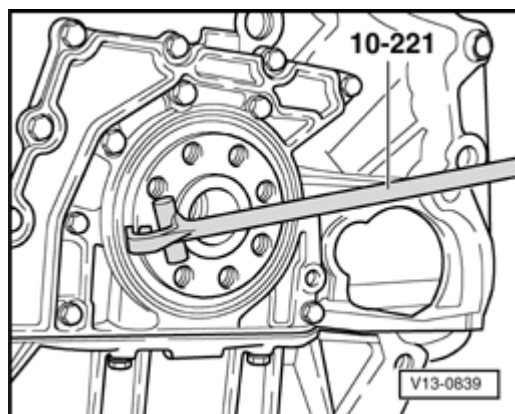
Dual-mass flywheel

Notes:

- ◆ Only replace oil seal with sealing flange.
- ◆ Drain coolant before removing sealing flange ⇒ [page 19-11](#) .

If sealing flange is not available, proceed as follows:

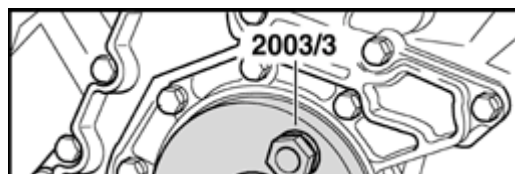
- Remove clutch and dual-mass flywheel or driveplate.



- A - Pry out seal using 10-221 extractor.
- Clean running and sealing surfaces.
- Push seal onto crankshaft using assembly aid.

Notes:

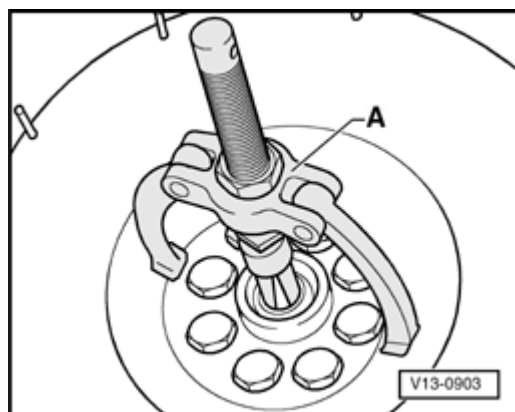
- ◆ Do not lubricate sealing lip or outer edge of seal before pressing in.
- ◆ The assembly aid is supplied with the seal.



- A - Press in seal up to stop using 2003/3 seal installer and bolts for dual-mass flywheel or driveplate.

13-21

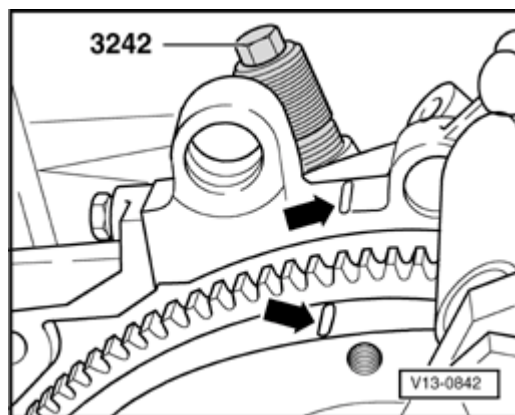
Dual-mass flywheel pilot needle bearing, removing and installing

**A**

- Remove pilot needle bearing using puller -A- (e.g. KUKKO 21/2 and KUKKO 22/1).
- Install bearing using 3264 bearing driver.

Dual-mass flywheel or driveplate, removing and installing, installation dimensions

Dual-mass flywheel



A

- With crankshaft at Top Dead Center (TDC), install 3242 crankshaft holder.
- Mark position of dual-mass flywheel and engine housing (arrows).
- Remove bolts and replace.

Note:

A pilot needle bearing is in the dual-mass flywheel and must be inserted when dual-mass flywheel is replaced.

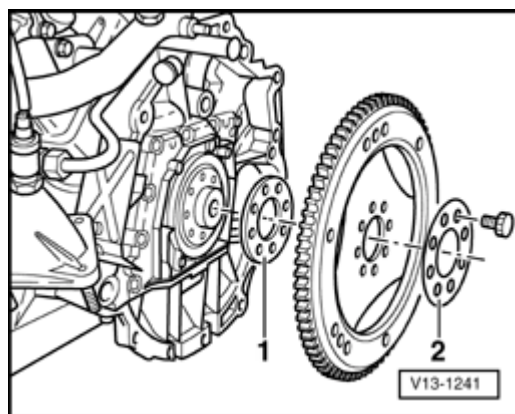
Component	Tightening torque
Dual-mass flywheel to crankshaft	60 Nm (44 ft lb) + 180°
Clutch to dual-mass flywheel	20 Nm (15 ft lb)

Note:

Always replace dual-mass flywheel mounting bolts.

Driveplate

- Hold crankshaft in position using 3242 crankshaft holder ⇒ [page 13-12](#) .
- Mark hole pattern of driveplate, shim -1- and washer -2- to crankshaft.
- Mark positions of shim -1- and washer -2- (behind driveplate).
- Install driveplate with washer -2- (Part No. 035 105 303 A) and shim -1- 3.0 mm (Part No. 054 105 301) or 4.0 mm (Part No. 054 105 202).



A

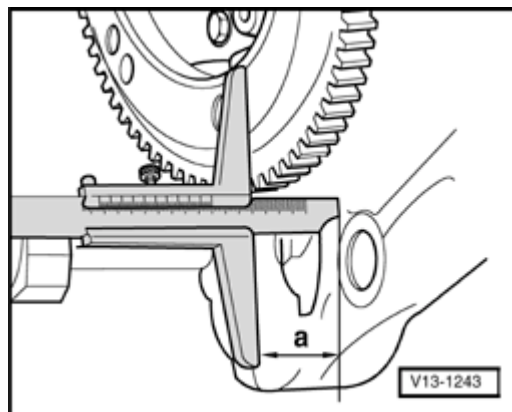
CAUTION!

Part numbers are listed here for reference only. Always check with your Parts department for the latest information.

Notes:

- ◆ Short engines and exchange engines are supplied without a bushing in the crankshaft. Always install a new bushing before installing the driveplate.
- ◆ Remove bushing using 21/1 Kukko puller and 21/2 Kukko support.
- ◆ Always replace driveplate mounting bolts.

Component	Tightening torque
Driveplate to crankshaft	30 Nm (22 ft lb) + 90°



- A**
- Measure distance -a- at three places and calculate average.
Distance -a-: approx. 12.3 mm.
 - If necessary, install different shim.

Note:

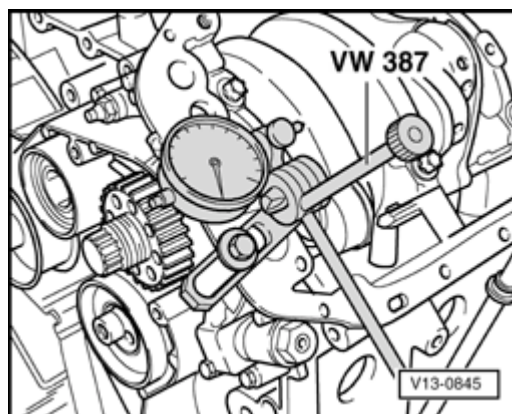
Before installing the engine, make sure the engine to transmission centering sleeves are installed in the engine flange.

Crankshaft axial and radial clearance, measuring

Axial clearance

CAUTION!

Bearing shells must be reinstalled in their original location and orientation. Always label the bearing shells according to their installed position before removing. Never interchange used bearing shells.



A

- Attach dial indicator together with VW387 dial indicator holder to oil pump and set indicator against crankshaft counterweight.
- Press crankshaft against dial indicator by hand and set indicator to zero.
- Press crankshaft away from dial indicator.
- Read gauge.

Clearance when new	Wear limit
0.07-0.23 mm (0.0028-0.0091 in.)	0.25 mm (0.0098 in.)

Radial clearance

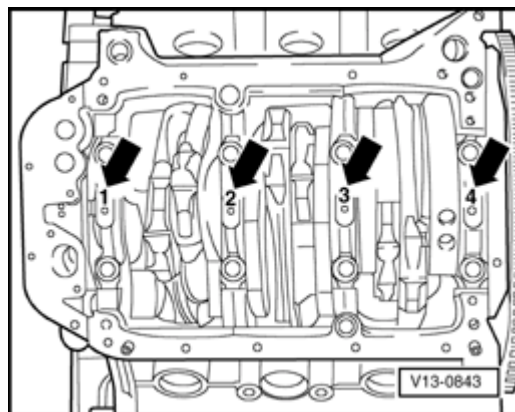
- Measure radial clearance using Plastigage[®].
- Read clearance.

Clearance when new	Wear limit
0.018-0.045 mm (0.0007-0.0018 in.)	0.10 mm (0.0039 in.)

CAUTION!

DO NOT turn the crankshaft or allow it to rotate while measuring with Plastigage[®] in place.

Crankshaft bearing cap, installing



- A** Bearing -1- is installed on the oil pump side of the cylinder block, and bearing -4- on the dual-mass flywheel side of the cylinder block.

Crankshaft dimensions

Engine codes AHA, ATQ

Reconditioning dimension	Crankshaft journal diameter mm (in.)	Connecting rod journal diameter mm (in.)
maximum size (from nominal)	-0.022 (0.00087)	-0.022 (0.00087)
Standard (nominal dimension)	65.00 (2.559)	54.00 (2.126)
minimum size (from nominal)	-0.042 (0.00165)	-0.042 (0.00165)
maximum size (from nominal)	-0.022 (0.00087)	-0.022 (0.00087)
1st undersize (nominal dimension)	64.75 (2.549)	53.75 (2.116)
minimum size (from nominal)	-0.042 (0.00165)	-0.042 (0.00165)
maximum size (from nominal)	-0.022 (0.00087)	-0.022 (0.00087)
2nd undersize (nominal dimension)	64.50 (2.539)	53.50 (2.106)
minimum size (from nominal)	-0.042 (0.00165)	-0.042 (0.00165)
maximum size (from nominal)	-0.022 (0.00087)	-0.022 (0.00087)
3rd undersize (nominal dimension)	64.25 (2.530)	53.25 (2.096)
minimum size (from nominal)	-0.042 (0.00165)	-0.042 (0.00165)

Pistons and piston rings

Pistons

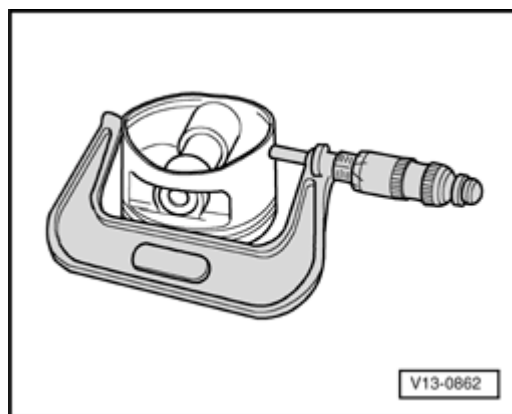
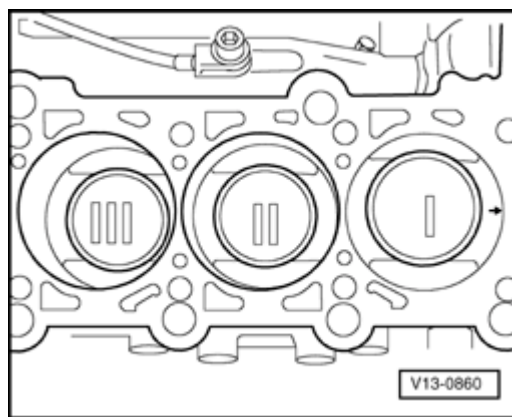
- ▲ Installation position: arrow on piston crown must point in driving direction.
- Mark cylinder number on piston crown using waterproof felt pen.

CAUTION!

DO NOT scratch or scribe on piston crown. The surface has a coating that must not be damaged.

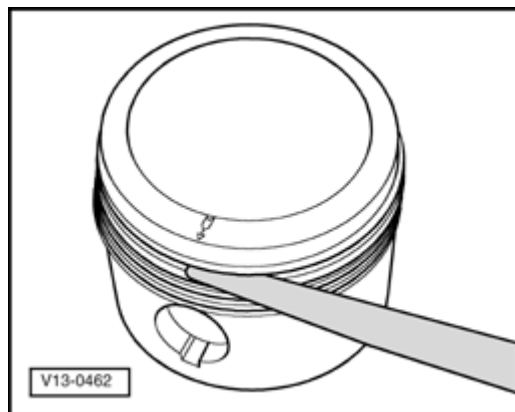
Checking piston diameter

- ▲ - Measure pistons approx. 10 mm (3/8 in.) from bottom edge at right angle (90°) to piston pin.
Deviation from nominal size: 0.04 mm (0.0016 in.).



Piston and cylinder bore dimensions

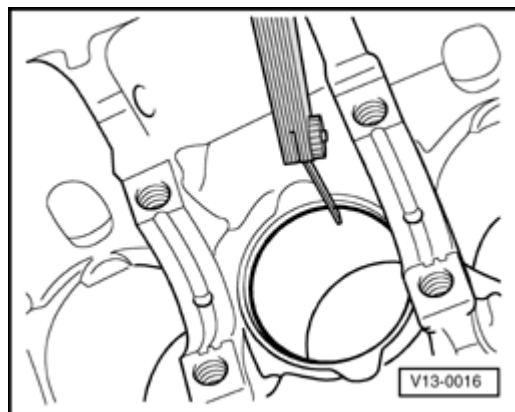
Reconditioning dimension	Piston diameter
Basic dimension	82.48 mm (3.247 in.)
1st oversize	82.74 mm (3.257 in.)



A

Checking piston ring side clearance

Clearance when new	Wear limit
0.02-0.08 mm (0.0008-0.0031 in.)	0.10 mm (0.004 in.)

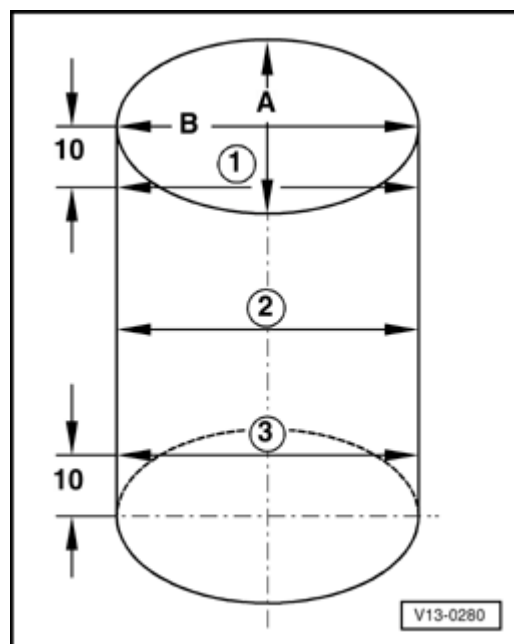


▲ Checking piston ring end gap

- Insert ring at right angle from top and slide down into lower cylinder opening until approx. 15 mm from lower edge of cylinder.

Engine codes AHA, ATQ

Piston ring	End gap, new mm. (in.)	Wear limit mm. (in.)
1 (compression)	0.35-0.50 mm (0.014-0.020 in.)	1.0 mm (0.039 in.)
2 (compression)	0.50-0.70 mm (0.020-0.028 in.)	1.4 mm (0.043 in.)
3 (oil scraper)	0.25-0.50 mm (0.010-0.020 in.)	0.8 mm (0.031 in.)



Cylinder bore, checking

A

- Measure at three locations diagonally in crosswise direction -A- and lengthwise direction -B-.

Inner bore gauge: 50-100 mm (1.96-3.94 in.)

Deviation from nominal size: max. 0.08mm (0.0031 in.)

Piston and cylinder bore dimensions

Engine codes AHA, ATQ

Reconditioning dimension	Piston diameter	Cylinder bore diameter
Basic dimension	82.48 mm (3.2472 in.)	82.51 mm (3.2484 in.)
1st oversize	82.74 mm (3.2575 in.)	82.76 mm (3.2578 in.)

Note:

Replacement pistons are only available in the basic dimension.

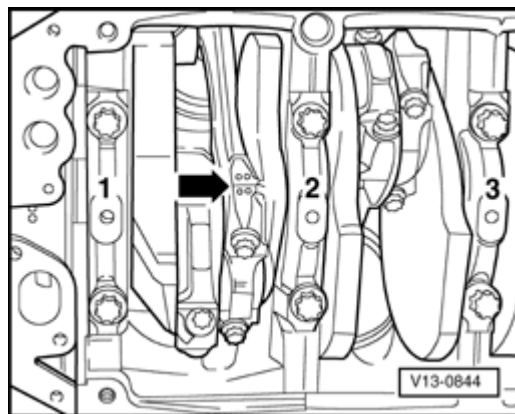
CAUTION!

DO NOT measure cylinder bore dimensions while the cylinder block is mounted on the engine stand. The cylinder block is stressed and deformed by its own weight under these conditions and the measurements will not be accurate.

Connecting rod and connecting rod bearings, checking clearance

Notes:

- ◆ Replace the connecting rods only as a set.
- ◆ Do not interchange connecting rod bearings.



A

- Mark connecting rod bearing caps with light center punch marks before removing.

Checking radial clearance

- Remove connecting rod bearing caps. Clean bearing shells and journals.
- Place Plastigage[®] over entire width of bearing journal or bearing cap.
- Install connecting rod bearing cap and tighten to 20 Nm (15 ft lb).

CAUTION!

DO NOT turn the crankshaft or allow it to rotate while measuring with Plastigage[®] in place.

- Remove connecting rod bearing cap again.
- Compare width of Plastigage[®] with calibrated scale.

13-34

Clearance when new	Wear limit
0.015-0.062 mm (0.0006-0.0024 in.)	0.12 mm (0.0047 in.)

- Always replace connecting rod bolts.