CRANKCASE AND CRANKSHAFT

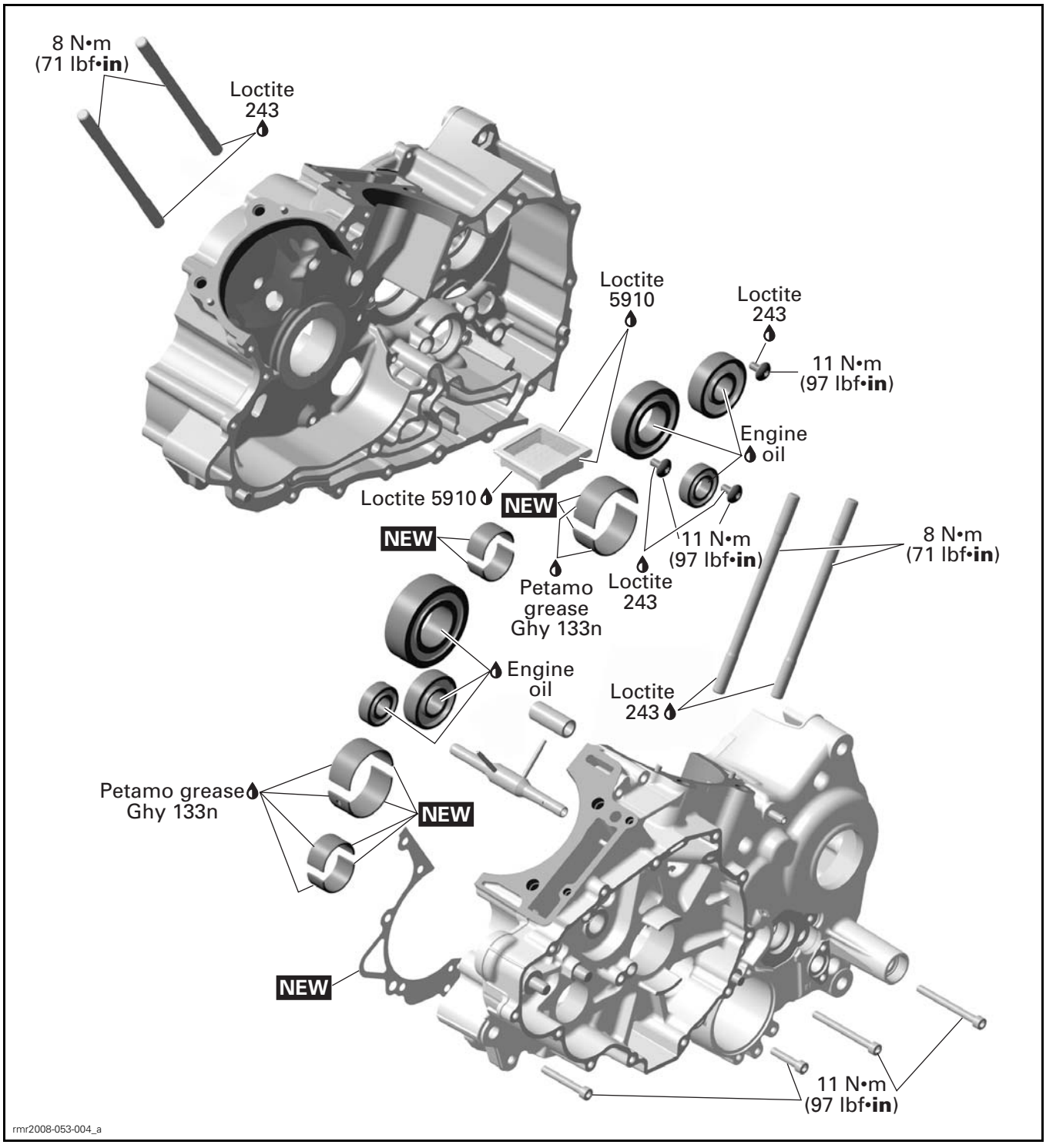
SERVICE TOOLS

Description	Part Number	Page
BALANCE SHAFT PLAIN BEARING REM/INST	529 036 094	15
BLIND HOLE BEARING PULLER SET	529 036 117	15
CRANKCASE PLAIN BEARING REM/INST	529 036 093	15
PULLER/LOCKING TOOL	529 036 098	4–5, 19

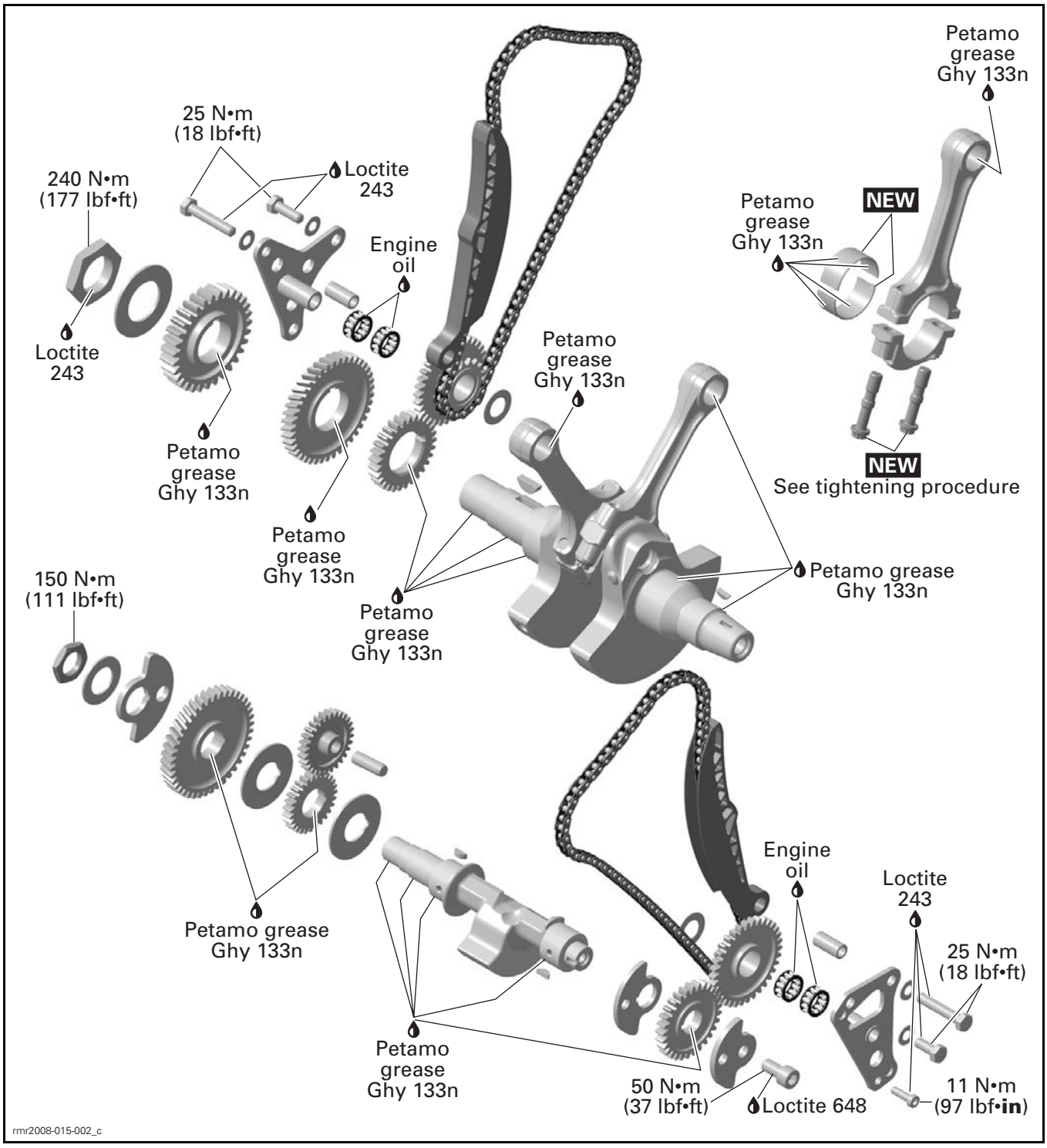
SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	15
LOCTITE 5910	293 800 081	17
PETAMO GREASE GHY 133N	420 899 271	16–17

CRANKCASE


8 N•m
(71 lbf•in)
Loctite
243
Loctite
5910
Loctite
243
11 N•m
(97 lbf•in)
Engine
oil
Loctite 5910
NEW
NEW
11 N•m
(97 lbf•in)
8 N•m
(71 lbf•in)
Petamo
grease
Ghy 133n
Loctite
243
Engine
oil
Loctite
243
Petamo grease
Ghy 133n
NEW
NEW
11 N•m
(97 lbf•in)
rmr2008-053-004_a

CRANKSHAFT AND BALANCE SHAFT



GENERAL

Always disconnect battery before working on the engine.

Even though many parts do not need to be removed to reach other parts, it is recommended to remove these parts anyway in order to inspect them.

When disassembling parts that are duplicated in the engine, (e.g.: timing chain, drive gears), it is strongly recommended to note their position (front/rear cylinder) and to store them as a "group".

During assembly/installation, use the torque values and service products as specified in the exploded views.

Clean threads before applying a threadlocker. Refer to *SELF-LOCKING FASTENERS* and *LOCTITE APPLICATION* at the beginning of this manual for procedure.

NOTICE **Torque wrench tightening specifications must be strictly adhered to.**
Locking devices (e.g.: locking tabs, elastic stop nuts, cotter pin, etc.) must be replaced with new ones.

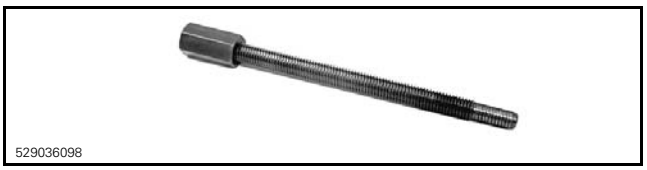
ENGINE REASSEMBLY SEQUENCE

NOTE: This procedure describes only the reassembly sequence of critical components, which are important to achieve the proper camshaft timing for both cylinders. Refer to appropriate topic in this manual for complete instructions.

NOTICE **After a complete engine tear down, in order to achieve proper camshaft timing, the following engine reassembly sequence must be strictly followed.**

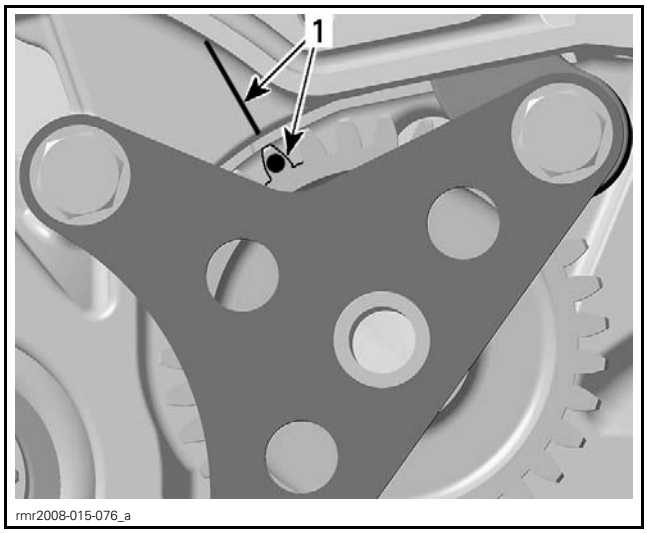
Rear Cylinder Reassembly

Lock crankshaft when connecting rod of rear cylinder is at TDC, using the PULLER/LOCKING TOOL (P/N 529 036 098).



Install timing chain and timing chain drive gears of rear cylinder, refer to *TIMING CHAIN* in this subsection.

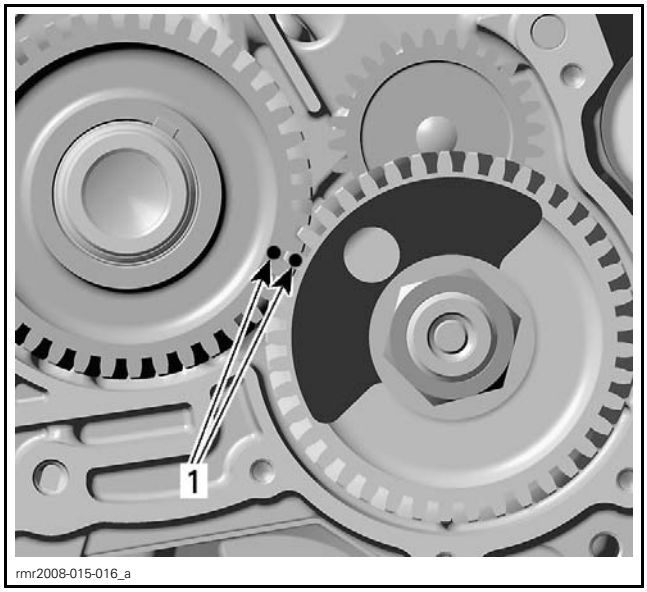
NOTE: Ensure to align mark on timing chain intermediate gear with mark on crankcase, then install mating gear on crankshaft.



1. Align marks

Install water pump drive gears, then balance shaft drive gears.

NOTE: Ensure to align both dots on balance shaft drive gears.



1. Align dots of balance shaft drive gears

Install and torque locking nuts of crankshaft and balance shaft.

Refer to *CYLINDER HEAD AND CYLINDER* to reinstall the following components of rear cylinder:

– Piston
– Cylinder
– Cylinder head
– Camshaft timing gears

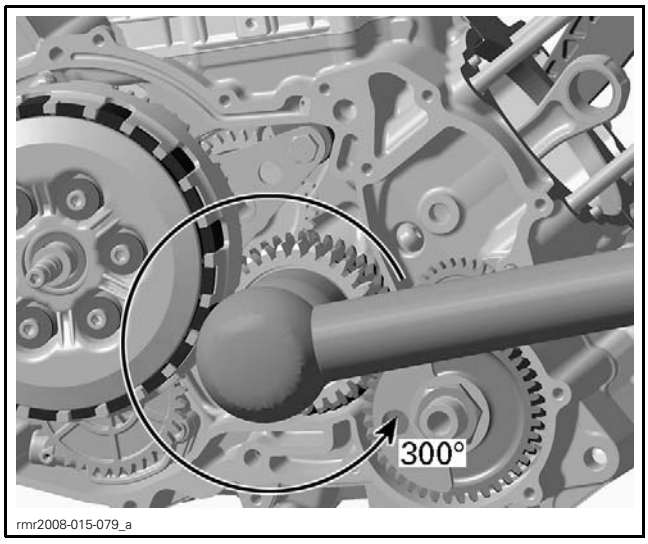
– Timing chain guide and chain tensioner
– Balance shaft drive gears of upper balance shaft.

Reinstall remaining parts of rear cylinder.

Front Cylinder Reassembly

NOTICE **Rear cylinder reassembly must be completed FIRST as explained above.**

Unscrew the PULLER/LOCKING TOOL (P/N 529 036 098), turn crankshaft on clutch side 300° **counterclockwise** and lock crankshaft when connecting rod of front cylinder is at TDC.

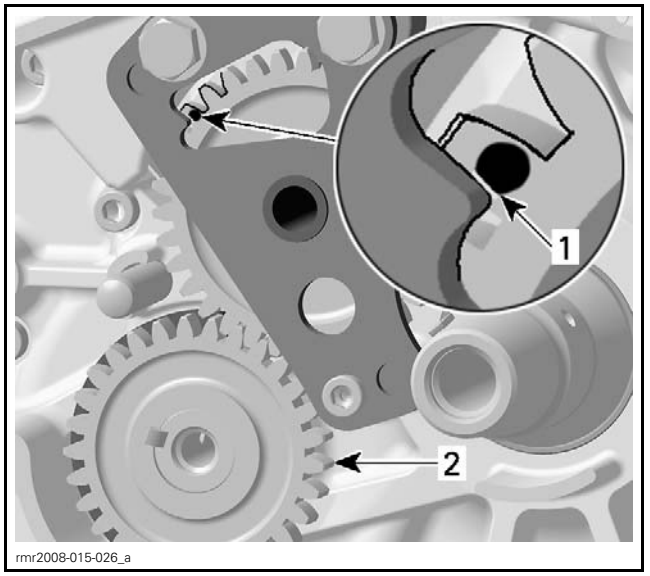


TYPICAL – TURN CRANKSHAFT 300° COUNTERCLOCKWISE

NOTICE **Keep connecting rod of front cylinder in central position when turning the crankshaft, to avoid it getting tilted in crankcase.**

Install timing chain and timing chain drive gears of front cylinder, refer to *TIMING CHAIN* in this subsection.

NOTE: Ensure to align mark on timing chain intermediate gear with mark on the bearing flange, then install mating gear on balance shaft.



1. Align marks
2. Timing chain drive gear

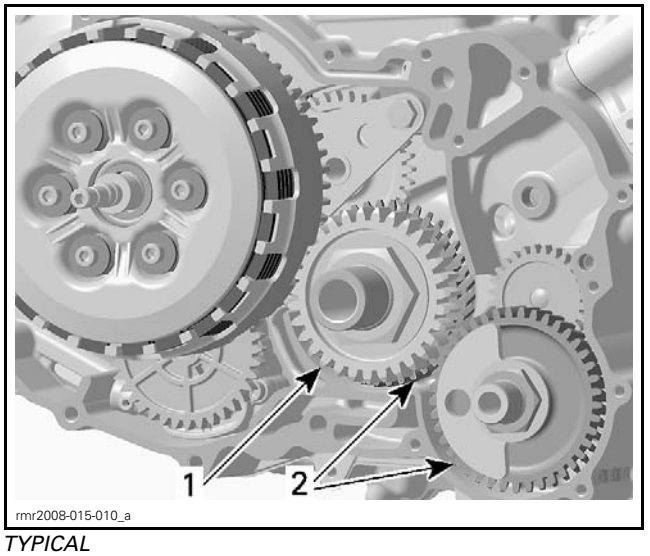
Refer to *CYLINDER HEAD AND CYLINDER* to reinstall the following components of front cylinder:
– Piston
– Cylinder
– Cylinder head
– Camshaft timing gears
– Timing chain guide and chain tensioner.

Reinstall remaining parts of front cylinder.

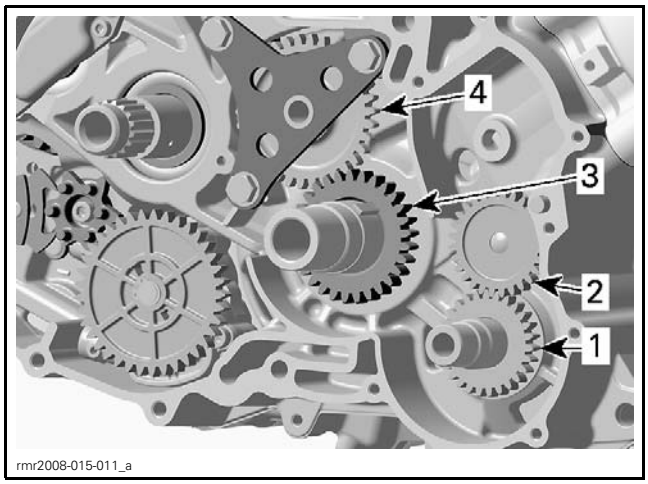
PROCEDURES

DRIVE GEARS

The drive gears are located on the engine clutch side behind the clutch housing.



TYPICAL
1. Primary drive gear
2. Balance shaft drive gears



1. *Water pump gear*
2. *Water pump intermediate gear*
3. *Timing chain drive gears, rear cylinder*
4. *Timing chain intermediate gear, rear cylinder*

Drive Gear Removal

Lock crankshaft at ignition TDC of rear cylinder, refer to *CRANKSHAFT* in this subsection.

Remove chain tensioner of rear cylinder.

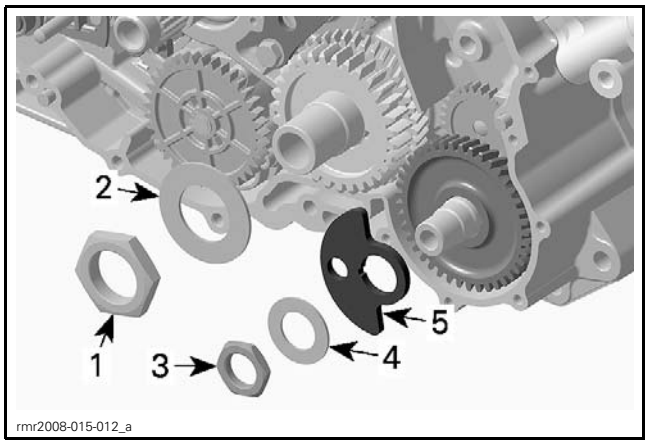
Remove clutch housing and clutch drum assembly. Refer to *CLUTCH* subsection.

Unscrew crankshaft locking nut.

Remove spring washer.

Unscrew balancer shaft locking nut.

Remove spring washer and balancing mass.



1. *Crankshaft locking nut*
2. *Crankshaft spring washer*
3. *Balance shaft locking nut*
4. *Balance shaft spring washer*
5. *Balancing mass*

Remove primary drive gear.

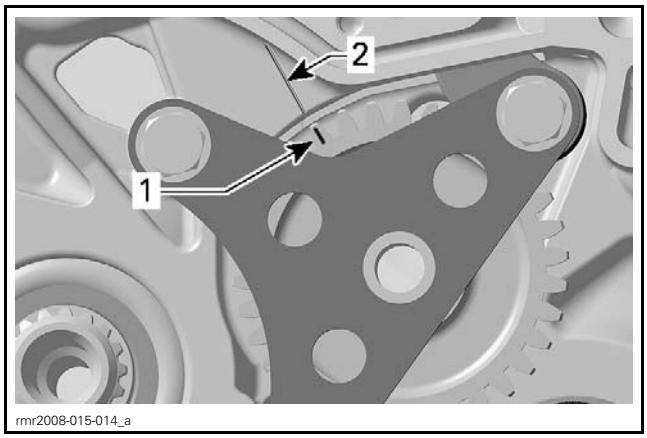
Remove balance shaft drive gears.

Remove thrust washer.

Remove water pump drive gear.

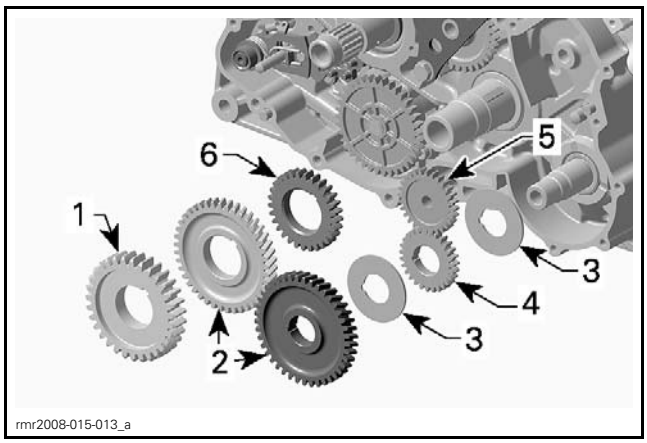
Remove water pump intermediate gear.

Scribe a mark on timing chain intermediate gear aligned with the crankcase molded mark, prior removing timing chain drive gear.



1. *Scribe a mark on timing chain intermediate gear*
2. *Molded crankcase mark*

Remove timing chain drive gear.



1. *Primary drive gear*
2. *Balance shaft drive gears*
3. *Thrust washers*
4. *Water pump drive gear*
5. *Water pump intermediate gear*
6. *Timing chain drive gear*

Drive Gear Inspection

Inspect gear tooth for wear or other damage. If gears are pitted, scored, rounded, cracked or chipped, they should be replaced.

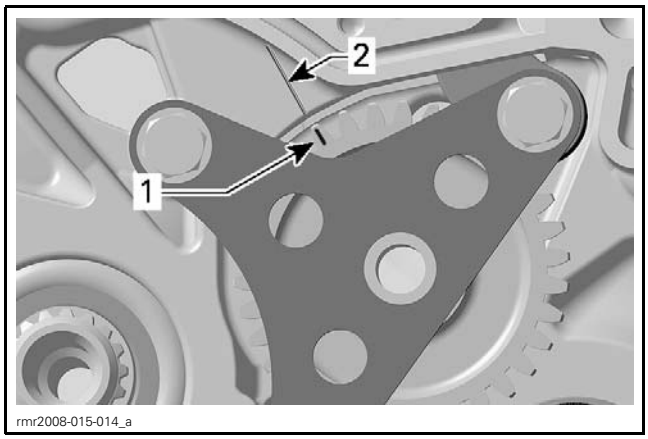
NOTE: Balance shaft drive gears and timing chain drive gears are paired. Replace balance shaft drive gears and timing chain drive gears as a set.

Drive Gear Installation

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

NOTE: Crankshaft must still be locked at ignition TDC of rear cylinder.

Ensure mark (scribed during removal) of timing chain intermediate gear (rear cylinder) matches with the molded mark on crankcase.



1. Mark on timing chain intermediate gear
2. Crankcase molded mark

NOTICE Wrong position of timing chain drive gears will lead to wrong camshaft timing and cause severe engine damage.

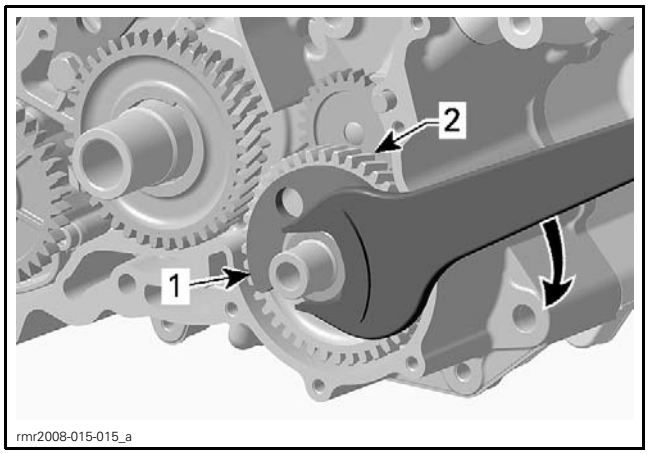
Balance Shaft Drive Gears

NOTICE The following instruction is only valid if camshaft timing gears of front cylinder have not been removed before. In this case, the camshaft of front cylinder is spring loaded and will turn the balance shaft counterclockwise.

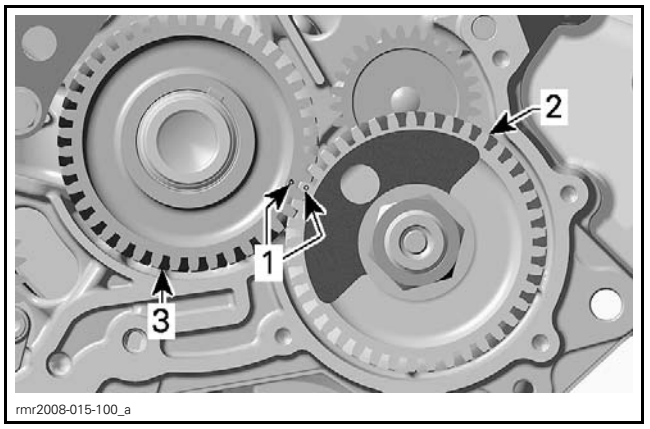
Temporarily install balance shaft drive gears in any position.

Install balancing mass, spring washer and torque locking nut to 150 N•m (111 lbf•ft).

Temporary pull up drive gear from crankshaft and turn balance shaft **clockwise** until marks of drive gears can be aligned. Then install balance drive gear on crankshaft to its final position.



1. Balancing mass
2. Balance shaft gear



1. Align marks — balance shaft drive gears
2. Balance shaft gear
3. Balance shaft drive gear

NOTICE Wrong position of balance shaft drive gears will lead to wrong camshaft timing of front cylinder and cause severe engine damage.

Reinstall remaining parts, use service products and torque values as described in the exploded view.

NOTICE After a complete tear down of the engine, to achieve proper camshaft timing, the *ENGINE REASSEMBLY SEQUENCE* detailed at the beginning of this subsection must be strictly followed.

TIMING CHAIN

The engine is equipped with two timing chains. The front cylinder timing chain is located on the engine MAG side behind the magneto cover. The rear cylinder timing chain is located on the engine clutch side behind the clutch housing.

Timing Chain Removal (Front Cylinder)

Lock crankshaft at ignition TDC of front cylinder, refer to *CRANKSHAFT* in this subsection.

Refer to *CYLINDER HEAD AND CYLINDER* subsection and remove the following parts:

– Valve cover
– Chain tensioner
– Timing chain guide
– Camshaft timing gears.

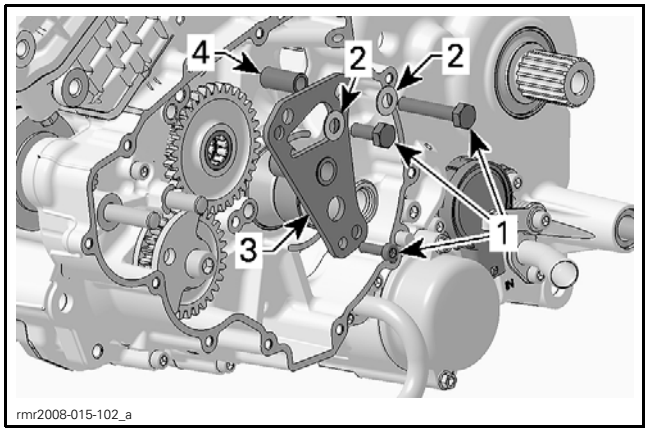
Refer to *MAGNETO AND STARTER* subsection and remove:

1. Magneto cover
2. Rotor
3. Starter drive gears.

Remove screws and spring washers securing the bearing flange.

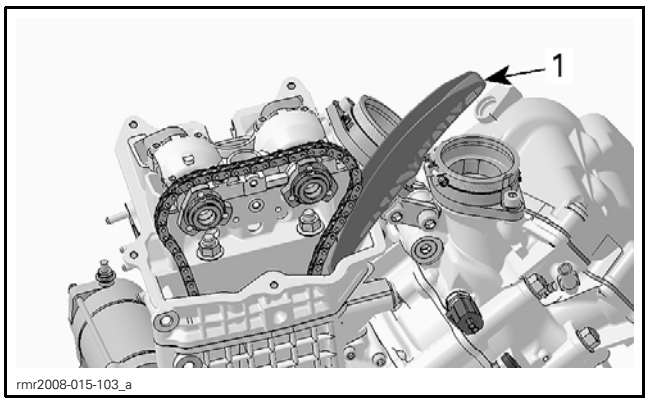
Remove the bearing flange.

Remove distance sleeve.



TYPICAL
1. *Retaining screws*
2. *Spring washers*
3. *Bearing flange*
4. *Distance sleeve*

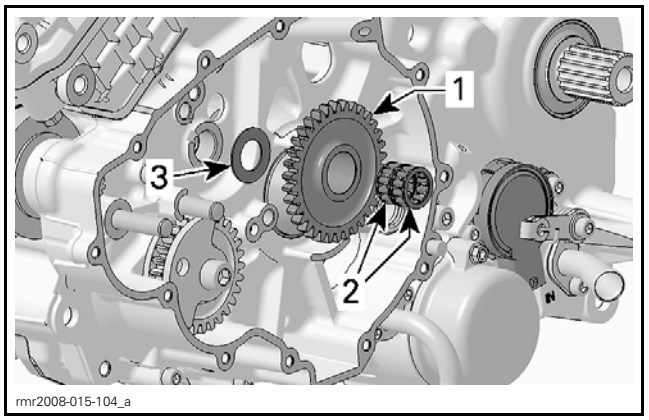
Remove chain tensioner guide.



1. *Chain tension guide*

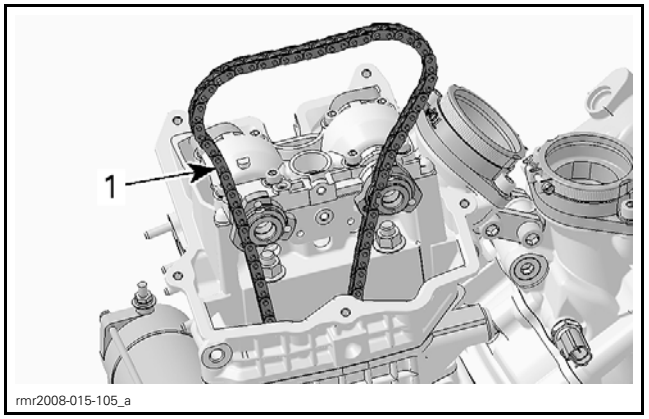
Remove timing chain intermediate gear and needle bearings.

Remove thrust washer.



TYPICAL
1. *Timing chain intermediate gear*
2. *Needle bearings*
3. *Thrust washer*

Remove timing chain.



1. *Timing chain*

NOTE: Mark the operating direction of the timing chain before removal.

Timing Chain Removal (Rear Cylinder)

Lock crankshaft at ignition TDC of rear cylinder, refer to *CRANKSHAFT* in this subsection.

Refer to *CYLINDER HEAD AND CYLINDER* subsection and remove the following parts:

– Valve cover
– Chain tensioner
– Timing chain guide
– Camshaft timing gears.

Refer to *CLUTCH* subsection and remove:

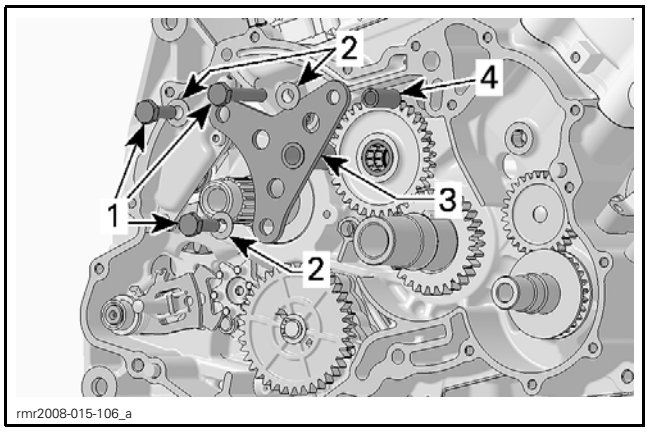
1. Clutch housing
2. Clutch drum assembly.

Remove primary drive gear and balance shaft gear. See *DRIVE GEARS* in this subsection.

Remove screws and spring washers securing the bearing flange.

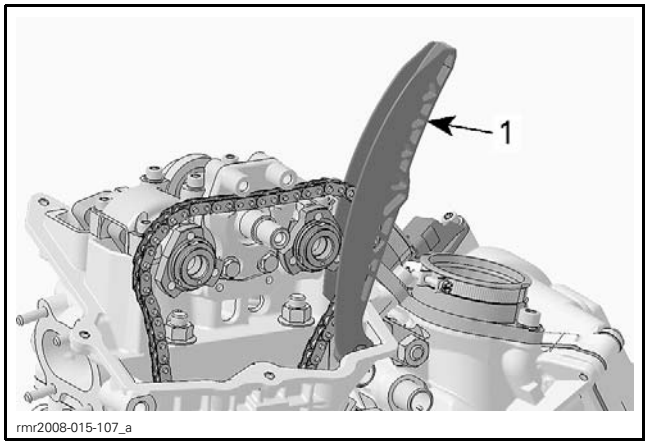
Remove the bearing flange.

Remove distance sleeve.



1. *Retaining screws*
2. *Spring washers*
3. *Bearing flange*
4. *Distance sleeve*

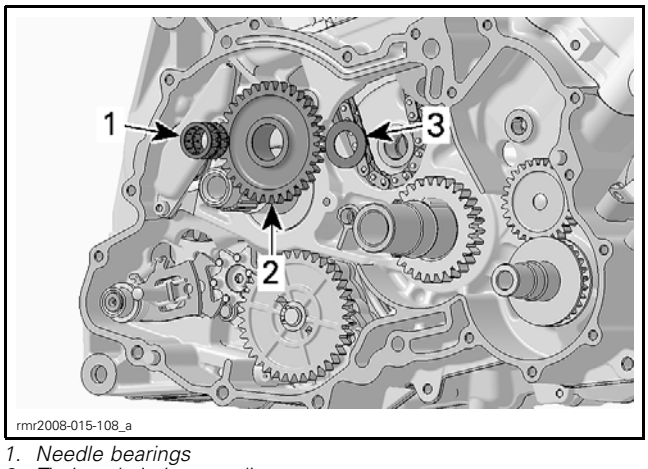
Remove chain tension guide.



1. *Chain tension guide*

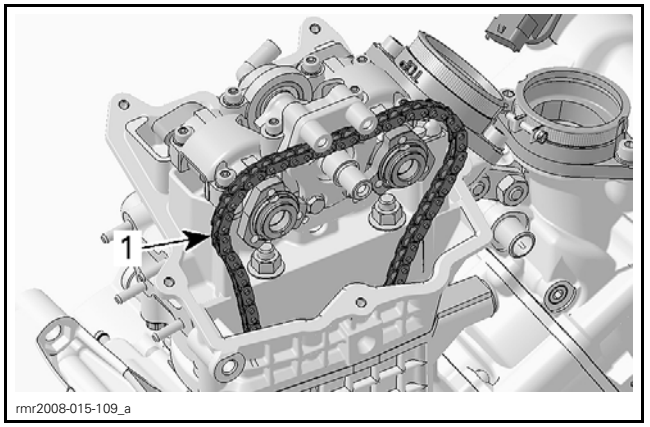
Remove timing chain intermediate gear and needle bearings.

Remove thrust washer.



1. *Needle bearings*
2. *Timing chain intermediate gear*
3. *Thrust washer*

Remove timing chain.



1. *Timing chain*

NOTE: Mark the operating direction of the timing chain before removal.

Timing Chain and Drive Gear Inspection

Inspection is the same for both timing chains and timing chain drive gears.

NOTE: Always keep the parts of each cylinder as a group.

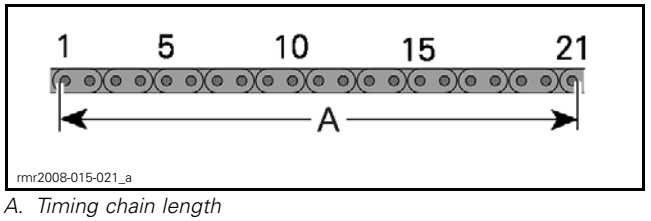
Timing Chain

NOTE: Check timing chain on camshaft timing gear for excessive radial play.

Check chain links condition for wear or other damage.

Measure timing chain length. Mark 21 pins on chain and measure the distance at the outer diameter of pins.

NOTE: Ensure to eliminate play in chain while measuring.



A. Timing chain length

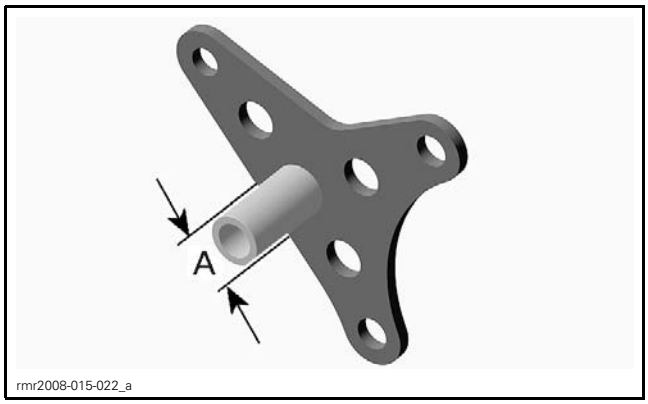
TIMING CHAIN LENGTH (DISTANCE OF 21 PINS)	
SERVICE LIMIT	165.2 mm (6.504 in)

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

Bearing Flange

Inspect bearing flange pin for scoring, pitting or other damages.

Measure pin diameter at the running surface of the needle bearings.



A. Pin diameter

BEARING FLANGE PIN DIAMETER	
SERVICE LIMIT	15.980 mm (.6291 in)

Replace bearing flange if pin is out of specification.

Needle Bearings

Check needles for wear or pitting.

Check needle cage for cracks or other damage. Replace if necessary.

Timing Chain Intermediate Gear

Inspect gear teeth for wear or other damage. If gear is pitted, scored, rounded, cracked or chipped, it should be replaced.

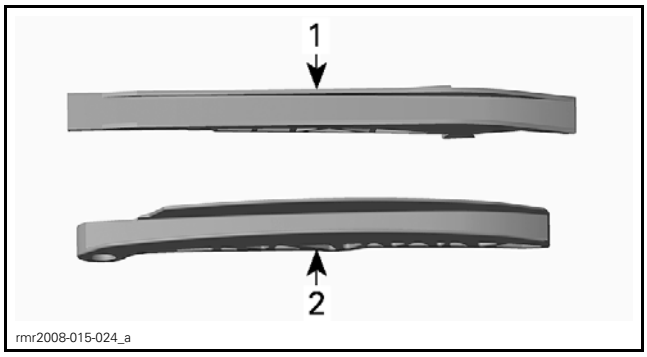
Measure inside diameter of intermediate gear.

INTERMEDIATE GEAR INSIDE DIAMETER	
SERVICE LIMIT	22.015 mm (.8667 in)

Replace timing chain intermediate gear if out of specification.

NOTE: Timing chain intermediate gear and timing chain drive gear are paired. Replace as a set.

Timing Chain Guide and Chain Tension Guide



1. Timing chain guide
2. Chain tension guide

Check timing chain guide and chain tension guide for wear, cracks, deforming or grooves caused by timing chain.

If groove depth exceed 1.2 mm (.0472 in), replace timing chain guide and/or chain tension guide.

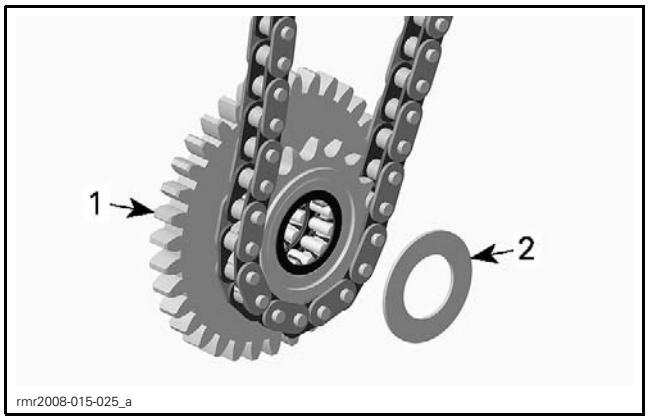
Timing Chain Installation (Front Cylinder)

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

NOTE: Crankshaft must be still locked at ignition TDC of front cylinder, prior installing timing chain and timing chain drive.

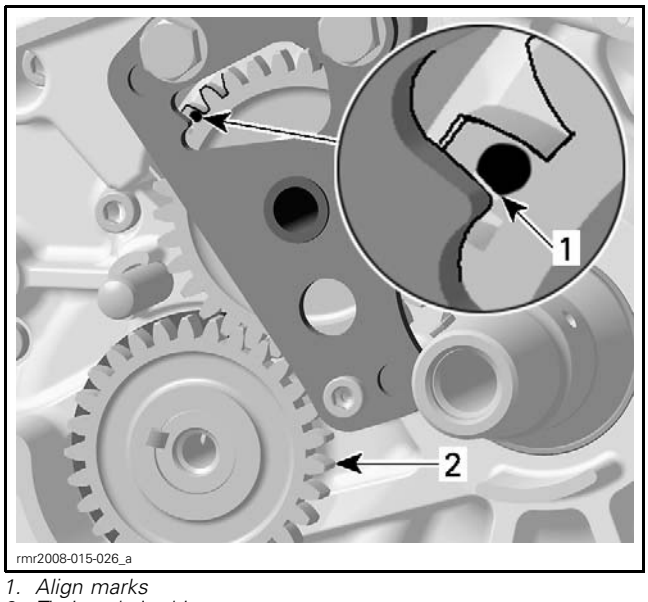
NOTICE **After a complete tear down of the engine, to achieve proper camshaft timing, the *ENGINE REASSEMBLY SEQUENCE* detailed at the beginning of this subsection must be strictly followed.**

Fit thrust washer with grease onto timing chain intermediate gear, to avoid dropping it into crankcase.



1. Timing chain intermediate gear
2. Thrust washer

Ensure to align mark on timing chain intermediate gear with mark on bearing flange during installation.



1. Align marks
2. Timing chain drive gear

NOTICE **Wrong position of timing chain drive gears will lead to wrong camshaft timing and cause severe engine damage.**

Properly reinstall camshaft timing gears, refer to *CAMSHAFT TIMING GEAR* in *CYLINDER/CYLINDER HEAD* subsection.

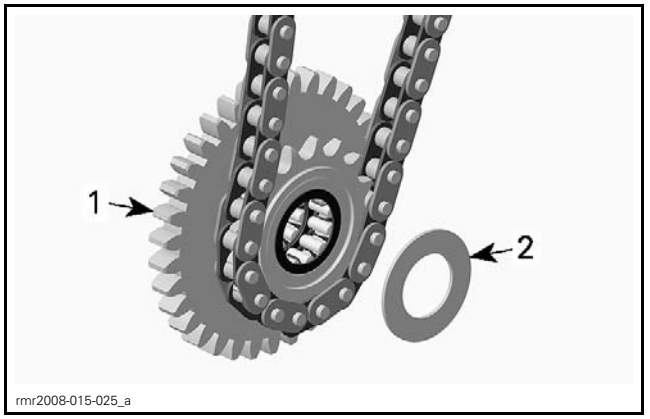
Timing Chain Installation (Rear Cylinder)

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

NOTE: Crankshaft must be still locked at ignition TDC of rear cylinder, prior installing timing chain and timing chain drive.

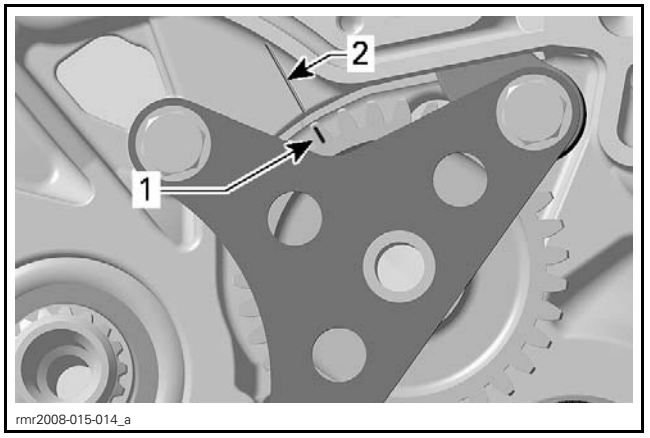
NOTICE **After a complete tear down of the engine, to achieve proper camshaft timing, the *ENGINE REASSEMBLY SEQUENCE* detailed at the beginning of this subsection must be strictly followed.**

Fit thrust washer with grease onto timing chain intermediate gear, to avoid dropping it into crankcase.



1. Timing chain intermediate gear
2. Thrust washer

NOTE: Ensure to align mark on timing chain intermediate gear with mark on crankcase during installation.



1. Align mark on timing chain intermediate gear
2. Crankcase mark

NOTICE **Wrong position of timing chain drive gears will lead to wrong camshaft timing and cause severe engine damage.**

Properly reinstall camshaft timing gears, refer to *CAMSHAFT TIMING GEAR* in *CYLINDER/CYLINDER HEAD* subsection.

CRANKCASE

Remove engine from vehicle, refer to *ENGINE REMOVAL AND INSTALLATION*.

Crankcase Disassembly

Lock crankshaft at ignition TDC of front cylinder, refer to *CRANKSHAFT* in this subsection.

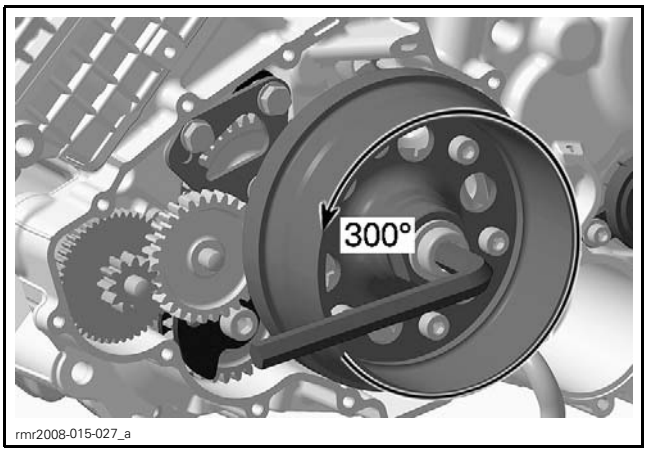
Remove electric starter from engine.

Refer to *CYLINDER/CYLINDER HEAD* subsection to remove the following parts:

– Front cylinder head
– Cylinder
– Piston.

Unscrew crankshaft locking bolt.

Use a 14 mm Allen wrench and turn crankshaft on magneto side 300° counterclockwise, then lock it at ignition TDC of rear cylinder.



TURN CRANKSHAFT 300° COUNTERCLOCKWISE

Refer to *CYLINDER/CYLINDER HEAD* subsection and remove the following parts:

1. Rear cylinder head
2. Cylinder
3. Piston.

Refer to *CLUTCH* subsection to remove the following parts:

4. Clutch housing
5. Clutch plates
6. Clutch hub
7. Clutch drum.

Remove *DRIVE GEARS*, see procedure in this subsection.

NOTE: Oil pump removal from crankcase is not necessary, but recommended to see condition of oil pump (refer to *LUBRICATION SYSTEM* subsection).

Remove the oil filter cover and the oil filter.

Refer to *MAGNETO AND STARTER* subsection and remove the following parts:

8. Magneto cover
9. Rotor
10. Starter drive gears.

Refer to *TIMING CHAIN* in this subsection to remove timing chains and timing chain drive gears.

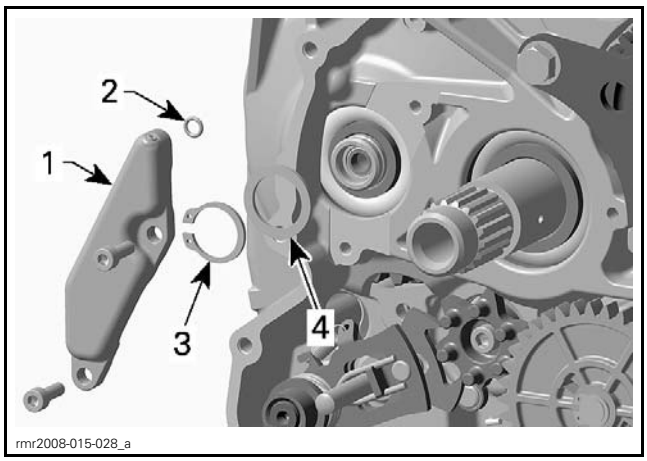
Refer to *GEARBOX* subsection and remove the following parts:

11. Front sprocket
12. Gearbox position sensor (GBPS)
13. Shifting mechanism.

Remove the oil duct cover. Discard O-ring.

Remove the snap ring.

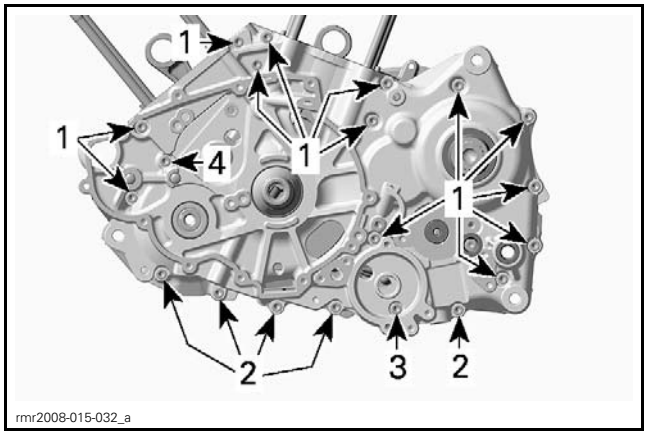
Remove the thrust washer.



1. Oil duct cover
2. O-ring
3. Snap ring
4. Thrust washer

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

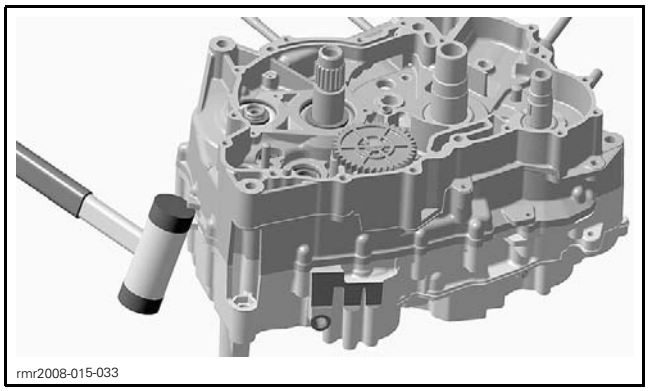
Remove crankcase screws.



1. Screws M6 x 65 (qty 13)
2. Screws M6 x 45 (qty 5)
3. Screw M6 x 30
4. Screw M6 x 80

Carefully split crankcase halves by using a soft hammer.

NOTE: During disassembly, do not damage the sealing surfaces of the crankcase halves.


rmr2008-015-033

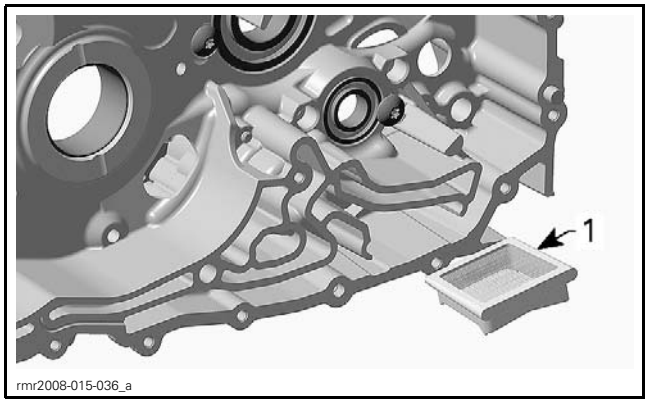
Pull crankshaft and balance shaft out of crankcase.

Refer to *GEARBOX* and remove:

14. Gearbox

15. Reverse intermediate gear.

Remove engine oil strainer from crankcase halve (clutch side).



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1. Engine oil strainer

NOTE: For oil strainer inspection, refer to *LUBRICATION SYSTEM* subsection.

Crankcase Inspection and Cleaning

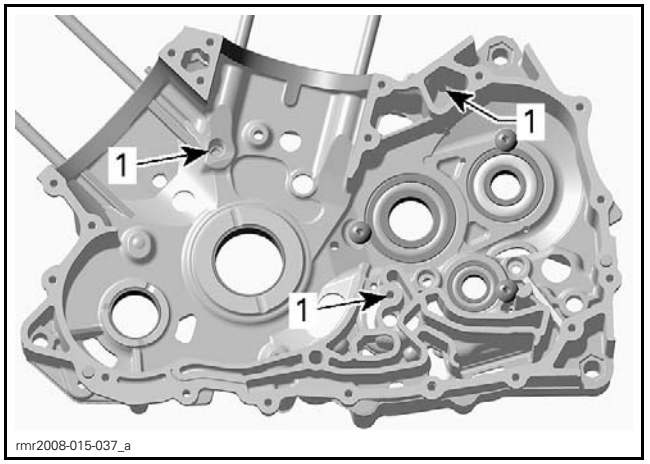
Clean crankcase using a part cleaner.

Dry crankcase using compressed air.

Blow out the oil supply orifices and check if they are not clogged.

⚠ WARNING

Always wear skin and eye protection. Chemicals can cause skin rash, skin burns and severe eye injury.



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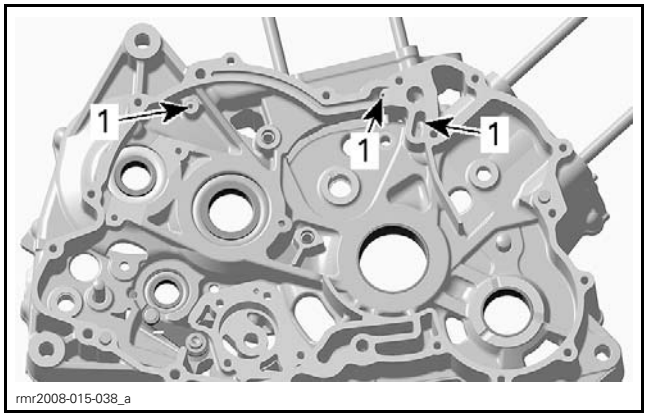
CRANKCASE HALVE — CLUTCH SIDE
1. Check oil supply orifices



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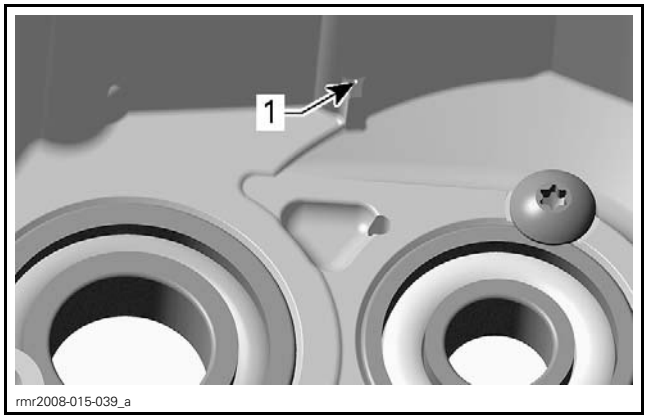
CRANKCASE HALVE — CLUTCH SIDE
1. Check oil supply orifices



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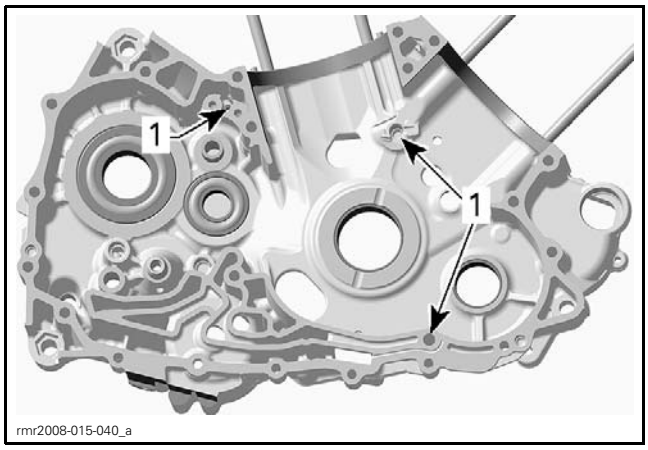
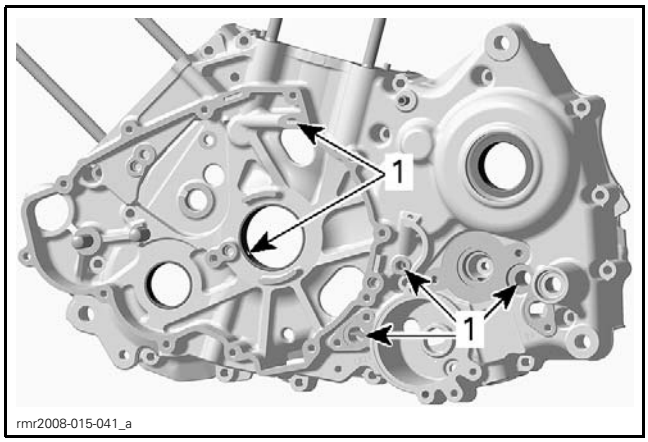
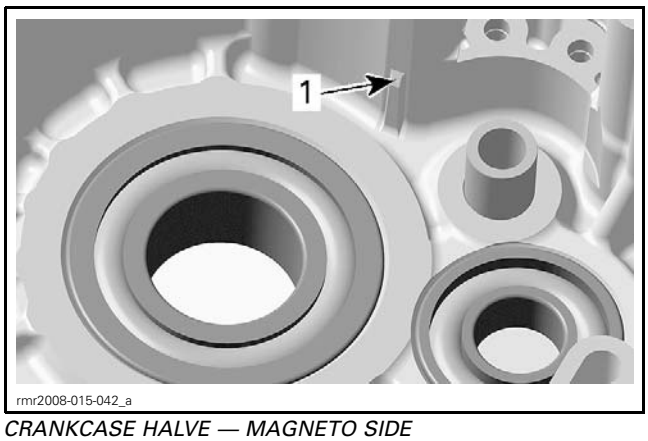
CRANKCASE HALVE — CLUTCH SIDE
1. Check oil supply hole



CRANKCASE HALVE — MAGNETO SIDE
1. Check oil supply orifices



CRANKCASE HALVE — MAGNETO SIDE
1. Check oil supply orifices



CRANKCASE HALVE — MAGNETO SIDE
1. Check oil supply hole

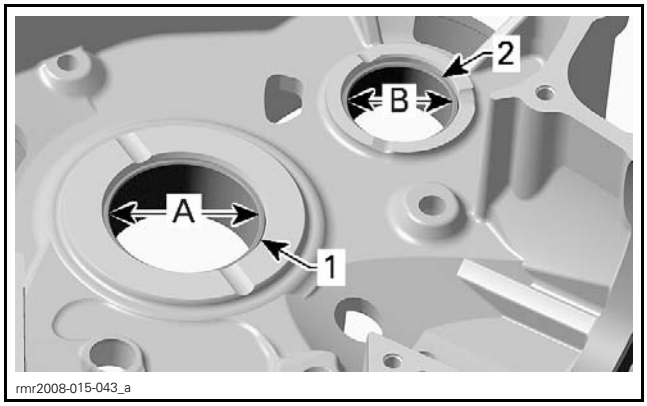
Check crankcase halves for cracks or other damage. Replace if damaged.

Check if oil hose connectors are bent or otherwise damaged. Refer to *OIL HOSE CONNECTORS* in *LUBRICATION SYSTEM* subsection if replacement is necessary.

Oil ball bearings and check for smooth operation. Check for excessive play and/or pitting. Replace if necessary.

Check plain bearings for scoring or other damages.

Measure plain bearing inside diameter and compare with crankshaft/balance shaft bearing journal diameters (refer to *CRANKSHAFT* and *BALANCE SHAFT*). Replace if the measurements are out of specification.



TYPICAL — CRANKCASE HALVE
1. Crankshaft plain bearing
2. Balance shaft plain bearing
A. Measure plain bearing inside diameter — crankshaft
B. Measure plain bearing inside diameter — balance shaft

PLAIN BEARING INSIDE DIAMETER (SERVICE LIMIT)	
CRANKSHAFT	46.035 mm (1.8124 in)
BALANCE SHAFT	32.060 mm (1.2622 in)

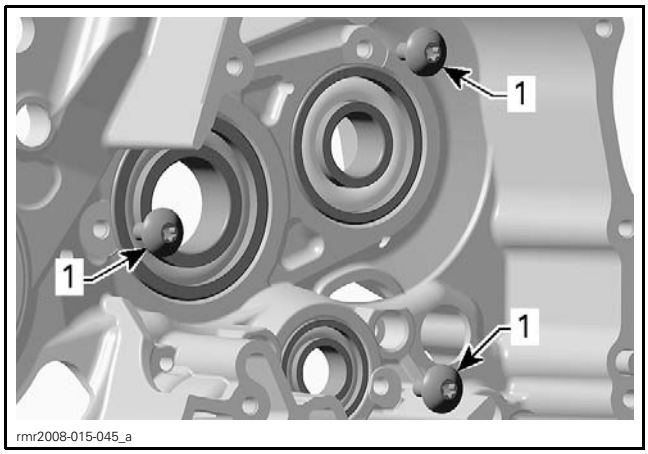
Crankcase Bearing Replacement

Always heat crankcase halves up to 140°C (284°F) for removal and installation of bearings.

NOTICE **Always support crankcase halves properly when ball bearings and/or plain bearings are removed and installed. Damages to crankcase halves may occur if this procedure is not performed correctly.**

Ball Bearing Removal

Remove screws securing bearings.



1. Bearing screws

Notice the assembly direction of the ball bearings during removal.

Remove clutch shaft ball bearing from magneto side crankcase half, by using the BLIND HOLE BEARING PULLER SET (P/N 529 036 117).

Press out remaining ball bearings with suitable punch.

Ball Bearing Installation

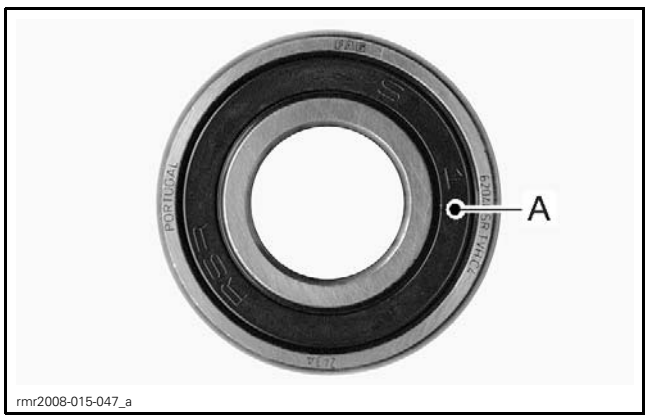
NOTE: As a rule, disassembled ball bearings must be replaced by new ones.

NOTICE **Unless otherwise instructed, never use hammer to install ball bearings. Use press only.**

Install NEW ball bearings in the same direction as during removal, using suitable punch.

Slightly oil ball bearings at the outer race to ease installation.

NOTE: Sealing ring of clutch shaft ball bearing (on magneto side) must face outside the crankcase (bearing balls visible from inside).



A. Sealing ring

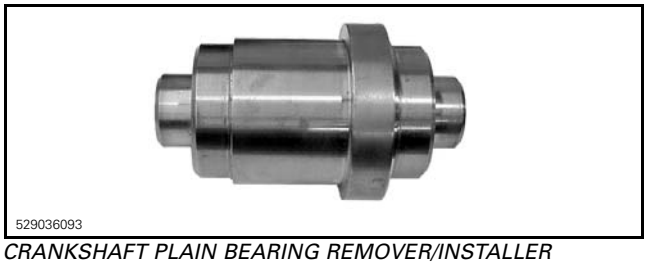
Reinstall bearing screws, apply LOCTITE 243 (BLUE) (P/N 293 800 060) and torque to 11 N•m (97 lbf•**in**).

Plain Bearing Removal

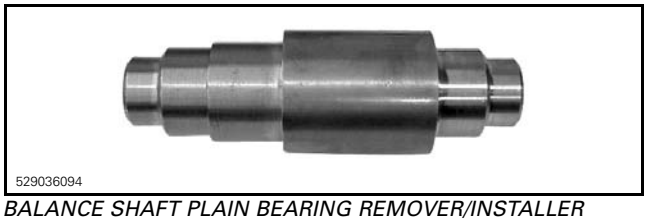
Mark the partition of the plain bearings on crankcase halves, prior removing the plain bearings.

Remove plain bearings with the proper plain bearing remover/installer.

PLAIN BEARING REMOVER/INSTALLER	
CRANKSHAFT	CRANKCASE PLAIN BEARING REM/INST (P/N 529 036 093)
BALANCE SHAFT	BALANCE SHAFT PLAIN BEARING REM/INST (P/N 529 036 094)



CRANKSHAFT PLAIN BEARING REMOVER/INSTALLER



BALANCE SHAFT PLAIN BEARING REMOVER/INSTALLER

Place suitable support sleeve underneath the proper bearing seat before removing plain bearings.

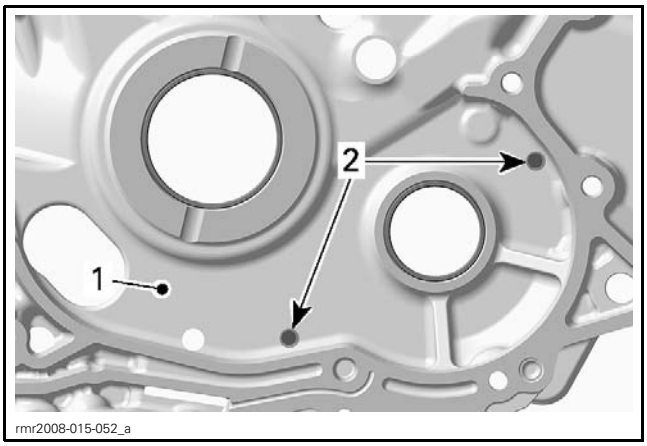
Using a press, carefully push the plain bearings out from the crankcase half inside towards the outside.

NOTE: During disassembly, make sure not to damage the sealing surfaces of the crankcase halves.

Plain Bearing Installation

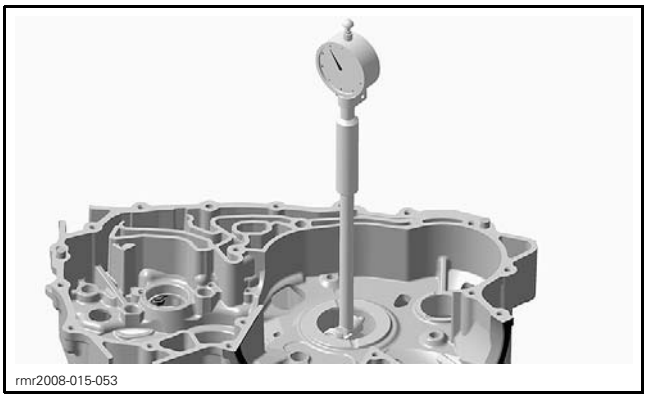
NOTE: Plain bearings are available in 3 tolerance groups (red, blue and yellow).

The proper tolerance group is marked with paint on the crankcase.



1. Crankcase half
2. Marking of tolerance group

If marking is not visible anymore, measure inside diameter of crankcase where plain bearing fits.



MEASURE INSIDE DIAMETER OF CRANKCASE

Use the following table to find proper tolerance group of plain bearing.

CRANKCASE INSIDE DIAMETER (CRANKSHAFT)	PLAIN BEARING TOLERANCE GROUP
49.899 mm to 49.908 mm (1.9645 in to 1.9649 in)	RED
49.908 mm to 49.918 mm (1.9649 in to 1.9653 in)	BLUE
49.918 mm to 49.929 mm (1.9653 in to 1.9657 in)	YELLOW

CRANKCASE INSIDE DIAMETER (BALANCE SHAFT)	PLAIN BEARING TOLERANCE GROUP
35.909 mm to 35.918 mm (1.4137 in to 1.4141 in)	RED
35.918 mm to 35.928 mm (1.4141 in to 1.4145 in)	BLUE
35.928 mm to 35.939 mm (1.4145 in to 1.4149 in)	YELLOW

NOTICE Unless otherwise instructed, never use hammer to install plain bearings. Use press only.

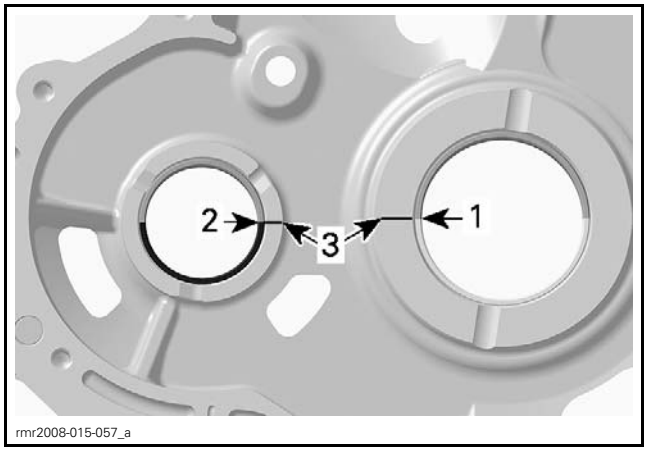
Install plain bearings with the same tools as per removal.

Fit the plain bearings with PETAMO GREASE GHY 133N (P/N 420 899 271).

Use an O-ring to hold the plain bearings in place during installation.

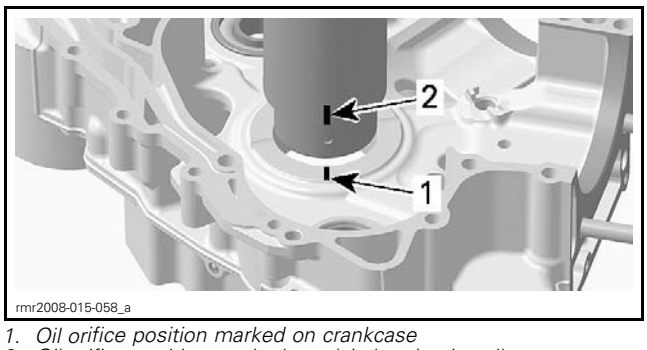
Place suitable support sleeve underneath the proper bearing seat before installing plain bearings.

NOTICE The partition of the plain bearings must be positioned in the same direction as marked on crankcase halves during removal.



TYPICAL
1. Partition of crankshaft plain bearings
2. Partition of balance shaft plain bearings
3. Marks

Mark position of oil orifice on crankcase half (magneto side) and on plain bearing installer. Align mark on plain bearing installer with mark on crankcase half.



1. Oil orifice position marked on crankcase
2. Oil orifice position marked on plain bearing installer

NOTICE Wrong oil orifice position will stop oil supply to plain bearings and will cause engine damage.

Carefully press-in the plain bearings in the same direction as during disassembly.

NOTE: Remove O-ring before completely press-in plain bearings.

During installation, make sure not to damage the sealing surfaces of the crankcase halves.

Crankcase Assembly

The assembly of crankcase is essentially the reverse of removal procedure. However, pay attention to the following details.

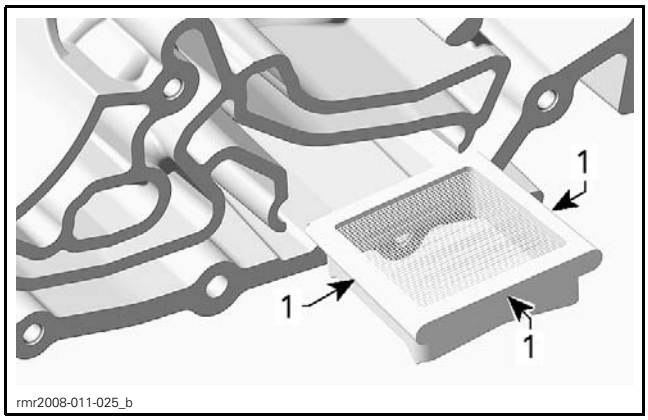
Install a new crankcase gasket.

Coat the plain bearings with PETAMO GREASE GHY 133N (P/N 420 899 271) before mounting crankshaft and balance shaft.

NOTE: Correctly reinstall crankshaft (refer to *CRANKSHAFT*).

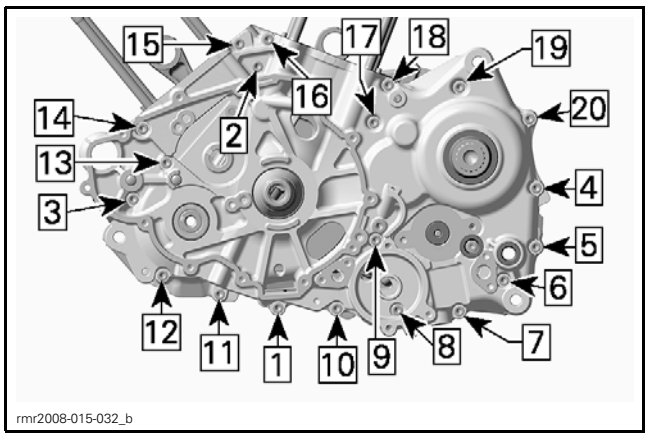
For reinstallation of gearbox and oil seals, refer to *GEARBOX* subsection.

Apply a seam of LOCTITE 5910 (P/N 293 800 081) on the oil strainer to fit into crankcase.



1. Apply Loctite 5910 here

Tighten crankcase screws as per the following sequence.

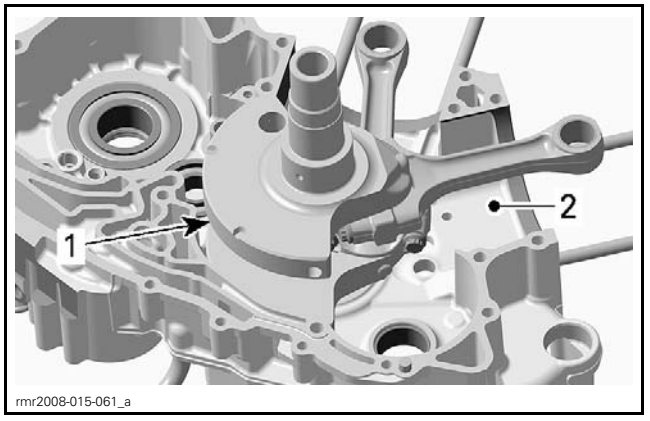


TIGHTENING SEQUENCE

Install all other removed parts.

NOTICE **After a complete tear down of the engine, to achieve proper camshaft timing, the *ENGINE REASSEMBLY SEQUENCE* detailed at the beginning of this subsection must be strictly followed.**

CRANKSHAFT



1. Crankshaft
2. Crankcase MAG

Crankshaft Locking Procedure

NOTICE **The crankshaft must be locked at the ignition TDC of the respective cylinder for removal and installation work on crankshaft, balance shaft and camshaft.**

NOTE: Crankshaft can be locked at ignition TDC for each cylinder separately.

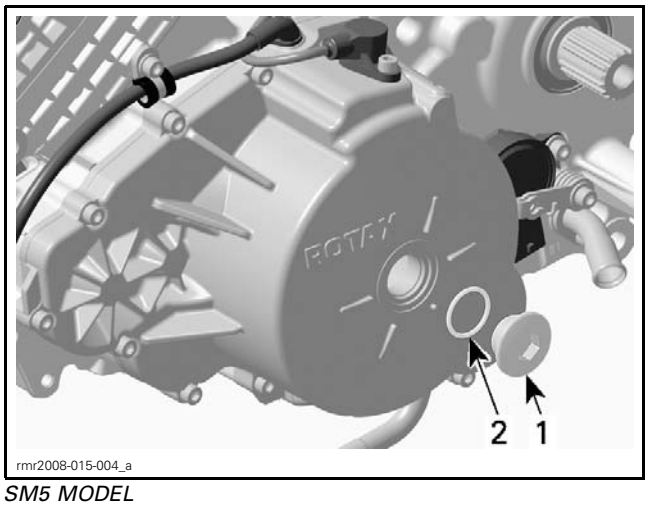
The following procedure is valid for both cylinders.

Remove upper side panels. Refer to *BODY*.

Remove spark plugs.

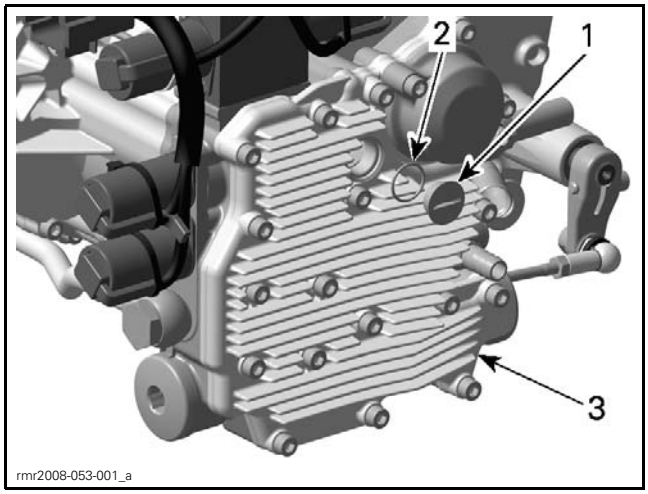
Remove valve covers. Refer to *CYLINDER HEAD/CYLINDER*.

On **SM5 model**, remove magneto cover plug screw.



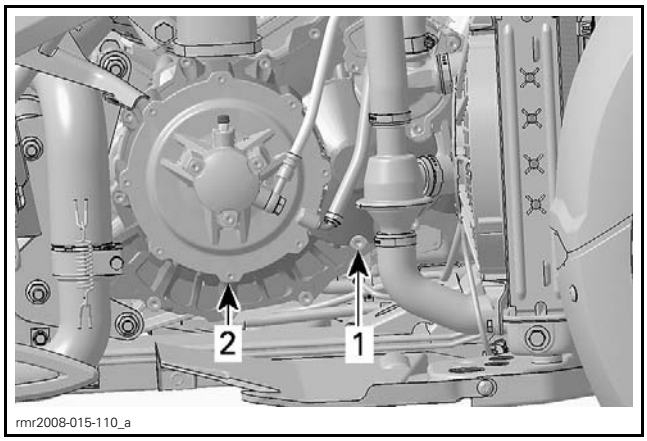
SM5 MODEL
1. *Plug screw*
2. *O-ring*

On **SE5 model**, remove plug screw on the hydraulic control module (HCM) housing.

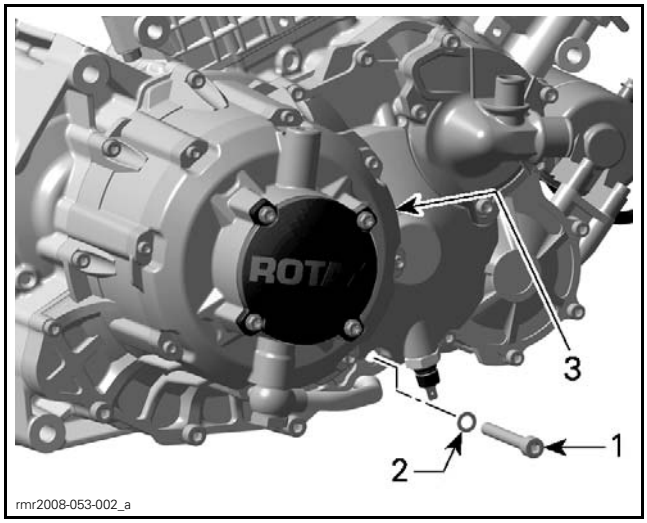


SE5 MODEL
1. *Plug screw*
2. *O-ring*
3. *HCM housing*

Remove M8 screw with sealing ring blocking access hole.

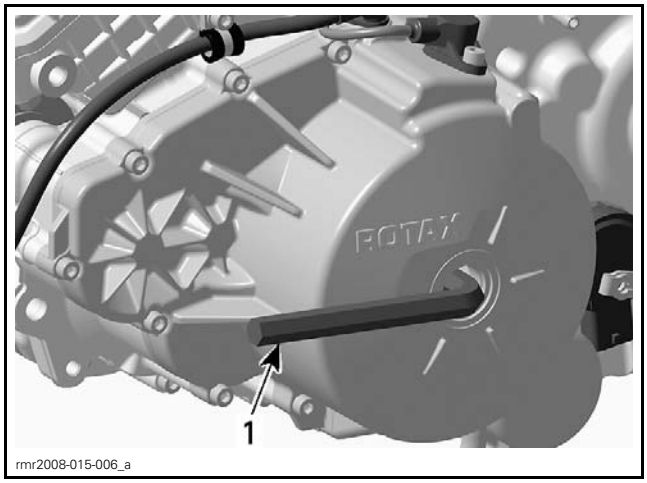


SM5 MODEL
1. *Access screw*
2. *Clutch cover*

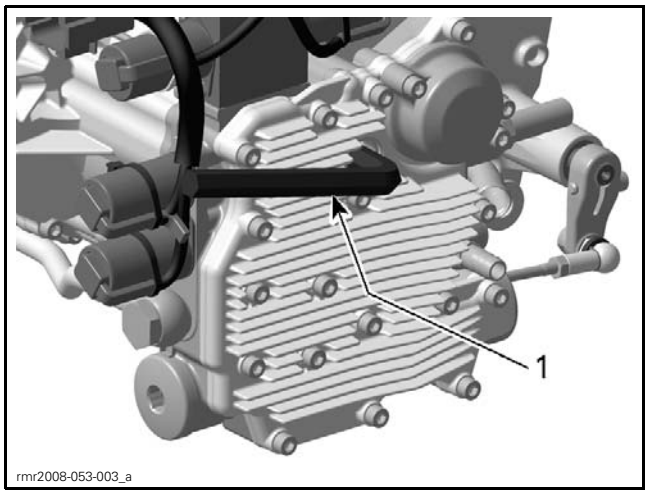


SE5 MODEL
1. *Access screw*
2. *Sealing ring*
3. *Clutch cover*

Use a 14 mm Allen wrench to turn the crankshaft until the piston is at the ignition TDC of the respective cylinder.

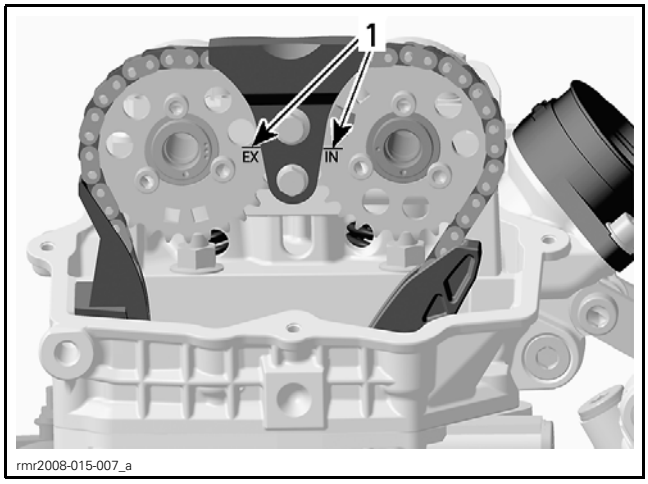


SM5 MODEL
1. *Allen wrench*



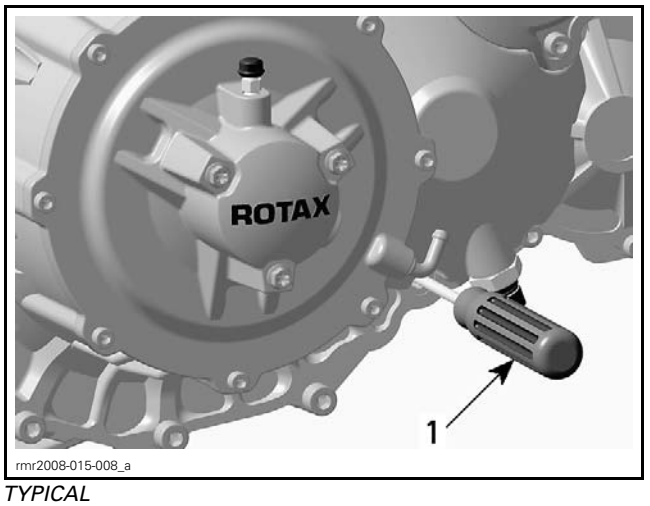
SE5 MODEL
1. Allen wrench

NOTE: When piston is at ignition TDC, the printed marks ("IN" and "EX") on the camshaft timing gears must be aligned, as shown in the next illustration.



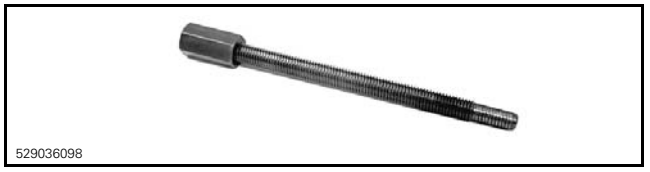
TYPICAL
1. Align marks

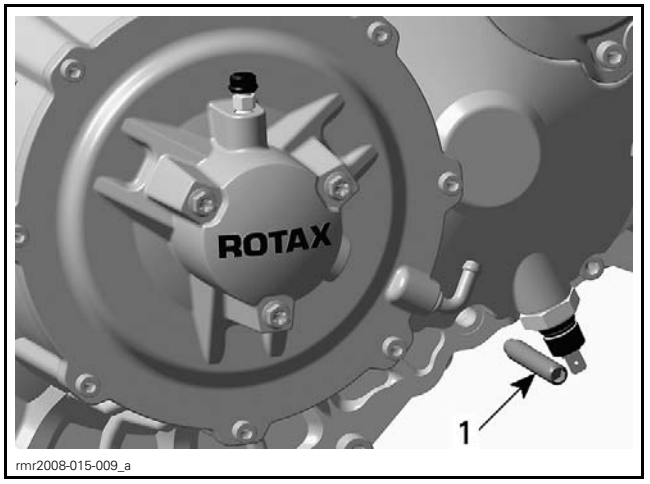
Use a small screwdriver to check if the groove in the crankshaft is aligned with the hole.



TYPICAL
1. Screwdriver

Lock crankshaft with the PULLER/LOCKING TOOL (P/N 529 036 098).





TYPICAL
1. Crankshaft locking bolt

Crankshaft Removal

Refer to *CRANKCASE* in this subsection.

Crankshaft Inspection

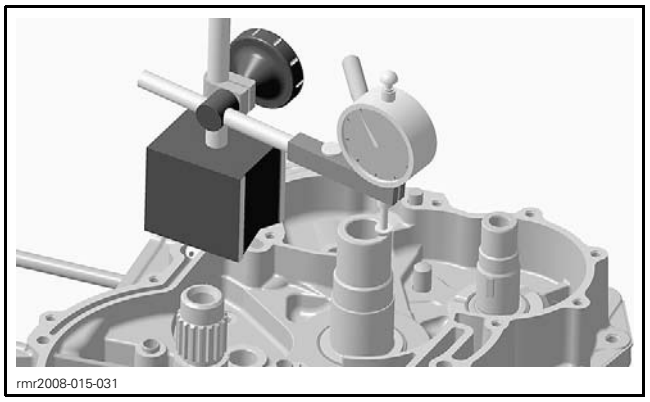
NOTE: Check each bearing journal of crankshaft for scoring, scuffing, cracks or other signs of wear.

NOTICE **Components with less than the service limit always have to be replaced. If this is not observed, severe damage may be caused to the engine.**

Crankshaft Axial Play

NOTE: Axial play needs to be measured before splitting the crankcase.

Measure play on PTO end, using a dial indicator.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CRANKSHAFT AXIAL PLAY	
SERVICE LIMIT	0.7 mm (.0276 in)

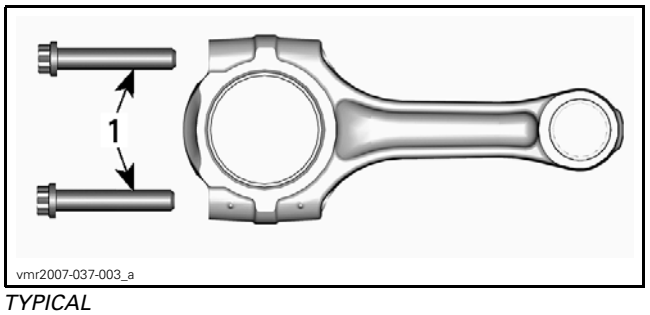
If play is out of specification, replace crankcase and/or crankshaft.

Connecting Rod Big End Radial Play

NOTE: Prior to remove connecting rods from the crankshaft, mark assembly direction (front cylinder and rear cylinder, magneto and clutch side) and big end halves together to ensure a correct reinstallation.

Remove connecting rods from crankshaft.

NOTICE Always replace connecting rod screws if removing the connecting rod. It is also recommended to replace plain bearings, within an overhaul of the engine.



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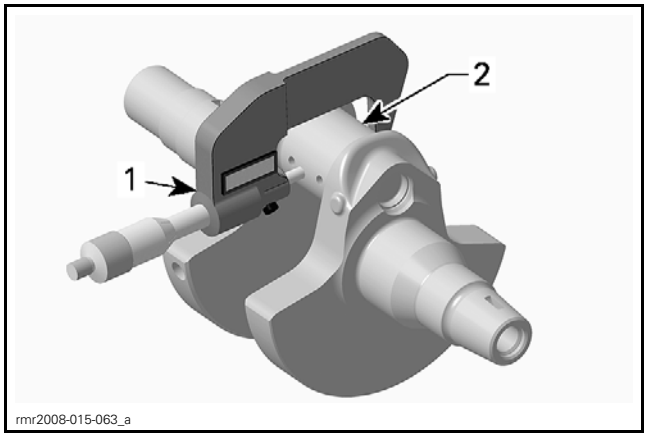
TYPICAL
1. Connecting rod screws

Clean crankshaft oil orifices and make sure they are not clogged.

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



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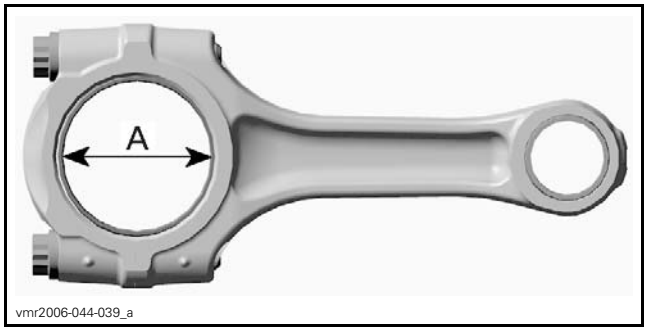
1. Micrometer
2. Crankshaft pin area for plain bearing

To measure the connecting rod big end diameter, leave the OLD plain bearings in place.

Install the connecting rod cap and follow the torque procedure as described in *CRANKSHAFT ASSEMBLY* further using the OLD connecting rod screws.

NOTE: Secure the connecting rod in a vise with aluminum jaws.

Measure connecting rod big end diameter.



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TYPICAL
A. Connecting rod big end diameter (plain bearing in place)

CRANKSHAFT PIN DIAMETER	
SERVICE LIMIT	41.960 mm (1.652 in)
CONNECTING ROD BIG END DIAMETER	
SERVICE LIMIT	42.080 mm (1.6567 in)
CONNECTING ROD BIG END RADIAL PLAY (WITH USED PLAIN BEARING)	
SERVICE LIMIT	0.07 mm (.0028 in)

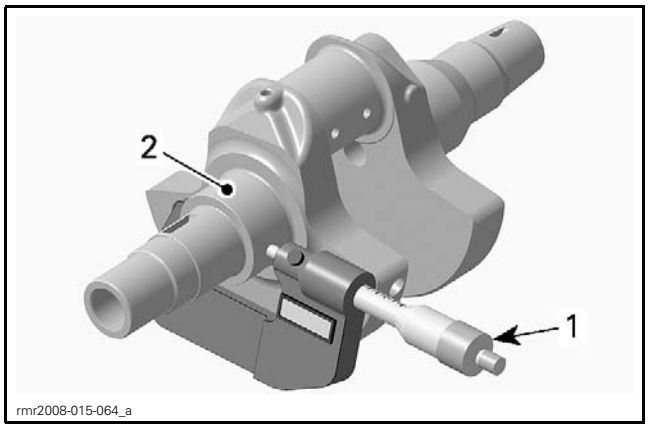
NOTE: Use NEW plain bearings, when connecting rod big end radial play is out of specification.

Connecting Rod/Piston Pin Clearance

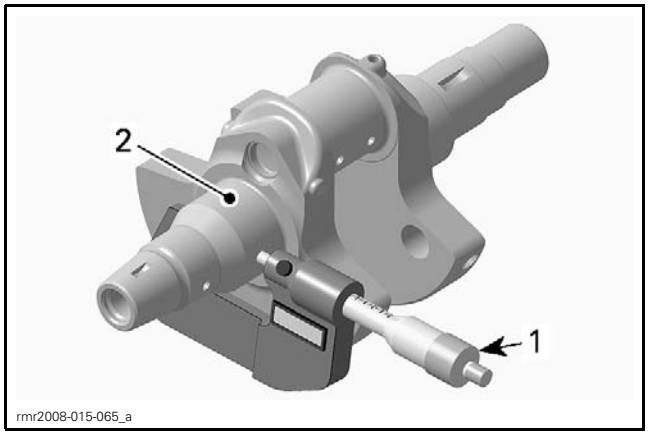
Refer to *CYLINDER HEAD/CYLINDER* subsection.

Crankshaft Radial Play (MAG/Clutch Side)

Measure crankshaft journal on MAG/clutch side. Compare to inside diameter of MAG/clutch side plain bearings in crankcase (refer to *CRANKCASE* in this subsection).



1. Micrometer
2. Crankshaft area for MAG side plain bearing



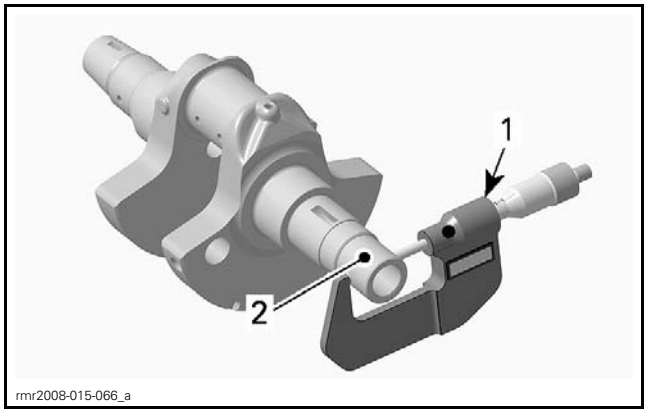
1. Micrometer
2. Crankshaft area for clutch side plain bearing

CRANKSHAFT BEARING JOURNAL (MAG/CLUTCH SIDE)	
SERVICE LIMIT	45.955 mm (1.8093 in)

CRANKSHAFT RADIAL PLAY (MAG/CLUTCH SIDE)	
SERVICE LIMIT	0.06 mm (.0024 in)

Crankshaft Radial Play (Clutch Support Bearing Side)

Measure the crankshaft bearing journal that inserts in the clutch support bearing. Compare to inside diameter of plain bearing in clutch housing (refer to *CLUTCH HOUSING* in *CLUTCH* subsection).



1. Micrometer
2. Crankshaft journal (clutch support bearing)

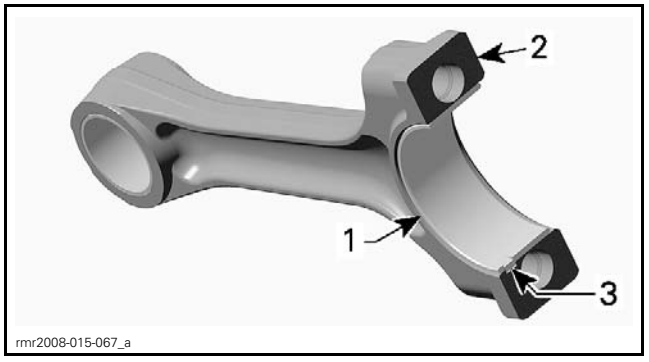
CRANKSHAFT BEARING JOURNAL (CLUTCH SUPPORT BEARING)	
SERVICE LIMIT	29.970 mm (1.1799 in)

CRANKSHAFT RADIAL PLAY (CLUTCH SUPPORT BEARING)	
SERVICE LIMIT	0.065 mm (.0026 in)

Crankshaft Assembly

For assembly, reverse the disassembly procedure. Pay attention to following details.

Put NEW plain bearings correctly in place and clean the split surface on both sides carefully with a clean rag.

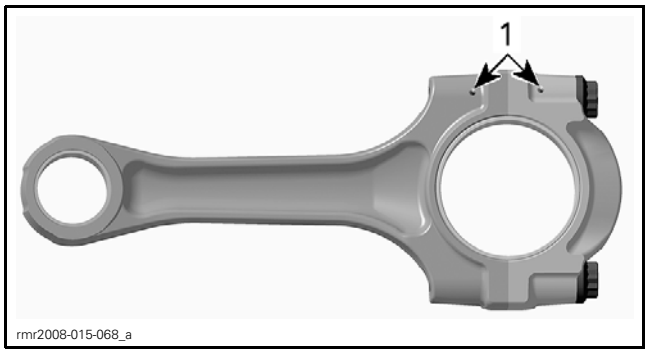


1. Half plain bearing of connecting rod big end
2. Split surface of the connecting rod
3. Nose of plain bearing in line with connecting rod groove

Oil the plain bearing surface of the connecting rod and crank pin before installation.

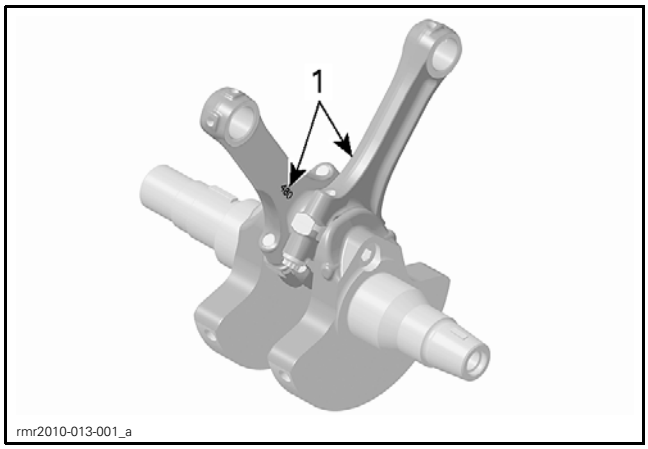
NOTICE **Properly reinstall connecting rods in the same assembly direction as marked during removal.**

Printed marks on connecting rod and cap must point together.

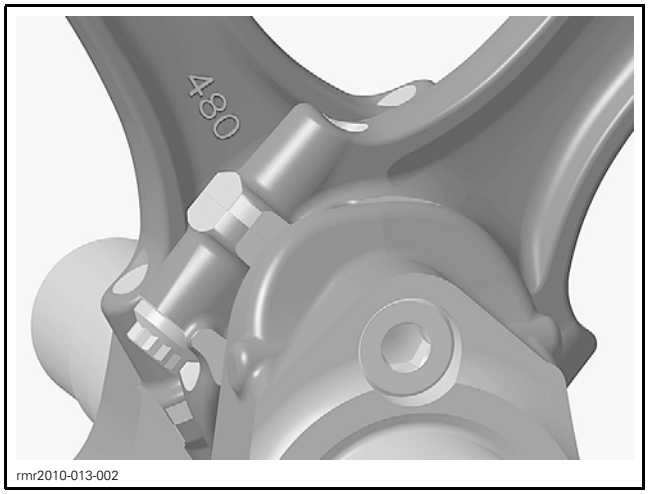


1. Printed marks

Install connecting rods on crankshaft in a way that stamped part numbers face together.



1. Stamped marks on connecting rods facing together

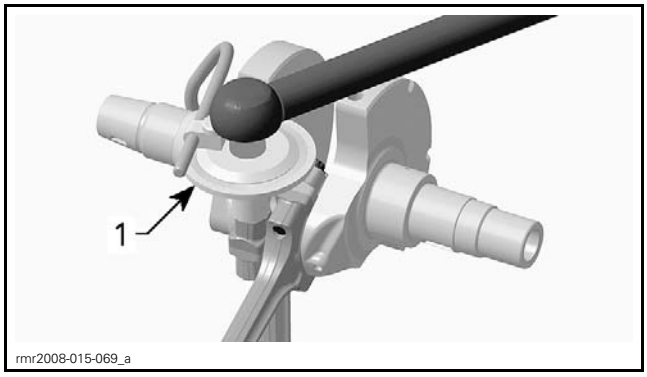


TYPICAL - STAMPED MARK

NOTICE Always use NEW connecting rod screws for the final assembly of the crankshaft.

Apply oil on head of NEW connecting rod screws and torque as per following procedure:

– First, torque screws to 2 N•m (18 lbf•**in**). Do not apply any thread locker.
– Secondly, torque screws to 30 N•m (22 lbf•ft).
– Finish tightening the screws with an additional 75° turn using an angle torque wrench.



1. Angle torque wrench

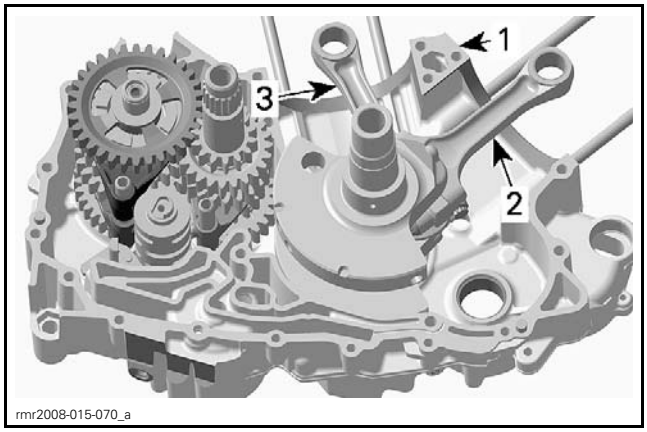
NOTICE Failure to strictly follow this procedure may cause screw to loosen and lead to engine damage. The plain bearing tapered end must be against the counterweight.

Crankshaft Installation

For installation of crankshaft in crankcase reverse the removal procedure. Pay attention to the following details.

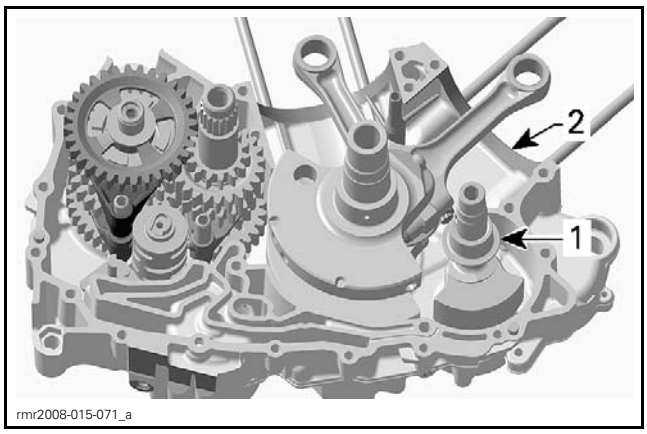
Do not mix up the connecting rods of front and rear cylinders during installation.

NOTICE Observe the correct installation position when fitting the crankshaft with the connecting rods. The connecting rod clutch side must to face to front cylinder.



1. Crankcase half MAG side
2. Connecting rod front cylinder
3. Connecting rod rear cylinder

BALANCE SHAFT



1. *Balance shaft*
2. *Crankcase MAG*

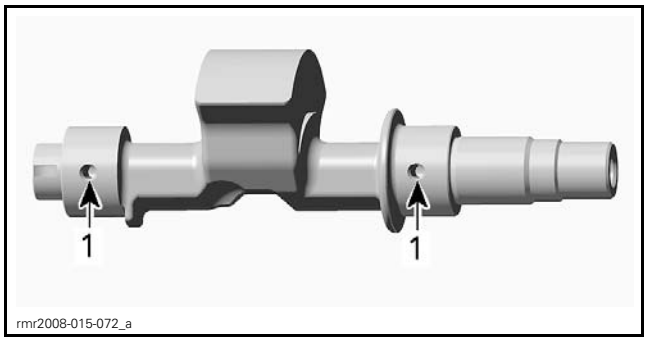
Balance Shaft Removal

Refer to *CRANKCASE* in this subsection.

Balance Shaft Inspection

NOTE: Check each bearing journal of balance shaft for scoring, scuffing, cracks or other signs of wear.

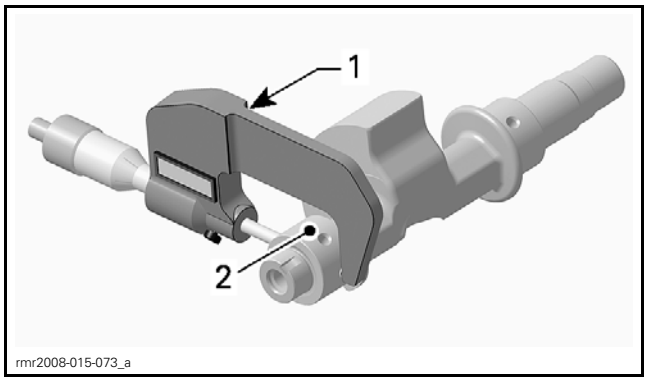
Clean balance shaft oil orifices and make sure they are not clogged.



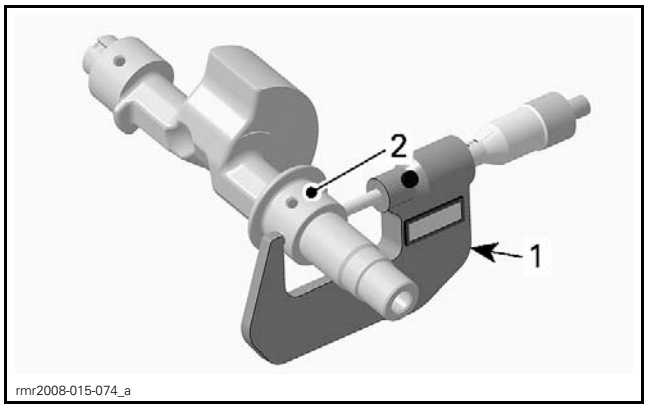
1. *Clean oil orifices*

Balance Shaft Radial Play (MAG/CLUTCH Side)

Measure balance shaft bearing journals on MAG/CLUTCH side. Compare to inside diameter of plain bearings in crankcase (refer to *CRANKCASE* in this subsection).



1. *Micrometer*
2. *Bearing journal — MAG side*



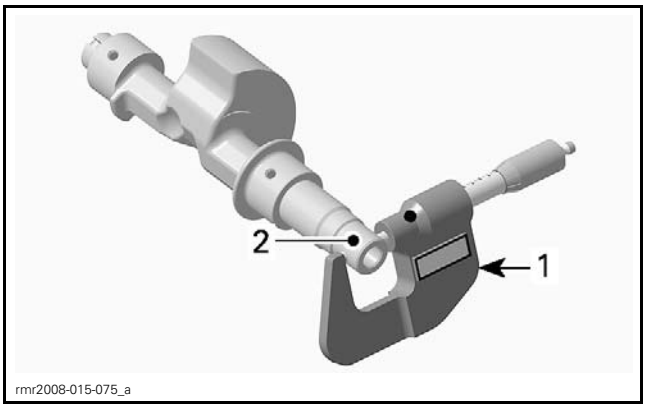
1. *Micrometer*
2. *Bearing journal — clutch side*

BALANCE SHAFT BEARING JOURNAL (MAG/CLUTCH SIDE)	
SERVICE LIMIT	31.980 mm (1.2591 in)

BALANCE SHAFT RADIAL PLAY (MAG/CLUTCH SIDE)	
SERVICE LIMIT	0.06 mm (.0024 in)

Balance Shaft Radial Play (Clutch Support Bearing Side)

Measure balance shaft bearing journal on clutch side (support bearing). Compare to inside diameter of plain bearing in clutch housing (refer to *CLUTCH HOUSING* in *CLUTCH* subsection).



1. Micrometer
2. Bearing journal — clutch support bearing

BALANCE SHAFT BEARING JOURNAL (CLUTCH SUPPORT BEARING)	
SERVICE LIMIT	19.990 mm (.787 in)

BALANCE SHAFT RADIAL PLAY (CLUTCH SUPPORT BEARING)	
SERVICE LIMIT	0.06 mm (.0024 in)

Balance Shaft Installation

The installation is the reverse of the removal procedure.