

TOP END

SERVICE TOOLS

Description	Part Number	Page
CRANKSHAFT LOCKING BOLT	529 035 617	21
DIAL INDICATOR ADAPTER	529 036 159	6
ENGINE LEAK DOWN TEST KIT	529 035 661	6
PISTON CIRCLIP INSTALLER.....	529 035 921	24
PISTON CIRCLIP INSTALLER.....	529 036 083	24
PISTON CIRCLIP INSTALLER.....	529 036 153	24
TDC DIAL INDICATOR	414 104 700	6
VALVE GUIDE INSTALLER	529 036 140	18
VALVE GUIDE INSTALLER	529 036 269	18
VALVE GUIDE REMOVER (6 MM)	529 036 074	18
VALVE GUIDE REMOVER 5 MM	529 035 924	18
VALVE SPRING COMPRESSOR CUP.....	529 035 764	14
VALVE SPRING COMPRESSOR CUP.....	529 036 270	14
VALVE SPRING COMPRESSOR	529 035 724	14

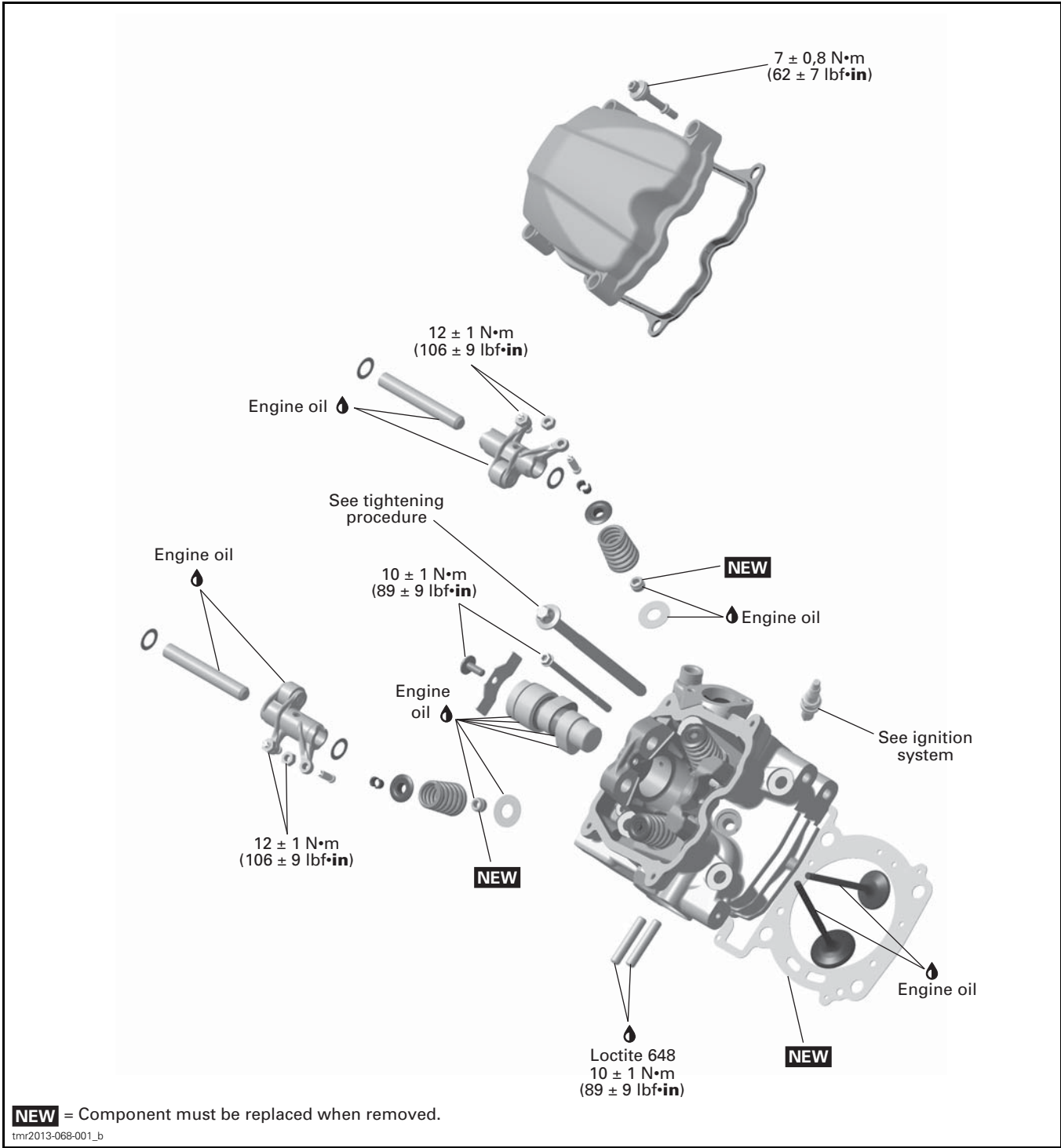
SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
SNAP-ON PLIERS.....	YA 8230	16

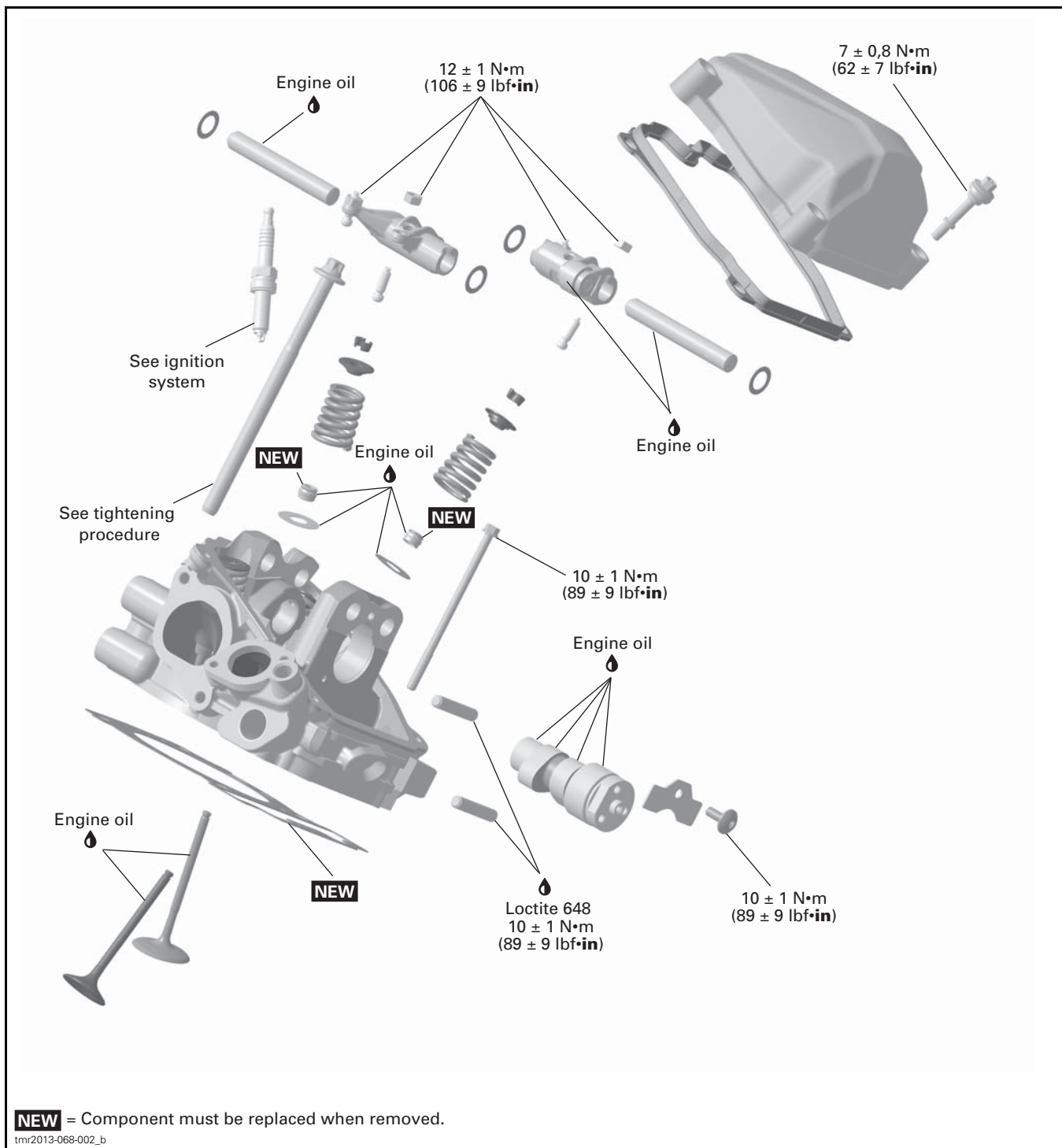
SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	19

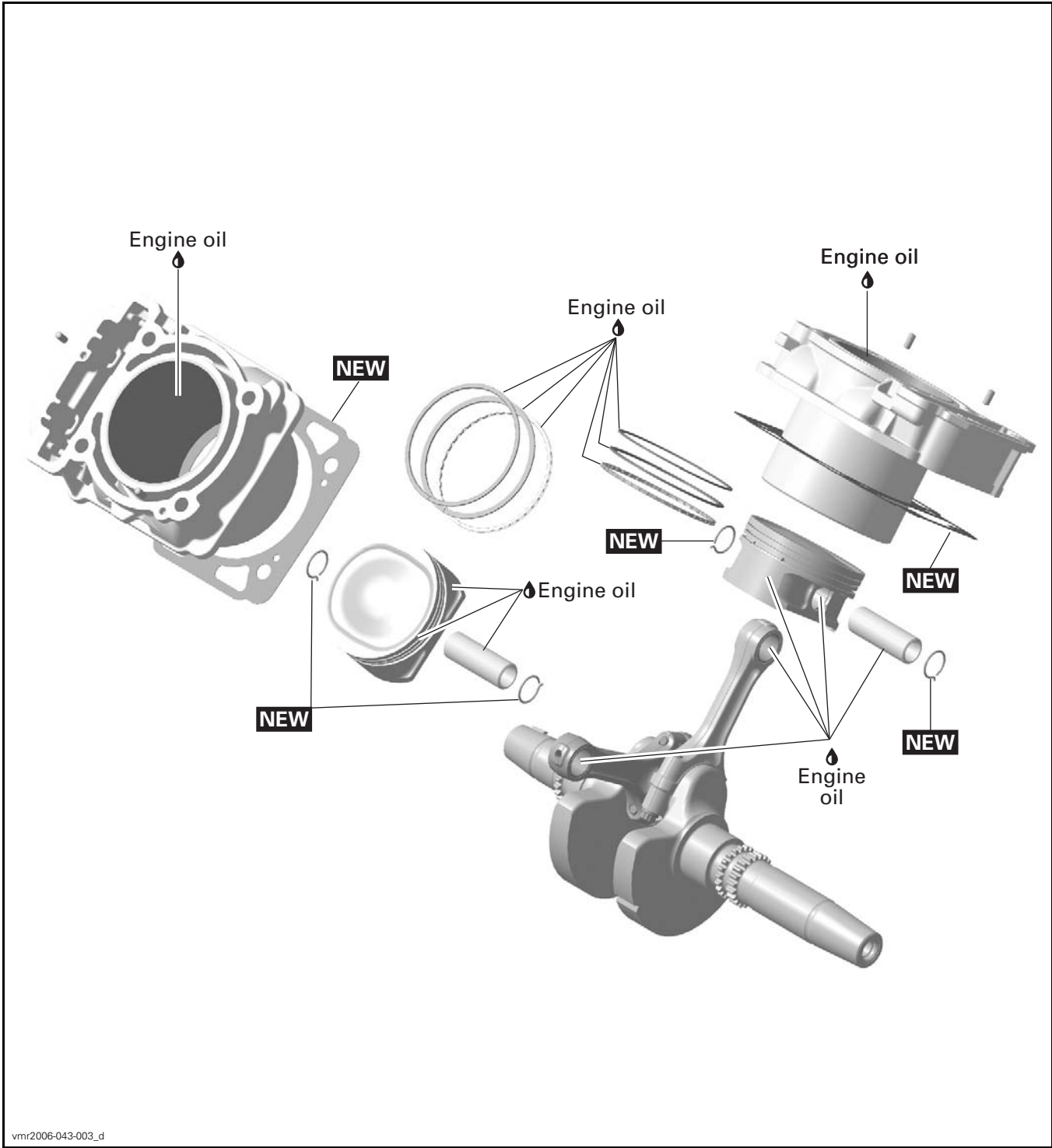
CYLINDER HEAD NO. 1



CYLINDER HEAD NO. 2

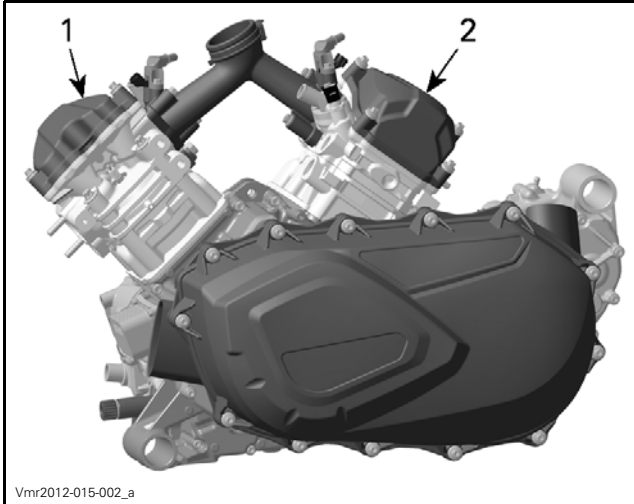


CYLINDERS AND PISTONS



GENERAL

Special reference are made in the text for procedures which are different for cylinder no. 1 and cylinder no. 2.



TYPICAL

1. Cylinder 1 (front)
2. Cylinder 2 (rear)

When diagnosing an engine problem, always perform a cylinder leak test.

NOTE: Even though the following procedures do not require the engine removal, many illustrations show the engine out of the vehicle for more clarity.

IMPORTANT: Note position of parts upon disassembly. This may help to find the root cause of a problem. A component that is not replaced should be reinstalled in the same position as originally mounted.

INSPECTION

LEAK TEST

Before performing the cylinder leak test, verify the following:

- Clamp(s) tightness
- Radiator and hoses.

NOTE: For best accuracy, the leak test should be done with the engine at normal operating temperature.

WARNING

Prevent burning yourself on hot engine parts.

Preparing the Leak Test

1. Disconnect battery.

WARNING

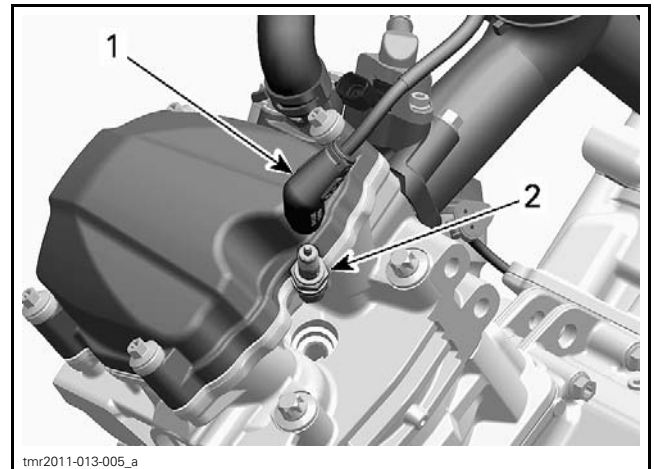
Always respect this order for disassembly; disconnect **BLACK (-)** cable first.

2. Remove radiator cap.

WARNING

To prevent being burned, ensure the radiator is cool and wear the appropriate safety equipment before removing the radiator cap.

3. Unplug spark plug cable.
4. Clean spark plug area and remove spark plug from cylinder head.



1. Spark plug cable
2. Spark plug

5. Remove *VALVE COVER*. See procedure in this subsection.
6. Rotate crankshaft until piston is at ignition TDC.
7. Turn crankshaft using one of the following two procedures.

First Procedure

Turn the drive pulley.

Second Procedure

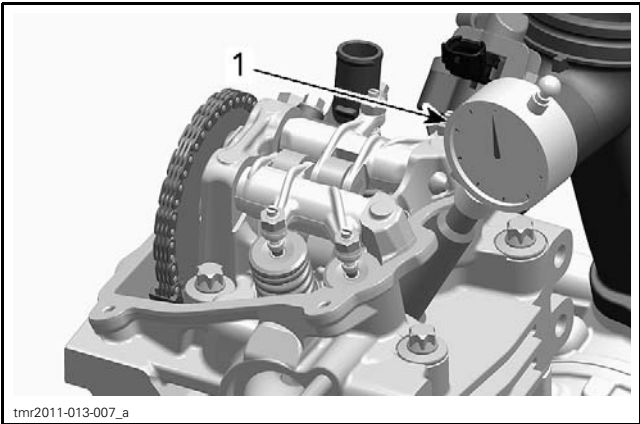
1. Remove plug screw with O-ring from magneto cover.
2. Use a 14 mm Allen key and turn crankshaft.

NOTICE Turn only clockwise to avoid loosening of magneto flywheel Allen screw.

3. Set the piston to precisely ignition TDC.

Subsection 08 (TOP END)

ENGINE	REQUIRED TOOL	
All	TDC DIAL INDICATOR (P/N 414 104 700)	
850 and 1000R	DIAL INDICATOR ADAPTER (P/N 529 036 159)	

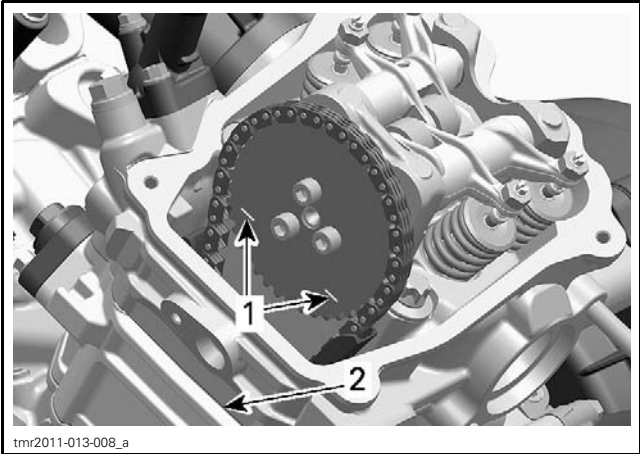


1. TDC dial indicator

NOTE: If a dial gauge is not available, use a screw-driver or another similarly suitable tool.

NOTICE Do not scratch or damage piston/cylinder surface.

NOTE: At ignition TDC the marks on the camshaft timing gear have to be parallel to cylinder head base as per following illustration.



1. Marks on camshaft timing gear
2. Cylinder head base

Leak Test

1. Install the gauge adapter in the spark plug hole.

REQUIRED TOOL	
ENGINE LEAK DOWN TEST KIT (P/N 529 035 661)	

2. Connect to an adequate air supply.
 3. Set needle of measuring gauge to zero.
- NOTE:** All testers have specific instructions on gauge operation and required pressure.
4. Supply combustion chamber with air pressure.
 5. Note the amount or percentage of leakage (depending on tester).

LEAKAGE PERCENTAGE	ENGINE CONDITION
0% to 15%	Excellent condition
16% to 25%	Good condition
26% to 40%	Fair condition; reduced engine performance
41% and higher	Poor condition, diagnose and repair engine

NOTE: To make sure there is no false reading due to a valve not being perfectly seated, tap each valve adjustment screw (on the rocker arm) using a soft hammer.

Diagnosis

- Listen for air leaks.
- Air escaping in intake port/throttle body means leaking intake valve(s).
 - Air escaping in exhaust port means leaking exhaust valve(s).
 - Air bubbles in the coolant (radiator) means leaking cylinder head gasket.
 - Air/coolant escaping from cylinder/head means damaged gasket(s) and/or loosened screws.
 - Air escaping into crankcase area means excessively worn cylinder and/or broken piston rings.
 - Air/oil escaping from crankcase means damaged gasket and/or loosened screws (refer to *BOTTOM END* subsection).

NOTE: For all checkpoints mentioned above, see appropriate engine section to diagnose and repair the engine.

Reassembly

Reverse the preparation procedure. Ensure to respect torque values and use of appropriate products/lubricants. Refer to exploded views in other subsections of this manual as required.

PROCEDURES

VALVE COVER

Valve Cover Access

Front Cylinder

Refer to *BODY* subsection and remove the following.

- Seat
- Console
- RH side panel
- RH inner fender panel

Rear Cylinder

Refer to *BODY* and remove:

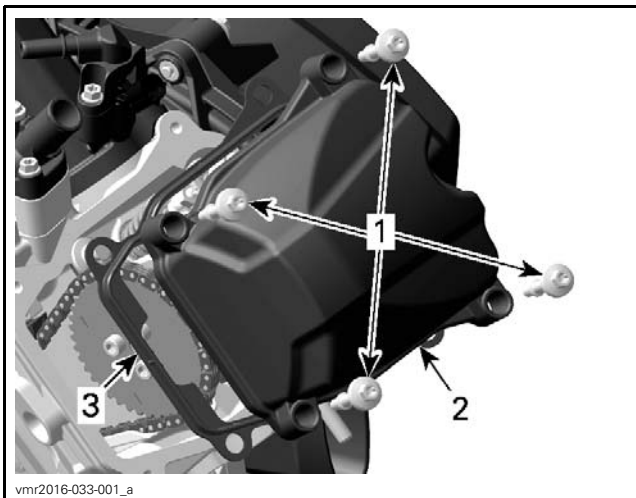
- Seat
- Console
- RH side panel
- LH side panel.

Refer to *EXHAUST SYSTEM* and remove exhaust pipe.

Removing the Valve Cover

Remove:

- Valve cover screws
- Valve cover
- Gasket.



TYPICAL — FRONT CYLINDER SHOWN

1. Valve cover screws
2. Valve cover
3. Gasket

Inspecting the Valve Cover

Check the gasket on the valve cover if it is brittle, cracked or hard. If so, replace the gasket.

Installing the Valve Cover

For installation, reverse the removal procedure. However, pay attention to the following.

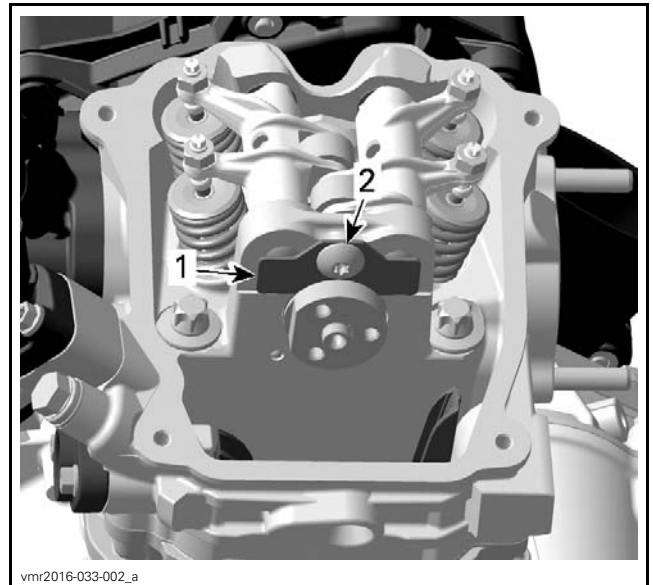
Tighten valve cover retaining screws to specified torque in a criss-cross sequence.

TIGHTENING TORQUE	
Valve cover retaining screws	7 N•m ± 0.8 N•m (62 lbf•in ± 7 lbf•in)

ROCKER ARM

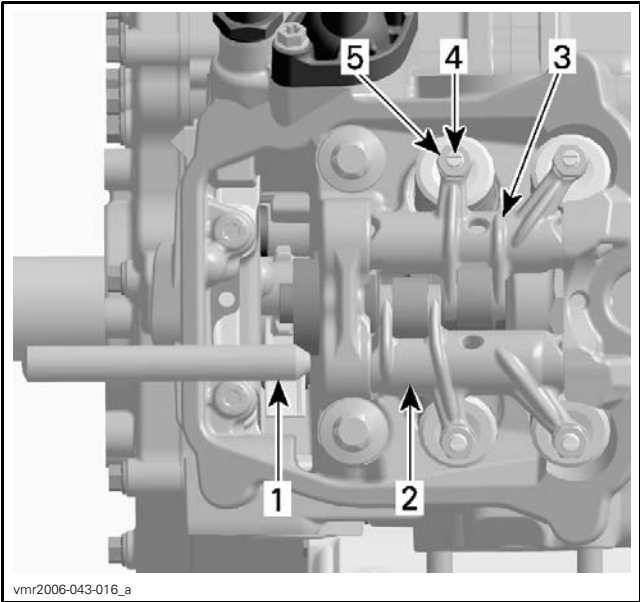
Removing the Rocker Arm

1. Remove *VALVE COVER*. See procedure in this subsection.
2. Refer to *TIMING CHAIN* subsection and remove following parts:
 - Timing chain tensioner
 - Camshaft timing gear.
3. Remove pan head screw and camshaft retaining plate.



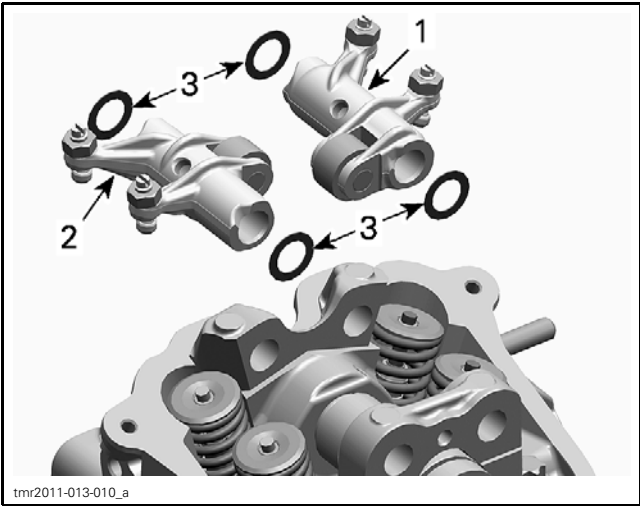
1. Camshaft retaining plate
2. Pan head screw

4. Remove rocker arm shafts.



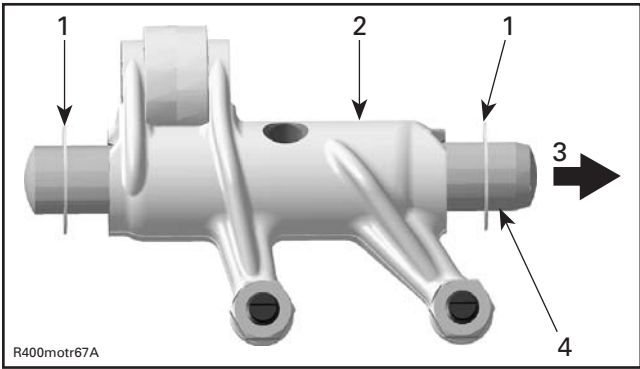
- 1. Rocker arm shaft
- 2. Rocker arm (exhaust side)
- 3. Rocker arm (intake side)
- 4. Adjustment screw
- 5. Lock nut

- 5. Remove rocker arm assembly (exhaust side and intake side) with adjustment screws and lock nuts.
- 6. Remove thrust washers.



- 1. Rocker arm (exhaust side)
- 2. Rocker arm (intake side)
- 3. Thrust washers

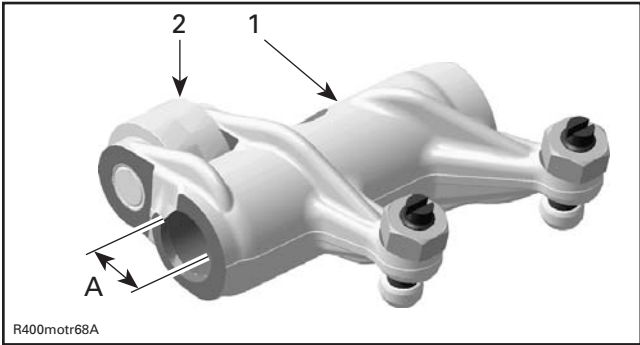
NOTICE Pay attention not to lose thrust washers or drop them into the timing chain compartment.



- 1. 2 thrust washers
- 2. Rocker arm (exhaust side)
- 3. Cylinder head (spark plug side)
- 4. Big taper to spark plug side

Inspecting the Rocker Arm

Inspect each rocker arm for cracks and scored friction surfaces. If so, replace rocker arm assembly. Check the rocker arm rollers for free movement, wear and excessive radial play. Replace rocker arm assembly if necessary.

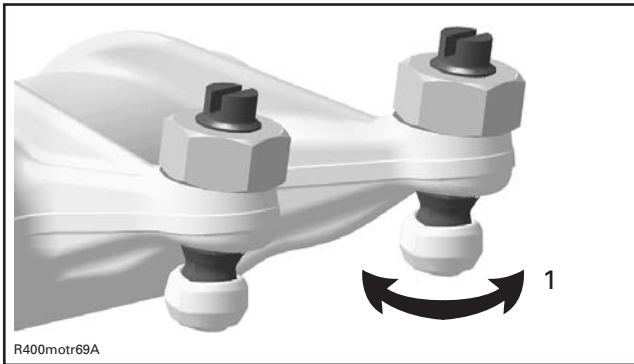


- 1. Rocker arm (exhaust side)
- 2. Roller
- A. Bore for rocker arm shaft

Measure rocker arm bore diameter. If diameter is out of specification, change the rocker arm assembly.

ROCKER ARM BORE DIAMETER	
NEW	12.036 mm to 12.050 mm (.4739 in to .4744 in)
SERVICE LIMIT	12.060 mm (.4748 in)

Check adjustment screws for free movement, cracks and/or excessive play.

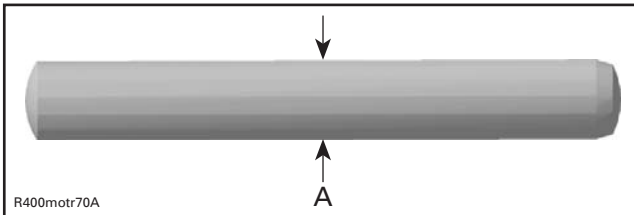


1. Free movement of adjustment screw top

Inspecting the Rocker Arm Shaft

Check for scored friction surfaces; if so, replace parts.

Measure rocker arm shaft diameter.



A. Measure rocker arm shaft diameter here

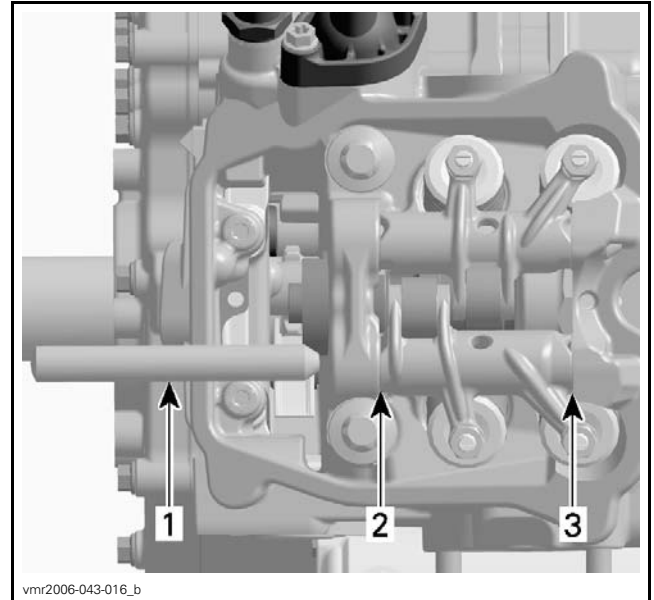
ROCKER ARM SHAFT DIAMETER	
NEW	12.000 mm to 12.018 mm (.4724 in to .4731 in)
SERVICE LIMIT	11.990 mm (.472 in)

Any area worn excessively will require parts replacement.

Installing the Rocker Arm

NOTE: Use the same procedure for exhaust and intake rocker arm.

1. Apply engine oil on rocker arm shaft.
2. Insert a rocker arm shaft with the chamfered edge first through rocker arm pin bore.
3. Install a thrust washer at timing chain side, then the proper rocker arm (exhaust side or intake side).
4. Push in rocker arm shaft until its chamfer reaches the end of rocker arm bore.



1. Rocker arm shaft
2. Thrust washer (timing chain side)
3. Thrust washer (spark plug side)

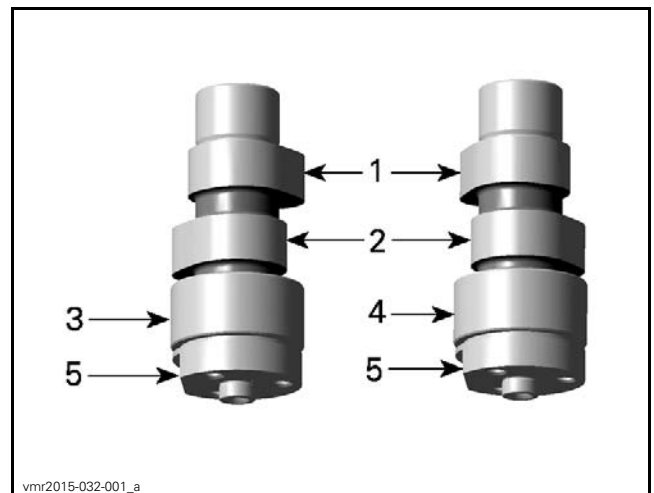
5. Place the other thrust washer and push rocker arm shaft to end position.

6. Install the camshaft retaining plate.

7. Adjust valve clearance, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

CAMSHAFT

NOTE: The engine is equipped with two different camshafts.



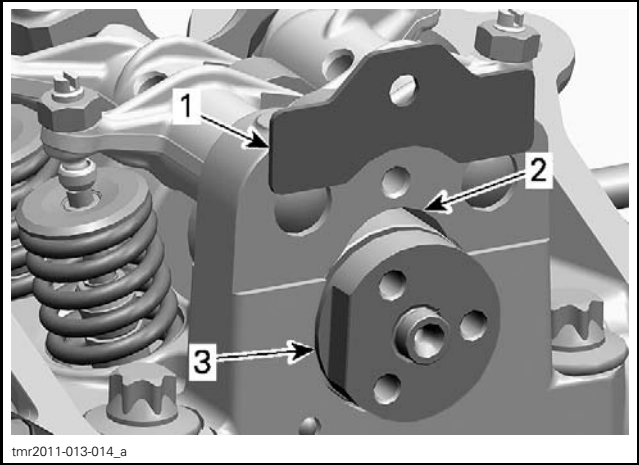
1. Intake cam
2. Exhaust cam
3. Camshaft of cylinder 1
4. Camshaft of cylinder 2
5. Flat spot

Removing the Camshaft

The removal procedure is the same for both camshafts.

NOTICE Each camshaft is different in design. Thus, it is important not to mix up any parts of the camshaft assembly with that of the other cylinder. Keep parts as a group.

- 1. Remove valve cover (see *VALVE COVER* in this subsection).
- 2. Refer to the *TIMING CHAIN* subsection to remove the following parts:
 - Chain tensioner
 - Camshaft timing gear.
- 3. Remove the camshaft retaining plate.



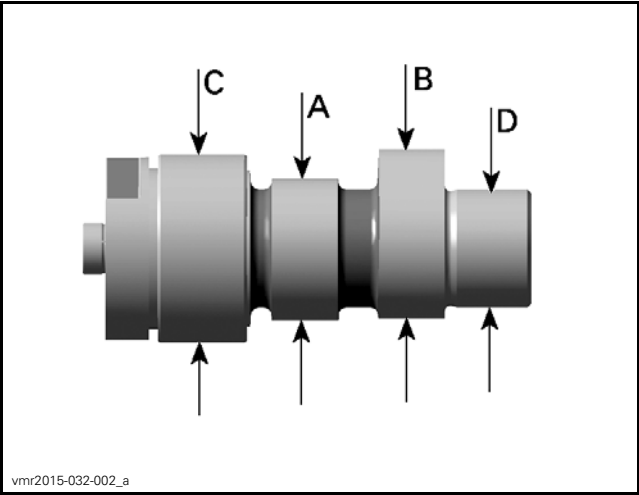
1. Camshaft retaining plate
2. Area for camshaft lobes
3. Camshaft

Inspecting the Camshaft

Inspecting the Camshaft Lobe

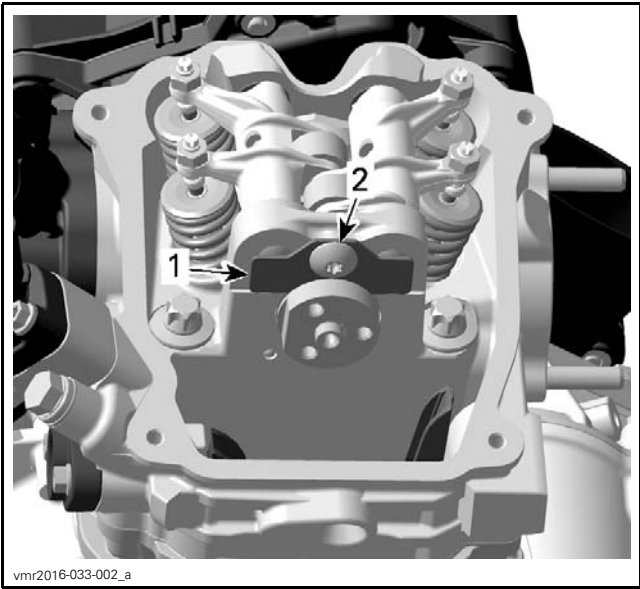
Check each lobe for scoring, scuffing, cracks or other signs of wear.

Measure camshaft lobe height using a micrometer.



A. Camshaft lobe (exhaust valves)
B. Camshaft lobe (intake valves)
C. Camshaft journal (timing chain side)
D. Camshaft journal (spark plug side)

CAMSHAFT LOBE (INTAKE)		
570 engine	NEW	31.830 mm to 32.030 mm (1.2531 in to 1.261 in)
	SERVICE LIMIT	31.810 mm (1.2524 in)



1. Camshaft retaining plate
2. Pan head screw
3. Cylinder head

- 4. Remove rocker arms (see *ROCKER ARM* in this subsection).
- 5. Remove the camshaft.

NOTE: For removal rotate camshaft so that intake/exhaust lobe shows to upper side of cylinder head.

CAMSHAFT LOBE (INTAKE)		
850 engine	NEW	32.890 mm to 33.090 mm (1.2949 in to 1.3028 in)
	SERVICE LIMIT	32.870 mm (1.2941 in)
1000R engine	NEW	32.960 mm to 33.160 mm (1.2976 in to 1.3055 in)
	SERVICE LIMIT	32.940 mm (1.2969 in)

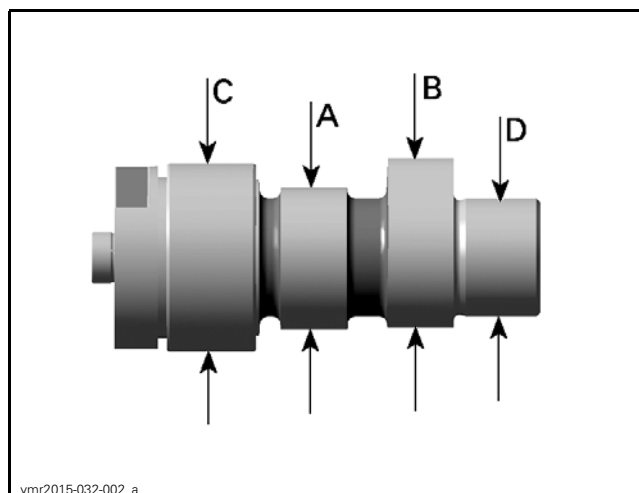
CAMSHAFT LOBE (EXHAUST)		
570 engine	NEW	31.730 mm to 31.930 mm (1.2492 in to 1.2571 in)
	SERVICE LIMIT	31.710 mm (1.2484 in)
850 engine	NEW	32.950 mm to 33.150 mm (1.2972 in to 1.3051 in)
	SERVICE LIMIT	32.930 mm (1.2965 in)
1000R engine	NEW	32.860 mm to 33.060 mm (1.2937 in to 1.3016 in)
	SERVICE LIMIT	32.840 mm (1.2929 in)

Measure camshaft bearing in cylinder head. Refer to *CYLINDER HEAD INSPECTION* in this subsection.

Inspecting the Camshaft Journal

Check each journal for scoring, scuffing, cracks or other signs of wear.

Measure camshaft journal using a micrometer.



- A. Camshaft lobe (exhaust valves)
 B. Camshaft lobe (intake valves)
 C. Camshaft journal (timing chain side)
 D. Camshaft journal (spark plug side)

CAMSHAFT JOURNAL (TIMING CHAIN SIDE)	
NEW	34.959 mm to 34.975 mm (1.3763 in to 1.377 in)
SERVICE LIMIT	34.950 mm (1.376 in)

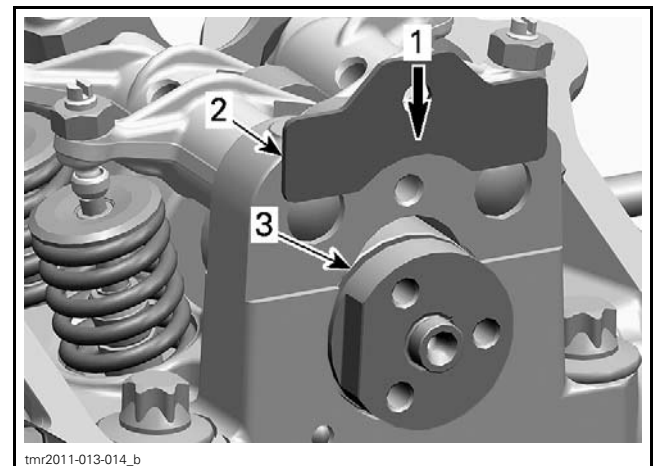
CAMSHAFT JOURNAL (SPARK PLUG SIDE)	
NEW	21.959 mm to 21.980 mm (.8645 in to .8654 in)
SERVICE LIMIT	21.950 mm (.8642 in)

Installing the Camshaft

Reverse the removal procedure. Pay attention to the following details.

NOTICE The camshafts are not identical in design. Do not invert the camshafts during assembly. Any mix-up of the components will lead to engine damage.

Place the camshaft retaining plate in the slot of the camshaft.



1. Direction of movement
 2. Camshaft retaining plate
 3. Slot retaining camshaft

For other parts, refer to proper installation procedure.

CYLINDER HEAD

Cylinder Head Access

Refer to *VALVE COVER* in this subsection.

Removing the Cylinder Head

1. The removal procedure is the same for both cylinder heads.

Subsection 08 (TOP END)

2. Drain coolant (refer to *PERIODIC MAINTENANCE PROCEDURES* subsection).

3. Disconnect the coolant hose from the thermostat housing.

NOTE: Before removing cylinder head, blow out remaining coolant by air pressure. During cylinder head removal, the remaining coolant in cylinder head could overflow into the engine and a little quantity of coolant could drop into the engine. In this case, the engine oil will be contaminated.

4. Refer to *EXHAUST SYSTEM* subsection and disconnect exhaust system head pipe from cylinder head.

5. Disconnect spark plug wire.

6. Disconnect temperature sensor connector, located at rear cylinder head.

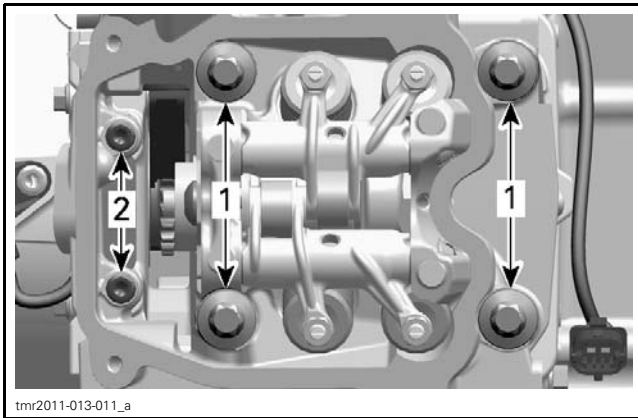
7. Remove the intake manifold. Refer to *INTAKE MANIFOLD* subsection.

8. Remove the valve cover and its gasket (see *VALVE COVER* in this subsection).

9. Refer to the *TIMING CHAIN* subsection to remove the following parts:

- Chain tensioner
- Camshaft timing gear.

10. First remove the M6 cylinder head screws, then the cylinder head screws M10.

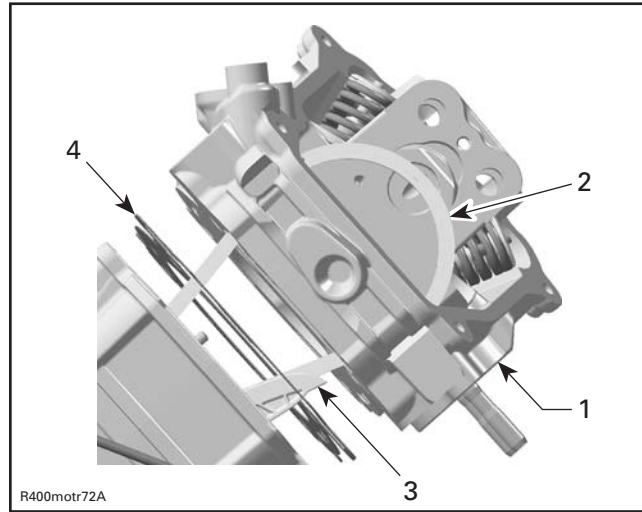


1. Cylinder head screws M10
2. Cylinder head screws M6

11. Pull up cylinder head.

12. Remove timing chain guide (fixed).

13. Remove and discard the cylinder head gasket.



1. Cylinder head
2. Timing chain
3. Chain guide (fixed)
4. Cylinder head gasket

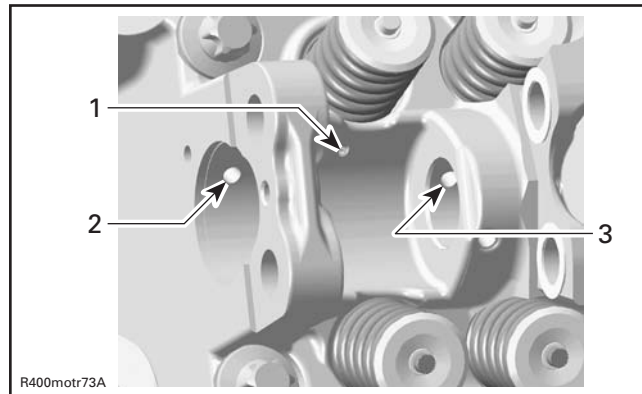
Inspecting the Cylinder Head

Inspect timing chain guide (fixed) for wear, cracks or other damages. Replace if necessary.

Check for cracks between valve seats, if so, replace cylinder head.

Check mating surface between cylinder and cylinder head for contamination. If so, clean both surfaces.

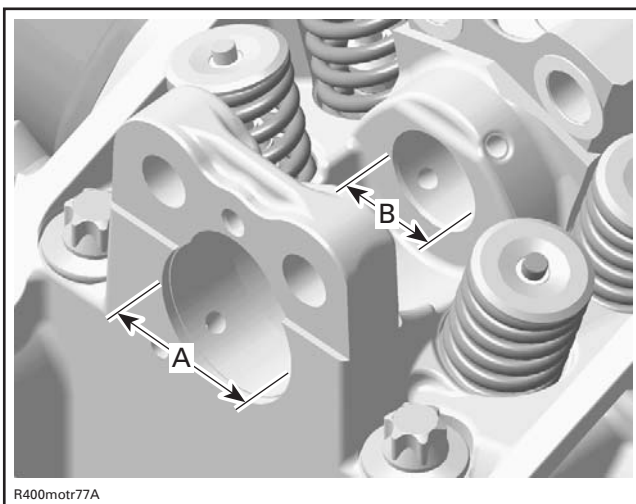
Clean oil support through the cylinder head from contamination.



1. Oil port to lubricate camshaft lobes intake/exhaust
2. Oil supply to camshaft bearing journal (timing chain side)
3. Oil supply to camshaft bearing journal (spark plug side)

Inspecting the Cylinder Head Camshaft Bearing

Measure camshaft bearing in cylinder head.



A. Camshaft bearing (timing chain side)
B. Camshaft bearing (spark plug side)

CAMSHAFT BEARING (TIMING CHAIN SIDE)	
NEW	35.000 mm to 35.025 mm (1.378 in to 1.3789 in)
SERVICE LIMIT	35.040 mm (1.3795 in)
CAMSHAFT BEARING (SPARK PLUG SIDE)	
NEW	22.000 mm to 22.021 mm (.8661 in to .867 in)
SERVICE LIMIT	22.040 mm (.8677 in)

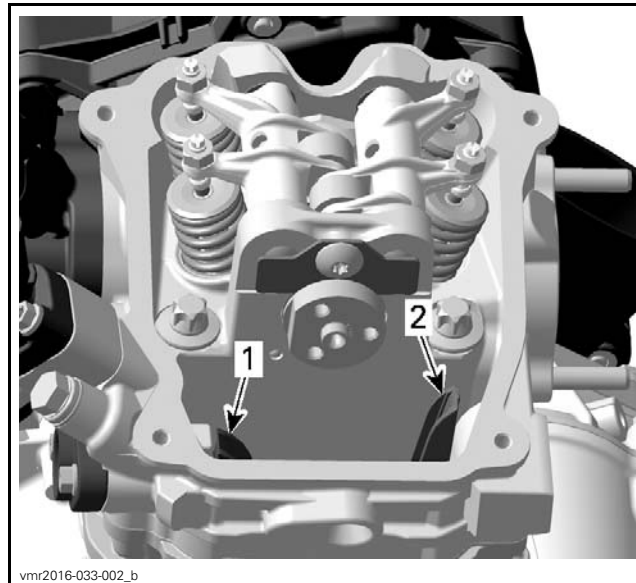
Installing the Cylinder Head

NOTE: Front and rear cylinder heads are not identical. **Never** interchange cylinder heads.

Reverse the removal procedure. Pay attention to the following details.

Ensure dowel pins are in place.

NOTICE Timing chain guide (fixed) has to be fixed between cylinder and cylinder head.

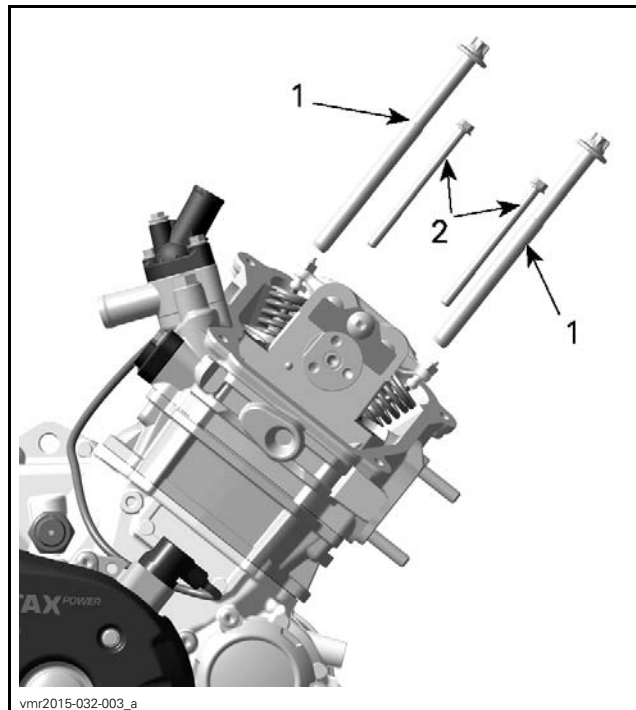


1. Timing chain guide (tensioner side) mounted in crankcase
2. Timing chain guide (fixed) between cylinder and cylinder head

Install a **NEW** cylinder head gasket.

Install cylinder head screws in correct position.

NOTICE Cylinder head screws have different sizes and lengths.



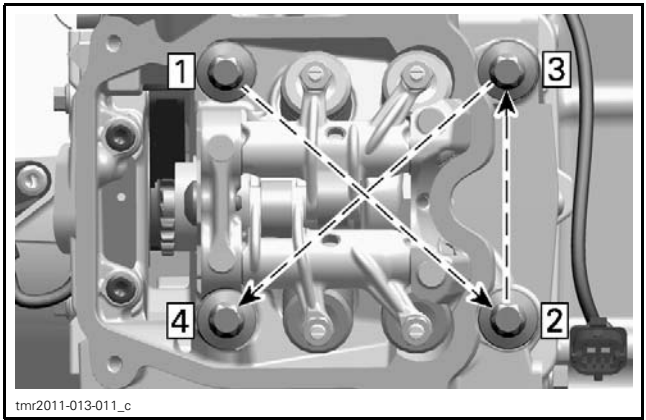
1. Location no. 1
2. Location no. 2

Subsection 08 (TOP END)

CYLINDER HEAD SCREW IDENTIFICATION		
570 and 850 engines	Location no. 1	M10 x 140
	Location no. 2	M6 x 85
1000R engine	Location no. 1	M10 x 159
	Location no. 2	M6 x 105

Tighten M10 cylinder head screws FIRST as per following specifications.

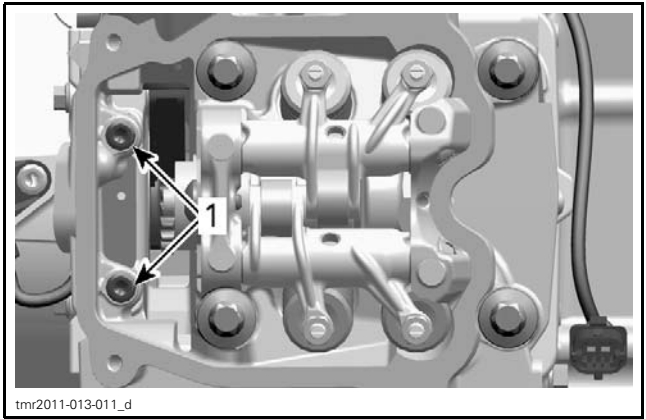
NOTE: Always perform one step on all M10 cylinder head screws before going to the next step.



TIGHTENING SEQUENCE - M10 CYLINDER HEAD SCREWS

TIGHTENING TORQUE		
M10 cylinder head screws	STEP A	20 N•m ± 1 N•m (15 lbf•ft ± 1 lbf•ft)
	STEP B	180° +/- 5°

Tighten M6 cylinder head screws as per following specification.



1. M6 Screws

TIGHTENING TORQUE	
M6 cylinder head screws	10 N•m ± 1 N•m (89 lbf•in ± 9 lbf•in)

Check timing chain guide (tensioner side) for movement.

Refer to applicable subsection for installation details of remaining removed parts.

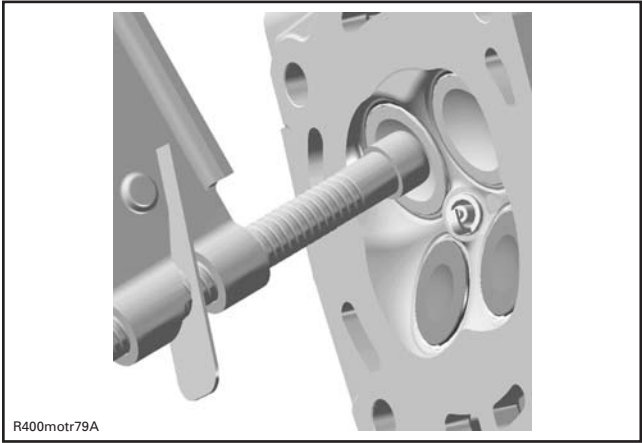
VALVE SPRINGS

Removing the Valve Spring

1. Refer to following procedures in this subsection to remove:
 - CAMSHAFT
 - CYLINDER HEAD.
2. Remove valve spring.

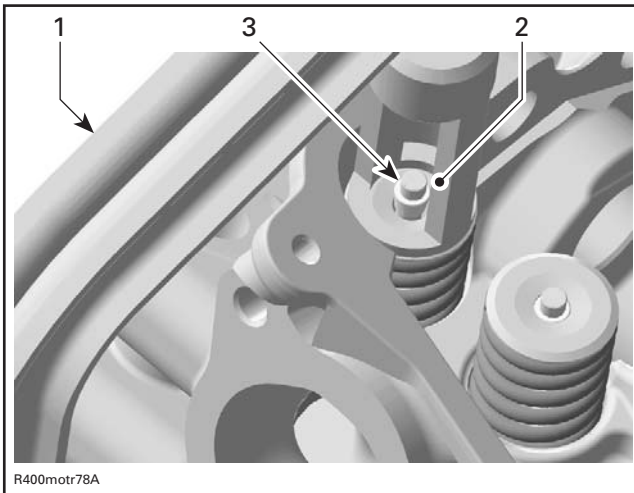
ENGINE	REQUIRED TOOL	
All engines	VALVE SPRING COMPRESSOR (P/N 529 035 724)	
570 engine	VALVE SPRING COMPRESSOR CUP (P/N 529 035 764)	
850 and 1000R engines	VALVE SPRING COMPRESSOR CUP (P/N 529 036 270)	

WARNING
Always wear safety glasses when disassembling valve springs. Be careful when unlocking valves. Components could fly away because of the strong spring preload.



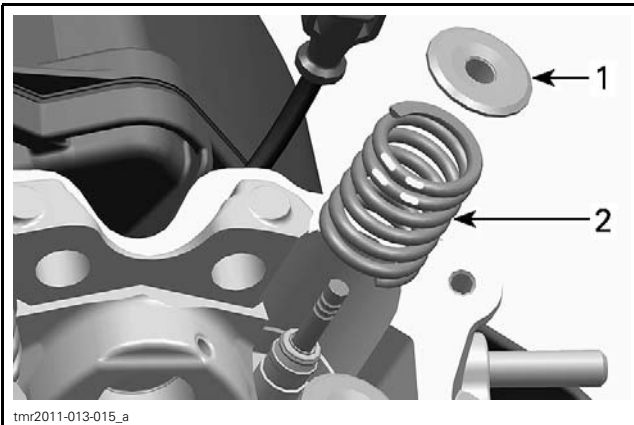
LOCATE VALVE SPRING COMPRESSOR CLAMP IN CENTER OF THE VALVE

3. Remove valve cotters.



1. Valve spring compressor clamp
2. Valve spring compressor cup
3. Valve cotter

4. Remove tools and withdraw valve spring retainer and valve spring.

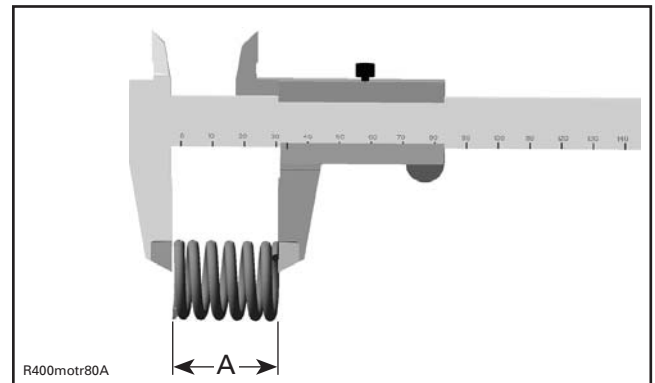


1. Valve spring retainer
2. Valve spring

Inspecting the Valve Spring

Check valve spring for visible damage. If so, replace valve spring.

Check valve spring for free length and straightness.



A. Valve spring length

VALVE SPRING FREE LENGTH		
570 ENGINE	NOMINAL NEW	40.81 mm (1.607 in)
850 AND 1000R ENGINES	NOMINAL NEW	40.41 mm (1.591 in)
ALL ENGINES	Service limit	39.00 mm (1.535 in)

Replace valve springs if not within specifications.

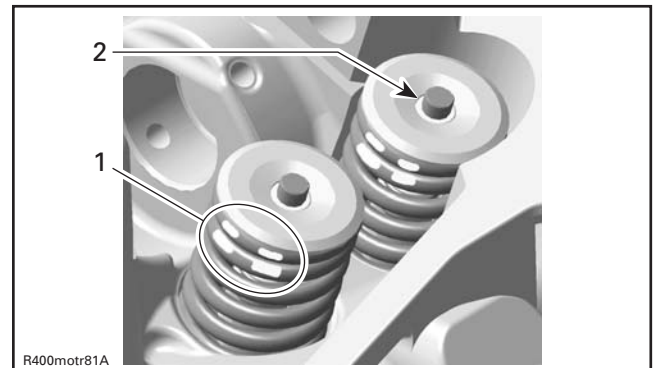
Installing the Valve Spring

For installation, reverse the removal procedure. Pay attention to the following details.

Colored area of the valve spring must be placed on top.

To ease installation of cotters, apply oil or grease on them so that they remain in place while releasing the spring.

NOTE: Valve cotter must be properly engaged in valve stem grooves.



1. Position of the valve spring
2. Valve cotter

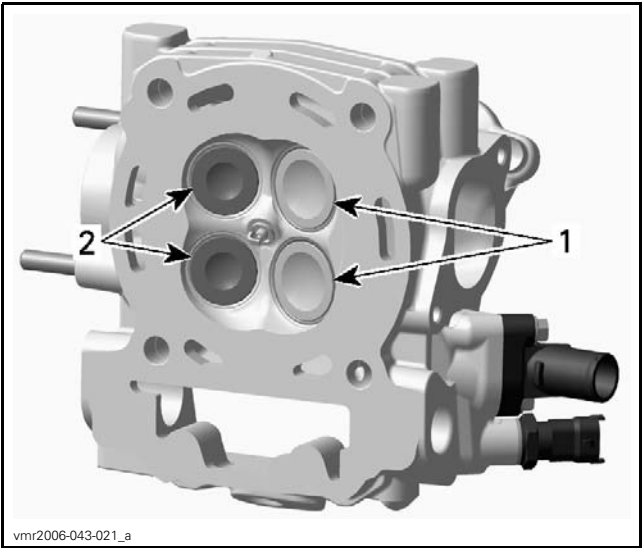
After spring is installed, ensure it is properly locked by tapping on valve stem end with a soft hammer so that valve opens and closes a few times.

NOTICE An improperly locked valve spring will cause engine damage.

VALVES

Removing the Valve

- 1. Remove valve spring, see *VALVE SPRING* in this subsection.
- 2. Push valve stem, then pull valves (intake and exhaust) out of valve guide.



- 1. Intake valves 31 mm
- 2. Exhaust valves 27 mm

- 3. Remove valve stem seal and discard it.

REQUIRED TOOL
SNAP-ON PLIERS (P/N YA 8230)



Inspecting the Valve

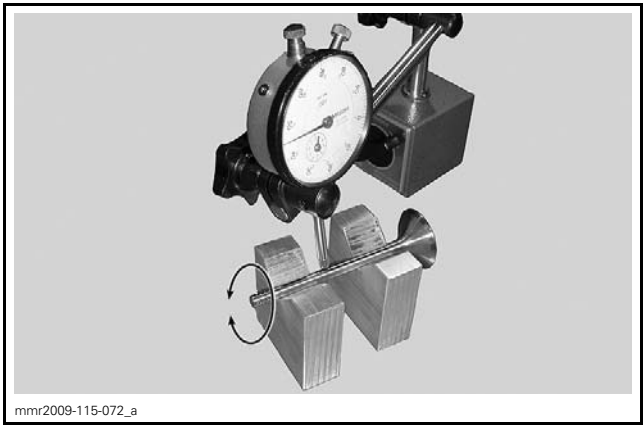
Whenever valves are removed always inspect valve guides. Refer to *VALVE GUIDES* in this subsection.

Valve Stem Seal

Always install **NEW** seals whenever valves are removed.

Inspecting the Valve

Inspect valve surface, check for abnormal stem wear and bending. If out of specification, replace by a new one.

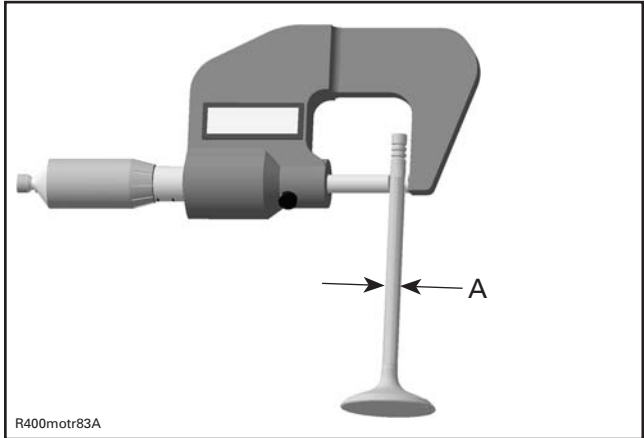


VALVE OUT OF ROUND (INTAKE AND EXHAUST VALVES)	
NEW	0.005 mm (.0002 in)
SERVICE LIMIT	0.06 mm (.0024 in)

Inspecting the Valve Stem

Measure valve stem in three places using a micrometer.

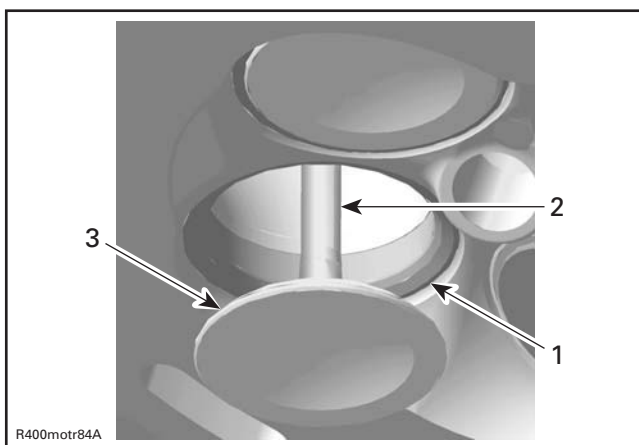
Replace valve if valve stem is out of specification or has other damages such as wear or friction surface.



A. Valve stem diameter

VALVE STEM DIAMETER		
EXHAUST VALVE		
570 engine	NEW	4.956 mm to 4.970 mm (.1951 in to .1957 in)
	SERVICE LIMIT	4.930 mm (.1941 in)
850 and 1000R engines	NEW	5.461 mm to 5.476 mm (.215 in to .2156 in)
	SERVICE LIMIT	5.440 mm (.2142 in)
INTAKE VALVE		
570 engine	NEW	4.966 mm to 4.980 mm (.1955 in to .1961 in)
	SERVICE LIMIT	4.930 mm (.1941 in)
850 and 1000R engines	NEW	5.472 mm to 5.486 mm (.2154 in to .216 in)
	SERVICE LIMIT	5.450 mm (.2146 in)

Inspecting the Valve Face and Seat



1. Valve seat
2. Exhaust valve contaminated area
3. Valve face (contact surface to valve seat)

Check valve face and seat for burning or pitting and replace valve or cylinder head if there are signs of damage.

Ensure to seat valves properly. Apply some lapping compound to valve face and work valve on its seat with a lapping tool (see *VALVE GUIDES* in this subsection).

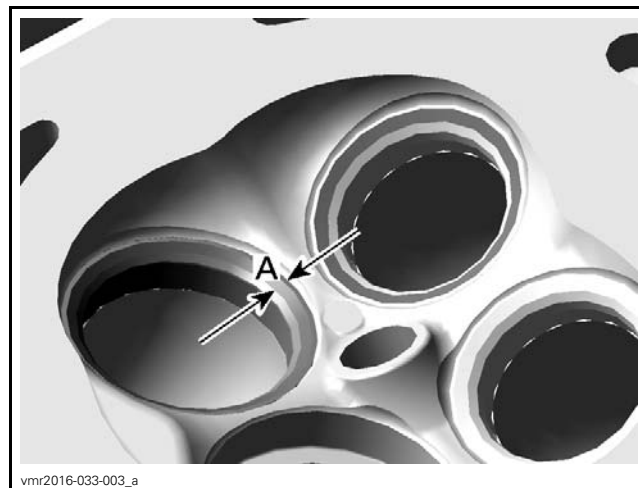
Measure valve face contact width.

NOTE: The location of contact area should be in center of valve seat.

Measure valve seat width using a caliper.

VALVE SEAT CONTACT WIDTH	
EXHAUST VALVE	
NEW	1.25 mm to 1.55 mm (.049 in to .061 in)
SERVICE LIMIT	2.00 mm (.079 in)
INTAKE VALVE	
NEW	1.05 mm to 1.35 mm (.041 in to .053 in)
SERVICE LIMIT	1.80 mm (.071 in)

If valve seat contact width is too wide or has dark spots, replace the cylinder head.



A. Valve seat contact width

Installing the Valve

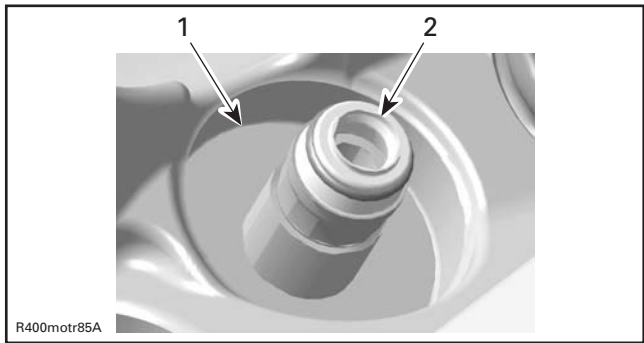
Reverse the removal procedure. Pay attention to the following details.

Install a **NEW** valve stem seal. Make sure thrust washer is installed before installing seal.

Apply engine oil on valve stem and install it.

NOTICE Be careful when valve stem is passed through sealing lips of valve stem seal.

Subsection 08 (TOP END)



1. Thrust washer
2. Sealing lips of valve stem seal

To ease installation of cotters, apply oil or grease on them so that they remain in place while releasing the spring.

After spring is installed, ensure it is properly locked by tapping on valve stem end with a soft hammer so that valve opens and closes a few times.

NOTICE An improperly locked valve spring will cause engine damage.

VALVE GUIDES

Inspecting the Valve Guide

Always replace valve stem seals whenever valve guides are removed.

Measure valve guide in three places using a small bore gauge.

NOTE: Clean valve guide to remove carbon deposits before measuring.

Replace valve guide if it is out of specification or has other damages such as wear or friction surface.

VALVE GUIDE DIAMETER (INTAKE AND EXHAUST VALVES)		
570 ENGINE	NEW	4.998 mm to 5.018 mm (.1968 in to .1976 in)
	SERVICE LIMIT	5.050 mm (.1988 in)
850 AND 1000R ENGINES	NEW	5.506 mm to 5.518 mm (.2168 in to .2172 in)
	SERVICE LIMIT	5.568 mm (.2192 in)

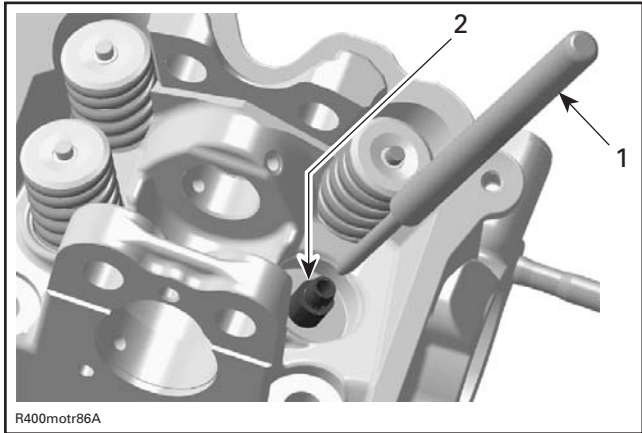
Removing the Valve Guide

1. Remove cylinder head (see *CYLINDER HEAD* in this subsection).
2. Remove valves (see *VALVES* in this subsection).

NOTE: Clean valve guide area from contamination before removal.

3. Drive valve guide out of cylinder head using specified tool.

ENGINE	REQUIRED TOOL	
570 engine	VALVE GUIDE REMOVER 5 MM (P/N 529 035 924)	
850 and 1000R engines	VALVE GUIDE REMOVER (6 MM) (P/N 529 036 074)	
All engines	Hammer	



1. Valve guide remover
2. Valve guide

Installing the Valve Guide

For installation, reverse the removal procedure. Pay attention to the following details.

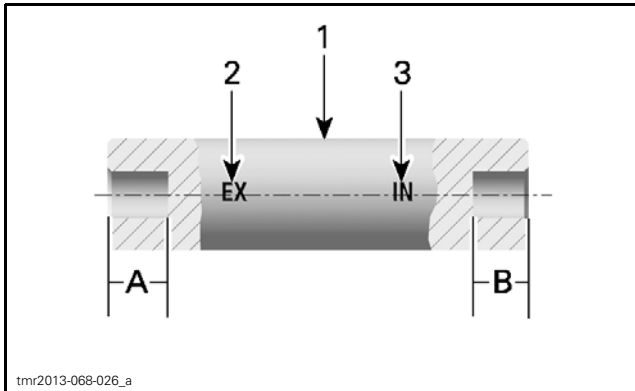
Clean the valve guide bore before reinstalling the valve guide into cylinder head.

Install valve guide.

ENGINE	REQUIRED TOOL	
570 engine	VALVE GUIDE INSTALLER (P/N 529 036 140)	
850 and 1000R engines	VALVE GUIDE INSTALLER (P/N 529 036 269)	

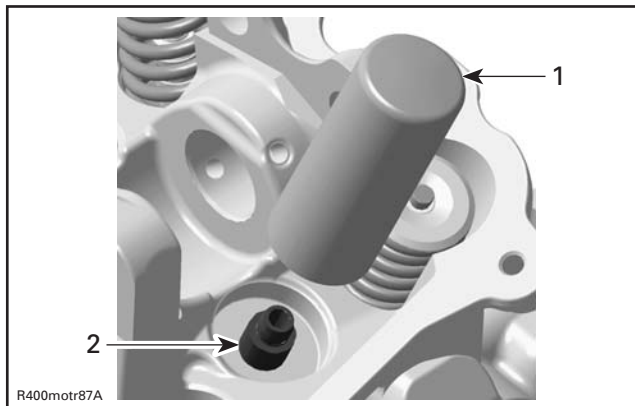
850 and 1000R Engines

NOTICE Valve guide installer is used for intake and exhaust valve guides. Choose proper side for installation.



1. Valve guide installer
 2. Mark "EX" - exhaust valve guide installer
 3. Mark "IN" - intake valve guide installer
- A. 14.5 mm (.571 in)
B. 13.3 mm (.524 in)

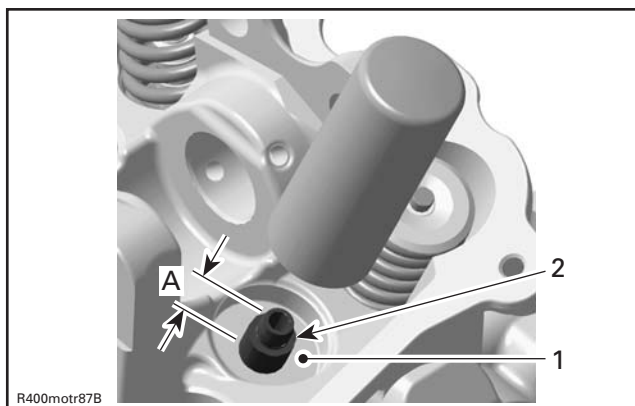
All Engines



1. Valve guide installer
2. Valve guide

NOTE: Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) on valve guide prior to install it into the cylinder head.

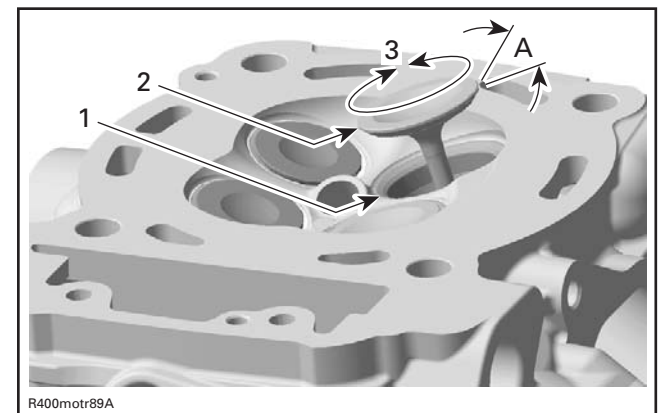
NOTICE Push valve guide in the cold cylinder head as per following illustration.



1. Thrust surface of cylinder head
 2. Valve guide
- A. Measurement from thrust surface to valve guide top

VALVE GUIDE (MEASUREMENT A)		
570 ENGINE	INTAKE and EXHAUST	14.00 mm to 14.40 mm (.5512 in to .5669 in)
850 AND 1000R ENGINES	INTAKE	13.1 mm to 13.5 mm (.5157 in to .5315 in)
	EXHAUST	14.3 mm to 14.7 mm (.563 in to .579 in)

Apply some lapping compound to valve face and work valve on its seat with a lapping tool.



1. Valve seat
 2. Valve face (contact surface to valve seat)
 3. Turn valve while pushing against cylinder head
- A. Valve seat angle 45°

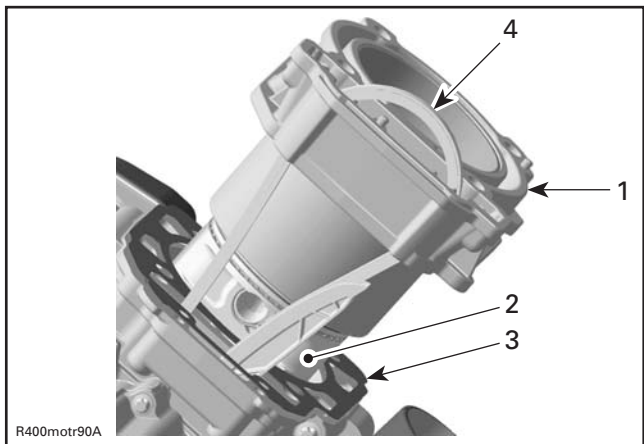
NOTE: Ensure to seat valves properly. Apply marking paste to ease checking contact pattern.

Repeat procedure until valve seat/valve face fits together.

CYLINDER

Removing the Cylinder

1. Refer to the *TIMING CHAIN* subsection to remove the following parts:
 - Chain tensioner
 - Camshaft timing gear.
2. Remove the cylinder head (see *CYLINDER HEAD* in this subsection).
3. Pull cylinder.
4. Discard cylinder base gaskets.



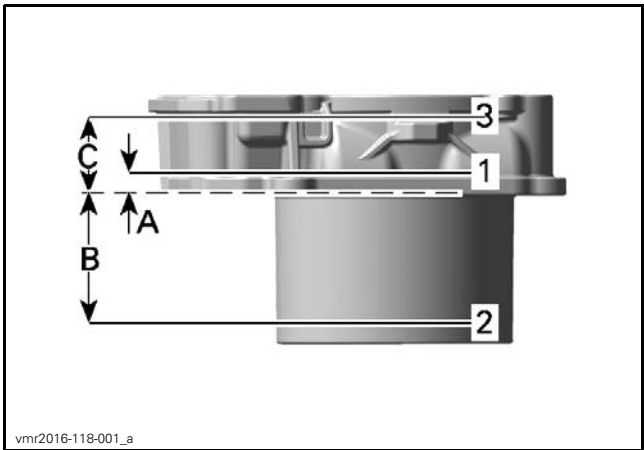
- 1. Cylinder
- 2. Piston assembly
- 3. Cylinder base gasket
- 4. Camshaft timing chain

Inspecting the Cylinder

Check cylinder for cracks, scoring and wear ridges on the top and bottom of the cylinder. If so, replace cylinder.

Cylinder Taper

Measure cylinder bore at recommended positions.



- A. First measurement
- B. Second measurement
- C. Third measurement

CYLINDER TAPER MEASUREMENTS		
ENGINE	MEASUREMENT	SPECIFICATION
570 engine	A	5 mm (.197 in)
	B	58 mm (2.28 in)
	C	37 mm (1.46 in)
1000R engine	A	5 mm (.197 in)
	B	53 mm (2.09 in)
	C	57 mm (2.24 in)

CYLINDER TAPER SPECIFICATION	
NEW (MAXIMUM)	0.038 mm (.0015 in)
SERVICE LIMIT	0.090 mm (.0035 in)

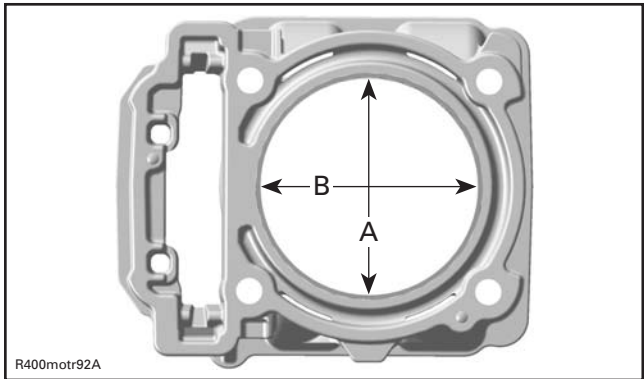
Distance between measurements should not exceed the service limit. Otherwise, replace cylinder and piston rings.

Cylinder Out of Round

Measure cylinder diameter:

- in piston axis
- perpendicular to piston axis.

NOTE: Use 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)	0.015 mm (.0006 in)
SERVICE LIMIT	0.020 mm (.0008 in)

Installing the Cylinder

Reverse the removal procedure. Pay attention to the following details.

NOTICE Always replace cylinder base gasket before installing the cylinder.

NOTE: Make sure piston rings are properly spaced, refer to *PISTON RINGS* in this subsection.

Apply engine oil:

- In the bottom area of the cylinder bore
- On the piston rings
- On the piston ring compressor.

Compress piston rings.

REQUIRED TOOL

Piston ring compressor with band width of 15 mm to 20 mm (.59 in to .79 in)

First mount cylinder 2.

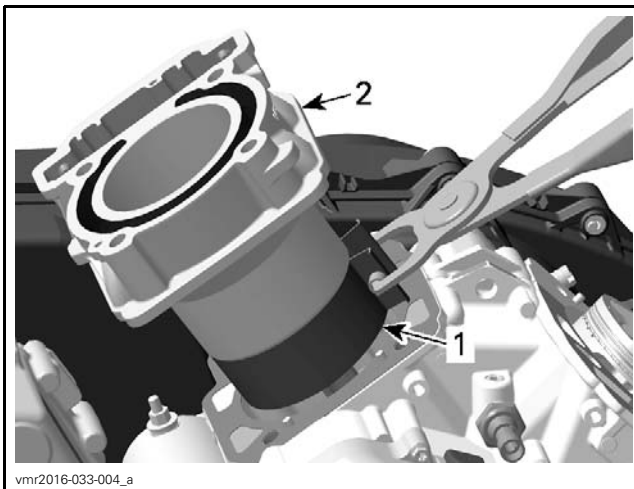
NOTE: The cylinder can not be pushed fully over the piston unless the piston is located at TDC.

Then remove the CRANKSHAFT LOCKING BOLT (P/N 529 035 617).

Crank the engine further and position piston 1 at TDC.

Mount cylinder 1.

Put timing chain through the chain passage, then slide cylinder over piston.



1. Piston ring compressor
2. Cylinder

NOTICE Chain guide has to be fixed between cylinder and cylinder head.

NOTE: After both cylinders are installed, turn crankshaft until piston of cylinder 2 is at TDC and lock crankshaft. Refer to *CRANKSHAFT* in the *BOTTOM END* subsection.

Install cylinder head and the other parts in accordance with the proper installation procedures.

PISTON

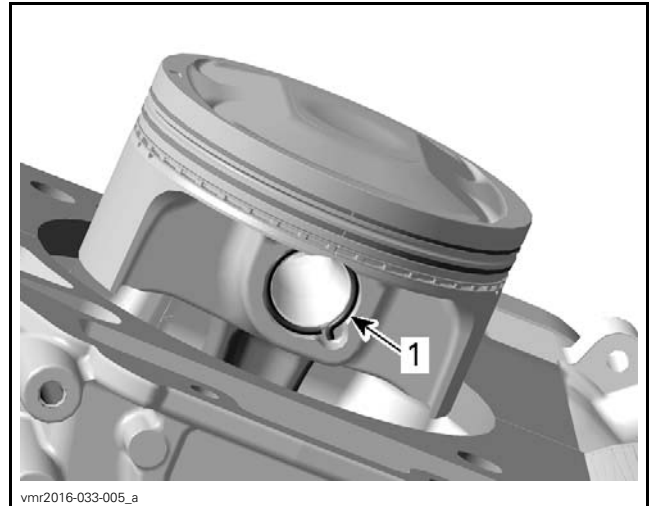
Removing the Piston

1. Refer to following procedures in this subsection and remove following parts:
 - Cylinder head
 - Cylinder.
2. Place a rag under piston and in the area of timing chain compartment.

⚠ WARNING

Piston circlips are spring loaded.

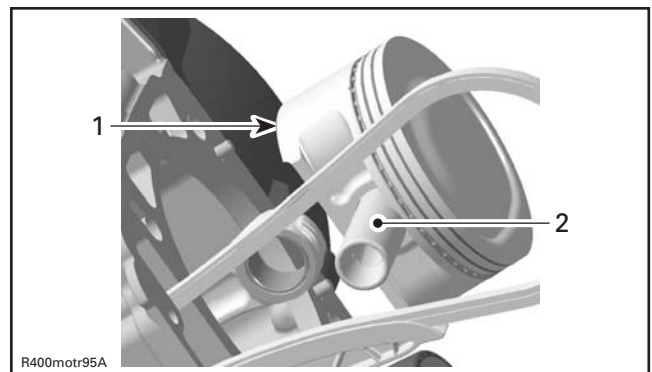
3. Remove one piston circlip and discard it.



1. Piston circlip

NOTE: The removal of both piston circlips is not necessary to remove piston pin.

4. Push piston pin out of piston.



1. Piston
2. Piston pin

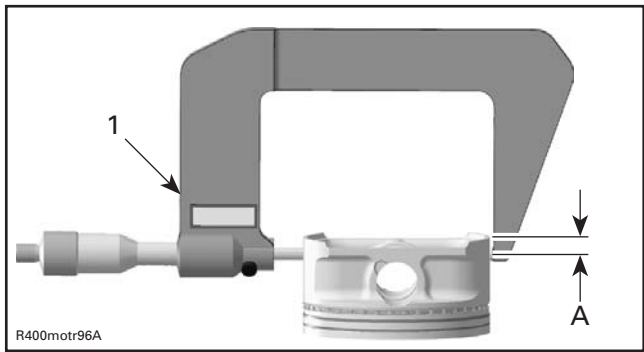
5. Detach piston from connecting rod.

Inspecting the Piston

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

Using a micrometer, measure piston at 8 mm (.315 in) perpendicularly (90°) to piston pin.

Subsection 08 (TOP END)



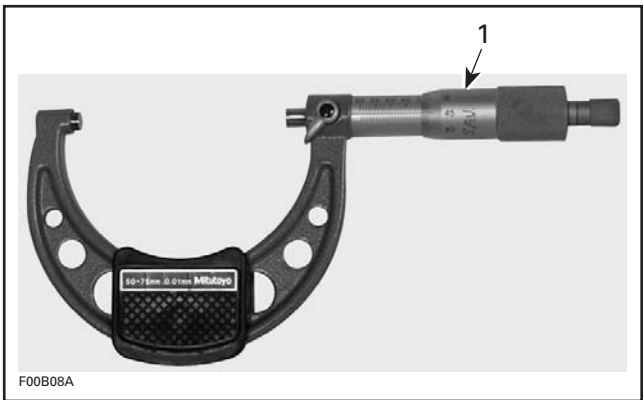
1. Measuring perpendicularly (90°) to piston pin
A. 8 mm (.315 in)

The measured dimension should be as described in the following tables. If not, replace piston.

PISTON MEASUREMENT		
570 ENGINE	NEW	83.950 mm to 83.966 mm (3.3051 in to 3.3057 in)
	SERVICE LIMIT	83.850 mm (3.3012 in)
850 ENGINE	NEW	93.950 mm to 93.966 mm (3.6988 in to 3.6994 in)
	SERVICE LIMIT	93.900 mm (3.6969 in)
1000R ENGINE	NEW	90.950 mm to 90.966 mm (3.5807 in to 3.5813 in)
	SERVICE LIMIT	90.900 mm (3.5787 in)

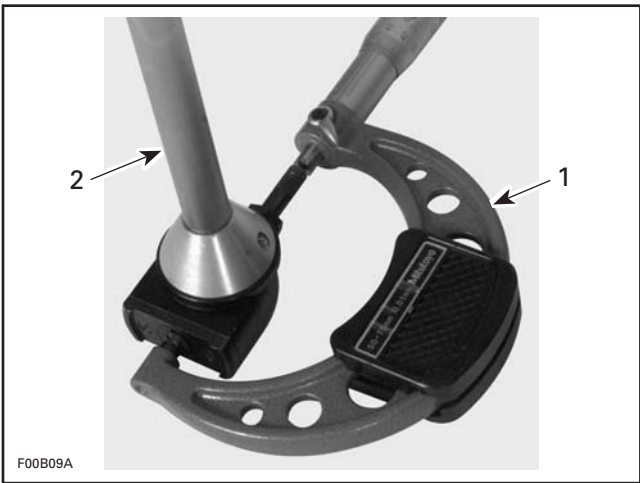
Piston/Cylinder Clearance

Adjust and lock a micrometer to the piston dimension.

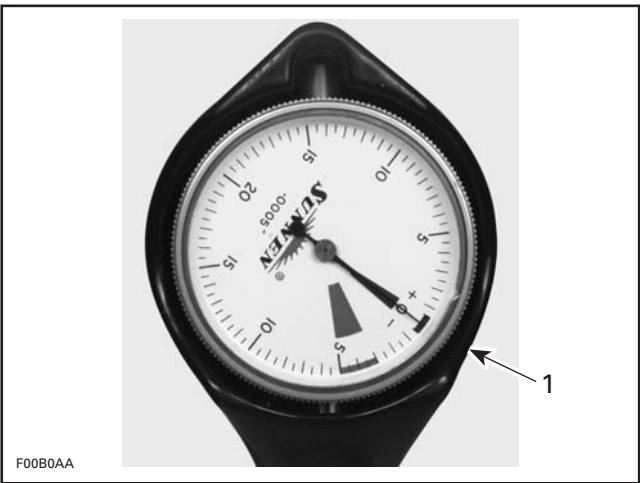


1. Micrometer set to the piston dimension

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)

Position the dial bore gauge 20 mm (.787 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		
570 ENGINE	NEW	0.057 mm to 0.087 mm (.0022 in to .0034 in)
	SERVICE LIMIT	0.130 mm (.0051 in)
850 AND 1000R ENGINES	NEW	0.027 mm to 0.057 mm (.0011 in to .0022 in)
	SERVICE LIMIT	0.100 mm (.0039 in)

NOTE: Make sure used piston is not worn.

If clearance exceeds specified tolerance, replace piston by a new one and measure piston/cylinder clearance again.

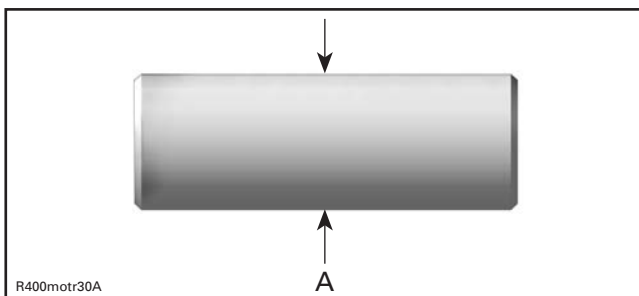
NOTE: Make sure the cylinder bore gauge indicator is set exactly at the same position as with the micrometer, otherwise the reading will be false.

Connecting Rod/Piston Pin Clearance

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 positions.

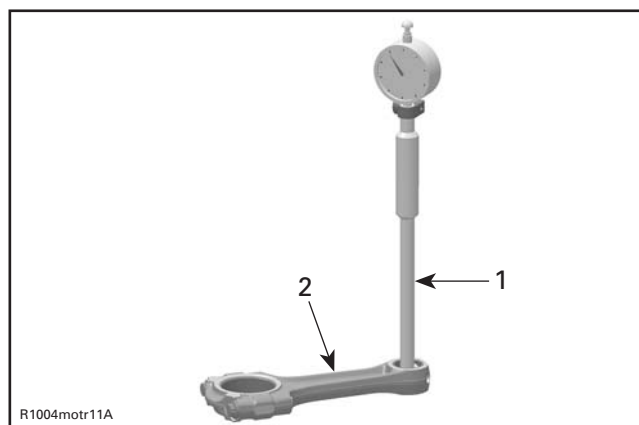


A. Piston pin diameter

PISTON PIN DIAMETER		
570 AND 850 ENGINES	NEW	19.996 mm to 20.000 mm (.7872 in to .7874 in)
	SERVICE LIMIT	19.980 mm (.7866 in)
1000R ENGINE	NEW	21.996 mm to 22.000 mm (.866 in to .866 in)
	SERVICE LIMIT	21.980 mm (.8654 in)

Replace piston pin if diameter is out of specifications.

Measure inside diameter of connecting rod small end bushing.



1. Bore gauge
2. Connecting rod

CONNECTING ROD SMALL END DIAMETER		
570 AND 850 ENGINES	NEW	20.010 mm to 20.020 mm (.7878 in to .7882 in)
	SERVICE LIMIT	20.060 mm (.7898 in)
1000R ENGINE	NEW	22.010 mm to 22.020 mm (.8665 in to .8669 in)
	SERVICE LIMIT	22.050 mm (.8681 in)

Replace connecting rod if diameter of connecting rod small end is out of specifications. Refer to **BOTTOM END** subsection for removal procedure.

Compare measurements to obtain the connecting rod/piston pin clearance.

CONNECTING ROD/ PISTON PIN CLEARANCE	
SERVICE LIMIT	0.080 mm (.0031 in)

Installing the Piston

Reverse the removal procedure. Pay attention to the following details.

Apply engine oil on the piston pin.

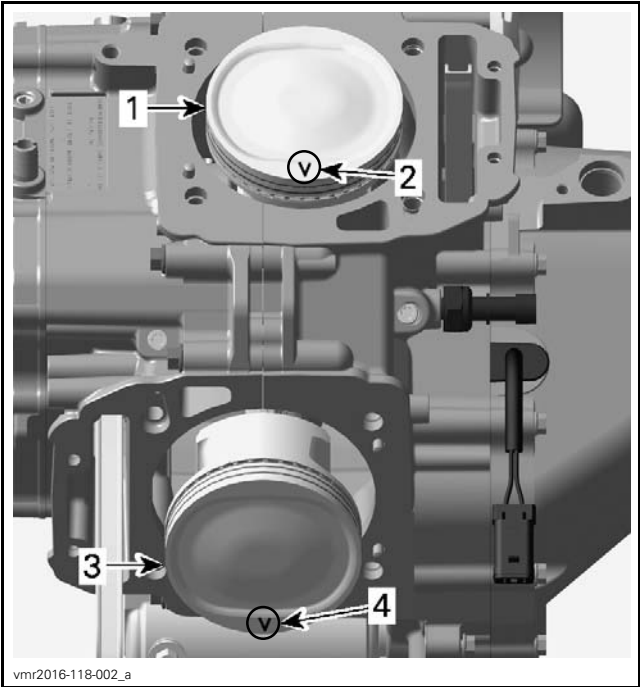
Insert piston pin into piston and connecting rod.

570, 850 and 1000R Engines

For each cylinder, install piston with the punched arrow on piston dome pointing towards the rear side of the engine.

Front cylinder: Mark on top of piston must show to intake side.

Rear cylinder: Mark on top of piston must show to exhaust side.



570 , 850 AND 1000R ENGINES

- 1. Piston of cylinder 1 (front)
- 2. Mark on piston must show to intake side of cylinder 1
- 3. Piston of cylinder 2 (rear)
- 4. Mark on piston must show to exhaust side of cylinder 2

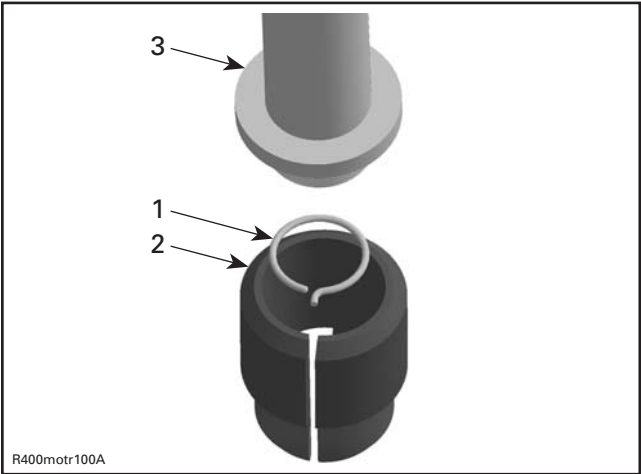
All Engines

Use the piston appropriate circlip installer to assemble the NEW piston circlip as per following procedure:

ENGINE	REQUIRED TOOL	
570	PISTON CIRCLIP INSTALLER (P/N 529 035 921)	
850	PISTON CIRCLIP INSTALLER (P/N 529 036 083)	
1000R	PISTON CIRCLIP INSTALLER (P/N 529 036 153)	

NOTICE Always replace disassembled piston circlip(s) by NEW ones. Place a rag on cylinder base to avoid dropping the circlip inside the engine.

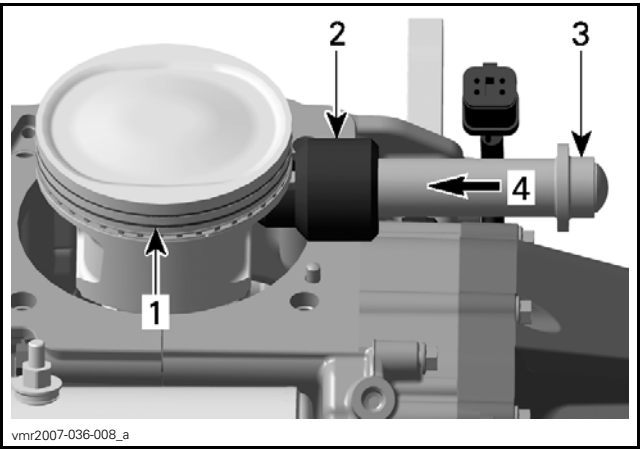
Place circlip in sleeve as per following illustration.



- 1. Circlip
- 2. Sleeve
- 3. Assembly jig from piston clip installer

Push taper side of assembly jig until circlip reaches middle of sleeve.

Align sleeve with piston pin axis and push assembly jig until circlip engages in piston.



- 1. Hold piston while pushing circlip in place
- 2. Sleeve
- 3. Assembly jig
- 4. Direction to push circlip

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



CORRECT POSITION OF THE PISTON CIRCLIP

PISTON RINGS

Removing the Piston Rings

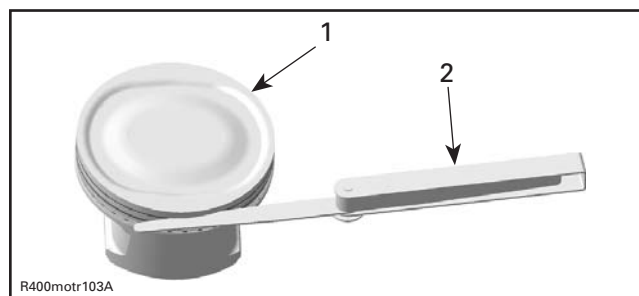
Remove the piston (see *PISTON* in this subsection).

Inspecting the Piston Rings

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.

RING/PISTON GROOVE CLEARANCE		
UPPER COMPRESSION RING		
570 engine	NEW	0.025 mm to 0.070 mm (.001 in to .0028 in)
	SERVICE LIMIT	0.100 mm (.0039 in)
850 and 1000R engines	NEW	0.030 mm to 0.070 mm (.0012 in to .0028 in)
	SERVICE LIMIT	0.150 mm (.0059 in)
LOWER COMPRESSION RING		
All engines	NEW	0.020 mm to 0.060 mm (.0008 in to .0024 in)
	SERVICE LIMIT	0.150 mm (.0059 in)
OIL SCRAPER RING		
All engines	NEW	0.010 mm to 0.180 mm (.0004 in to .0071 in)
	SERVICE LIMIT	0.250 mm (.0098 in)



1. Piston
2. Feeler gauge

Ring End Gap

RING END GAP		
UPPER COMPRESSION RING		
570 engine	NEW	0.10 mm to 0.30 mm (.004 in to .012 in)
	SERVICE LIMIT	0.50 mm (.02 in)
850 engine	NEW	0.20 mm to 0.35 mm (.008 in to .014 in)
	SERVICE LIMIT	0.60 mm (.024 in)
1000R engine	NEW	0.20 mm to 0.40 mm (.008 in to .016 in)
	SERVICE LIMIT	0.60 mm (.024 in)
LOWER COMPRESSION RING		
570 and 850 engines	NEW	0.35 mm to 0.55 mm (.014 in to .022 in)
	SERVICE LIMIT	0.85 mm (.033 in)
1000R engine	NEW	0.20 mm to 0.40 mm (.008 in to .016 in)
	SERVICE LIMIT	0.70 mm (.028 in)
OIL SCRAPER RING		
All engines	NEW	0.20 mm to 0.70 mm (.008 in to .028 in)
	SERVICE LIMIT	1.00 mm (.039 in)

To measure the ring end gap place the ring in the cylinder in the area of 8 mm to 16 mm (5/16 in to 5/8 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 specified tolerance.

Installing the Piston Rings

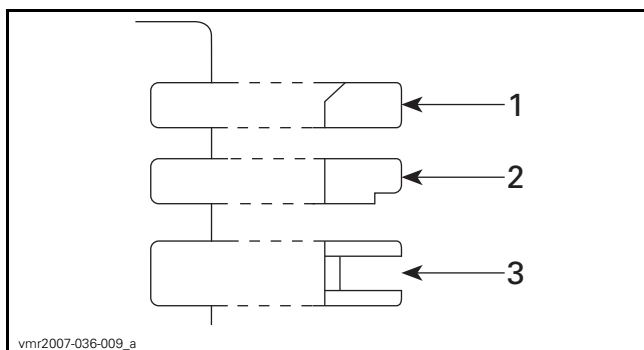
For installation, reverse the removal procedure. Pay attention to the following details.

NOTE: First install spring and then rings of oil scraper ring.

Subsection 08 (TOP END)

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

Install the oil scraper ring first, then the lower compression ring with the word "N and TOP " facing up, then the upper compression ring with the word "N and TOP" facing up.

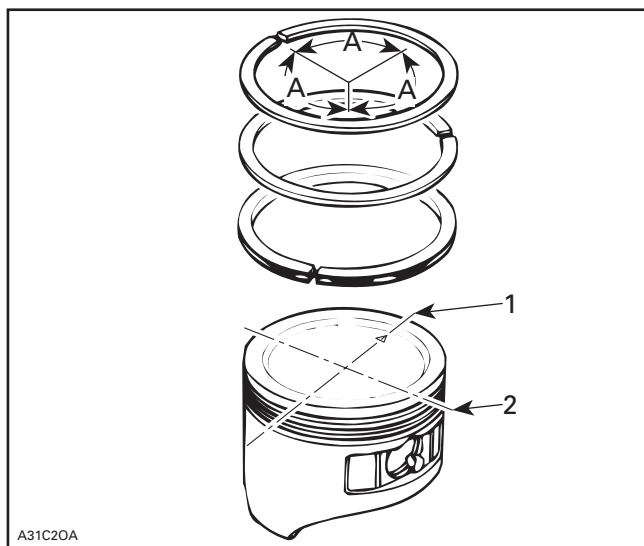


1. Upper compression ring
2. Lower compression ring
3. Oil scraper ring

NOTICE Ensure that top and second rings are not interchanged.

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°