

CYLINDER BLOCK

SERVICE TOOLS

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CRANKSHAFT LOCKING TOOL	529 035 821	12, 15, 22
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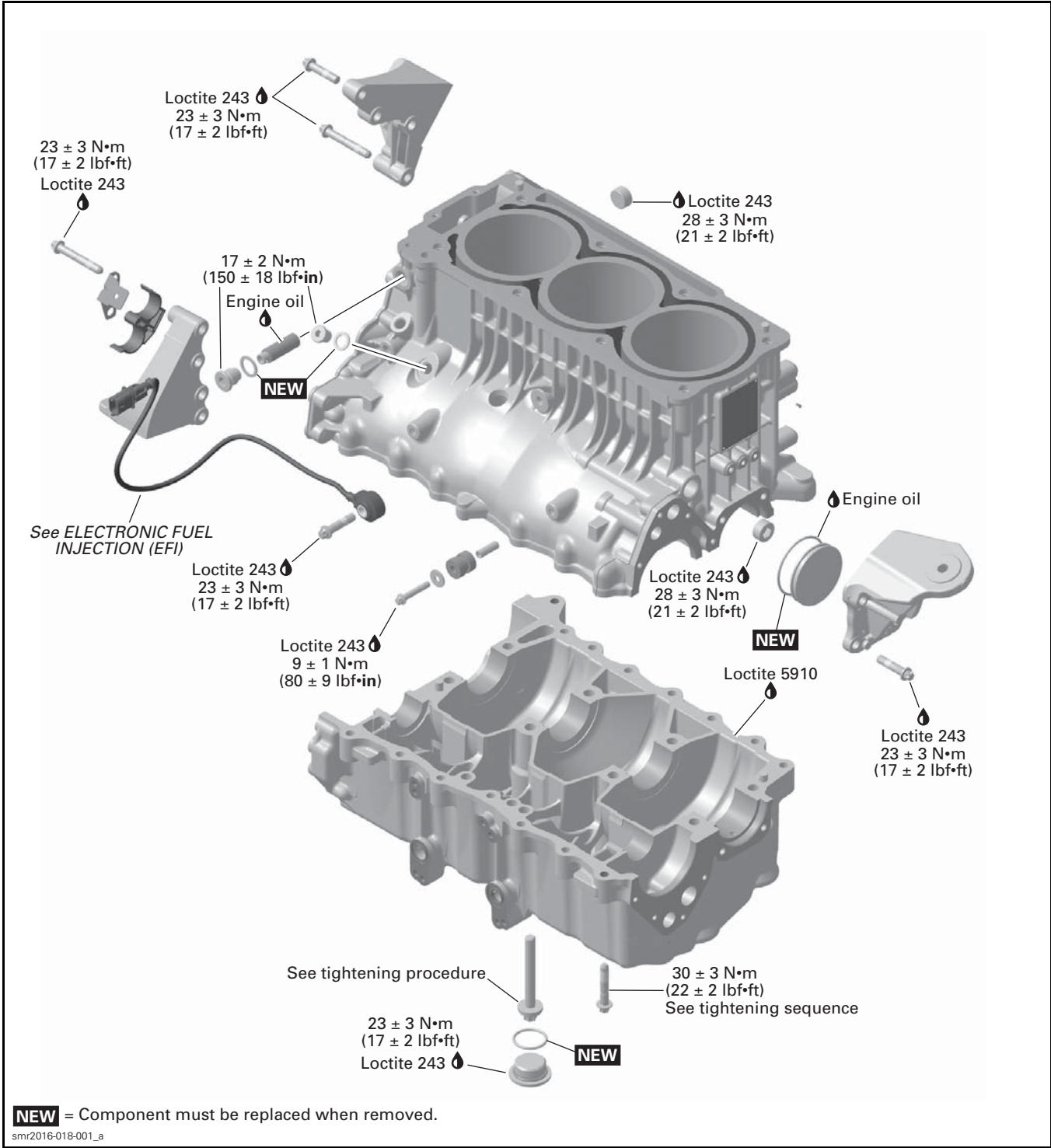
SERVICE TOOLS – OTHER SUPPLIER

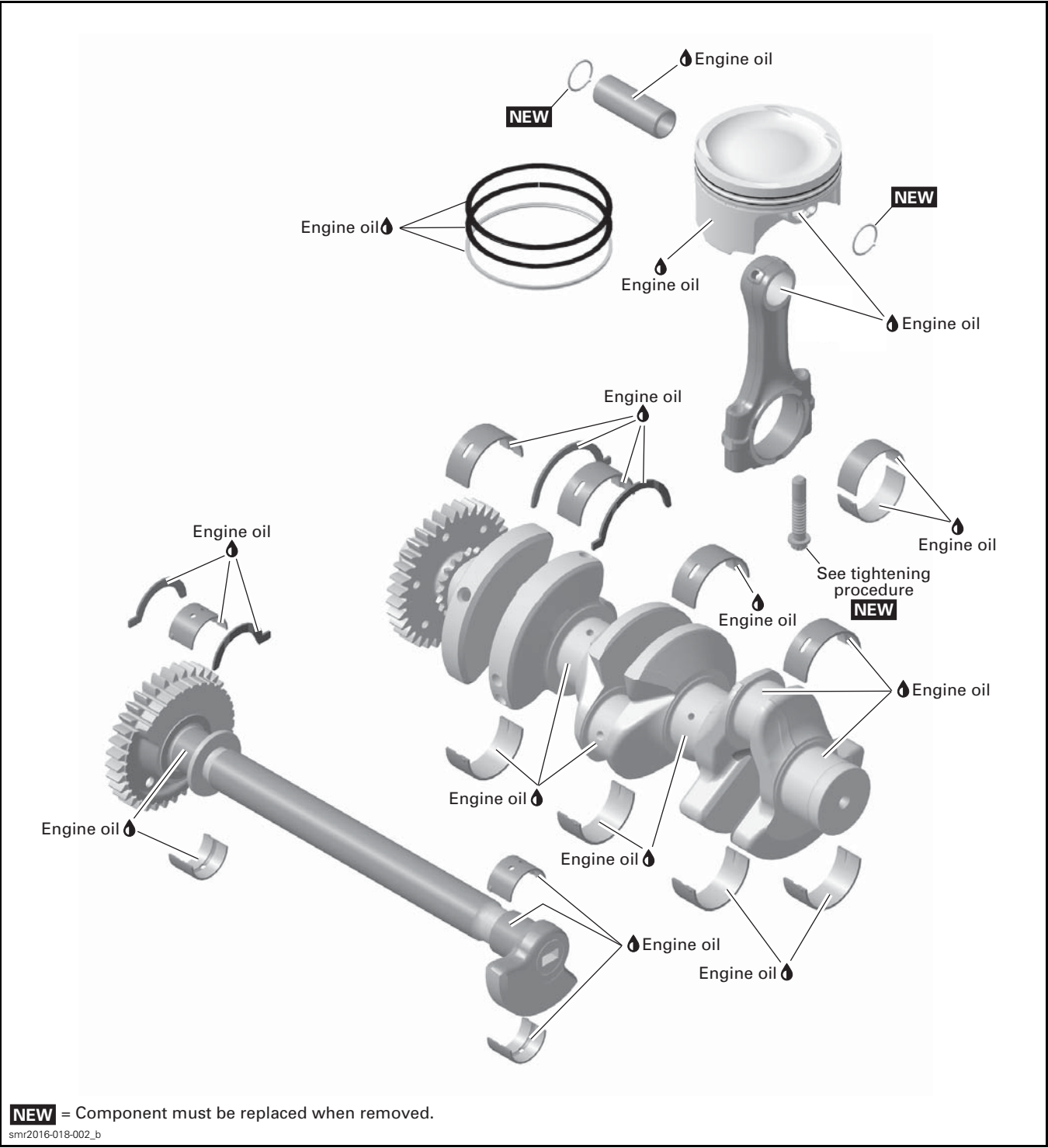
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SERVICE PRODUCTS

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Subsection XX (CYLINDER BLOCK)





GENERAL

When disassembling parts that are duplicated in the engine, (e.g.: pistons, connecting rods etc.), it is strongly recommended to note their position and to keep them as a "group". If you find a defective component, it will be much easier to find the cause of the failure. Since parts were break-in together during the engine operation, they will keep their matched fit when parts are reassemble together within their "group".

TROUBLESHOOTING

The following is provided to help in diagnosing the probable source of troubles. It is a guideline and it should not be assumed to list all possible problems.

Always check for fault codes. If a fault code is detected, service the fault code first. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

UNUSUAL ENGINE NOISE OR VIBRATIONS

1. Heavy wear on plain bearings
 - Check radial play of plain bearings.
 - Replace plain bearings if out of specification.
2. Crankshaft and balancer shaft are not properly aligned
 - Disassemble cylinder block and check if marks are properly aligned.
3. Crankshaft or balancer shaft axial play out of specification
 - Measure crankshaft and balancer shaft axial play.
 - If axial play is out of specification, replace thrust washers.
4. Connecting rod axial play out of specification
 - Measure connecting rod axial play on crankshaft.
 - Replace connecting rod or crankshaft if out of specification.
5. Connecting rod screws got loose
 - Replace damaged components and retighten screws with the recommended torque.

BLUE SMOKE IN THE EXHAUST

1. Oil scrapper rings worn out
 - Replace piston rings.

ENGINE SUDDENLY TURNS OFF (POOR IDLING)

1. Piston rings worn out
 - Replace piston rings.

2. Piston/cylinder wall clearance out of specification
 - Check piston/cylinder wall clearance.
 - Replace if out of specification.
3. Melted or broken piston
 - Check if oil spray nozzle is not clogged. Refer to *LUBRICATION SYSTEM* subsection.
 - Replace piston and cylinder block if necessary.

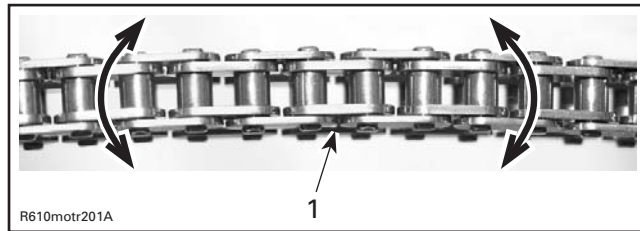
PROCEDURES

TIMING CHAIN

Inspecting the Timing Chain

Check timing chain on camshaft gear for excessive radial play.

Check chain condition for wear and rollers condition.



1. Timing chain

If chain is excessively worn or damaged, replace it as a set (camshaft timing gear and timing chain).

Removing the Timing Chain

Remove:

- Engine from vehicle (refer to *ENGINE REMOVAL AND INSTALLATION* subsection)
- Cylinder head (refer to *CYLINDER HEAD* subsection)
- PTO housing (refer to *PTO HOUSING, MAGNETO AND STARTER* subsection)
- Crankshaft (refer to *CRANKSHAFT* in this subsection)
- Timing chain.

Installing the Timing Chain

The installation is the reverse of the removal procedure. However, pay attention to the following details.

Ensure to perform proper valve timing.

NOTICE Improper valve timing will damage engine components.

Lock crankshaft and camshaft at TDC (refer to *CYLINDER HEAD* subsection for the camshaft locking procedure).

Install chain, then install chain tensioner.

CHAIN TENSIONER

Chain Tensioner Access

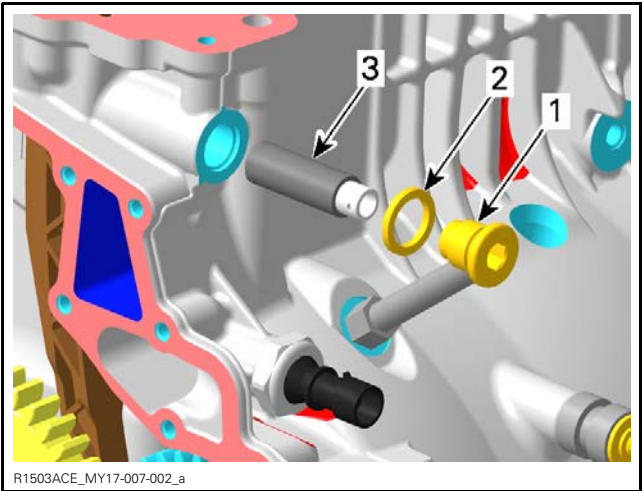
NOTE: Removal of the intake manifold allows easier access to the chain tensioner, but is not necessary. Refer to *INTAKE MANIFOLD* subsection.

Removing the Chain Tensioner

Lock crankshaft, refer to *CRANKSHAFT LOCKING PROCEDURE* in this subsection.

Remove:

- Chain tensioner plug screw
- Gasket ring (discard it)
- Chain tensioner.



- 1. Plug screw
- 2. Gasket ring
- 3. Chain tensioner

Inspecting the Chain Tensioner

Check chain tensioner for:

- excessive wear
- cracks
- free movement of the chain tensioner piston.

Installing the Chain Tensioner

The installation is the reverse of the removal procedure. However, pay attention to the following details.

Install plug screw with a **NEW** gasket ring .

NOTICE This engine uses gasket ring with specific thickness. Using any other gasket ring may cause severe engine damage.

GASKET RING THICKNESS
2.5 mm (.0984 in)

Tighten the chain tensioner plug screw to specification.

TIGHTENING TORQUE	
Chain tensioner plug screw	17 N•m ± 2 N•m (150 lbf•in ± 18 lbf•in)

PISTONS AND CONNECTING RODS

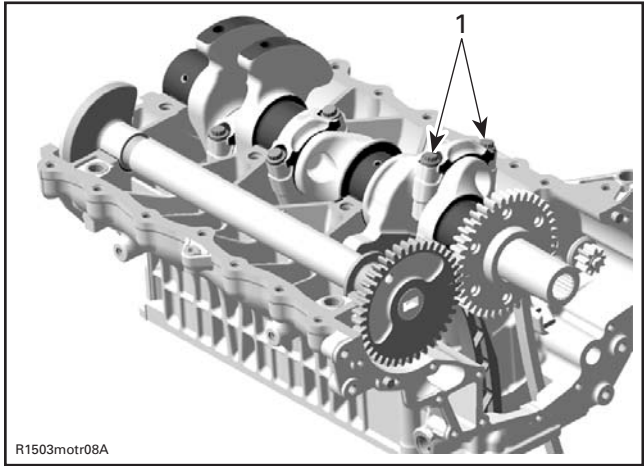
Removing Piston and Connecting Rod

1. Disassemble *CYLINDER BLOCK* as per procedure in this subsection.

NOTE: It is recommended to measure connecting rod big end axial play prior to remove connecting rod. Refer to *INSPECTING THE CONNECTING ROD* below.

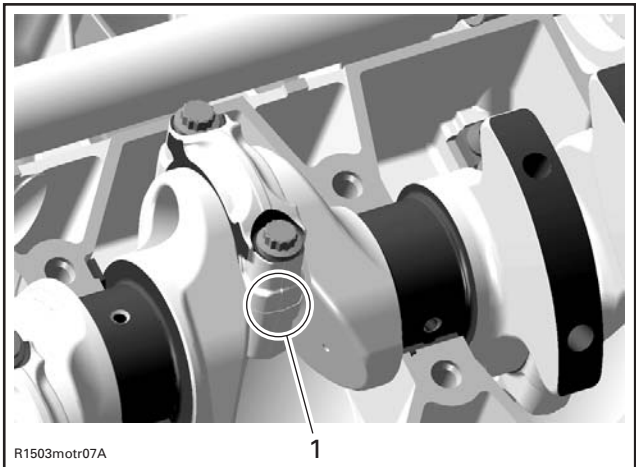
2. Remove:

- Connecting rod screws
- Connecting rod caps.



- 1. Connecting rod screws

NOTE: Before removing the connecting rod caps, mark them to remember the right position when reassembling.



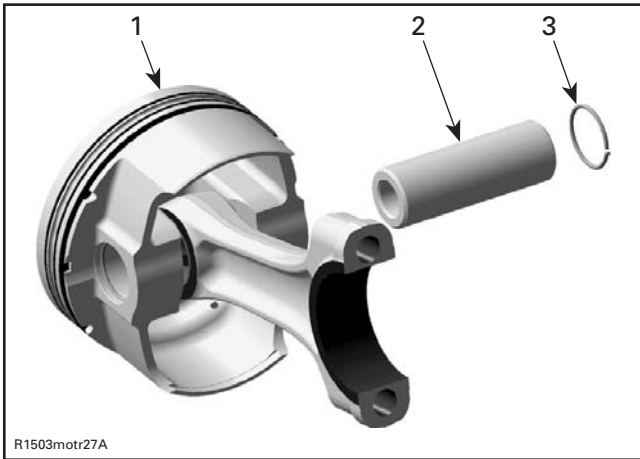
1. Connecting rod mark

- 3. Pull piston with connecting rod out of the cylinders.
- 4. Remove one piston circlip and discard it.



1. Piston circlip

- 5. Push piston pin out of piston.



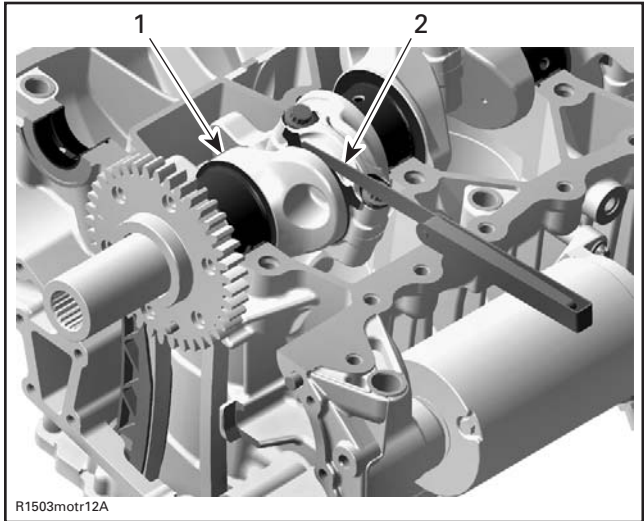
1. Piston
2. Piston pin
3. Circlip

- 6. Detach piston from connecting rod.

Inspecting the Connecting Rod

Connecting Rod Big End Axial Play

Using a feeler gauge, measure distance between butting face of connecting rod and crankshaft counterweight. If the distance exceeds specified tolerance, replace the worn part.

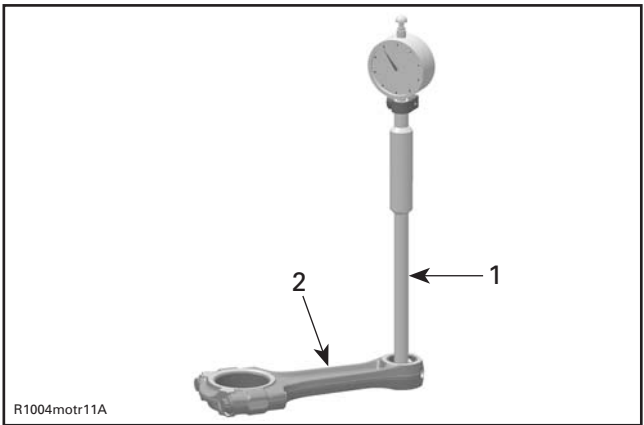


TYPICAL
1. Crankshaft
2. Feeler gauge

CONNECTING ROD BIG END AXIAL PLAY	
New	0.100 mm to 0.352 mm (.004 in to .014 in)
Service limit	0.500 mm (.02 in)

Connecting Rod Small End Radial Play

Measure connecting rod small end.



TYPICAL
1. Bore gauge
2. Connecting rod

CONNECTING ROD SMALL END DIAMETER	
New	23.01 mm to 23.02 mm (.9059 in to .9063 in)
Service limit	23.07 mm (.9083 in)

If the connecting rod small end diameter is out of specification, replace small end bearing sleeve.

Measure piston pins, refer to *INSPECTING THE PISTON PIN* in this subsection. Compare to inside diameter of connecting rod to obtain connecting rod small end radial play.

CONNECTING ROD SMALL END RADIAL PLAY	
Service limit	0.080 mm (.003 in)

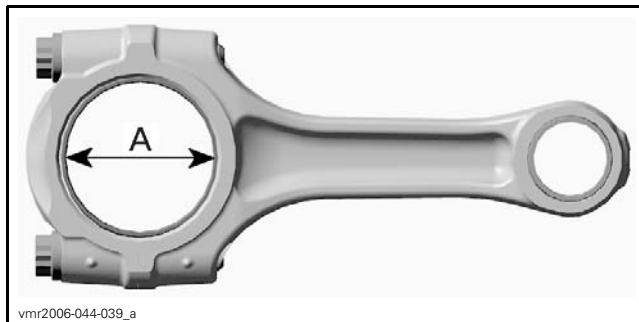
Connecting Rod Big End Radial Play

Measure inside diameter of connecting rod big end. Compare to crankshaft pin.

To measure the connecting rod big end diameter, use the **OLD** screws.

Install the **OLD** bearings as they were mounted initially.

Tighten connecting rod screws, refer to *INSTALLING THE PISTON AND CONNECTING ROD* in this subsection.



TYPICAL
A. Connecting rod big end bearing

CONNECTING ROD BIG END DIAMETER	
Service limit	45.080 mm (1.7748 in)

CONNECTING ROD BIG END RADIAL PLAY	
Service limit	0.09 mm (.0035 in)

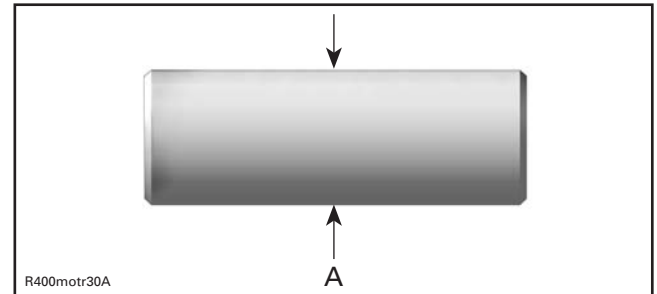
Use **NEW** bearings, when connecting rod big end diameter is out of specification.

Inspecting the Piston Pin

Using synthetic abrasive woven, clean piston pin from deposits.

Inspect piston pin for scoring, cracking or other damages.

Measure piston pin. See the following illustration for the proper measurement position.



TYPICAL
A. Piston pin diameter here

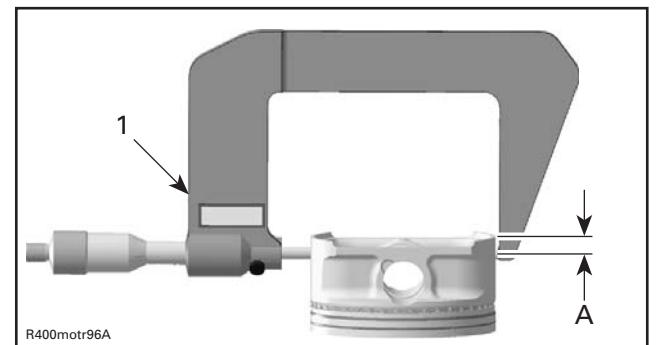
PISTON PIN DIAMETER	
New	22.996 mm to 23.000 mm (.9054 in to .9055 in)
Service limit	22.990 mm (.9051 in)

Measure connecting rod small end diameter, refer to *CONNECTING RODS INSPECTION* in this subsection to check connecting rod small end radial play.

Inspecting the Piston

Inspect piston for scoring, cracking or other damages. Replace piston and piston rings if necessary.

Using a micrometer, measure piston at 5 mm (.197 in) perpendicularly (90°) to piston pin axis.



TYPICAL
1. Measuring perpendicularly (90°) to piston pin axis
A. 5 mm (.197 in)

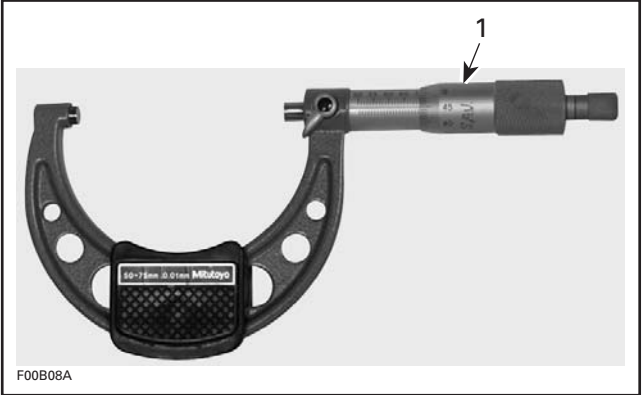
The measured dimension should be as described in the subsequent table. If not, replace piston.

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PISTON MEASUREMENT	
New	99.931 mm to 99.949 mm (3.9343 in to 3.935 in)
Service limit	99.900 mm (3.9331 in)

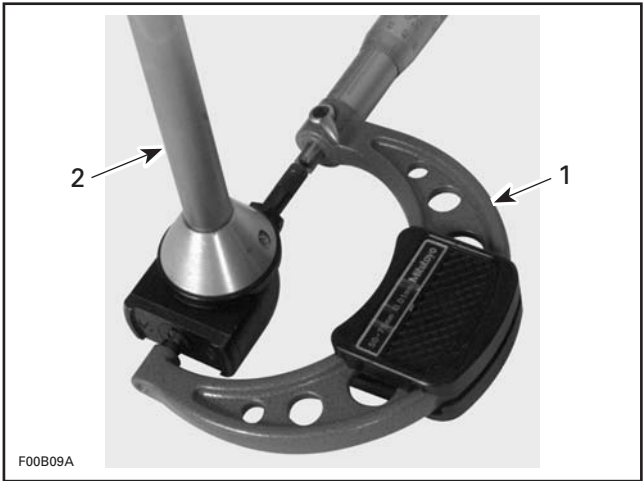
Piston/Cylinder Wall Clearance

Adjust and lock a micrometer to the piston dimension.

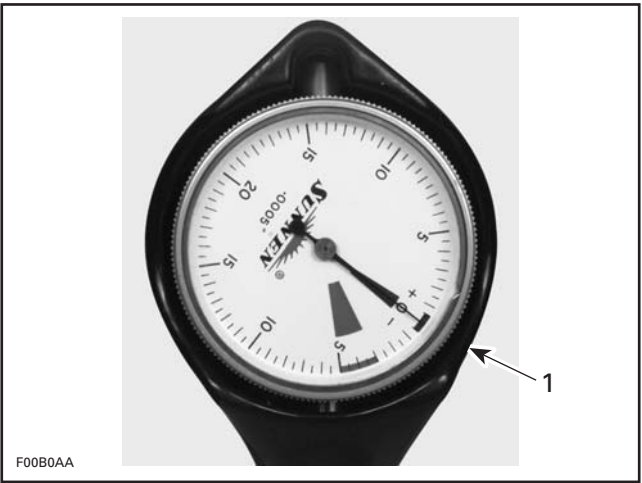


1. Micrometer set to the piston dimension

NOTE: Make sure used piston is not worn.
With the micrometer set to the dimension, adjust a cylinder bore gauge to the micrometer dimension and set the indicator to 0 (zero).



1. Use the micrometer to set the cylinder bore gauge
2. Dial bore gauge



TYPICAL
1. Indicator set to 0 (zero)

NOTE: Make sure the cylinder bore gauge indicator is set exactly at the same position as with the micrometer, otherwise the reading will be false.

Position the dial bore gauge 62 mm (2.44 in) above cylinder base, measuring perpendicularly (90°) to piston pin axis.

Read the measurement on the cylinder bore gauge. The result is the exact piston/cylinder wall clearance.

PISTON/CYLINDER CLEARANCE	
New nominal	0.044 mm to 0.076 mm (.0017 in to .003 in)
Service limit	0.100 mm (.0039 in)

If clearance exceeds specified tolerance, replace cylinder block and pistons.

Piston and Connecting Rod Assembly

The installation is the reverse of the removal procedure. However, pay attention to the following details.

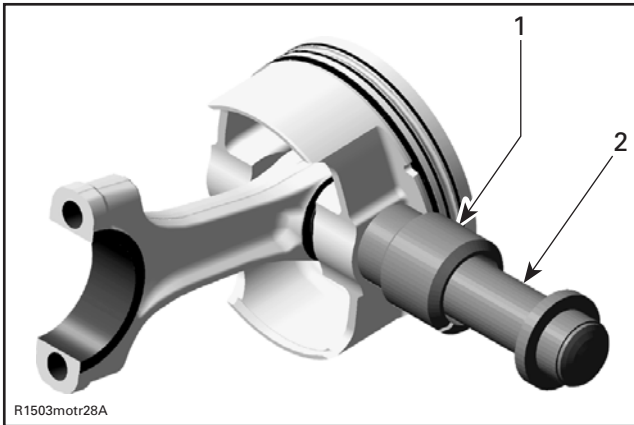
1. Apply engine oil on the piston pin.
2. Insert piston pin into piston and connecting rod.

NOTE: Be sure to reinstall all parts in their original position as marked during removal.

3. Install **NEW** piston circlip.

REQUIRED TOOL	
PISTON CIRCLIP INSTALLER (P/N 529 035 765)	

NOTICE Always replace removed piston pin circlips by **NEW** ones.

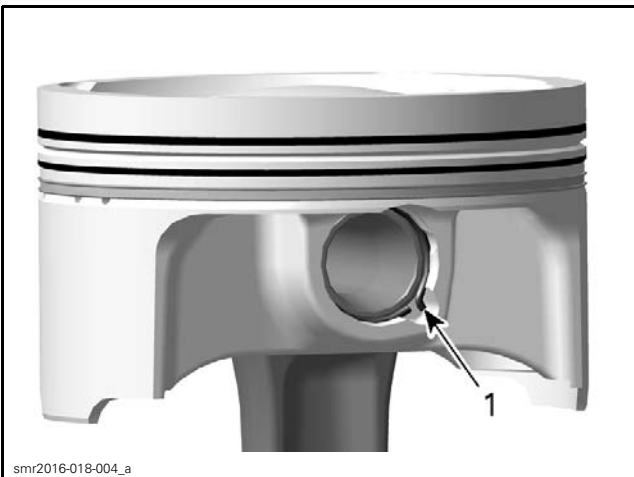


TYPICAL

1. Sleeve with piston circlip inside
2. Assembly jig from piston clip installer

NOTICE If piston pin circlip installation fails, repeat step 3 by using a NEW circlip.

NOTE: Ensure that hook of the piston circlip is positioned properly.



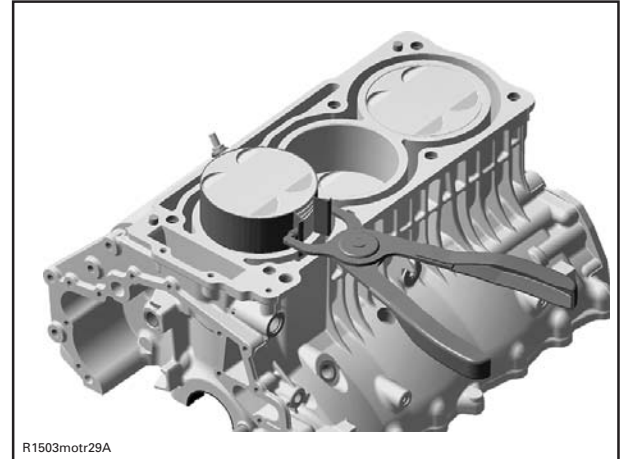
CORRECT POSITION OF THE PISTON CIRCLIP

Installing the Piston and Connecting Rod

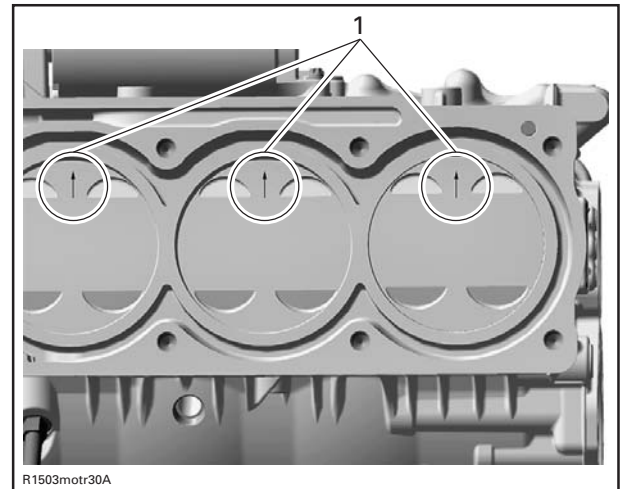
1. Use engine oil and lubricate:
 - Piston
 - Piston rings
 - Band of the piston ring compressor tool
 - Connecting rod bearings.
 - Cylinder bore
2. Slide piston into cylinder.

RECOMMENDED TOOL

SNAP-ON PISTON RING COMPRESSOR PLIERS
(P/N RC980)

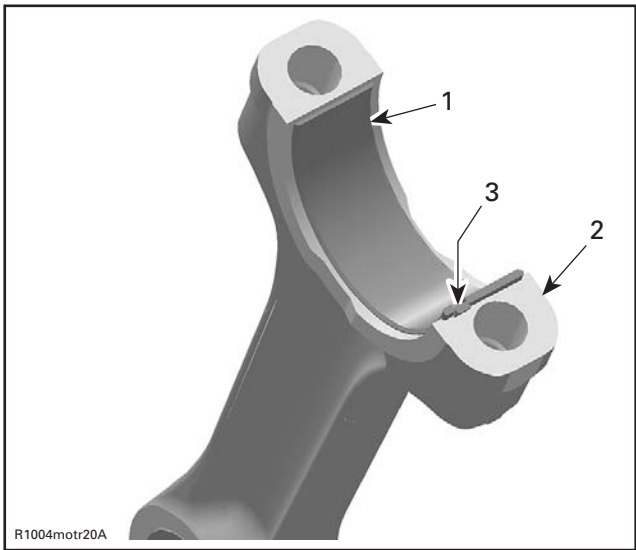


NOTICE Install piston with punched arrow toward exhaust side.



1. Arrows toward exhaust side

3. Correctly install bearings and carefully clean split surface on both sides (cracked area).

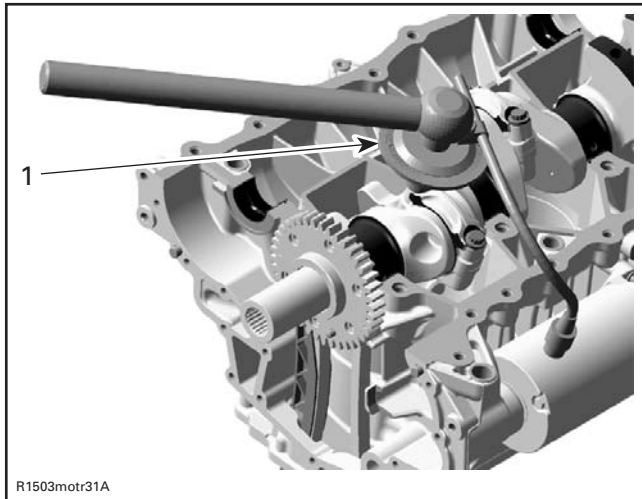


- TYPICAL**
- 1. Half bearing of connecting rod big end
 - 2. Split surface of the connecting rod
 - 3. Protrusion of bearing in line with connecting rod groove
4. Tighten **NEW** connecting rod screws as per following procedure:

NOTICE This assembly uses stretch screws. Always use **NEW** screws and strictly adhere to the tightening procedure.

NOTICE All connecting rod screws must be torque **FIRST** according to step A before performing the step B.

TIGHTENING PROCEDURE		
Connecting rod screws	Step A	45 N•m ± 3 N•m (33 lbf•ft ± 2 lbf•ft)
	Step B	Additional 90° ± 5°



1. Angle torque wrench

PISTON RINGS

Removing the Piston Ring

Remove piston, see procedure in this subsection.
Remove piston rings.

Inspecting the Piston Ring Inspection

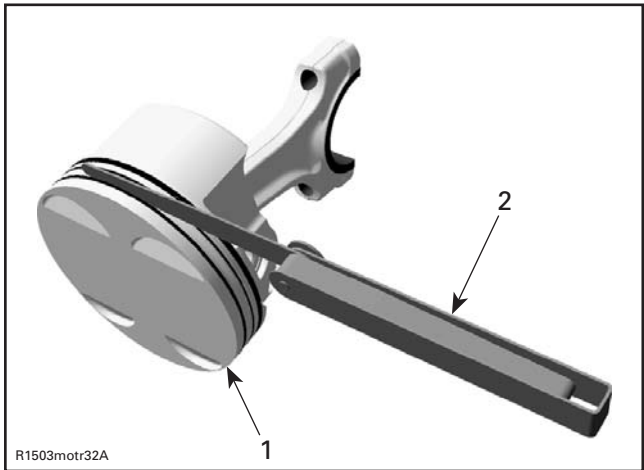
Ring/Piston Groove Clearance

Using a feeler gauge measure each ring/piston groove clearance. If the clearance is too large, the piston and the piston rings should be replaced.

GROOVE CLEARANCE - RECTANGULAR	
New	0.025 mm to 0.070 mm (.001 in to .0028 in)
Service limit	0.150 mm (.0059 in)

GROOVE CLEARANCE - TAPER-FACE	
New	0.015 mm to 0.060 mm (.0006 in to .0024 in)
Service limit	0.150 mm (.0059 in)

GROOVE CLEARANCE - OIL SCRAPER RING	
New	0.010 mm to 0.180 mm (.0004 in to .0071 in)
Service limit	0.200 mm (.0079 in)



1. Piston
2. Filler gauge

Ring End Gap

RING END GAP - RECTANGULAR	
New	0.30 mm to 0.50 mm (.012 in to .02 in)
Service limit	1.20 mm (.047 in)

RING END GAP - TAPER-FACE	
New	0.35 mm to 0.55 mm (.014 in to .022 in)
Service limit	1.20 mm (.047 in)
RING END GAP - OIL SCRAPER RING	
New	0.20 mm to 0.70 mm (.008 in to .028 in)
Service limit	1.20 mm (.047 in)

Measure position for ring end gap in the area of 8 mm to 16 mm (.315 in to .63 in) from top of cylinder.

NOTE: In order to correctly position the ring in the cylinder, use piston as a pusher.

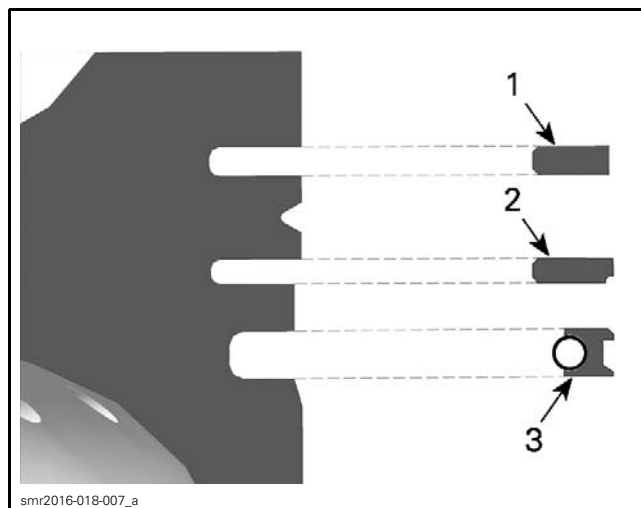
Using a feeler gauge, check ring end gap. Replace ring if gap exceeds service limit.

Installing the Piston Ring

The installation is the reverse of the removal procedure. However, pay attention to the following details.

Install rings in the following order and layout:

PISTON RING INSTALLATION		
ORDER	RING	POSITION
FIRST STEP	Oil scraper ring	equal
SECOND STEP	Taper-face ring	Stamped "E" and "TOP" facing UP
THIRD STEP	Rectangular ring	Stamped "E" and "TOP" facing UP

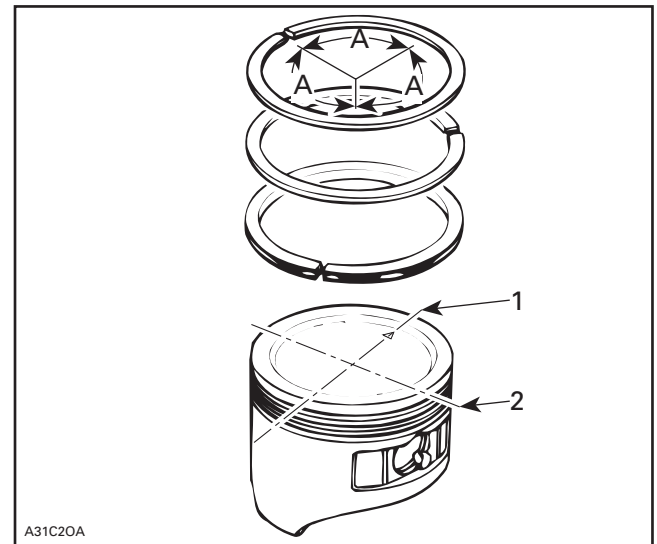


1. Rectangular ring
2. Taper-face ring
3. Oil scraper ring

NOTICE Ensure that top and second rings are not interchanged.

NOTE: Use a ring expander to prevent breakage during installation. The oil ring must be installed by hand.

Check that rings rotate smoothly after installation. Space the piston ring end gaps 120° apart and do not align the gaps with the piston pin bore or the thrust side axis.



1. DO NOT align ring gap with piston thrust side axis
2. DO NOT align ring gap with piston pin bore axis
- A. 120°

CRANKSHAFT

Crankshaft Locking Procedure

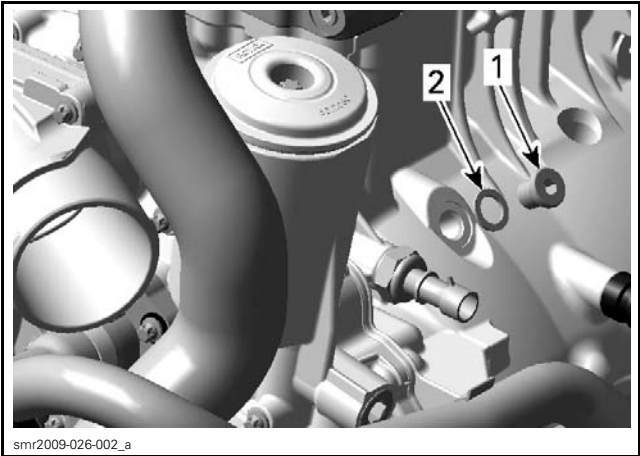
NOTICE The crankshaft must be locked at TDC for removal and installation of crankshaft, balancer shaft and camshaft.

NOTE: When the crankshaft is locked, the piston of cylinder 3 is at ignition TDC.

Remove:

- Intake manifold (refer to *INTAKE MANIFOLD* subsection)
- Spark plugs
- Valve cover (refer to *CYLINDER HEAD* subsection)
- Crankshaft access plug screw.

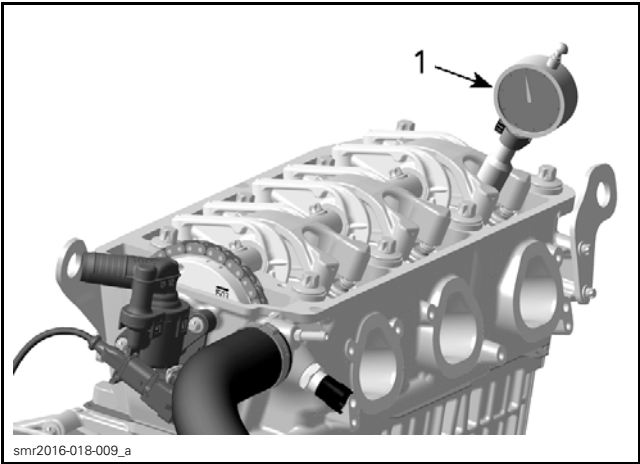
Subsection XX (CYLINDER BLOCK)



- 1. Crankshaft access plug screw
- 2. Gasket ring

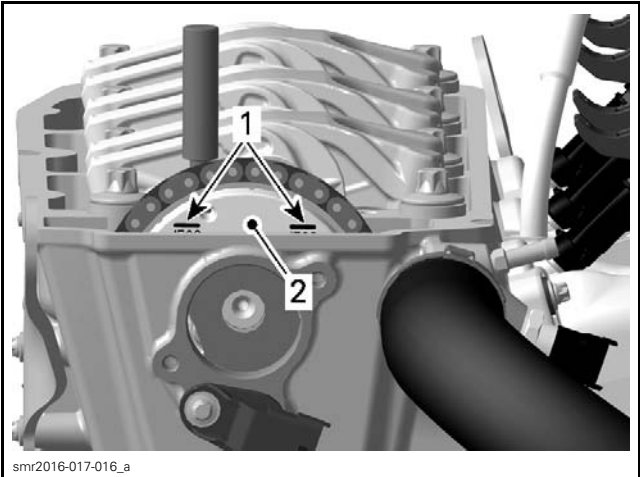
Turn engine counterclockwise.
Bring piston of cylinder 3 to ignition TDC, using a dial gauge or another similarly suitable tool.

NOTICE Do not scratch or damage piston and cylinder surface.



- 1. Dial gauge

NOTE: When the piston of cylinder 3 is at ignition TDC, the position lines on oil separator cover must be lined up as shown in the following illustration.

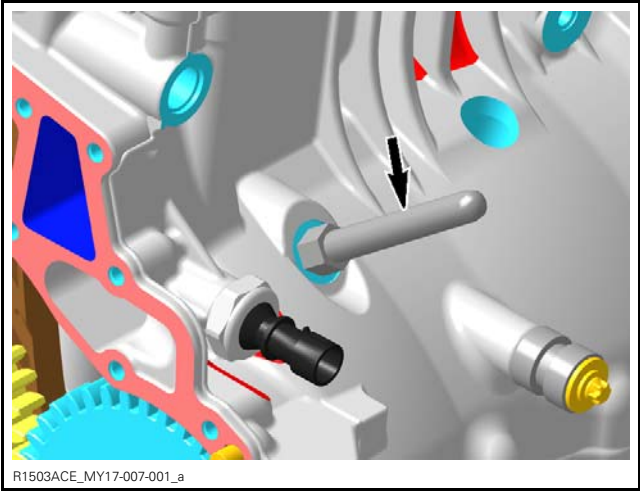


- 1. Position lines
- 2. Oil separator cover

Use a small screwdriver to check if the groove in the crankshaft is aligned with the hole.

In this position, lock the crankshaft.

REQUIRED TOOL	
CRANKSHAFT LOCKING TOOL (P/N 529 035 821)	

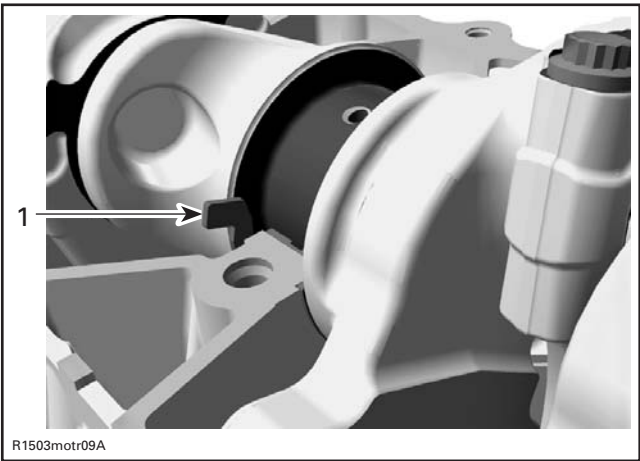


After removing the crankshaft locking tool install plug screw with a **NEW** gasket ring.

TIGHTENING TORQUE	
Plug screw	17 N•m ± 2 N•m (150 lbf•in ± 18 lbf•in)

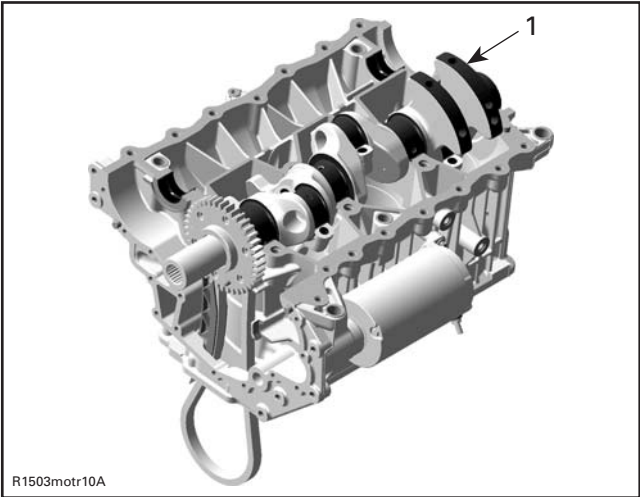
Removing the Crankshaft

1. Disassemble *CYLINDER BLOCK* as per procedure described in this subsection.
2. Remove connecting rod screws. Refer to *PISTONS AND CONNECTING RODS* in this subsection.
3. Remove thrust washers.



1. Thrust washer

4. Remove crankshaft.

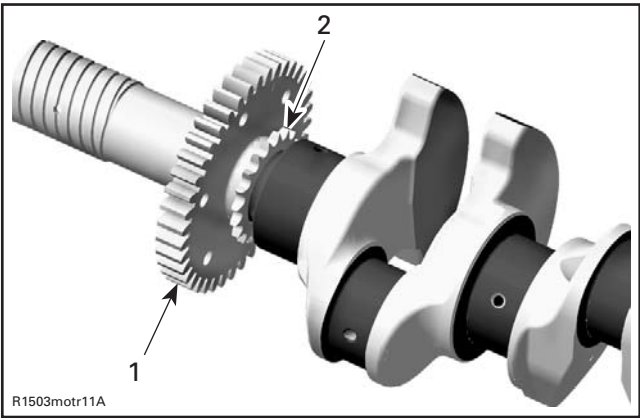


1. Crankshaft

Inspecting the Crankshaft

Inspecting the Crankshaft Gear

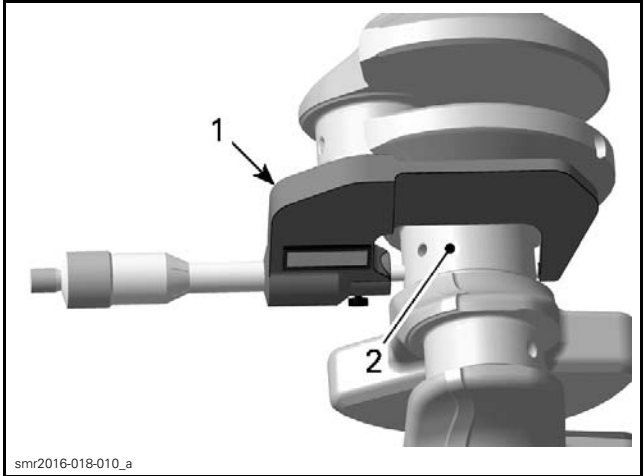
Replace crankshaft if the gears are worn or otherwise damaged.



1. Balancer gear
2. Crankshaft timing gear

Crankshaft Radial Play

Measure all crankshaft journals. Compare to inside diameter of crankshaft bearings, refer to *CYLINDER BLOCK* in this subsection.



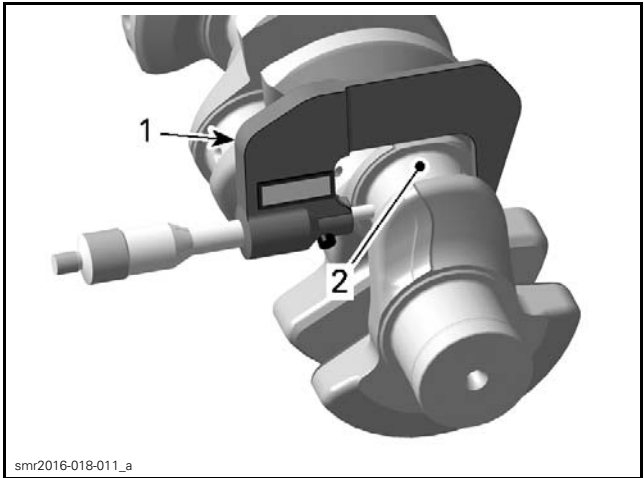
1. Micrometer
2. Crankshaft area for bearing

CRANKSHAFT JOURNAL DIAMETER	
New	49.991 mm to 50.010 mm (1.9681 in to 1.9689 in)
Service limit	49.950 mm (1.9665 in)

CRANKSHAFT JOURNAL RADIAL CLEARANCE	
Service limit	0.07 mm (.0028 in)

Crankshaft Pin

Measure all crankshaft pin diameters. Compare to inside diameter of connecting rod bearings, refer to *PISTONS AND CONNECTING RODS* in this subsection.



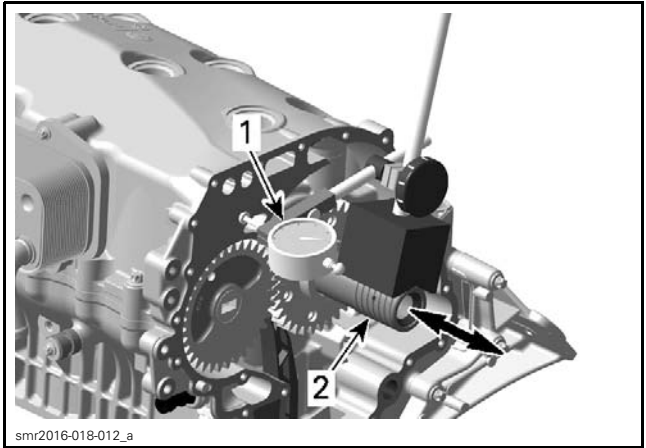
1. Micrometer
2. Crankshaft pin area for bearing

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CRANKSHAFT PIN DIAMETER	
New	45.032 mm to 45.048 mm (1.7729 in to 1.7735 in)
Service limit	45.029 mm (1.7728 in)

Crankshaft Axial Clearance

When assembling the cylinder-block, measure the crankshaft axial clearance.



TYPICAL
1. Dial gauge
2. Crankshaft

CRANKSHAFT AXIAL CLEARANCE	
New	0.08 mm to 0.22 mm (.003 in to .009 in)
Service limit	0.35 mm (.014 in)

Installing the Crankshaft

The installation is the reverse of the removal procedure. However, pay attention to following details.

NOTE: Be careful that connecting rods do not hit the cylinder block.

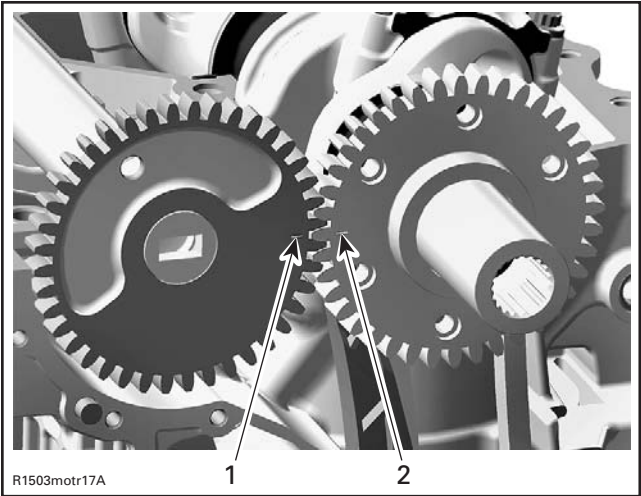
NOTICE Before installing the crankshaft, ensure that:

- chain guide is already installed
- timing chain is installed on crankshaft timing gear.

Those parts cannot be installed when the crankshaft is in place.

Install crankshaft with the timing chain.

NOTICE Crankshaft and balancer shaft marks must be aligned.

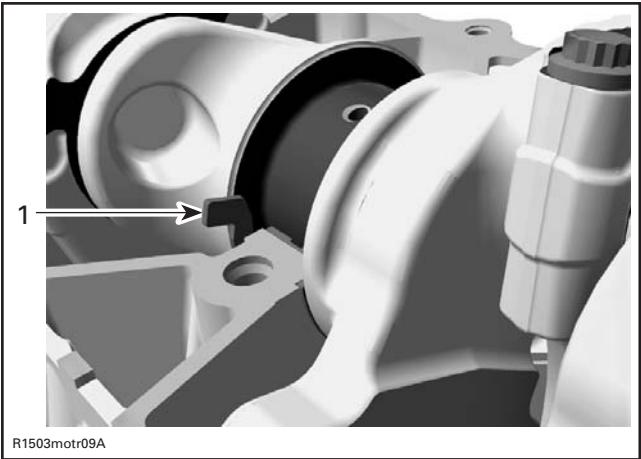


1. Mark on balancer shaft
2. Mark on crankshaft

Install connecting rod caps, refer to *PISTONS AND CONNECTING RODS* in this subsection.

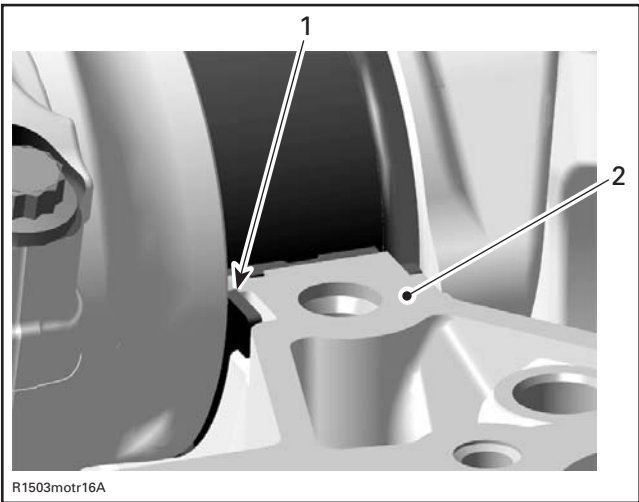
NOTICE It is absolutely necessary to follow this procedure. Otherwise severe engine damage can occur.

Insert thrust washers as soon as crankshaft is in place as per following illustration.



THRUST WASHER INSERT DIRECTION
1. Thrust washer

NOTICE Thrust washers have to be flush with the cylinder block sealing surface.

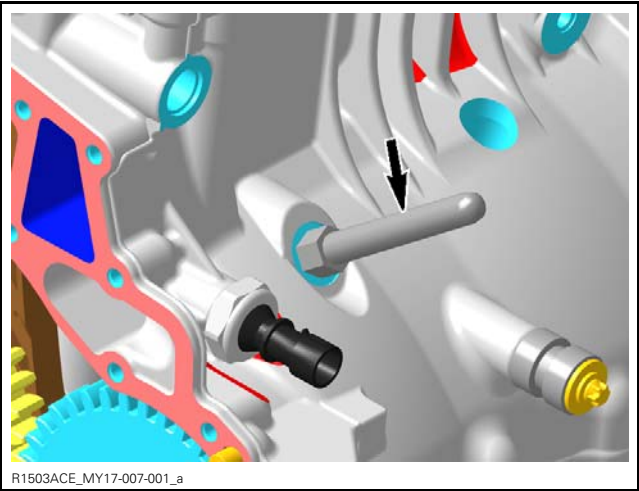


- 1. Thrust washer
- 2. Sealing surface

Install cylinder block lower half. Refer to *CYLINDER BLOCK* in this subsection.

Lock crankshaft at TDC before installing the camshaft and the rocker arms (refer to *CYLINDER HEAD* subsection).

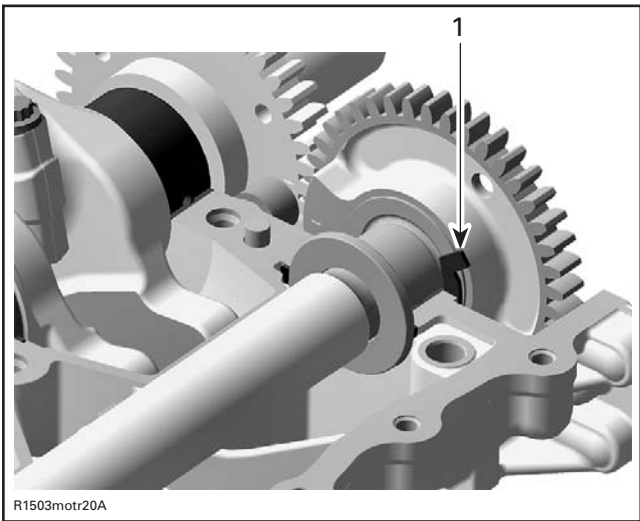
REQUIRED TOOL	
CRANKSHAFT LOCKING TOOL (P/N 529 035 821)	



BALANCER SHAFT

Removing the Balancer Shaft

1. Disassemble *CYLINDER BLOCK*, see procedure in this subsection.
2. Remove thrust washers.



- 1. Thrust washer

3. Remove balancer shaft.

Inspecting the Balancer Shaft

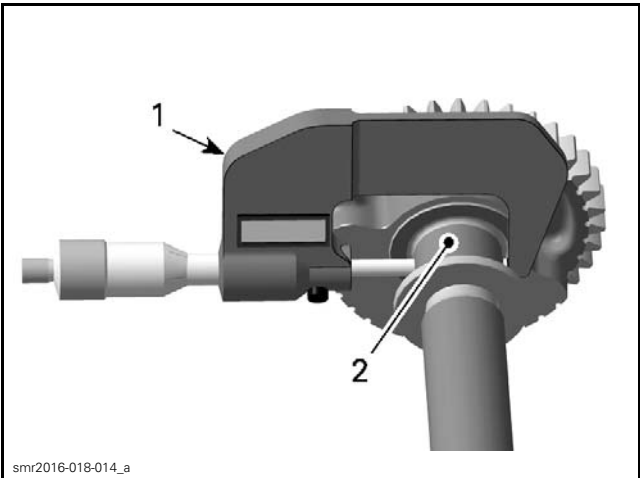
Check balancer shaft and replace if damaged.

If the gear on the balancer shaft is damaged, replace balancer shaft.

Check gear on the crankshaft at the same time and replace crankshaft if necessary (refer to *CRANKSHAFT* in this subsection).

Balancer Shaft Bearing Seat Play

Measure all balancer shaft bearing journals. Compare to inside diameter of balancer shaft bearings (see *INSPECTING THE CYLINDER BLOCK* in this subsection).



- 1. Micrometer
- 2. Balancer shaft area for bearing

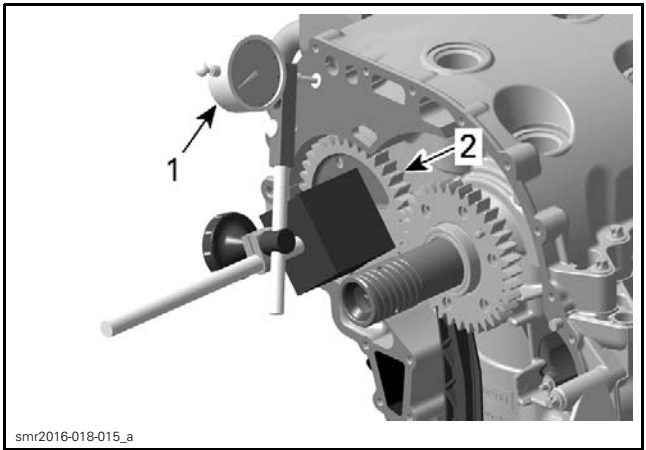
Subsection XX (CYLINDER BLOCK)

BALANCER SHAFT JOURNAL DIAMETER	
New	31.984 mm to 32.000 mm (1.2592 in to 1.2598 in)
Service limit	31.950 mm (1.2579 in)

BALANCER SHAFT JOURNAL RADIAL CLEARANCE	
Service limit	0.07 mm (.0028 in)

Balancer Shaft Axial Clearance

When assembling the cylinder-block, measure the balance shaft axial play.



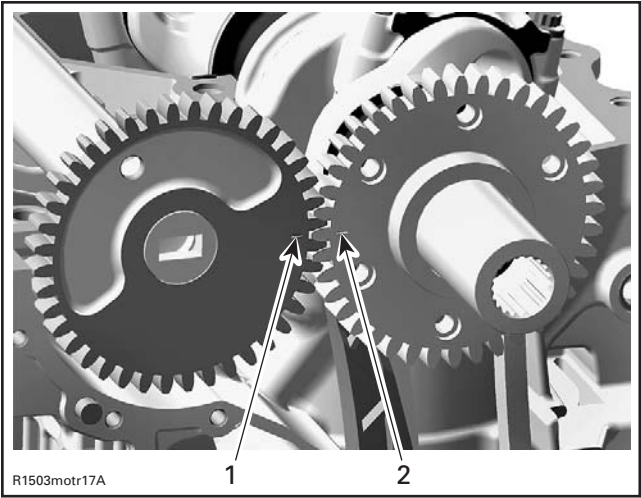
- 1. Dial gauge
- 2. Balancer shaft

BALANCER SHAFT AXIAL CLEARANCE	
New	0.02 mm to 0.25 mm (.001 in to .01 in)
Service limit	0.35 mm (.014 in)

Installing the Balancer Shaft

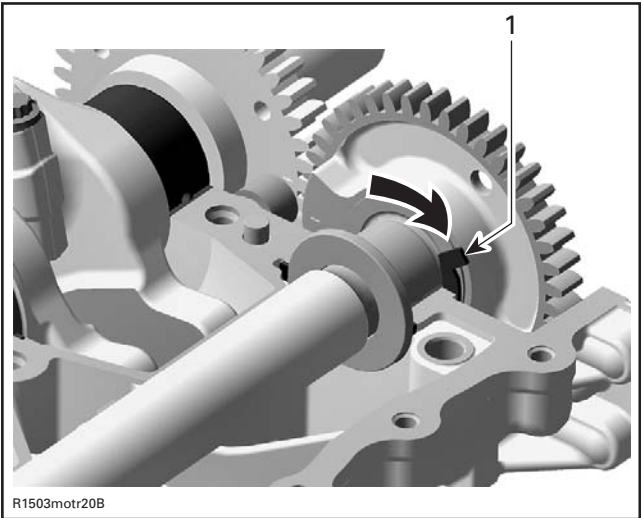
The installation is the reverse of the removal procedure. However, pay attention to following details.

NOTICE Balancer shaft and crankshaft marks have to be aligned.



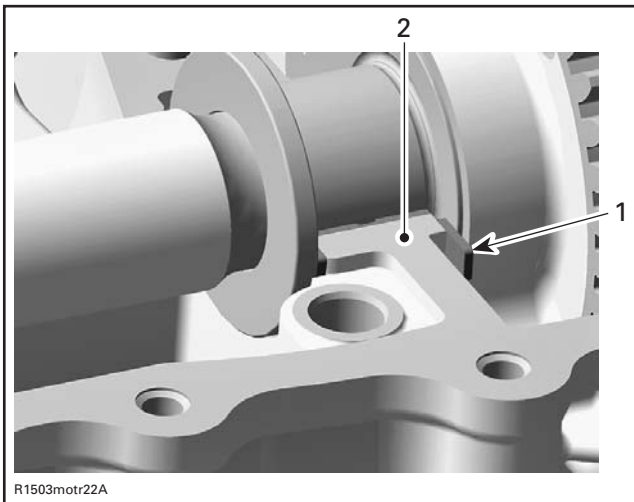
- 1. Mark on balancer shaft
- 2. Mark on crankshaft

Install thrust washers in place as per following illustration.



- THRUST WASHER INSERT DIRECTION
- 1. Thrust washer

NOTICE Thrust washers must be flush with the cylinder block sealing surface.



1. Thrust washer
2. Sealing surface

Install cylinder block lower half. Refer to *CYLINDER BLOCK* in this subsection.

Reassemble engine in accordance with the proper assembly procedures.

CYLINDER BLOCK

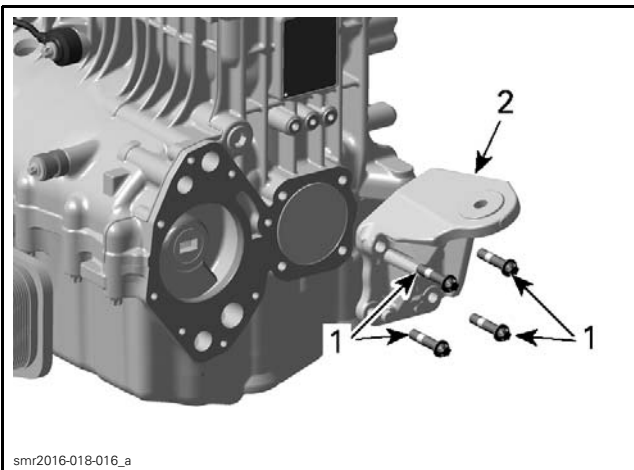
Disassembling the Cylinder Block

Refer to *PTO HOUSING, MAGNETO AND STARTER* subsection and remove:

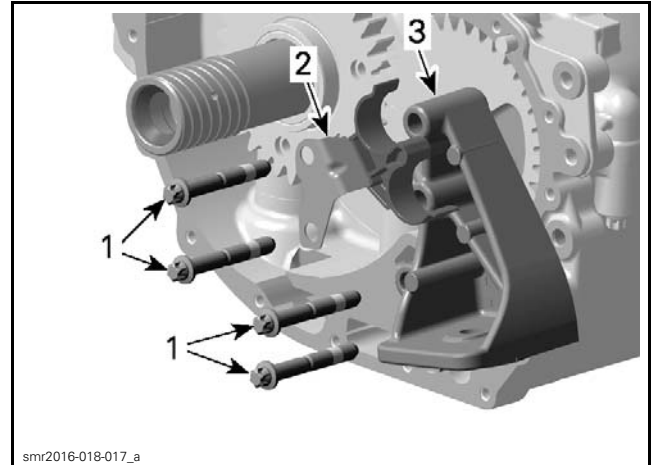
- PTO housing
- Starter gear
- Starter drive.

Remove engine mounting brackets.

Refer to *LUBRICATION SYSTEM* subsection and remove oil suction pump.



- TYPICAL**
1. Retaining screws
 2. Engine mounting bracket

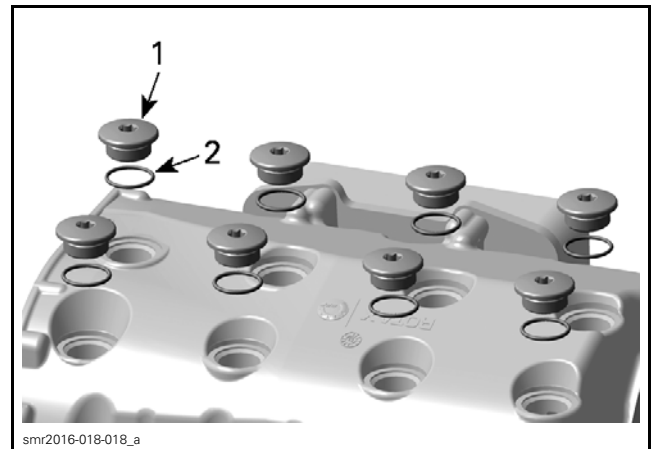


1. Retaining screws
2. Engine mounting bracket

Refer to *CYLINDER HEAD* subsection and remove cylinder head.

NOTE: Before splitting the cylinder block, measure crankshaft axial play. Refer to *CRANKSHAFT* in this subsection.

Remove oil reservoir plug screws with O-rings.

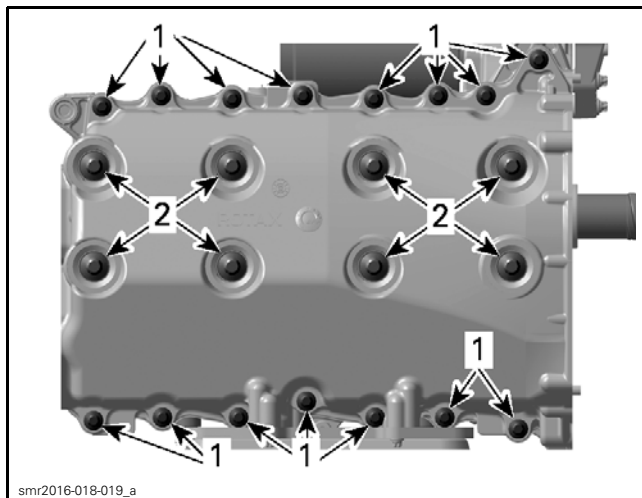


- TYPICAL**
1. Oil reservoir plug screw
 2. O-ring

Remove cylinder block screws:

1. Start removing the M8 screws.
2. Then remove the M10 screws.

Subsection XX (CYLINDER BLOCK)

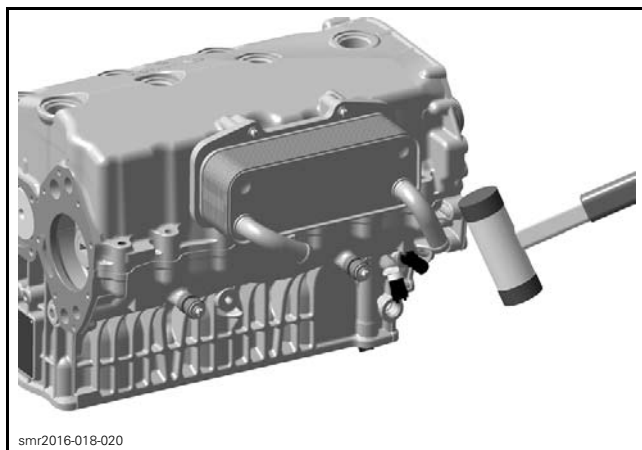


TYPICAL

1. M8 screws
2. M10 screws

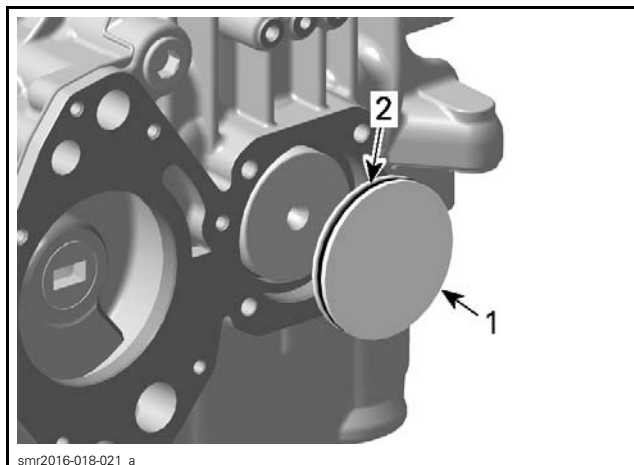
Carefully remove cylinder block lower half by using a soft hammer.

NOTE: Take care not to damage the sealing surfaces of the cylinder block halves.



TYPICAL

Remove crankshaft cover with O-ring.



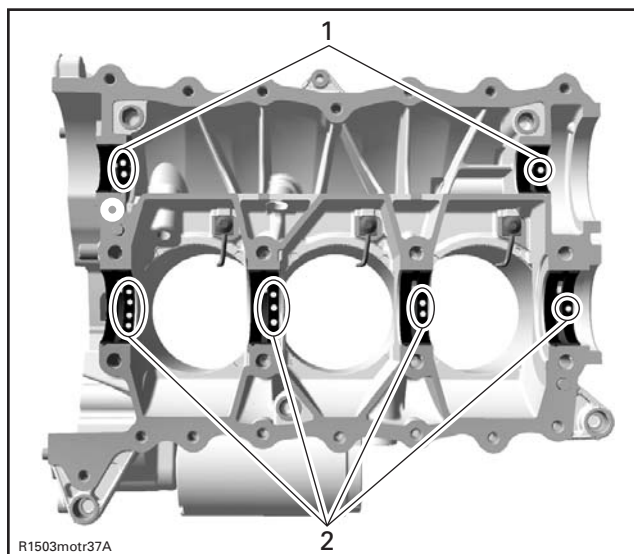
1. Crankshaft cover
2. O-ring

Refer to procedures in this subsection and remove:

- Balancer shaft
- Crankshaft
- Piston with connecting rod.

Removing the Plain Bearings

When the plain bearings of crankshaft and balancer shaft need to be removed from the cylinder block, mark them to identify the correct position at installation. See the following illustration for an example:



1. Marks on balancer shaft bearings
2. Marks on crankshaft bearings

Cleaning the Cylinder Block

Clean cylinder block using a part cleaner, then use compressed air to dry it.

Blow out the oil orifices using compressed air and make sure they are not clogged.

Clean all metal components in a solvent.

Cylinder block mating surfaces are best cleaned using a combination of the LOCTITE CHISEL (GAS-KET REMOVER) (P/N 413 708 500) and a brass brush. Brush a first pass in one direction then make the final brushing perpendicularly (90°) to the first pass (cross hatch).

NOTICE Do not wipe with rags. Use a new clean hand towel only.

Inspecting the Cylinder Block

Cylinder Block and Cylinder Bores

Check cylinder block for cracks or other damage.

Check cylinder block mating surfaces for flatness using a straight edge.

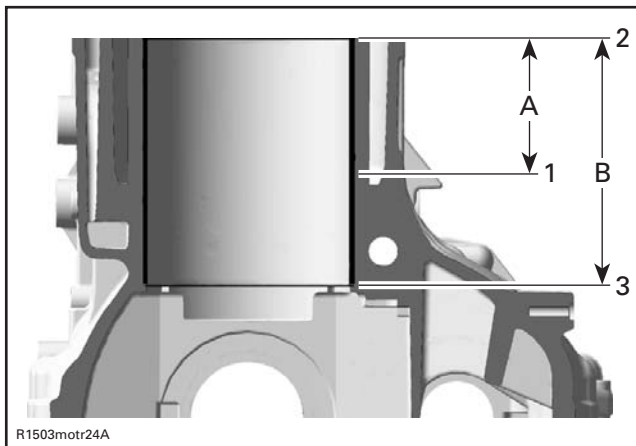
Check cylinder bores for cracks, scoring and wear ridges on the top and bottom of the cylinder.

Replace cylinder block if necessary.

Cylinder Taper

Measure cylinder bore and if it is out of specifications.

Measure cylinder bore at 3 recommended positions. See the following illustration.



1. First measuring diameter
2. Second measuring diameter
3. Third measuring diameter
- A. 60 mm (2.362 in)
- B. 110 mm (4.331 in)

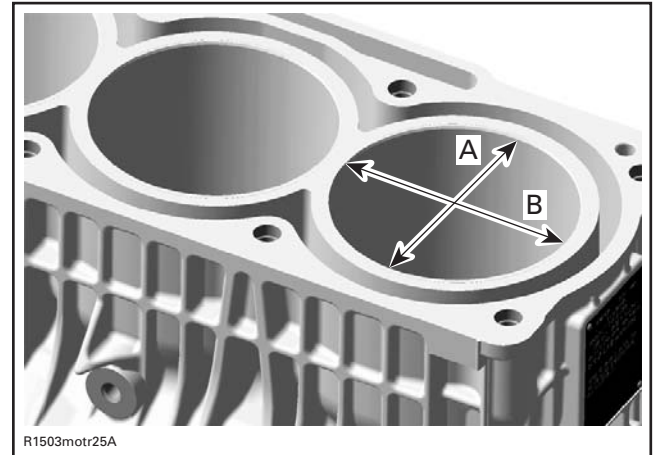
CYLINDER TAPER IN DIAMETER	
New maximum	0.036 mm (.0014 in)
Service limit	0.100 mm (.0039 in)

If a cylinder bore is out of specification, please replace cylinder block assembly.

Cylinder Out of Round

Measure cylinder diameter in piston axis direction from top of cylinder. Take an other measurement 90° from first one and compare.

NOTE: Take the same measuring points as described in *CYLINDER TAPER*.



- A. Perpendicular to crankshaft axis
- B. Parallel to crankshaft axis

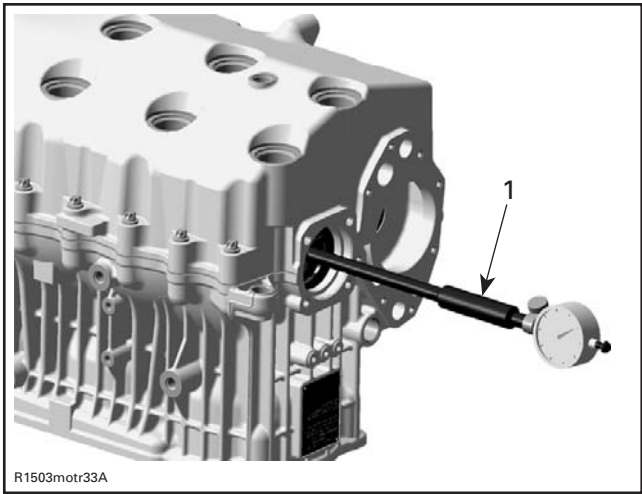
CYLINDER OUT OF ROUND	
New maximum	0.008 mm (.0003 in)
Service limit	0.025 mm (.001 in)

Bearings

Measure plain bearing inside diameter and compare with crankshaft bearing journal diameter (refer to *CRANKSHAFT* in this subsection). Proceed as follows:

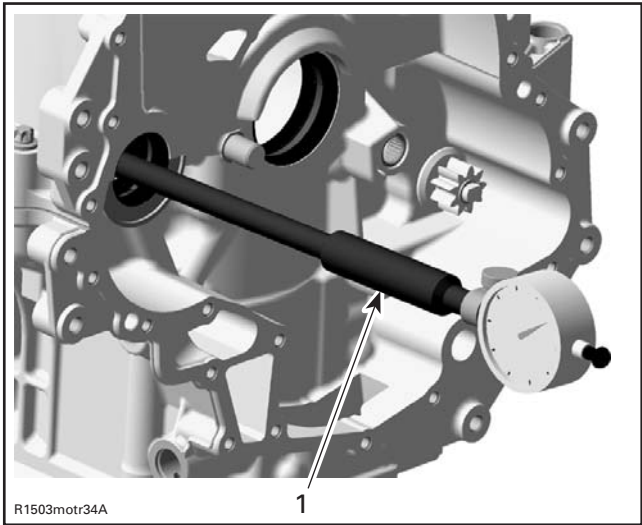
- Use the **OLD** plain bearings and put both cylinder block halves together.
- Tighten screws as described in *ASSEMBLING THE CYLINDER BLOCK*.
- Measure the inside diameter of the crankshaft plain bearings using a bore gauge

Subsection XX (CYLINDER BLOCK)



ENGINE UPSIDE DOWN
1. Bore gauge

CRANKSHAFT BEARING INSIDE DIAMETER	
Service limit	50.10 mm (1.9724 in)



ENGINE UPSIDE DOWN
1. Bore gauge

BALANCER SHAFT BEARING INSIDE DIAMETER	
Service limit	32.11 mm (1.2642 in)

Replace plain bearings if they are out of specifications.

Assembling the Cylinder Block

The assembly is the reverse of the disassembly procedure. However, pay attention to the following details.

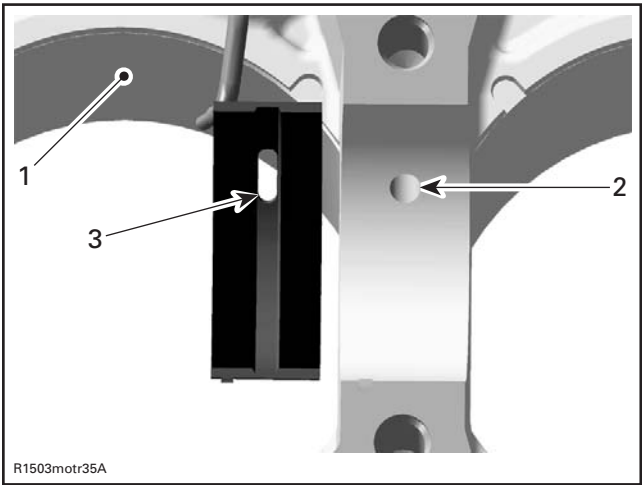
Install the following components:

- Piston oil nozzles, refer to *LUBRICATION SYSTEM* subsection

- Oil cooler, refer to *LUBRICATION SYSTEM* subsection
- Electric starter, refer to *PTO HOUSING, MAGNETO AND STARTER* subsection
- Chain tensioner guide.

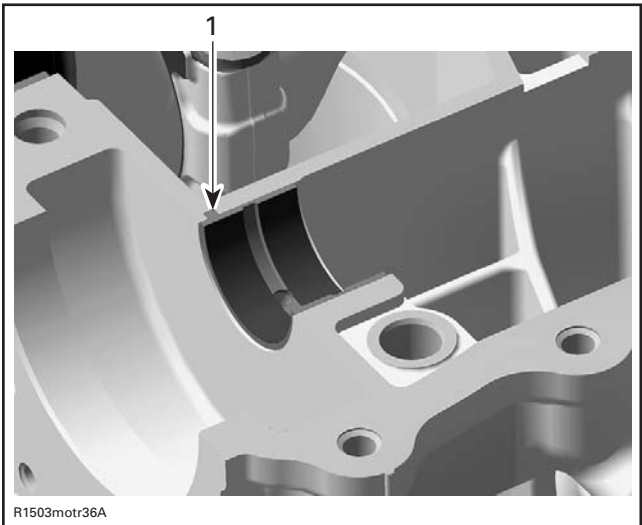
If **OLD** bearings will be used again, reinstall them at the same position as they were before.

Correctly install bearings. Top crankshaft bearing halves have a bore which has to be placed in the upper cylinder block.



1. Cylinder block upper half
2. Oil bore in cylinder block
3. Oil bore in bearing

Bearings have to be flush with the cylinder block split surface and their protrusions have to fit in the notched areas in the cylinder block seat.



1. Bearing protrusion in cylinder block notch

Apply engine oil on all plain bearings.

For proper installation of pistons, refer to *PISTONS AND CONNECTING RODS* in this subsection.

NOTICE Before installing the crankshaft, ensure that:

- chain guide is already installed
- timing chain is installed on crankshaft timing gear.

Those parts cannot be installed after as the crankshaft is in place.

IMPORTANT: When beginning the application of the crankcase sealant, the assembly and the first torquing should be done within 10 minutes. It is suggested to have all you need on hand to save time.

Apply sealant on mating surfaces.

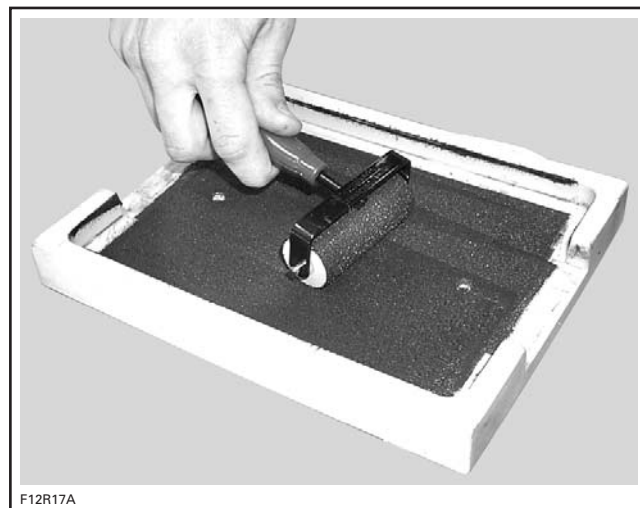
CYLINDER BLOCK SEALANT	
Service product	LOCTITE 5910 (P/N 293 800 081)

NOTE: When beginning the application of the gear housing sealant, the assembly and the first torquing should be done within 10 minutes. It is suggested to have all you need on hand to save time.

REQUIRED TOOL	
	Plexiglas plate
	Soft rubber roller

Apply some sealant on the plate and get a thin uniform coat (spread as necessary).

Then apply the sealant on cylinder block lower half sealing surface.

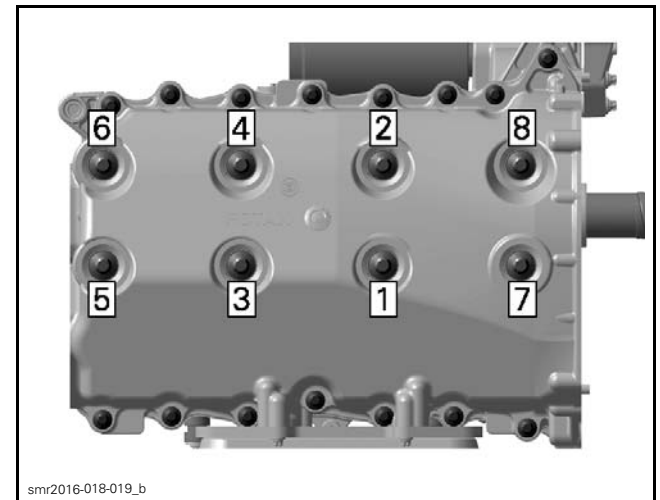


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NOTE: If you do not use the roller method, you may use your finger to uniformly distribute this sealant.

Do not apply in excess as it will spread out inside crankcase.

Tighten M10 cylinder block screws as per following sequence.



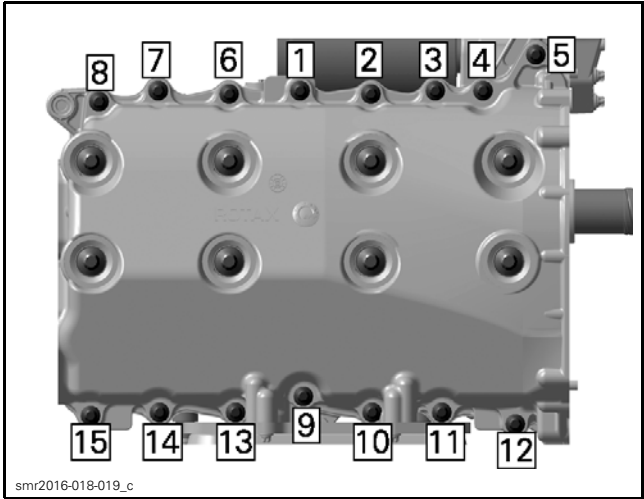
TYPICAL - M10 SCREWS TIGHTENING SEQUENCE

NOTICE All M10 cylinder block screws must be torque **FIRST** according to step A before performing to step B.

TIGHTENING PROCEDURE		
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)	
M10 cylinder block screws	Step A	40 N•m ± 3 N•m (30 lbf•ft ± 2 lbf•ft)
	Step B	55 N•m ± 4 N•m (41 lbf•ft ± 3 lbf•ft)

Tighten M8 cylinder block screws as per following sequence.

Subsection XX (CYLINDER BLOCK)

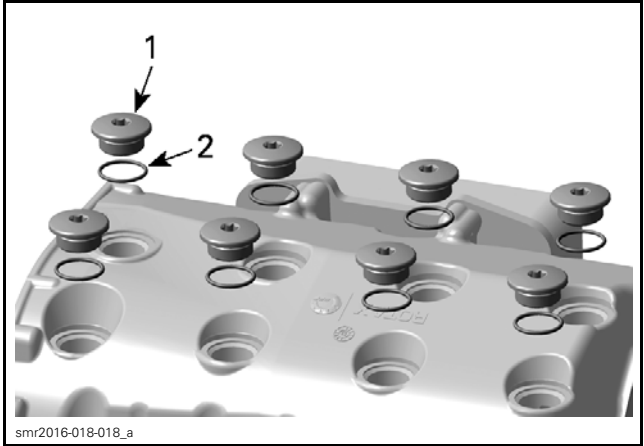


M8 SCREWS TIGHTENING SEQUENCE

TIGHTENING TORQUE	
M8 cylinder block screws	30 N•m ± 3 N•m (22 lbf•ft ± 2 lbf•ft)

NOTE: Check axial clearance of balancer shaft and crankshaft before continuing the assembly. Refer to *CRANKSHAFT* and *BALANCER SHAFT* in this subsection for the procedure.

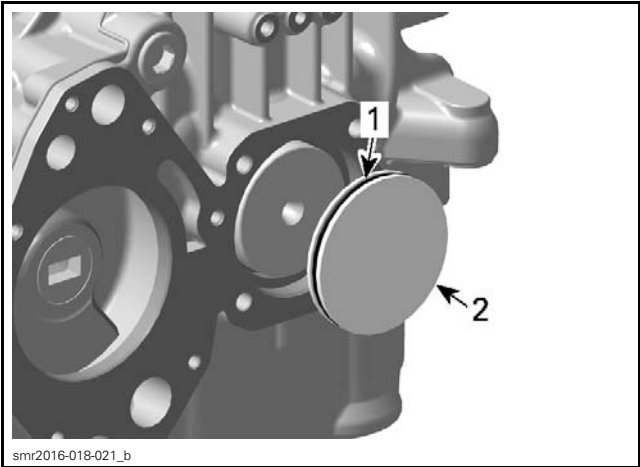
Install oil reservoir plug screws with O-rings.



1. Oil reservoir plug screw
2. O-ring

TIGHTENING TORQUE	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Oil reservoir plug screw	23 N•m ± 3 N•m (17 lbf•ft ± 2 lbf•ft)

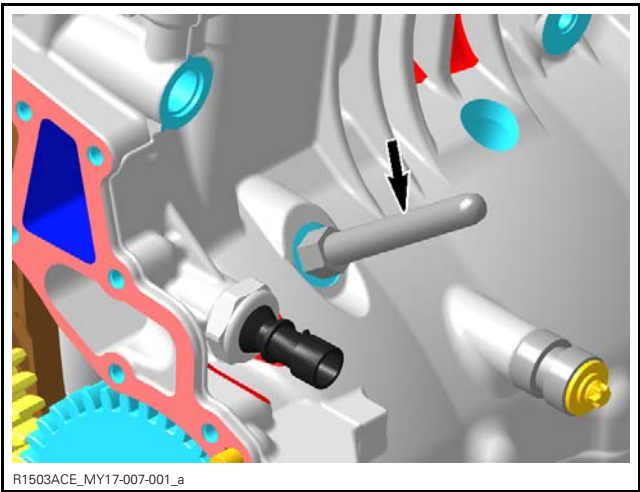
Apply engine oil on O-ring and press in crankshaft cover.



1. O-ring
2. Crankshaft cover

Position crankshaft at TDC before installing the camshaft and the rocker arms (refer to *CYLINDER HEAD* subsection).

REQUIRED TOOL	
CRANKSHAFT LOCKING TOOL (P/N 529 035 821)	



Reassemble engine in accordance with the proper assembly procedures.