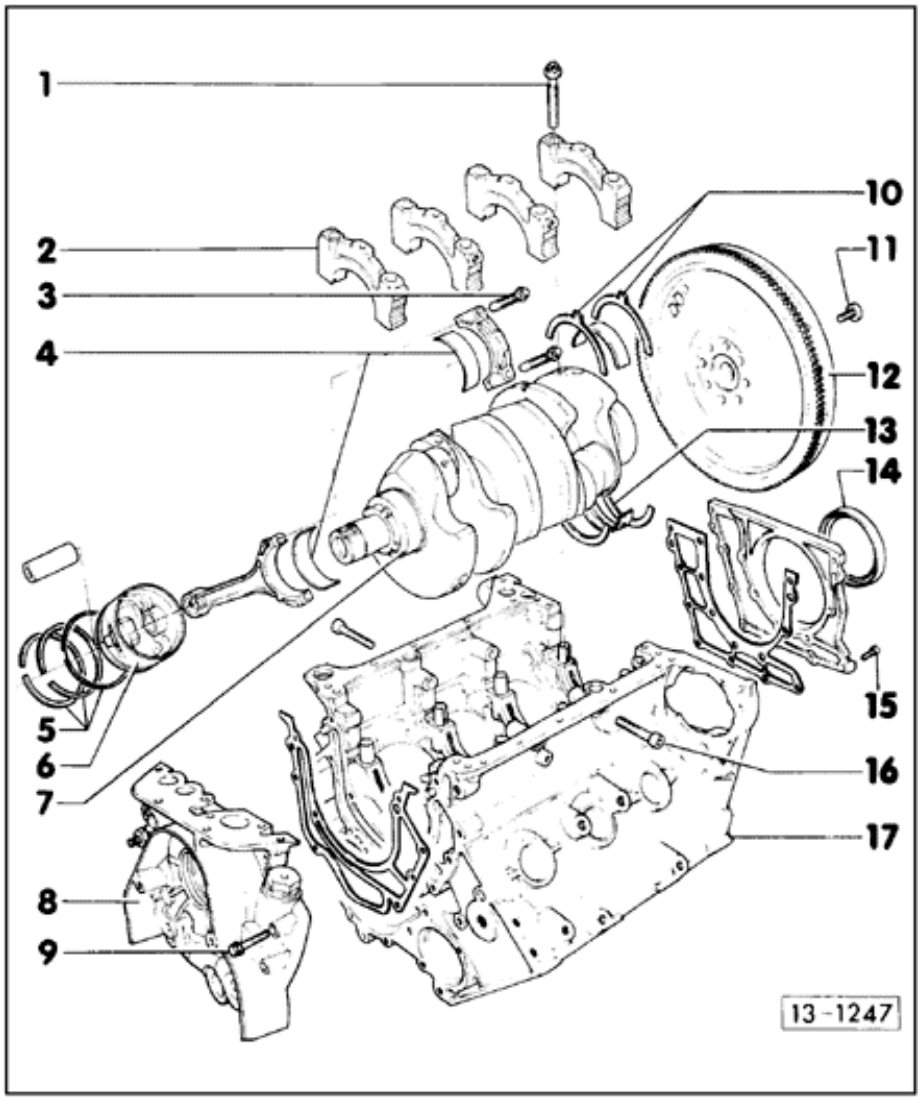
13-6



Cylinder block, crankshaft and flywheel, component layout

Note:

Always replace gaskets and seals.

1 - Main bearing cap bolts

- Always replace
- Tightening torque: 60 Nm (44 ft lb) plus 1/2-turn (180°)

2 - Main bearing cap

- ID: "1" on side facing oil pump
- Always replace bolts
- Checking bearing clearance ⇒ page 13-21

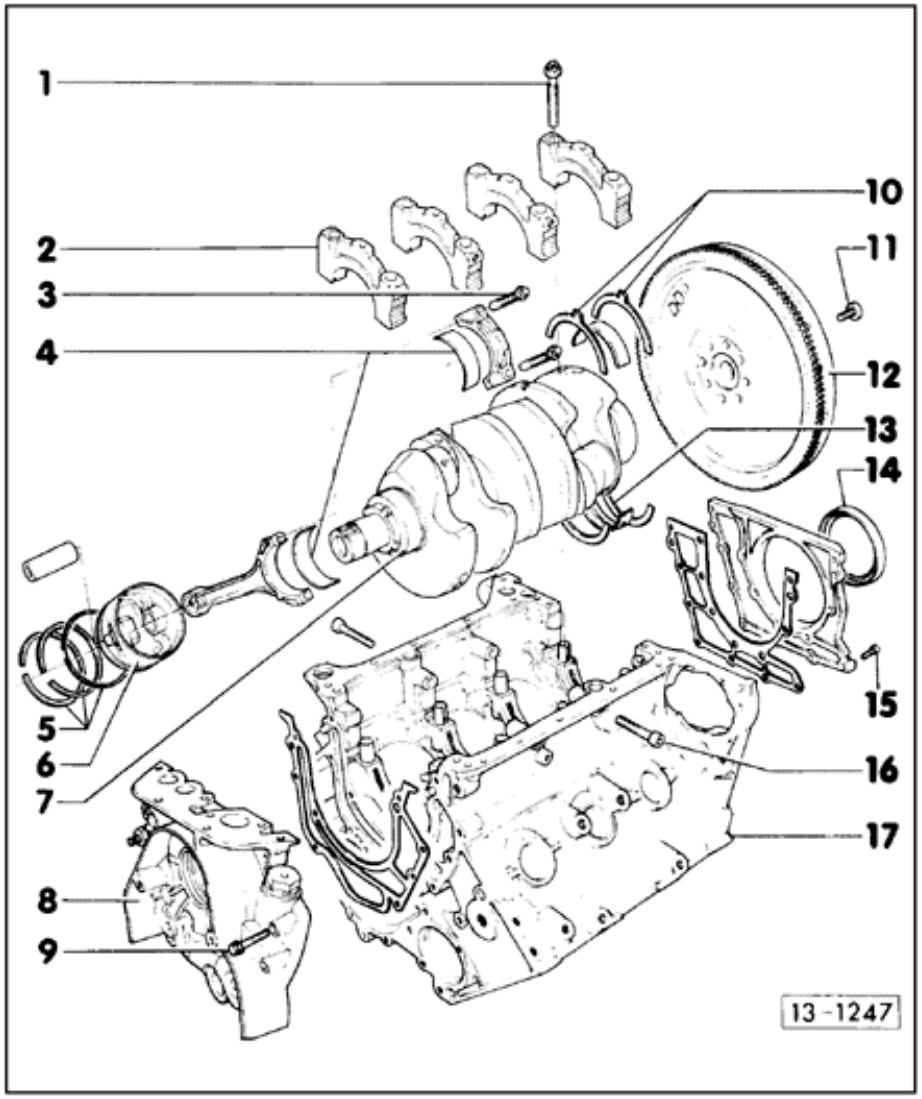
3 - Connecting rod bearing cap bolts

- Always replace
- Tightening torque: 30 Nm (22 ft lb) plus 1/4-turn (90°)
- Tighten to 20 Nm (15 ft lb) for measuring radial clearance, but do NOT tighten further

4 - Connecting rod bearing shells

- Never interchange used connecting rod bearing shells

- Checking connecting rods and bearings ⇒ page 13-31



5 - Piston rings

- Checking ⇒ page 13-25

6 - Piston

- Checking ⇒ page 13-26

7 - Crankshaft

- Checking ⇒ page 13-21
- Dimensions ⇒ page 13-24

8 - Oil pump

- Check drive gear on crankshaft when installing
- Removing ⇒ Repair Group 17

9 - 10 Nm (7 ft lb)

10 - Thrust washers

- Installed only at 4th crankshaft main bearing
- Checking crankshaft axial clearance ⇒ page 13-21

11 - Bolt

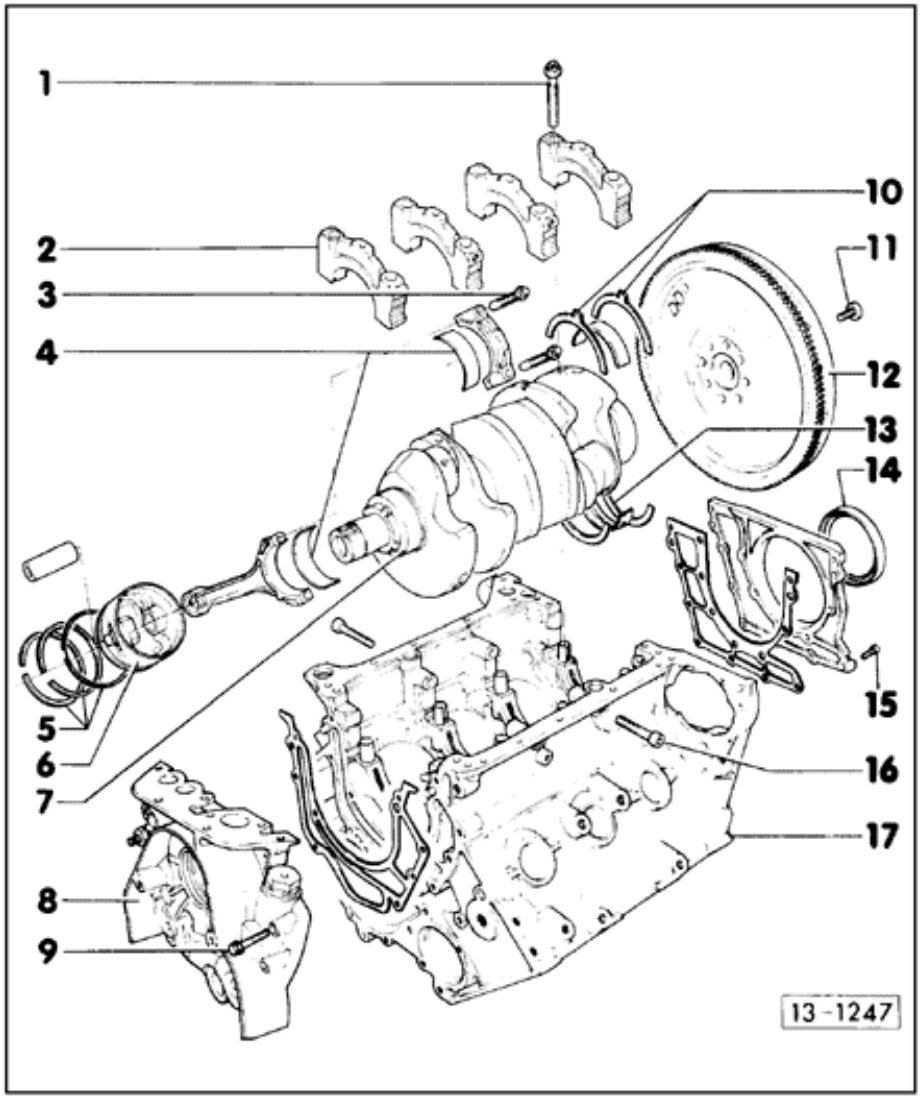
Automatic trans. (drive plate)

- Always replace
- Tightening torque: 60 Nm (44 ft lb) plus 1/4-turn (90°)

Manual trans. (flywheel)

- Always replace
- Tightening torque: 40 Nm (30 ft lb) plus 1/2-turn (180°)

13-8



12 - Dual mass flywheel or drive plate

- Removing and installing, installation dimensions ⇒ page 13-17
- Removing and installing pilot needle bearing ⇒ page 13-16
- Adjusting engine speed (RPM) sensor bracket -G28- ⇒ page 13-20

13 - Main bearing shell

- Checking radial clearance ⇒ page 13-21

14 - Seal

- Replacing ⇒ page 13-14

15 - 10 Nm (7 ft lb)

16 - 25 Nm (18 ft lb)

- Thread bolts in hand-tight before tightening crankshaft main bearing caps

17 - Cylinder block

13-9

Ribbed belt, removing and installing

CAUTION!

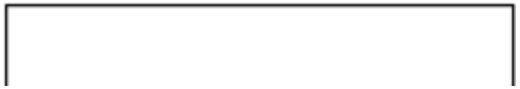
Mark the direction of belt travel before removing, using a crayon or marker. Reinstalling a used belt in the opposite direction could damage the belt.

Removing

- Remove engine and ribbed-belt guard.
- Loosen ribbed-belt tensioner using 17 mm wrench and secure with locking drift 3204.
- Remove ribbed belt.

Installing

- Install ribbed belt over the crankshaft belt pulley and guide pulley first, and then push it onto the tensioning pulley.
- Remove locking drift 3204.
- Install engine and ribbed belt guard.



Routing of ribbed belt drive -D-

D1 - Without air conditioner

D2 - With air conditioner

Vibration damper, removing and installing

Removing

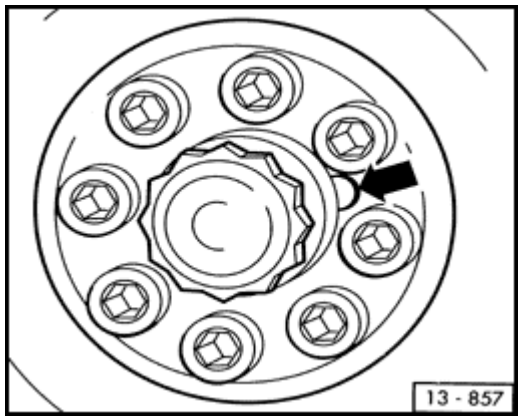
Removing ribbed belt ⇒ page 13-9 .

Note:

The center bolt does not have to be loosened to remove the vibration damper.

- Remove vibration damper.

Installing



- When installing, make sure that notch (arrow) in vibration damper is aligned with locking lug on toothed belt sprocket.

  Tightening torque: 25 Nm (15 ft lb)

13-11

Toothed belt, removing and installing

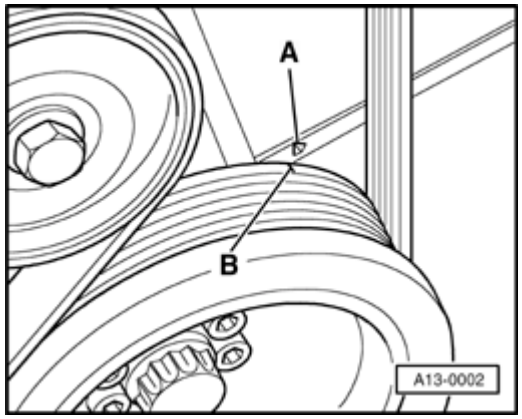
Removing

CAUTION!

Mark the direction of belt travel before removing, using a crayon or marker. Reinstalling a used belt in the opposite direction could damage the belt.

- Remove ribbed belt ⇒ page 13-9 .

- Unclip toothed belt guard on both sides.



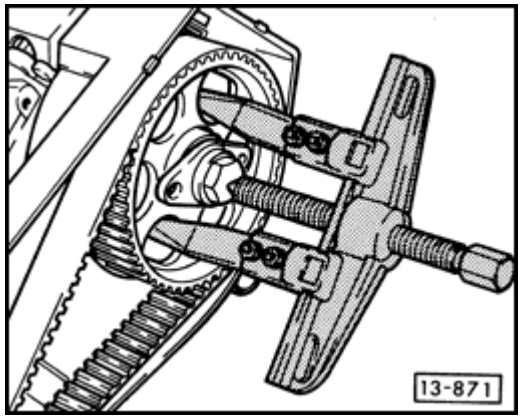
- Crank engine by hand to Top Dead Center (TDC) position.
- Check camshaft position. Large holes in camshaft sprocket locking plates must face toward each other. If not, turn crankshaft one more revolution.
- Remove Crankshaft Position (CKP) sensor from left-hand side of cylinder block.
  - The TDC hole in the crankshaft must be aligned with the hole for the removed crankshaft position sensor (check by looking and feeling).

- Thread crankshaft holder 3242 into hole left by crankshaft position sensor, and tighten slightly.
- Remove ribbed-belt tensioner.

13-12

- Remove left and right toothed-belt guards.
- Remove vibration damper ⇒ page 13-10 .
- Remove lower toothed-belt guard.
- Loosen toothed-belt tensioning pulley, and remove belt.

Installing

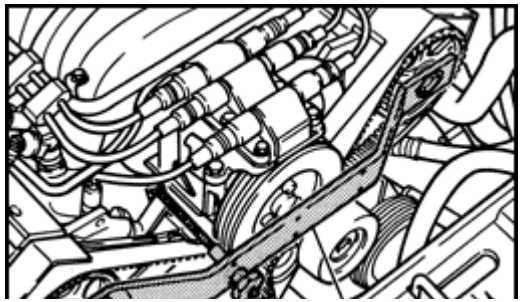


- Loosen right and left camshaft sprockets from tapered ends of camshafts using puller (Kukko 20-10 or equivalent).

Note:

The arms of the puller must engage on the rear hub of the sprocket.

- Install toothed belt over both camshaft sprockets first, then over remaining sprockets, and over tensioning roller last.



- Install camshaft holder 3243.

Note:

The camshaft sprockets must be loose enough on the tapered ends of the shafts so that the camshafts can still be turned, but tight enough that the sprockets do not tilt out of alignment.

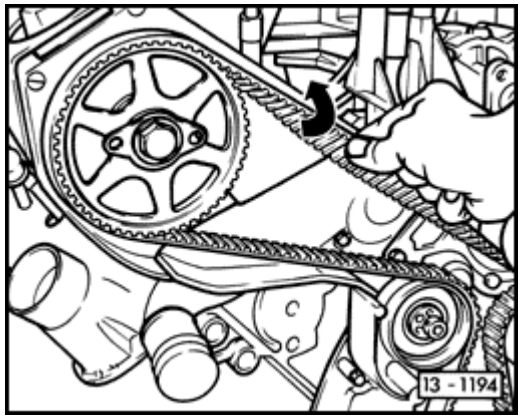
- Adjust belt tension ⇒ page 13-13 .

13-13

Toothed belt, adjusting tension

- Adjust toothed belt tension by turning tensioning roller to right and holding using 8 mm hex socket wrench.

- Tighten tensioning roller center bolt with another 8 mm hex socket wrench.



- Check toothed belt tension between right camshaft sprocket and coolant pump.

  Holding toothed belt half way between camshaft sprocket and coolant pump with thumb and index finger, it must be just possible to twist toothed belt by 90°.

  Tightening torque (tensioning roller): 45 Nm (33 ft lb)

Center crankshaft bolt: Always replace, using new double hex head (12-pt.) cap screw grade 9.8

Component	Tightening torque
Toothed belt sprocket to camshaft	70 (52 ft lb)
Idler roller	25 (18 ft lb)
Toothed belt tensioner	45 (33 ft lb)
Belt cog to crankshaft	25 (18 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.

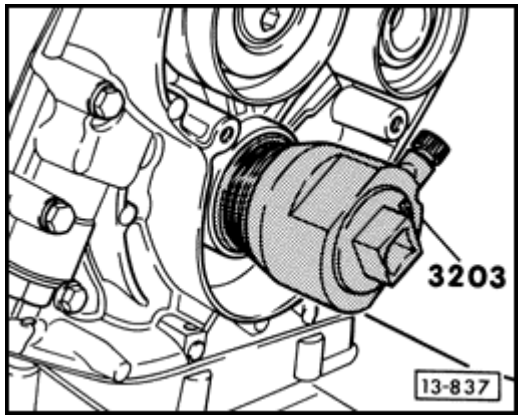
13-14

Crankshaft oil seals, replacing

Toothed belt end (front)

- Remove toothed belt ⇒ page 13-11 .

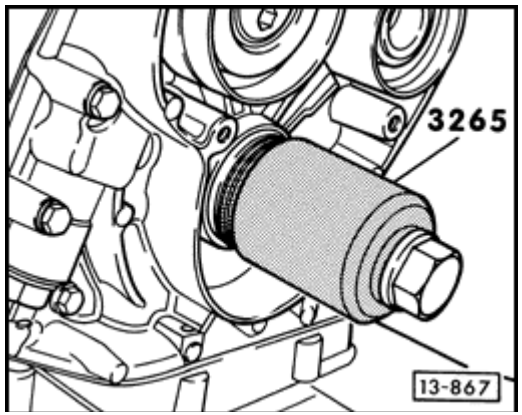
- Remove toothed belt sprocket from crankshaft.



- Remove oil seal using seal remover 3203.
- Clean running and sealing surfaces.

Note:

Do not oil sealing lip or outer edge of seal before pressing in.



- Push oil seal over 3202/1 from retractor 3202.
- Press in oil seal flush with seal installer 3265 and center crankshaft bolt.

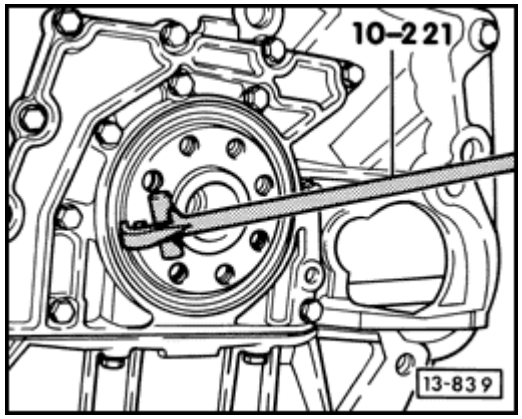
13-15

Flywheel/drive plate end (rear)

CAUTION!

Always replace the seal with the flange, if available. Drain engine coolant before removing flange (⇒ Repair Group 19). Replace only seal as described below if oil seal with flange is not available.

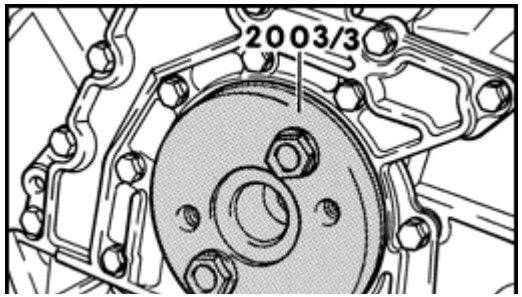
- Remove clutch and flywheel, or drive plate, as necessary.



- Pry out oil seal with extractor 10-221.
- Clean running and sealing surfaces.

Note:

Do not oil sealing lip or outer edge of seal before pressing in.



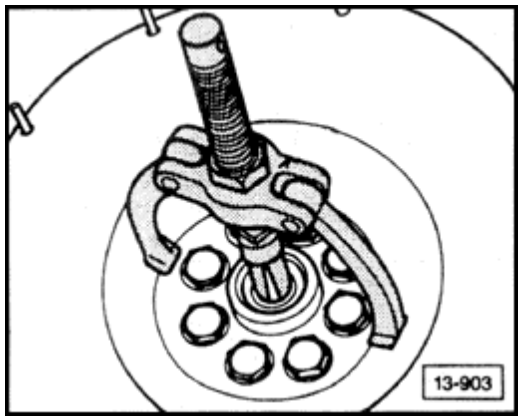
- Using assembly aid supplied with new oil seal, slide seal onto crankshaft.

  Assembly aid is supplied with oil seal

- Press in oil seal as far as possible using seal installer 2003/3 and flywheel or drive plate mounting screws.

13-16

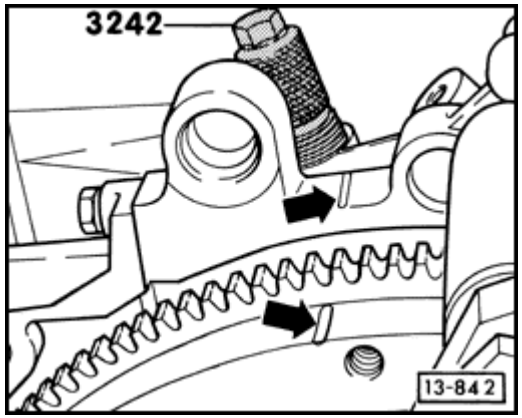
Flywheel pilot needle bearing, removing and installing



- Remove bearing with puller assembly such as Kukko 21/2 and Kukko 22-1, as shown
- Install bearing with drift 3264.

Dual mass flywheel or drive plate, removing and installing

Flywheel



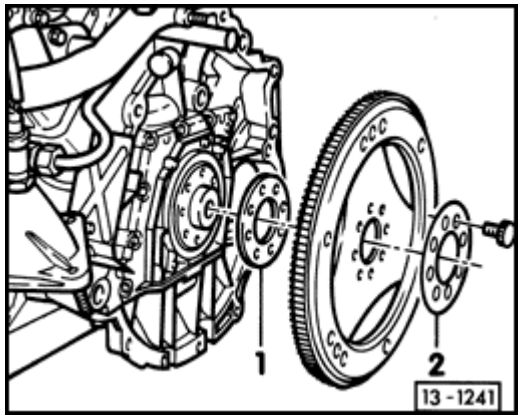
- Install crankshaft holder 3242 with crankshaft at Top Dead Center (TDC) position.
- Mark relationship between flywheel and engine cylinder block (arrows).
- Remove flywheel.

Note:

The needle roller bearing is in the flywheel and must be pressed in when replacing the flywheel.

Tightening torque

- Dual mass flywheel: 40 Nm (30 ft lb) plus 1/2-turn (180 °)



Drive plate

- Hold crankshaft in position using crankshaft holder 3242 ⇒ page 13-11

- Mark bolt hole pattern of drive plate and washers -1- and -2- relative to crankshaft. Mark position of shim in front and shim behind drive plate.

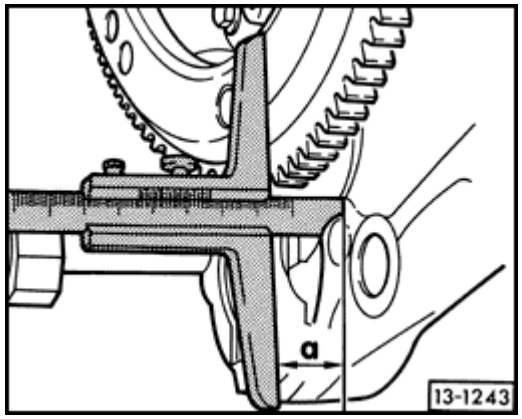
CAUTION!

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

- Install drive plate with 3.0 mm shim -1- (Part no. 054 105 301) or 4.0 mm shim -1- (Part no. 054 105 202), and spacer -2- (Part no. 035 105 303A).

Note:

Short blocks are supplied without a bushing in the crankshaft. For vehicles with automatic transmission, tap the bushing into place before installing the drive plate.



- Check clearance -a- between drive plate and cylinder block in three places and calculate average value.

  Dimension -a-:

  - Transmission 01V: 18.1-19.7 mm (0.713-0.776 in.)

- If necessary, install other shims to achieve correct clearance dimension.

Tightening torque: 60 Nm (44 ft lb) plus 1/4-turn (90°)

Note:

Before installing the engine, make sure that the engine-to-transmission dowel sleeves are installed in the cylinder block flange.

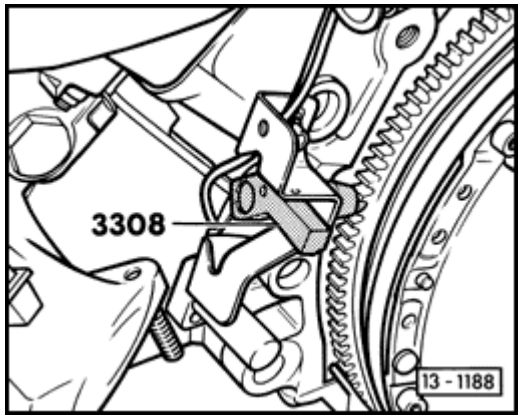
Engine speed (RPM) sensor mounting bracket, adjusting

Note:

The crankshaft must be at TDC and locked in position with crankshaft holder 3242 ⇒ page 13-11 .

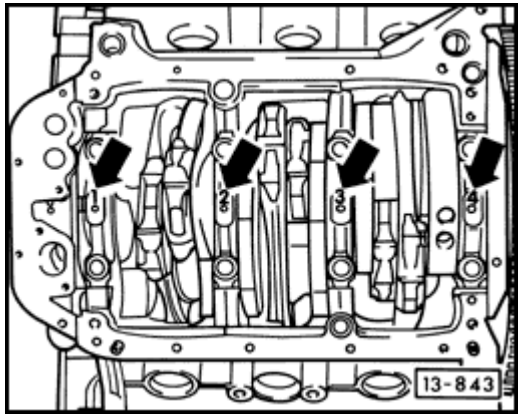
- Remove heat shield for RPM sensor, and then remove RPM sensor.

- Loosen bracket.



- Insert adjustment tool 3308 in place of sensor.
  - Adjustment tool must engage in flywheel ring gear.
- Tighten bracket securely.
- Install RPM sensor.

Crankshaft axial and radial clearance, checking



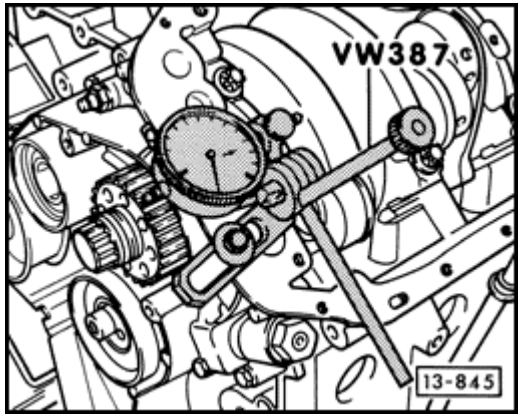
Orientation of crankshaft bearing caps

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.

- Main bearing cap -1- is at the oil pump end (front).
- Main bearing cap -4- is at the flywheel end (rear).

Checking axial clearance



- Install dial indicator with holder VW 387 on oil pump and set indicator against crankshaft counterweight.
- Press crankshaft against dial indicator by hand.
- Set dial gauge to zero.
- Press crankshaft away from dial indicator and read gauge.

  Specifications:

  - New: 0.07-0.23 mm (0.0027-0.0091 in.)
  - Wear limit: 0.25 mm (0.0098 in.)

Checking radial clearance

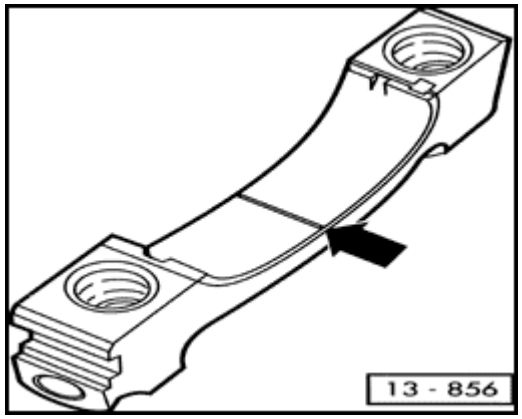
Note:

Radial clearance is measured using Plastigage®.

Plastigage® type	Color	Measuring range
PG-1	Green	0.025 - 0.076 mm
PR-1	Red	0.050 - 0.150 mm

- Remove crankshaft bearing cap.

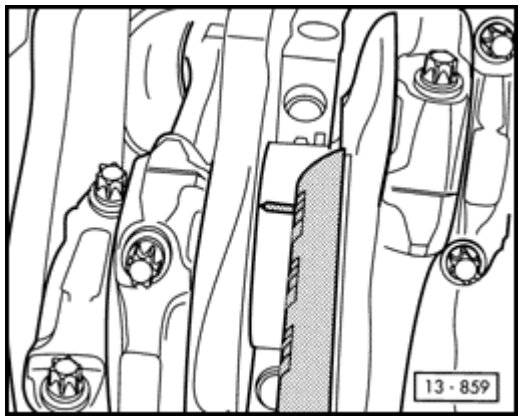
- Clean bearing shell and crankshaft journal.



- Place Plastigage® on crankshaft journal over entire width of bearing, or in bearing shell (arrow).
- Install crankshaft bearing cap with bearing shell and new bolts.
- Tighten to 60 Nm (44 ft lb) plus1/2-turn 180°.

CAUTION!

Do NOT turn the crankshaft or allow it to rotate during the measurement with Plastigage® in place.



- Remove crankshaft bearing cap again.

- Compare width of Plastigage® with measuring scale.

  Specifications:

  - New: 0.018-0.045 mm (0.0007-0.0018 in.)
  - Wear limit: 0.10 mm (0.0039 in.)

Crankshaft dimensions

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)
Basic dimension (nominal)	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)	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)	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)	64.25 (2.530)	53.25 (2.096)
minimum size (from nominal)	-0.042 (0.00165)	-0.042 (0.00165)

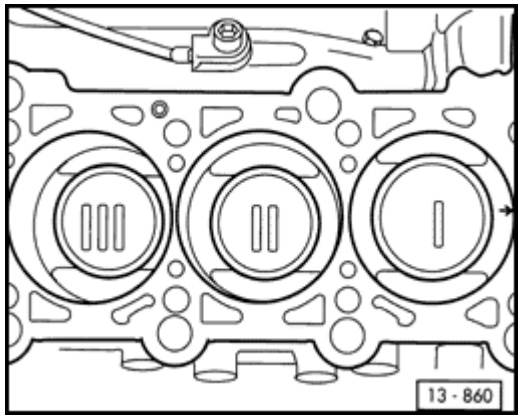
13-25

Pistons and piston rings, checking and installing

Note:

Before removing the pistons, mark their installation positions clearly on the piston crowns (as shown in illustration 13-860) using a waterproof felt-tipped pen.

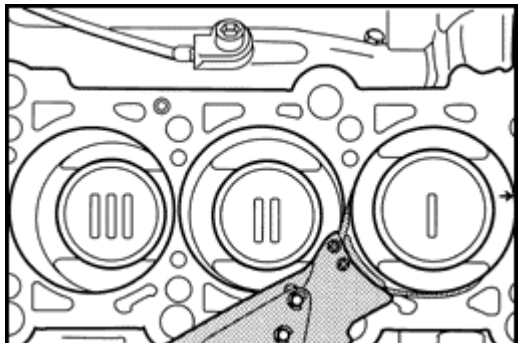
Piston installed position



- Arrow marking must point toward oil pump (front).
- Mark position clearly on piston crown with waterproof felt pen.

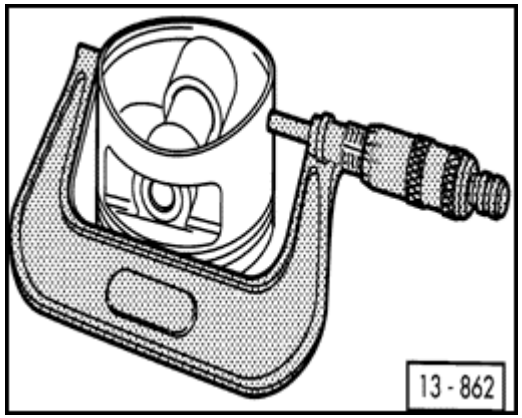
CAUTION!

Do NOT scratch or scribe the piston surface. This surface has a coating on it that must not be disturbed.



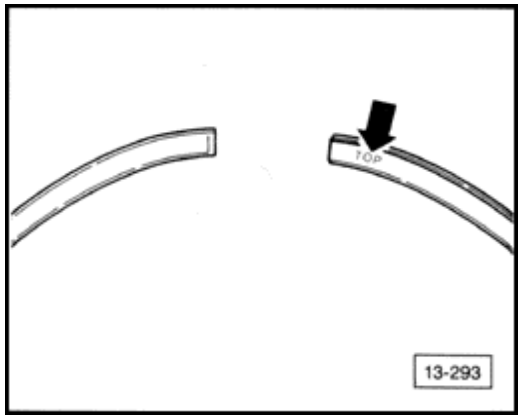
- Install piston using piston ring compressor.

Checking pistons



- Measure piston approx. 10 mm (0.39 in.) from bottom of skirt, at right angle (90 °) to piston pin.

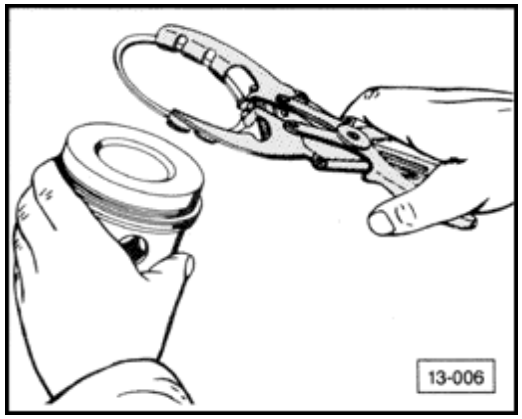
  Maximum deviation from nominal dimension: 0.04 mm (0.0016 in.)



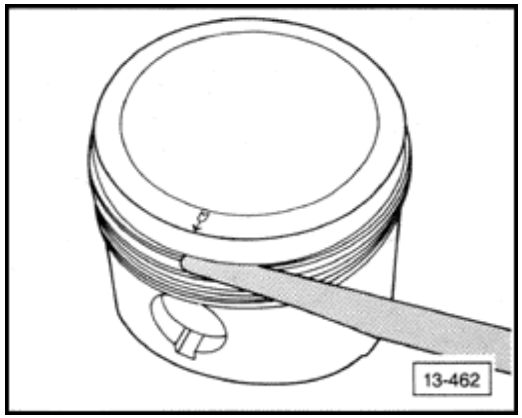
Checking and installing piston rings

- "TOP" inscription must point toward piston crown
- Inner chamfer on plain ring must point toward piston crown
- Outer chamfer of stepped ring must point toward piston crown

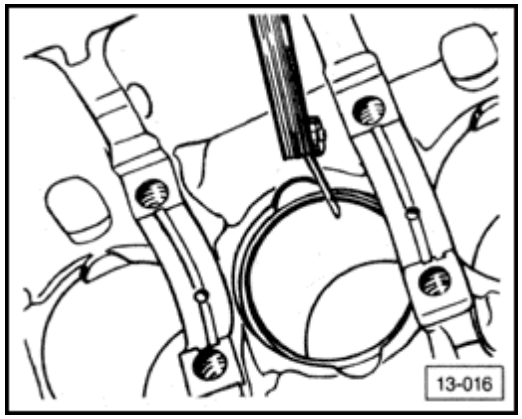
13-27



- Remove and install piston rings using ring expander as shown.



- Check piston ring clearance in groove.
  - New: 0.02-0.08 mm (0.001-0.003 in.)
  - Wear limit: 0.10 mm (0.004 in.)



- Check piston ring gap.
  - Push piston ring into lower end of cylinder at right angle until approx. 15 mm (0.59 in.) from bottom edge.

Piston ring	End gap	Wear limit
1	0.35 - 0.50 mm (0.014 - 0.020 in.)	1.0 mm (0.039 in.)
2	0.50 - 0.70 mm (0.020 - 0.028 in.)	1.4 mm (0.055 in.)
3	0.25 - 0.50 mm (0.010 - 0.020 in.)	0.8 mm (0.032 in.)

13-29

Checking cylinder bore

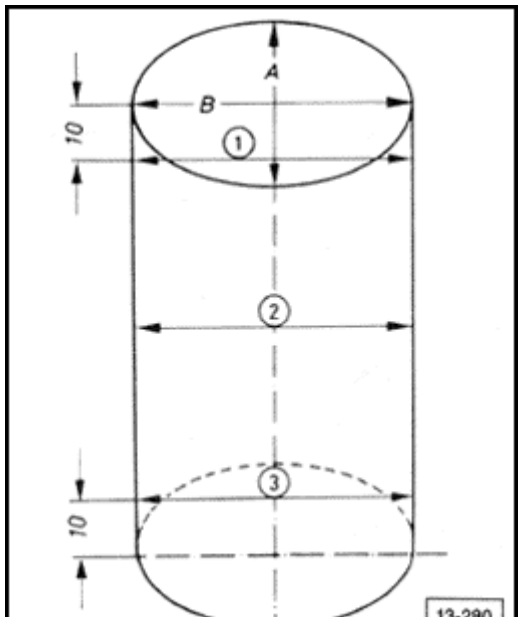
1 - Approx. 10 mm from top

2 - Center

3 - Approx. 10 mm from bottom

A - Across cylinder block (perpendicular to crankshaft)

B - In line with cylinder block (parallel to crankshaft)



- Measure diagonally at three points in transverse direction -A- and in longitudinal direction -B-.
  - Use internal dial gauge 50-100 mm (2-4 in.)
  - Maximum deviation from nominal dimension: 0.08 mm (0.0031 in.)

CAUTION!

DO NOT have the cylinder block mounted to the assembly stand while measuring the cylinder bores. The block is deformed by its own weight under these conditions and this stress will result in false measurements that are not accurate after the tension has been relieved.

Piston and cylinder dimensions

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 (3.2583 in.)
2nd oversize	82.98 mm (3.2669 in.)	83.01 mm (3.2681 in.)

Note:

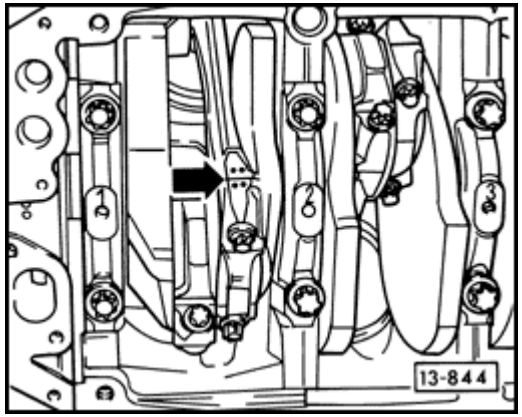
Only pistons of the "basic dimension" size are available from the Parts Department.

13-31

Connecting rods and connecting rod bearings, checking

- Replace connecting rods only as a complete set.
- Do not interchange connecting rod bearings.
- Always replace connecting rod bearing cap bolts.

Checking radial clearance



- Mark connecting rod bearing caps with light punch marks (arrow) before removing.
- Remove connecting rod bearing caps.
- Clean bearing caps and journals.
- Place Plastigage® over entire width of bearing journal or in bearing shell.
- Re-install connecting rod bearing cap and tighten to 20 Nm (15 ft lb) only; do NOT tighten further.

CAUTION!

Do NOT turn the crankshaft or allow it to rotate during the measurement with Plastigage® in place.

- Remove connecting rod bearing caps again.

- Compare width of Plastigage® with measuring scale.

Specifications:

♦ New:	0.015 to 0.062 mm (0.00059 to 0.00244 in.)
♦ Wear limit:	0.12 mm (0.0047 in.)